Sixth International Marine Debris Conference

Book of Abstracts

March 12-16, 2018
San Diego, California, USA

Introduction

The Sixth International Marine Debris Conference (6IMDC) was co-hosted by the National Oceanic and Atmospheric Administration (NOAA) and the United Nations Environment (UN Environment) in San Diego, California, United States of America. The five day conference occurred during March 12, 2018 – March 16, 2018.

The 6IMDC showcased 74 technical sessions and a poster night. Topics ranged over ten tracks including: Monitoring & Citizen Science; Research & Microplastics/Microfibers; Prevention; Private Sector Collaboration, Technology & Innovation; Education & Communication; Implementing Effective Law, Regulations & Policy; Removal; Single-Use Product Policies, Regulations & Laws; Derelict Fishing Gear; and Innovative Case Studies From Around the World. These sessions allowed for over 400 oral presentations from around the world to be shared throughout the week, as well as 170 posters. The following content contains the original abstract submissions from the 6IMDC oral and poster presenters.

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"A Permitted Crab Fishing Gear Recovery Program; Fisherman Working To Remove Marine Debris"

Dan L. Ayres, Washington Department of Fish and Wildlife
Heather Reed, Washington Department of Fish and Wildlife
Kyle Antonelis, Natural Resources Consultants, Inc.

ABSTRACT

The Washington coastal commercial Dungeness crab fishery, with 223 limited entry license holders, occurs in coastal waters extending approximately 140 miles from the US/Canada border to the Washington/Oregon border. Fishing occurs from the shallow near shore waters out 10 miles or to a depth of approximately 80 fathoms. The fishery is state's largest coastal commercial fishery producing ex-vessel income up to $50 M (US).

The accumulation of marine debris caused by the loss of fishing gear - crab pots, lines and buoys is a long term issue for this fishery. The major causes are poor weather, strong currents, and buoy lines cut-off by vessel propellers. Gear loss during some seasons and in some areas can be significant.

In an effort to reduce marine debris without major expense to the agency, the Washington Department of Fish and Wildlife (WDFW) developed the Permitted Stray and Abandoned Gear Recovery Program. This program issues permits to licensed state commercial crab fishers to recover and retain any crab gear (pots and lines) remaining in the ocean following the close of the commercial fishing season.

Acting on a request from WDFW and representatives of the Dungeness crab fishing industry, the Washington State Legislature modified long-standing lost property statutes to allow for the legal retention of recovered gear. This has proven to provide sufficient incentive for fishers to participate in the program. With their first-hand knowledge of where to find lost gear and how best to recover it, Washington's commercial Dungeness crab fishers have made this program a successful tool in reducing lost and derelict crab gear along the Washington coast.

This program, first implemented in 2009 was the first of its kind and since has been used by Oregon, California and some Washington coastal tribes as a model to

"Derelict Crab Trap Removal from BC's North Coast - building on the steps of the commercial industry's long standing practices"

Joan Drinkwin, Natural Resource Consultants
Kyle Antonelis, Natural Resource Consultants
Dan Edwards, Area A Crab Association

ABSTRACT

The Area A crab fleet of British Columbia's north coast have been quietly setting the bar high for fisheries monitoring and gear tracking for over a decade. In the early 2000s, the Area A fleet pushed for, and paid for, the first electronic monitoring systems in BC's crab fishery complete with video cameras and gear tracking technology. These systems not only allowed the fleet to eliminate issues of gear theft and tampering, it also provided harvesters and fisheries managers a way to monitor fleet and vessel trap allocations, soak times and location. Along with this EM technology, the Area A crab fleet has also been running a charter each spring in which commercial vessels and crews are hired and trained to collected data on crab moult timing so that their fishery closes when the male crab are most vulnerable and does not reopen until they are safe and marketable. During this yearly fishery closure the charter vessel does 1-5 days of gear clean-up throughout their fishing grounds using data points on lost or abandoned gear collected by skippers or by the EM systems.

In May 2017, building on the monitoring and charter operations long established by the Area A crab fleet, a derelict gear removal day was organized in one part of Area A, McIntyre Bay chosen since it is also an area with considerable use by the Haida Nation for Food, Social and Ceremonial harvesting and use by other recreational and commercial fisheries. The gear removal day was a success with two vessels and crews participating along with staff from WAP, NRC and the Department of Fisheries and Oceans Canada (DFO). The success of this one-day removal and the long standing success of the Area A charter and EM programs are due to the local knowledge and involvement of the Area A crab harvesters.

Achieving Regular And Systematic Removal Of Newly Lost Fishing Gear Through Collaborative Fisheries Management

"Fishermen-informed and led lost, abandoned and discarded fishing gear location and retrieval in California"

Kirsten Gilardi, Karen C. Drayer Wildlife Health Center
Jennifer Renzullo, Karen C. Drayer Wildlife Health Center

ABSTRACT

The California Lost Fishing Gear Recovery Project has been conducting lost, abandoned and discarded (lost) fishing gear recovery in partnership with commercial fishermen since 2006. To date, the Project has retrieved more than 100 tons of lost nets, pots, traps and fishing-related debris, the majority of it found and removed by fishermen. In Southern California, commercial urchin harvesters have been contracted for all in-water (SCUBA) gear retrieval work, and their underwater knowledge of lost gear "hotspots", as well as information shared with them by other commercial fishermen, has driven site-selection for the majority of gear retrieval. The project has also implemented an innovative partnership with commercial Dungeness crab fishermen in Northern and Central California (with the Humboldt Fishermen's Marketing Association in Eureka and the Commercial Fishermen's Association of Bodega Bay) in which the associations are running gear recovery themselves, recovering lost gear their members have located and reported. As well, these fishermen are testing a financially sustainable model developed by our Project, wherein the associations pay member fishermen to collect gear and then "profit" through sales of retrieved gear back to the original owner, putting these funds in escrow to support future gear retrieval. As a result, Dungeness crab fishermen have collected more than 1,500 lost and abandoned Dungeness traps. The knowledge and practical experience of commercial fishermen has been the single-most critical key to the success of the Project since its inception.

Achieving Regular And Systematic Removal Of Newly Lost Fishing Gear Through Collaborative Fisheries Management

"Newly Lost Net Reporting, Response, and Retrieval Program for Washington State's Salish Sea, USA"

Jason Morgan, Northwest Straits Foundation
Joan Drinkwin, Natural Resources Consultants
Kyle Antonelis, Natural Resources Consultants

ABSTRACT

Washington State's Salish Sea (WASS USA) boasts a strong history of salmon fishing and still supports hundreds of commercial salmon gillnet and purse seine fishers. Most of these fishers are from the many native tribes residing in the region, who have treaty rights to half of the harvestable salmon in the area. The other harvestable half is divided between non-tribal commercial and recreational salmon fishers. The history of salmon fishing had left a legacy of lost gillnets and, to a lesser extent, purse seine nets, throughout the WASS, but concentrated in the northern rocky areas of the San Juan archipelago. The Northwest Straits Initiative (NWSI) began removing derelict fishing gear from shallow sub-tidal waters of WASS in 2002. As of December 2015, the NWSI removed more than 5,600 pieces of derelict gillnets from WASS. This large-scale removal operation took over twelve years.

While reporting of lost nets has been encouraged for many years, in 2012 the NWSI launched the Reporting, Response and Retrieval Program. Managed in partnership with Puget Sound Tribes and the Washington Department of Fish and Wildlife, this no-fault, no-penalty program includes a robust reporting system, and a rapid response and retrieval process designed to ensure that newly lost nets are located and removed before they become derelict and cause unintended harm.

The RRR program was started with funding from the National Estuary Program and has been sustained by funding from a variety of grants. Since the program's inception in 2012 through February 2017, the NWSI has responded to 103 reports. Reporting from citizens still predominates but reports from fishers has slowly increased. A marketing-style campaign was launched in 2017 to increase reporting from fishers. Response and retrieval are coordinated by a private sector consulting firm.

Achieving Regular And Systematic Removal Of Newly Lost Fishing Gear Through Collaborative Fisheries Management

"The Texas Abandoned Crab Trap Removal Program"

Zachary Thomas, Texas Parks and Wildlife Department

ABSTRACT

Lost or abandoned, fishing gear represents around 10% of marine debris, and while there is always some fishing gear that is inevitably lost in any fishery, an effective clean-up program should include a systematic process to locate and regularly remove nets, traps, and other fishing gear as efficiently as possible. In Texas, abandoned or lost crab traps have been identified as a significant source of mortality for a variety of recreationally and commercially important non-target species. Additionally, these traps can have negative impacts on habitat, create navigation hazards, and become a source of visual pollution. The Texas Abandoned Crab Trap Removal Program was created in 2001 with the passing of Senate Bill 1410 during the 77th Texas Legislative session giving the Texas Parks and Wildlife Department (TPWD) the authority to create a community-based program to systematically remove abandoned or lost crab traps during a 10-day crabbing seasonal closure. Consequently, in February 2002, TPWD planned and facilitated the first ever Texas Abandoned Crab Trap Removal Program clean-up along the Gulf Coast in Texas. Since that time, for more than fifteen years, countless numbers of Texans have spent time on the water searching the bays for abandoned crab traps that have been left to foul shrimpers' nets, snag anglers' lines, "ghost fish," and create unpleasant views. To date, over 3,000 volunteers have removed over 34,000 crab traps using over 1,000 vessels coast-wide. This presentation will showcase program overviews, program highlights, measures of success, and lessons learned in its fifteen years of existence.

Building Evidence Around Ghost Gear: Global Trends And Analysis For Sustainable Solutions At Scale

“Building evidence for the health impacts of lost, abandoned and discarded fishing gear on marine wildlife”

Kirsten Gilardi, Karen C. Drayer Wildlife Health Center
Kristen MacDonald, School of Veterinary Medicine

ABSTRACT

Marine wildlife morbidity and mortality caused by fishing gear entanglement and ingestion is surprisingly poorly documented in the scientific literature. What data exist have largely been the result of larger studies evaluating impacts of fisheries or other threats to conservation of marine species, with just a handful of clinical case reports on individual injured animals hinting at the potential scale of this problem. We suspect that the impact of lost, abandoned and discarded fishing gear on marine wildlife is vastly under-reported, largely because the majority of data exist in the unpublished records of wildlife rehabilitation organizations. This is likely particularly true of data on fishing gear ingestion, as such data are collected primarily by wildlife rehabilitation organizations with access to diagnostic imaging equipment and surgery. Previously, in order to better understand the scale of the problem of fishing gear-related injuries in California marine wildlife, we systematically reviewed medical records held by wildlife rehabilitation organizations on admissions of select marine birds and mammals for fishing gear entanglement and ingestion injuries over multiple years, and determined that more than 10% of animals admitted for care were presenting with fishing-gear related morbidities. Utilizing similar methods for data retrieval and analyses, the Global Ghost Gear Initiative’s Build Evidence Working Group is now compiling data from unpublished records at wildlife rehabilitation organizations around the world to compile a comprehensive global database on fishing gear ingestion by marine wildlife that will enable an epidemiologic evaluation of the scale at which fishing gear ingestion impacts the health of marine wildlife.

"Documenting Species Impacts From Entanglement in Derelict Fishing Nets in the U.S. Salish Sea"

Joan Drinkwin, Natural Resources Consultants, Inc.
Kyle Antonelis, Natural Resources Consultants, Inc.
Tom Good, National Oceanic and Atmospheric Administration
Paul Rudell, Natural Resources Consultants, Inc.
Michael Etnier, Applied Osteology
Jason Morgan, Northwest Straits Marine Conservation Foundation
Anne Elz, National Oceanic and Atmospheric Administration

ABSTRACT

As early as the 1970s, researchers and managers were documenting negative impacts of lost commercial fishing nets in the Washington State region of the Salish Sea. After decades of salmon fishing, over 6,000 pieces of fishing nets may have been lost there. Since 2002, a concerted effort has removed lost nets and net remnants and quantified their negative impacts on species and habitats. Through 2016, 5,784 lost fishing nets and net remnants have been removed from U.S. Salish Sea waters to a depth of 100 feet.

The removal protocols established for retrieval activities include rigorous scientific data collection. All animals found entangled in retrieved nets were identified to the lowest possible taxon via onboard observation, laboratory identification of bones and carcasses, or DNA analysis. All data is stored in a publicly available online database.

Tens of thousands of animals were found entangled in retrieved nets. For birds, 1,103 individuals, representing 18 species, were documented. For fish, 5,709 individuals (3,493 dead/2,216 alive), representing over 50 species, were documented. For marine mammals, 71 individuals, representing four species, were documented. Many species of invertebrates were also found mortally entangled in retrieved nets, including 5,392 dead Dungeness crab (Cancer magister), a species of economic value to the regional fisheries economy.

Documenting these impacts has proved invaluable to engaging fisheries managers and political leaders in finding solutions to the problem of lost fishing nets in both the U.S and Canadian waters of the Salish Sea. Armed with scientifically defensible data, proponents for solutions have been successful at funding large-scale net retrieval operations as well as developing a rapid response program designed to retrieve newly lost nets reported by fishers.

Building Evidence Around Ghost Gear: Global Trends And Analysis For Sustainable Solutions At Scale

"Don't assume it is all trash: accurate gear type characterization is critical for entanglement mitigation"

Regina Asmutis-Silvia, whales.org
Susan Barco, Virginia Aquarium and Marine Science Center
Allison Henry, NOAA Northeast Fisheries Science Center
Laura Ludwig, Center for Coastal Studies
Amy Knowlton, New England Aquarium
Scott Landry, Center for Coastal Studies
David Mattila, International Whaling Commission
Michael Moore, Woods Hole Oceanographic Institution
Jooke Robbins, Center for Coastal Studies
Julie van der Hoop, Woods Hole Oceanographic Institution

ABSTRACT

Entanglement is a significant conservation and welfare issue which is limiting the recovery of a number of marine species, including marine mammals. It is therefore important to reliably identify the causes of these events, including the nature of the entangling gear in order to reduce or prevent them in the future. A recently published review of marine debris assessed 76 publications and attributed a total of 1805 cases of cetacean entanglements in "ghost gear", of which 78% (n=1413) were extracted from 13 peer reviewed publications. We examined the 13 publications cited in the review and found that the specific gear type or status of gear involved in the reported events was rarely mentioned beyond the fact that it was fishing related. This is likely due to the fact that determinations of debris as the entangling material are very difficult. In fact, in reviewing 10 years of large whale entanglement records for the U.S., the authors of another study reported that Hawaii was the only region in which any entangling gear was positively identified as ghost gear. We believe that the assumption that entangling gear is marine debris unless otherwise stated is dangerous because it could impact efforts to modify or restrict risk-prone fishing in key marine mammal habitats. Entanglement in actively fished gear poses a very real threat, and claims that only lost or abandoned fishing gear is responsible for entanglements can undermine conservation efforts.

"Harnessing the power of citizen science to build evidence for sustainable solutions: Dive Against Debris®, a case study"

Hannah Pragnell-Raasch, Project AWARE

ABSTRACT

Building evidence is an essential component for finding sustainable solutions not only to address the global ghost gear issue but also the marine debris issue more broadly.

Through Project AWARE®'s global marine debris survey, Dive Against Debris®, citizen scuba divers are empowered in the removal and reporting of marine debris items encountered at dive sites across the globe. Critical quantitative evidence is yielded regarding the types and quantities of marine debris items found underwater on the seafloor, including abandoned, lost or otherwise discarded fishing gear (ALDFG). Additionally, information concerning the impacts marine debris has on marine life is captured including entanglement, injury and death. Debris-free sites are also recorded.

Through the Global Ghost Gear Initiative's Building Evidence Working Group, Project AWARE has contributed the global Dive Against Debris dataset supporting the development of the centralised global ghost gear database. This data has helped inform where ALDFG has and has not been recorded at various dive sites across the globe. The geographic scope and diversity of the Dive Against Debris dataset provides unique insights to the global ghost gear issue. Additionally, the data generated through Dive Against Debris provides one of just a few sources of absence data to inform where ghost gear has not been found. This is an essential component for identifying true ghost gear hotspots where management efforts should be prioritised.

In this presentation we demonstrate the way in which a citizen science program, Dive Against Debris, whilst being more broadly marine debris focused, is invaluable in building evidence for sustainable solutions to the global ghost gear issue.

Building Evidence Around Ghost Gear: Global Trends And Analysis For Sustainable Solutions At Scale

“How building evidence on ghost gear drives advocacy efforts to implement the sustainable development agenda and catalyses sustainable solutions at scale.”

Ingrid Giskes, Global Ghost Gear Initiative - Chair of Steering Group

ABSTRACT

In 2014, World Animal Protection (WAP) launched its Sea Change Campaign with the Fishing’s Phantom Menace report highlighting that cross-sectoral global collaboration was a necessary approach to combat ghost gear. In 2015, WAP launched the Global Ghost Gear Initiative (GGGI), bringing together a critical group of stakeholders and experts on this topic. The GGGI addresses sea-based sources of marine debris, specifically ALDFG, and contributes to the delivery of the first target (14.1) under Sustainable Development Goal 14, calling for a significant reduction in marine debris of all kinds by 2025.

From the start of our campaign and the GGGI, we have understood that at the heart of facilitating buy-in, engagement and formulating effective solutions – whether prevention, mitigation or cure-based – is the need to understand the problem. Sharing data, intelligence and resources to understand global abundance, causes, impacts and trends has been critical to develop a successful pathway to change, as well as galvanise action and interest from the international community.

In my presentation, I will highlight the pathway to the decision to work on the issue of ghost gear and how evidence has played a key role in formulating a global approach and strategy, as well as supported our advocacy efforts at the international level. I will also highlight how building evidence is helping the Initiative direct solution delivery in ghost gear hotspots, create opportunities for solution projects using best practice models, and enable global monitoring to catalyse further change as part of the Sustainable Development Goal ambitions.

Building Evidence Around Ghost Gear: Global Trends And Analysis For Sustainable Solutions At Scale

"Papahānaumokuākea Marine National Monument (Northwestern Hawaiian Islands) Derelict Fishing Gear Removal Project"

Kevin O'Brien, NOAA Pacific Island Fisheries Science Center

ABSTRACT

Since 1996, NOAA's Pacific Islands Fisheries Science Center (PIFSC) Marine Debris Project and multi-agency partners have conducted large-scale derelict fishing gear (DFG) removal operations from the reefs and shorelines of the remote Northwestern Hawaiian Islands (now Papahānaumokuākea Marine National monument (PMNM)). This remote archipelago is home to numerous endangered, endemic, threatened, and protected species, including seabirds, green sea turtles, and Hawaiian monk seals. In addition to presenting an immediate threat to wildlife, DFG can scour, break, smother, and otherwise damage critically important marine habitats such as coral reefs.

To date PIFSC has removed more than 1.9 million pounds (848 metric tons) of DFG in an effort to mitigate the hazards that this marine debris presents to this important ecological community. To accomplish this, NOAA's team has utilized in-water manta-tow and swim survey methods and breath-hold snorkel removal techniques. This presentation will review survey and removal methods, summarize the 2012-2016 efforts and suggest best practices (and share lessons learned).

Building Evidence Around Ghost Gear: Global Trends And Analysis For Sustainable Solutions At Scale

"Using and improving data relating to lost fishing gear."

Gideon Jones, Emerald Sea Protection Society

ABSTRACT

Information relating to lost or abandoned fishing gear (ALDFG) is challenging to work with. It can be difficult to acquire; the quality of data is often indeterminate; the data is sourced from a wide range of geographical locations & organizations and typically incommensurate in structure and type.

Given these inherent challenges, we will discuss what questions can meaningfully be asked of this data and what can be done to work with such a disparate data set. Having reviewed existing datasets as well as worked with a range of stakeholders to develop a more idealized data structure, we are able to examine what we can achieve by looking back at data collected so far and how we can improve data collection moving forward. Past data is illustrated by geographical distribution and type, and I explore the validity of using that data to identify rates of gear loss and origin.

Looking forward, a new data structure is proposed that is designed to be compatible with a wide range of data collection efforts that might be focused on other marine debris issues (e.g. entanglement or ingestion surveys) and how we can benefit from those efforts in mapping lost fishing gear. I will also introduce a mobile application allowing the submission of lost fishing gear reports, as one example of a range of possible methods for submitting data to this improved database. Ideas relating to data stewardship and potential use of this dataset will be discussed.

"Fishermen's perception on the cause, motivation, and mitigation measures of derelict fishing gears in South Korea"

Sunwook Hong, Korea Marine Litter Institute
Jongmyoung Lee,
Won Joon Shim, Korea Institute of Ocean Science and Technology

ABSTRACT

Derelict fishing gears have high potential to damage marine ecosystem, navigation safety, fishing resource and its economy. To mitigate damage from DFGs, fishermen's role is very important because they are the main contributors and are also directly exposed to the damage. DFGs are significant sources of marine debris in South Korea. This study evaluated fishermen's perception on DFGs' causes, motivation/reasons, and measures that UNEP/FAO suggested in 2009. We also asked preferences of measures on DFGs by Korean government. A total of 134 people participated in the survey conducted in 2015, comprising 55 from capture fisheries and 79 from aquaculture. The fishermen answered that DFGs comprises about 30% of total marine debris and are abandoned, discarded, and lost in similar proportion. In comparison between groups, respondents from capture fishermen thought accidental loss at sea is more important cause than others whereas people from aquaculture answered deliberate disposal (discarded) is more significant. The fishermen in total picked improved port state measure and retrieval activities as more effective and feasible than others. About Korean governmental policies, they preferred to the existing policies such as floating reception barges and retrieval programs rather than adoption of new policies such as extended producer responsibility, gear deposit system, and others.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Leave No Traps Behind"

Sean Hastings, NOAA Channel Islands National Marine Sanctuary
Aubrie Fowler, NOAA Channel Islands National Marine Sanctuary

ABSTRACT

The National Oceanographic and Atmospheric Administration (NOAA) Channel Islands National Marine Sanctuary (CINMS) and NOAA Marine Debris Program continue to prevent the threat of Abandoned, Lost, or Discarded Fishing Gear (ALDFG) on multiple fronts. Sanctuary staff worked with filmmakers at Earth Media Lab, LLC to produce the film "Leave No Traps Behind" which highlights best practices for preventing lobster trap loss. The film features veteran lobster fishermen from Santa Barbara and Ventura who share their wisdom on trap construction, weather watching, and generally how to prevent losing lobster traps. The intended audiences are novice lobster fishermen, and secondarily fishery and ocean managers, and the general public. To address the later stages of ALDFG and other debris, the sanctuary and partners removed over two tons of marine debris in a series of four beach cleanups at Santa Cruz Island in the Channel Islands around Get Into Your Sanctuary and International Coastal Cleanup Day in 2017. Lobster fishermen created an invaluable pulley system between the shore and their vessels to safely transport trash bags and large debris. The cleanups were intended to bring together agencies and fishing communities in a collaborative effort. Outreach thus far includes cleanup event press releases, and sharing the film through domestic and international film festivals and through social media platforms. For targeted prevention and cleanup efforts, the sanctuary and partners continue to work together to learn about where debris ends up through Channel Islands National Park and California State University, Channel Islands partners who survey the islands regularly. In sum, the sanctuary's goal is to heighten awareness for prevention and strengthen partnerships for removing ALDFG and other marine debris from the Channel Islands.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Managing derelict fishing gear in marine aquaculture in Taiwan"

Chung-Ling Chen, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University, Taiwan
Po-Hsiu Kuo, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University

ABSTRACT

Derelict fishing gear (DFG) generated from marine aquaculture has caused serious pollution in Taiwan. Tainan City Government has been regulating oyster farming DFG since 2004, but still could not manage the Styrofoam buoys effectively. To understand how the management can be improved, this research carried out in-depth interviews with fishermen to identify the causes of and solutions to Styrofoam buoys debris pollution. A questionnaire survey was conducted to analyze the fishermen's acceptance of the management imposed by the Tainan City Government. The causes of Styrofoam buoy debris include bad weather, illegal farming, intentional discard and gear conflict. We learned that 88% of the fishermen approved of the subsidy offered by the government to purchase alternative buoys, but they did not apply them widely considering the high price and low performance. 94% of the fishermen approved of the provided incentive payments for retrieving Styrofoam buoys but the retrieval rate is only around 20%, because it is highly time-consuming. Besides, the local fisherman and the local government both did not have ability to secure huge space and disposal capacity to accommodate the retrieved buoys. The paper provided suggestions as what follows: using Styrofoam compactors to increase disposal capability, providing incentive to invent acceptable alternative buoys, improving obligatory retrieval of Styrofoam buoys, promoting circular economy by resourcezation of Styrofoam buoy debris, emphasizing education, community-based self-management, enhancing stakeholders' involvement, establishing eco-label system and participating in the Northwest Pacific Action Plan.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Mechanisms for fishing gear resource management"

Dina Margrethe Asåen, Norwegian University of Science and Technology
Laura Brodbeck, Kjeller Innovasjon AS
Paritosh Deschpande, Norwegian University of Science and Technology

ABSTRACT

Marine plastic waste is a growing issue negatively affecting ocean ecosystems, coastal communities and marine industries. A particularly troublesome waste fraction is fishing gear, which may continue to trap fish, marine mammals and birds for decades upon release. This article takes a systems approach at structuring and analyzing fishing gear resource management (FGRM) mechanisms to mitigate gear waste streams. Interviews with stakeholders in the Northern Periphery and Arctic (NPA) region was conducted to identify existing practices and problems related to FGRM. This encompass stakeholders from fisheries and aquaculture industries, gear suppliers, policy-makers and recovery, recycling and waste management companies. A literature review was further conducted to define and structure 13 regulatory, financial and technological FGRM mechanisms, Their benefits and disadvantages are discussed across a set of economic, environmental and social criteria. The work provides a structured understanding of potential mechanisms to be employed on national, regional and international levels and supports further quantified analysis of material flows covering alternative end-of-life scenarios.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Preventing loss and dumping of fishing gear in the Arctic"

Benedikte Farstad Nashoug, Salt Lofoten AS
Jannike Falk-Andersson, Norut
Kjersti Eline Busch, Salt Lofoten AS

ABSTRACT

Abandoned, Lost or Discarded Fishing Gear (ALDFG) make up a large proportion of the marine litter collected in the Arctic. Involvement of fisheries organizations and fishermen is a crucial factor in reducing the amount of ALDFG in the future.

As part of the research project MARP3 (MARine Plastic pollution in the Arctic: origin, status, costs and incentives for Prevention), representatives from fisheries organizations from Iceland, Norway and Russia were invited to a waste-workshop in Svalbard in 2016. At the workshop scientists and waste-experts (industry representatives) examined waste collected from beaches of the northern part of Svalbard. The cleanup action was carried out by Clean Up Svalbard. Through a qualitative analysis, the waste was graded according to source, reason of loss, nationality and age.

A large proportion of the waste originated from trawlers. This is coherent with the fact that most fishing activity in the area is carried out by bottom trawlers. According to the waste-expert judgements, a large proportion of the waste had been deliberately dumped into the sea. This included ropes and nets with clean cuts, knots of strapping band and broken fish crates and trawl bobbins.

As a result of the waste-workshop, the fisheries organizations have implemented measures to prevent future ALDFG in the Barents Sea.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Showcasing best practice guidelines and solutions to the problem of abandoned, lost and otherwise discarded fishing gear"

Lynn Kavanagh, World Animal Protection

ABSTRACT

Abandoned, lost or otherwise discarded fishing gear (ALDFG or 'ghost gear') worldwide is a major source of marine litter. It has numerous impacts, including the continued catching of target and non-target species (so called 'ghost fishing'), entanglement of marine wildlife, detrimental impacts to the marine environment and navigational hazards.

The Global Ghost Gear Initiative (GGGI) is a multi-stakeholder platform committed to driving solutions to the problem of ghost gear. Its cross-sectoral approach brings together participants with varied knowledge and experience, including representative from fishing groups, seafood companies and NGOs, with a shared interest in sustainable seafood and ocean protection.

This session will focus on progress being made to address ghost gear via the development and implementation of best practice. The GGGI developed the Best Practice Framework for the Management of Fishing Gear (BPF) to encourage stakeholders throughout the seafood supply chain – from gear manufacturers to fishermen, regulatory authorities and seafood businesses – to reduce both the causes and impacts of ALDFG through better management practices and processes. Drawing on both case studies and scientific evidence, the framework outlines prevention, mitigation and 'cure' approaches to gear management and discusses options for implementing such measures. In addition, solution projects demonstrating best practices on the ground, which are fundamental to the GGGI's mandate, will also be shared.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"The development of best practice measures to reduce ALDFG and its impacts at Intergovernmental level - an update on progress from the Food and Agriculture Organisation of the United Nations"

Joanna Toole, Food and Agriculture Organization of the United Nations

ABSTRACT

Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) is a form of marine litter addressed by the Food and Agriculture Organization of the United Nations (FAO) from the duel perspective of i) its impacts and ii) its causes.

ALDFG has negative impacts on marine ecosystems, wildlife, fisheries resources and coastal communities. Some ALDFG continues to catch both target and non-target species ('ghost-fishing'), and entangles marine animals. Some near-bottom ALDFG can also cause physical damage to the seabed and coral reefs and surface ALDFG often presents a navigation and safety hazard for ocean users. Once washed ashore ALDFG, pollutes beaches with plastic litter that does not readily degrade. ALDFG is also a source of microplasrics as it disintegrates over time. Retreval and clean-up of ALDFG has huge cost implications for authorities and for the fishing industry.

FAO has progressed work to address ALDFG through the development of Draft Guidelines on the Marking of Fishing Gear. An Expert Consultation convened by FAO in April 2016 provided the initial expertise to develop these Draft Guidelines and following recommendations endorsed by the FAO's Committee on Fisheries (COFI) in July 2016, these guidelines will be further developed via Technical Consultation in February 2018.

FAO has also been conducting pilot projects to support and inform the potential adoption of the Draft Guidelines and is currently facilitating two pilot probers, one on gill net fisheries in Indonesia focussing on the practical application of gear marking and lost gear retrieval in small-scale coastal fisheries and the other consisting of a global feasibility study focussing on drifting Fish Aggregation Devices (dFADs) used predominantly by the purse seine industry.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

“Working with User Groups to Develop Outreach Campaigns to Prevent Impacts of Lost and Abandoned Fishing Gear”

Jason Morgan, Northwest Straits Foundation

ABSTRACT

Washington State’s Salish Sea (WASS) hosts a robust recreational crab fishery and has a strong history of commercial gill net and purse seine salmon fishing. This high level of fishing effort combined with extreme changes in water depth, strong tidal current velocity, rocky reefs and vessel traffic has resulted in a large-scale derelict fishing gear problem for WASS. The Northwest Straits Initiative (NWSI) has been addressing the issue of derelict fishing gear in WASS since 2002 through removals, research, outreach and education. Having removed over 5,600 derelict fishing nets and 5,000 derelict crab pots, the NWSI is now focusing their efforts on prevention by working with user groups to create behavior change in fishing practices and reporting of lost fishing gear.

The NWSI worked with marketing firms conducting social marketing research to better understand the barriers and motivators to creating behavior change. Interviews were held with the targeted user groups, recreational crabbers and commercial salmon fishermen, to learn more about common practices, motivators for change, and appropriate messaging which would appeal to the target audience.

A separate outreach campaign was launched for each fishery driven by information collected during the interview sessions. Messaging developed for the campaigns focus on positive reinforcements based on the fishers’ goals, a diversion from previous outreach efforts which focused on the negative impacts of derelict fishing gear. Outreach materials produced include instructional videos, print ads, posters, informational brochures, wallet cards and magnets. A dissemination plan which includes distributing materials through social media, fishing docks and marinas, marine supply stores and meetings with commercial fishing groups has reached over 350,000 individuals.

Fighting The Ghosts In Our Oceans: Implementing Best Practice To Eliminate ALDFG Through Policy, Practice, Education And Outreach

"Working with Welsh fishermen to reduce impacts of derelict fishing gear"

Christina Dixon, World Animal Protection

ABSTRACT

The focus of this work relates to engaging fishermen in Wales in a programme to implement best practice for fishing gear management in a pot fishery in Pembrokeshire, Welsh to reduce incidence of pot loss following a series of major storms which resulted in high volumes of lost gear. The project, coordinated via a local partnership, also involved modifying fishing equipment to test different methods for reducing the ghost fishing potential of lost pots. World Animal Protection was responsible for sharing best practice and creating communications assets to support the project. These will be presented as part of the talk to stimulate a discussion about the pros and cons of the approach for encouraging fishermen to engage in best practice and share achievements to replicate success.

How Circular Economy And Cross-Sectoral Collaborations Can Unlock Solutions For Eliminating Ghost Fishing Gear

"A novel material recycling pathway for ghost fishing gear – lessons from Germany"

Falk Schneider, University of Bath
Sophie Parsons, University of Bath
Sally Clift, University of Bath
Andrea Stolte, World Wildlife Fund for Nature (WWF) Germany
Michael Krueger, Toensmeier
Marcelle C. McManus, University of Bath

ABSTRACT

Ghost fishing – the catch of marine life with abandoned, lost or otherwise discarded fishing gear (ALDFG) – has severe environmental and economic impacts. A common way to eliminate ghost fishing is the removal of ALDFG from the ocean. Yet, collected ghost fishing gear is typically landfilled or incinerated which is not in line with circular economy aspirations.

In 2016, World Wildlife Fund for Nature (WWF) Germany and the recycling company Toensmeier collected approximately five tonnes of ghost fishing gear from the Baltic Sea for which sustainable waste treatment pathways are currently investigated. In order to test a novel recycling pathway two tonnes of the collected material were sent to the machine manufacturer Vecoplan where several pre-treatment steps, including sorting, shredding, density separation and cleaning were conducted. Input, output and process data were collected and a material flow analysis was performed. Samples of the cleaned synthetic fibres were sent to the plastic pellet producer EREMA to examine their potential use.

The contamination of ghost fishing gear with dead fish, lead lines, anchors and sand, along with mixed synthetic fibre material impede the recycling process of high-value nylon and other polymers. In this presentation, the results of recycling tests, including process related obstacles and challenges which currently impact the useability of ghost fishing gear in view of an expanding circular economy are presented.

How Circular Economy And Cross-Sectoral Collaborations Can Unlock Solutions For Eliminating Ghost Fishing Gear

“Challenges and opportunities for collecting and recycling fishing gear”

Christina Dixon, World Animal Protection

ABSTRACT

With an estimated 640,000 tons entering our oceans annually, discarded fishing gear has become recognized as one of the most harmful forms of plastic pollution to marine mammals and ecosystems. One of the main reasons for this material becoming such a large source of plastic pollution is the limited waste management infrastructure available in coastal areas for when the fishing gear meets its end of life. By working together with fishermen, organizations around the world are finding ways to transform this material that was once considered a harmful burden into a valuable resources through the innovative process of collecting and recycling discarded fishing gear. This talk will provide an overview of the global landscape of fishing gear collection and recycling, highlighting challenges, opportunities and contextual specifics around plastic types gathered from research and interaction with the Global Ghost Gear Initiative solutions working group to set the scene for a discussion on the circular economy of end of life fishing gear.

How Circular Economy And Cross-Sectoral Collaborations Can Unlock Solutions For Eliminating Ghost Fishing Gear

"CREATING CONNECTIONS BETWEEN NON-PROFIT CLEANUP ORGANIZATIONS, SMALL BUSINESSES, & GENERAL PUBLIC"

Brittany Webster, Planet Love Life
Robert Webster, Planet Love Life

ABSTRACT

Planet Love Life upcycles salvaged ALDFG from beach & ocean cleanup projects around the world. Our wearable marine debris products are a physical and visual reminder of the marine debris issue. Each bracelet represents a different marine animal that is negatively affected by marine debris and can be used as a platform to create positive conversations leading to solutions of these issues. By providing a connection between marine debris and specific animal species of marine life, we are then able to create an emotional connection with consumers and the impact their actions have on the marine environment. The sales and profit from of our products can help to fund local cleanups and provide a fundraising tool for non-profit organizations.

“Design-led circular economy solutions to marine plastic and ghost gear”

Claire Potter, Claire Potter Design

ABSTRACT

Whilst ghost gear and marine litter are creating a global oceanic pollution crisis, there are huge opportunities to be gained – particularly in terms of circular economy thinking. Recovered materials show huge promise for re-introduction into new products that could allow a different type of material stream.

As a member of the Global Ghost Gear Initiative and active member of the working group, Replicating Solutions, Claire Potter brings her experience of running a marine plastic focused circular economy design studio to both the GGGI and as a proposed speaker on the panel of this session.

With a focus on products that could be created from marine plastic waste, the Claire Potter Design have been integrating marine plastic and ghost gear into their one-off and short run, design led pieces shown at Clerkenwell Design Week and 100% Design in the UK since 2015, bringing the issues to a wider consumer audience. The studio is also heading up an Innovate UK co-funded project which will identify, categorise and explore how ghost gear can be remanufactured locally in design/make hubs around the coast of the UK. It is proposed that the learnings from this project will also be launched at the 6IMDC (also submitted separately for a poster submission in this track)

How Circular Economy And Cross-Sectoral Collaborations Can Unlock Solutions For Eliminating Ghost Fishing Gear

"Insights from the Fishing Industry for a sustainable circular economy: Understanding the current situation in fishing areas of the Arctic and identifying ways to go forward."

Heidi R. Nilsen, Norut Northern Research Institute
Anne Katrine Normann, Norut Northern Research Institute
Kayleigh J. Wyles, University of Surrey
Ludmila Ivanova, Kola Science Centre
Galina Kharitonova, Kola Science Centre
Jannike Falk-Andersson, Norut Northern Research Institute

ABSTRACT

To complement ongoing scientific work towards a circular economy, the fishing industry is a valuable resource in terms of understanding the current state, composition, and impacts of marine litter. Also, optimistically, it is an industry that can help design and implement initiatives to prevent and reduce marine litter and consequences like ghost fishing. This paper will present results from the international research project Marine Plastic Pollution in the Arctic: origin, status, costs and incentives for Prevention (www.marp.no) and in specific results from a survey distributed to approximately 5000 commercial fishers in Norway and in the Kola region in Russia. The paper will contribute with insights for a sustainable circular economy, and combining it with the priorities of the waste hierarchy (Reduce, Reuse, Recycle). It is a cross-disciplinary work building on management, ecological economics, environmental psychology, ecology and human geography, in addition to a close cooperation with fishermen organizations in Norway and Russia, NGOs and researchers within the natural sciences. Using fishers' first-hand experiences, the survey addresses the current status of type and amount of marine litter in their catch, waste facilities in ports, and is also exploring their knowledge and attitudes towards marine litter. Preliminary findings from the survey to Norwegian fishers demonstrate that they acknowledge that it is litter deriving from fishing which dominates in their catch. These fishers report that this litter decreases fishing efficiency and creates worries for the reputation of fish from these waters, and that the waste management facilities in harbors are insufficient.

How Circular Economy And Cross-Sectoral Collaborations Can Unlock Solutions For Eliminating Ghost Fishing Gear

“Investigating how Ghost Gear and Marine Plastics can become Precious Plastics”

Jacob Arney, Claire Potter Design
Claire Potter, Claire Potter Design

ABSTRACT

Claire Potter Design is leading an Innovate UK funded research project to investigate how Ghost Gear and Marine Plastics can be reintegrated into new product streams to form precious plastics in the Brighton area.

With plastics and plastic fishing gear lasting up to 600 years in our oceans, the exponential growth is of great environmental concern, but from Circular Economy terms, it creates opportunity for recovery and reintroduction into newly designed products that align with changing consumer aspirations. Working directly with a local fish importer, MCB Seafoods and the Centre for Sustainable Design as sub-contractors, ghost gear / plastics are being investigated, understood and recovered in a collaborative project working directly with local Brighton fishers and designers, ghost gear will be subjected to a series of innovative, small scale, fast re-manufacturing methods that not only test the possibilities of the materials, but also the wider public response to the resulting concept prototypes made from ghost gear. The project will include the production of small-scale re-manufacturing equipment that can be used to create fast prototype concept products. This machinery and accompanying business model can then be replicated following the project findings; initially in the UK and then further afield.

The results of the project stages are open source and updated throughout, with final project presentations taking place from 5th March 2018. The 6IMDC would be an ideal opportunity to showcase these findings.

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Derelict Gillnets in the Salish Sea: Causes of Gillnet Loss, Extent of Accumulation and Development of a Predictive Transboundary Model"

Kyle Antonelis, Natural Resources Consultants, Inc.

ABSTRACT

From 2002 through the end of 2012, a total of 4,358 derelict nets were removed from the Washington waters of the Salish Sea (WASS), 95% of which were gillnets. Forty-five percent of these gillnets were removed from low to high relief rocky substrate. The causes and rates of gillnet loss from the WASS commercial salmon fishery were investigated through interviews with fishers and industry professionals and analysis of historical fishing effort. Major causes of gillnet loss included lack of experience, operator error, equipment malfunction, overcrowding of fishing grounds, mismatch of net depth with ocean depth, and more. The findings suggest that gillnet loss is currently much less frequent than in previous decades characterized by heavy fishing effort (i.e., 1970s–1980s). Analysis of net removal records identified patterns of association between net fishing depths and depths at which derelict nets are found. Spatial analysis and ArcGIS were used to produce a simple model capable of identifying areas of high, moderate and low probability of derelict gillnet occurrence. This model was applied to the British Columbia waters of the Salish Sea (BCSS) where an organized derelict fishing gear removal program has yet been implemented. This study refines previous estimates of derelict gillnet quantities in the WASS, identifies the major causes for derelict gillnet loss, and produces an exportable model that can be used to assist the design and implementation of derelict fishing gear surveys and removal efforts in British Columbia and beyond. This model was used successfully to design continued derelict net survey plans in the WASS since 2013. Additionally, recent derelict net surveys and removals in specific locations of the BCSS have provided valuable information to test hypotheses developed here and model accuracy.

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Estimating the Ecological Benefits of Techniques that Reduce Ghost Fishing"

Courtney Arthur, Industrial Economics, Inc. (IEc)
Scott Friedman, Industrial Economics, Inc. (IEc)

ABSTRACT

Ghost fishing in derelict fishing traps kills target and non-target species and, though research and removal efforts have targeted derelict traps in many coastal areas, ghost fishing remains a substantial problem across the United States. From a fisheries conservation standpoint, techniques that reduce ghost fishing in trap gear may help restore a number of marine and estuarine fish and shellfish species. Some of these species are important to commercial and recreational fisheries, and have economic and cultural value for many different groups. Techniques to reduce ghost fishing may include trap removal or trap construction strategies to limit ghost fishing if a trap is abandoned, lost, or otherwise discarded. Utilizing a model developed for the Gulf of Mexico, we will evaluate the ecological benefits to fish and shellfish resources due to removal of derelict fishing traps and advances in trap construction (e.g., installation of degradable escape panels). This model will estimate benefits in metrics of the number and biomass of fish and shellfish not killed in derelict fishing traps. We will apply this model to multiple affected coastal locations across the United States, provide an assessment and comparison of the benefits per location, and discuss how the model may be applied to generate information for resource managers considering implementation of derelict trap removal programs and/or initiatives to encourage installation of degradable components.

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Grappling the Invisible: A Derelict Crab Pot Removal Pilot Study in the Delaware Bay- Lessons Learned"

Nicole Rodi, Department of Natural Resources and Environmental Control, Delaware Coastal Programs
Kari St.Laurent, Department of Natural Resources and Environmental Control, Delaware Coastal Programs

ABSTRACT

The Mid-Atlantic region has had great success with watermen-led removal of derelict crab pots in shallow coastal bays. The success of Stockton University (SU) in the back bays of New Jersey, and of Virginia Institute of Marine Science in the Chesapeake Bay, inspired the Delaware Department of Natural Resources and Environmental Control, Delaware Coastal Programs (DCP), to expand on these efforts to provide similar data and consistent stewardship across the region. DCP is working with the commercial crabbing industry in the Delaware Bay to improve habitat and prioritize loss reduction. The DCP crab pot removal pilot project has had various challenges that came with working in a very different estuarine system compared to Chesapeake Bay and the New Jersey back bays; sharing knowledge about lessons learned and identifying important factors to consider when starting a project will help guide others interested in pursuing a derelict fishing gear removal project. The greatest challenge of the project has been the use of a more cost effective but less accurate Huminbird side scan unit for the primary identification of crab pots. In the coming months, DCP hopes to work in collaboration with SU to identify crab pots in the Delaware Bay using the Klein 3900, a more accurate, yet expensive, side scan. The DCP will be exploring how this system might compare in accuracy with the more affordable Humminbird side scan unit.

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Understanding causes of gear loss provides a sound basis for fisheries management"

Kelsey Richardson, University of Tasmania
Riki Gunn,
Chris Wilcox, Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Britta Denise Hardesty, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

ABSTRACT

Ghost nets are an acute problem in Australia's Gulf of Carpentaria, with most nets originating from South-east Asian fishing vessels outside Australia's Exclusive Economic Zone. A range of stakeholders in the Gulf including the Australian government, Indigenous communities, non-profit organisations and researchers have been working since the 1990s to collect data about these nets and remove them from the coastlines. While the work of these stakeholders has been invaluable in informing and mitigating impacts of the ghost net issue, long-term, sustainable solutions require an understanding of the causes and drivers of net loss that can inform solutions designed to reduce gear loss at its source.

To understand the drivers of gear loss and identify tractable solutions to this transboundary problem, we asked Australian and Indonesian fishers active in trawl, gill net and purse seine fisheries why, when and in what circumstances and conditions they are likely to lose gear. Using data from these interviews we address four questions: 1) what are the primary causes of gear loss in the region, 2) what are the underlying pressures and drivers that result in gear loss events, 3) what ongoing and past initiatives have been undertaken to address these pressures and drivers, and 4) what additional measures can be undertaken to further reduce gear loss. Our overall goal was to develop a fault tree tool which provides guidance for interventions and improvements in regional fisheries management to reduce the significant pressures that result from overcrowding, overcapacity and illegal, unreported and unregulated Fishing (IUU).

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Using ecosystem services to evaluate environmental impacts from ALDFG"

Dina Margrethe Aspen, Norwegian University of Science and Technology
Laura Brodbeck, Kjeller Innovasjon AS
Paritosh Deschpande, Norwegian University of Science and Technology

ABSTRACT

In order to understand the potentially harmful effects from abandoned, lost or otherwise discarded fishing gear (ALDFG) an environmental impact assessment approach is necessary. As there currently are no harmonized methodologies for which to describe and communicate such impacts, this study employs the ecosystem services theory to evaluate adverse impacts from ALDFG on marine and coastal ecosystems. The goal of the study is two-fold: Firstly to structure existing literature reporting on adverse environmental effects using a single, unified framework, and secondly to evaluate the feasibility of this approach as a common platform for monitoring and communicating impacts from ALDFG. For this purpose, 48 peer-reviewed articles and grey literature has been structured and analyzed according to impacts on human activities through supporting, provisioning, regulating, and cultural services. A taxonomy of impact sub-categories is developed based on the literature and mapped on to ecosystem services categories. The review shows that the approach provides a meaningful interpretation of adverse effects of ALDFG on marine and coastal ecosystems in a qualitative manner. Further development of indicators associated with ecosystem service categories is recommended to help specify the intensity of adverse impacts.

Innovative Advancements In Limiting The Impacts Of Derelict Fishing Gear

"Using Smart Buoys to Detect and Locate Lost Gear"

Kortney Opshaug, Blue Ocean Gear LLC

ABSTRACT

Derelict crab and lobster traps have a devastating financial and environmental impact, costing fishermen thousands of dollars in replacement gear, while continuing to ghost fish and entangle marine mammals at rates high enough to impact the sustainability of the fisheries. Being able to retrieve these traps as soon as possible after they are lost would reduce the amount of damage to the ocean ecosystem. The research presented here by describes a Smart Buoy developed by Blue Ocean Gear as part of the National Fish and Wildlife Foundation's Fishing For Energy Program with funding from NOAA's Marine Debris Program. The Smart Buoy can detect when gear starts to wander outside its normal range, which can indicate impending loss of the gear, and communicates alerts back to the fishermen onshore along with current location. This facilitates the recovery of gear by identifying where immediate retrieval efforts should be focused. The concept has been implemented and tested in Dungeness Crab fisheries off the coast of Northern California. Results from open-water testing of the gear will be presented, and potential broader applications discussed.

The Role Of Local Ecological Knowledge To Solve Derelict Fishing Gear And Other Marine Debris Problems

“Crowdsourcing ghost net location in Lake Superior”

Titus Seilheimer, Wisconsin Sea Grant
Heather Bliss, Great Lakes Indian Fish and Wildlife Commission
Al House, Apostle Islands Sport Fisherman's Association

ABSTRACT

Plastic pollution in the Great Lakes can come in many forms, but ghost nets are likely the most dangerous to boaters and anglers. These lost and unmarked nets can then become hazards, especially to anglers using trolling gear. Wisconsin Sea Grant, the Apostle Islands Sport Fishermen’s Association, Great Lakes Indian Fish and Wildlife Commission, and the NOAA Marine Debris Program partnered in a campaign to raise awareness about ghost nets in the upper Great Lakes and to more efficiently remove them. The project informs anglers and boaters to the risks associated with marked commercial nets and ghost nets. Best management practices help commercial, tribal, and subsistence fishers to avoid conditions where nets could be lost. Anyone encountering a ghost net is encouraged to report the net, so it can be quickly removed. This project led to the removal of more than 5 km of ghost nets, which helps make the upper Great Lakes a safer place for recreation and enjoyment. Local knowledge from informed anglers and tribal law enforcement help to remove ghost nets more efficiently.

The Role Of Local Ecological Knowledge To Solve Derelict Fishing Gear And Other Marine Debris Problems

"Metrics for Evaluating the Local Ecosystem Service Impacts from Derelict Fishing Gear"

Amanda Laverty, NOAA
Adam Domanski, ECONorthwest

ABSTRACT

Marine debris has a number of documented impacts to habitats and natural resources. Derelict fishing gear can cause physical degradation of habitat (via scouring), and in some cases can continue to catch, entangle, and kill wildlife (via ghostfishing). These resource-specific impacts also have broader ecosystem service effects, which are more difficult to quantify. Commonly applied in natural resource damage assessments, ecosystem service equivalency analysis approaches quantify the change in ecosystem services using one or more ecosystem service indicators such as faunal abundance, vegetation density, or some other measure of ecological function. We demonstrate the spatial and temporal information needs for applying a similar ecosystem-based approach to evaluate the local impacts of marine debris and the benefits of removal.

The Role Of Local Ecological Knowledge To Solve Derelict Fishing Gear And Other Marine Debris Problems

"Preliminary Results from Material Flow Analysis (MFA) of Five Types of Fishing Gears Used in Norway"

Paritosh Chakor Deshpande, NTNU, Norwegian University of Science and Technology
Gaspard Philis, NTNU Norwegian University of Science and Technology, Ålesund
Dina Aspen,
Annik Magerholm Fet, NTNU, Norwegian University of Science and Technology

ABSTRACT

Abandoned, lost and otherwise discarded fishing gear (ALDFG) may have significant adverse environmental effects on coastal and marine ecosystems. In order to employ sustainable fishing gear resource management, it is essential to understand life cycle processes and further monitor gear quantities in and between these processes. Material Flow Analysis (MFA) is an established environmental accounting tool used to assess flows and stocks of materials in industrial and natural systems suitable for this purpose.

In this study, we report on an MFA model to track material flows and stocks of fishing gear from capture fisheries in Norway through use and post-use processes. Based on data from gear producers and importers, fishermen, collectors, recycling and waste management companies, we quantify mass of the gear types trawls, seines, longlines, gillnets and traps. Preliminary results from the analysis shows that gillnets, longlines and traps are the main contributors to ALDFG in the ocean in Norway. These gear types are also more susceptible to get lost due to gear design, practice and ground deployment. We also identify an accumulating stock of gear shoreside for some gear types, which has a critical impact on overall recycling efficiency in the system.

The MFA approach shows great promise as a decision support tool for industry and policy-makers in exercising sustainable fishing gear resource management. The approach helps understand the extent of the problem on a regional level, identify contribution from gear types, target critical processes and evaluate feasible mitigation mechanisms. The model will be further developed to track plastic fractions embodied in the gear to understand assess the potential for gear recycling in Norway.

The Role Of Local Ecological Knowledge To Solve Derelict Fishing Gear And Other Marine Debris Problems

"The Role of LEK in the Development and Progress of the Derelict Fishing Gear Program in U.S. Waters of the Salish Sea"

Dan Tonnes, NMFS Protected Resource Division
Kyle Antonelis, Natural Resources Consultants, Inc.

ABSTRACT

Studies utilizing reviews of 'grey' literature and interviews with local experts and resource users have highlighted the value of local ecological knowledge (LEK), and its use in conservation management. LEK has been used extensively to document, prevent and remove derelict fishing gear in the U.S waters of the Salish Sea. Over the past 15 years thousands of derelict nets have been removed through a program initiated due to anecdotal citizen and agency staff reports which eventually became systematically documented and used to garner removal efforts. Subsequent systematic efforts to assess ways to prevent derelict fishing nets and pots have been conducted through outreach to local tribes and recreational and commercial fishermen. These efforts have helped in assessments about bycatch rates of fish and invertebrates in derelict gear, reasons why gear is lost, and ways to prevent more accumulation of nets and pots. We will also discuss spatial assessments through GIS analysis of fish habitat and derelict vessels from datasets compiled from (a) historical fishing guide books with maps depicting rockfish fishing areas, with publish dates ranging from 1971 to 2008, and (b) interviews with 55 regional fishers and researchers. This report showcases the magnitude of LEK in a specific region as the catalyst for the development of a robust derelict fishing gear removal program, and its continued importance as the program has progressed to accomplish research projects, legislative changes, and prevention measures to reduce the impacts of derelict fishing gear.

The Role Of Local Ecological Knowledge To Solve Derelict Fishing Gear And Other Marine Debris Problems

"Using Fishermen Survey to Realize the Behavior of Typical Fishing Gears upon Deployment and Potential Estimates of Gears Lost Annually in Norway."

Paritosh Chakor Deshpande, NTNU Norwegian University of Science and Technology
Gaspard Philis, Department of Biological Sciences, NTNU, Ålesund
Dina Aspen, NTNU
Annik Magerholm Fet,

ABSTRACT

Plastics debris is an ever-growing concern adversely affecting coastal and marine ecosystem. Among the total marine plastic waste, a particularly troublesome waste fraction is the Abandoned, Lost or Discarded Fishing Gears (ALDFG) continuing to trap marine life for years upon release. Although there exists a direct link between the fishing activity and the occurrence of ALDFG in marine waters, it is imperative to scrutinize the practices adopted by fishermen and to understand the behavior of different gear types upon deployment in the marine waters. In this study, scientific survey was designed and conduced on 75 Norwegian fishermen in order to understand the typical life cycle of various fishing gears deployed in Norway namely, gillnets, trawls, longlines and seines. Responses received from the fishermen are further analyzed statistically to generate evidences on patterns in Norwegian fishing, typical gear lifespan, average lost potential of gear types and waste management practices of the damaged fishing gears.

The preliminary results indicates that, if not lost during deployment, gears like gillnets and longlines last for around 2 years while bigger fishing gears such as trawls and seines can last for around 5 and 7 years respectively, with regular repairs and replacements of their parts. Gillnets and longlines are most commonly get lost in the ocean upon deployment whereas bigger gears often lose connecting plastic ropes or metal wires during the operation.

The evidence from the survey can be used further to develop strategies for sustainable management of fishing gear resources in Norway. Conducting anonymous surveys is proven a robust strategy to retrieve scientific information and can easily be replicated elsewhere to build the global evidences around the ALDFG problematic.

Using Acoustic Data To Locate, Identify, Assess And/Or Recover Derelict Fishing Gear In Myriad Habitats

"Derelict crab trap removal and prevention in southern New Jersey coastal bays: big implications for smaller scale systems"

Mark Sullivan, Stockton University
Steve Evert, Stockton University
Peter Straub, Stockton University
Kaitlin Gannon, Jacques Cousteau National Estuarine Research Reserve
Nathan Robinson, Stockton University
Elizabeth Zimmermann, Stockton University
David Ambrose, Stockton University
Christopher Janiszewski, Stockton University

ABSTRACT

Southern New Jersey's coastal bays provide Essential Fish Habitat and ecological services to numerous mid-Atlantic species that use these areas during coastal migrations or as seasonal nurseries. While small in size relative to Delaware Bay, these bays and rivers account for ~42% of the State's 10.5 million dollar blue crab fishery. Unfortunately, the dynamic nature of these systems (boat traffic, currents, storms) renders a substantial proportion of crabbing gear lost every year. The negative consequences of this loss are numerous: ecological impacts, navigational hazards, loss of commercial income. Over the past 5 years, Stockton University scientists have engaged local commercial crabbers and restoration groups throughout southern New Jersey to break the cycle of crab trap loss in these diverse coastal bay ecosystems. This work consists of four main objectives: (1) Survey and digitally map derelict crab trap targets via side-scan sonar in coastal bays and rivers covering 36 km of coastline, (2) Recover and recycle or repurpose derelict crab trap gear through the combined efforts of crabbers, scientists, and volunteers, (3) Train coastal bay crabbers on best practices for in-season recovery methods and low cost sonar operation skills, (4) Educate recreational boaters and crabbers on best practices for avoiding crab trap buoys and properly setting their own traps. To date, 2025 pieces of derelict gear have been removed off-season as part of these efforts, supplemented by in-season recoveries aimed at preventing future gear accumulation. Combined results and lessons learned from these NOAA Marine Debris Program-funded projects will be highlighted.

Using Acoustic Data To Locate, Identify, Assess And/Or Recover Derelict Fishing Gear In Myriad Habitats

"Don't Have a Pot to Ping in: The Efficacy of Using Sidescan Sonar to Detect, Locate and Identify Derelict Fishing Gear."

Mark Borrelli, University of Massachusetts, Boston
Laura Ludwig, Center for Coastal Studies
Bryan Legare, Center for Coastal Studies
Theresa Smith, Center for Coastal Studies
Owen Nichols, Center for Coastal Studies

ABSTRACT

Acoustic instruments with the ability to rapidly and accurately map the seafloor have long been in use. With increasing frequencies and other technological advances applications for these instruments have broadened dramatically. Several recent projects conducted by the Center for Coastal Studies have used both towed and mounted sidescan sonar instruments to locate and identify derelict fishing gear, particularly abandoned lobster pots. The mounted sidescan instrument used in these studies is a Phase-measuring sidescan sonar which yields co-registered dual frequency, sidescan sonar imagery (op. freq. 550/1600 kHz) and swath bathymetry (550 kHz), simultaneously. These data are also useful for trap assessment and recovery as well as habitat analysis. Examples from projects in Maine and Massachusetts, USA, using both mounted and towed sidescan sonar will be discussed. Gear was mapped over of multiple bottom types from mud and sand to cobble and rock outcrop in water depths ranging from <5m to over 50 m.

Using Acoustic Data To Locate, Identify, Assess And/Or Recover Derelict Fishing Gear In Myriad Habitats

"Use of Sidescan Sonar Imaging for Planning and Implementing Effective Derelict Fishing Gear Recovery Operations in Washington, British Columbia, and Alaska"

Kyle Antonelis, Natural Resources Consultants, Inc.
Joan Drinkwin, Natural Resources Consultants, Inc.
Crayton Fenn, Fenn Enterprises
Paul Rudell, Natural Resources Consultants, Inc.
Kamal Lindoff, Douglas Indian Association

ABSTRACT

The effectiveness of sidescan sonar to identify locations of derelict fishing gear in marine waters is well documented. However, when planning subsequent gear removal operations, deeper analysis of the sonar images must be accomplished to maximize efficiency. Here we provide three specific methods to interpret and use sidescan sonar data to plan effective and efficient lost gear removal operations.

In British Columbia waters of Boundary Bay, over 1,800 derelict Dungeness crab pots were identified using sidescan sonar during a transboundary project in 2011. Sonar images were evaluated and targets were categorized as either buried/dilapidated or unburied. Removal operations were then focused only on structurally viable, unburied targets most likely to still be ghost fishing.

In a major effort to identify and remove derelict nets in nearshore waters from the U.S. portion of the Salish Sea, sidescan sonar surveys covered high priority areas identified in models developed by project personnel. Survey targets were analyzed and categorized based on the level of confidence in derelict net presence (1 = high, 2 = moderate, 3 = low). Project cost savings occurred as dive removal teams focused on Category 1 targets while target verification dive teams investigated Category 2 and 3 targets prior to mobilizing full removal teams.

In Gastineau Channel, Juneau, Alaska, sidescan sonar was used to locate lost crab pots in anticipation of a removal by grapple operation. Vessel size and capacity limitations, and the presence of an unburied submarine fiber optic cable, required eliminating targets from the removal plan. Targets were categorized as 1, 2, or 3 by size and additional snag hazards were identified. Areas to avoid were overlain on charts in GIS and navigational software to further refine the targets to be removed.

“Using Side Scan Sonar to locate derelict fishing gear to mitigate the effects of ghost fishing in the Upper Gulf of California.”

Ryan Solymar, Monterey Bay Diving
Elizabeth Hogan, World Animal Protection
Jared Berg, monterey Bay Diving

ABSTRACT

The critically endangered (IUCN) vaquita (Phocoena sinus) is the smallest porpoise species in the world, and is endemic to Mexico’s Upper Gulf of California. The illegal totoaba (Totoaba macdonaldi) fishery poses a threat to the survival of P. sinus as abandoned gill nets left behind after the season ends entangle individuals and cause them to drown. monterey Bay Diving (MBD) in partnership with World Animal Protection (WAP) sought to use Side Scan Sonar (SSS) technology to aid in the location of derelict fishing gear in the upper Gulf of California. Working alongside local fishermen coordinated by Dr. Lorenzo Rojas-Bracho and Dr. Armando Jaramillo, on behalf of the International Committee for the Recovery of the Vaquita (CIRVA), they attempted to assist in efforts to mitigate the effect of ghost fishing on P. sinus. An EdgeTech 4125 SSS unit was used at 600 kHz and 1600 kHz simultaneously to locate derelict objects and assess the efficacy of the current technique of dragging hooks along the seafloor to remove derelict gear. The technique being employed was found to be effective at removing derelict fishing gear, and shortcomings in the use of acoustic imagery equipment were noted. Located nets were removed and transported by Parley for the Oceans to Plastix Global, a Danish company specializing in recycling fishing gear for use in other products.

Effective Marine Debris Messaging

"#I Care – A behavioural change campaign to raise awareness and empower the public to reduce plastic waste"

Sandra Ludescher, OceanCare
Fabienne McLellan, OceanCare
Silvia Frey, OceanCare

ABSTRACT

Vast quantities of disposable plastic items consumed daily such as bags, packaging or cups account for a large portion of marine plastic pollution. In order to solve this major environmental problem we are convinced that we have to stop plastic from entering the oceans in the first place. Therefore, OceanCare raises awareness for the issue among the public to make people rethink their use of disposable plastic and thus prevent plastic waste from entering the oceans. The recently launched «I Care» campaign raises awareness and offers practical ideas: for example, avoiding disposable plastic bags by replacing them with reusable alternatives.

The campaign is mainly directed towards young people and therefore focusses on social media channels. Moreover, a campaign song of an environmentally conscious rock band has been integrated and the campaign will go on tour with the band. As such, a broad audience will be encouraged to participate. On the campaign's website people are asked to take a pledge to reduce their disposable plastic consumption by choosing different options. A real time calculator on the site measures the equivalent impact of such commitment in terms of the reduced yearly consumption of disposable plastics. These impressive numbers are a catalyst to encourage participants to further rethink their daily plastic consumption. Additionally, participants are presented with eco-friendly products helping them to keep their promise.

We are convinced that innovative campaigns such as #I Care will significantly contribute to a rethinking about our attitude towards plastic use which is, among other instruments, an effective solution to the problem of marine plastic pollution.

Effective Marine Debris Messaging

"Cultural domains of marine debris among experts and novices"

Ava Lasseter, Gulf of Mexico Fishery Management Council

ABSTRACT

Marine debris as an environmental issue has gained broader attention among the public in recent years. However, experts and novices exhibit differences in their awareness and engagement with marine debris. Using the results of a free-listing exercise among groups of experts (clean-up volunteers; fishermen) and novices (people without a connection to the marine environment), differences in the cultural domain of marine debris is analyzed between the groups. By understanding the differences in how marine debris is conceptualized by groups with different levels of awareness and engagement, marine debris messaging can be targeted more effectively.

"From mountain to ocean: Educating the future generation, raising awareness among the public"

Julia Hager, Mountain 2 Ocean

ABSTRACT

From mountain to ocean

Educating the future generation, raising awareness among the public

Although the syllabi of secondary and high school education in Germany point out to the problem of environment and human responsibility, this remains rather theoretical and marine debris or plastic pollution seem to be problems at a distance. So how can this global issue be made relevant for secondary or high school students and adults while existing more or less out of their sight? Photos, facts and figures in the media are inevitable and play an important part. Raising awareness, initiating responsibility and commitment, however, is a complex process that has to adjust to and mirror the knowledge the students or adults have acquired so far. Me providing them with authentic visual documents and samples from my project on microplastic pollution in the Mergui Archipelago as well as from my observation of beaches in the Arctic and in South Georgia where I encountered an entangled elephant seal or at least on river banks in their local area , linked to facts about the various origins and circles of microplastic pollution, enables them to better turn their environmental awareness towards action. At schools, students projects, close to information on current results of investigation and research which they gain from my talks, are a core instrument. While monitoring, sampling, collecting and analysing data, the students apply, prove and extend their skills in basic scientific strategies and, where possible, make general initiatives like citizen science activities valid for themselves. My proposed report is based on my speeches at schools and institutions in Germany as well as my projects with high school students so far and will be updated with experiences from my activities to come in the next few months.

Effective Marine Debris Messaging

"Improving Marine Debris Hashtag Messaging"

Bette Booth, Splash Trash Intl.

ABSTRACT

Hashtags are an essential tool of marine debris social media communication and messaging. The right hashtags can connect and share messages amongst current marine debris advocates in powerful ways. They can increase the reach and frequency of marine debris messages to new audiences and potential advocates at little or no cost. Sufficient reach and frequency are essential elements of behavior change communication and messaging.

However, not all hashtags are the same, and, when used inappropriately, can actually have a negative impact on engagement with current and potential audiences. Marine debris organizations and advocates are currently using a plethora of hashtags. Are we using too many? Too few? Are they the right ones? Are we using them in the right way?

This paper explores and analyzes these questions. Specifically, the paper identifies and analyzes the top twenty marine debris messaging "hashtags" in terms of exposure per hour, usage in the last 30 days, best day of the week and time of day and languages. Based on this analysis and a literature review of hashtag social media best practices, it provides specific recommendations about how the marine debris community can strengthen their messaging using the hashtag communication tool.

Effective Marine Debris Messaging

"Messages to the Wise: Effective Marine Debris Communication for Older Generations"

Lisa Swanger, Coastal Carolina University

ABSTRACT

Marine debris continues to pose a serious threat to coastal and marine environments. A major contributor includes the input from land-based sources, including polluted stormwater. Delivering effective messaging to diverse audiences is critical for preventing debris from reaching marine waters. The Grand Strand, located on the northern coast of South Carolina, includes one of the fastest growing metropolitan areas within the United States. It is a popular destination for both tourists and transients. Additionally, the rapid influx of current and awaited retirees from diverse backgrounds poses a unique challenge when attempting to increase marine debris awareness and action throughout the region. Therefore, the Coastal Waccamaw Stormwater Education Consortium, established in 2004 to assist local governments meet federal requirements for stormwater education and public involvement under the National Pollutant Discharge Elimination System Phase II Permit Program of the Clean Water Act, developed an Osher Lifelong Learning Institute course at Coastal Carolina University targeting residents ages 50 and up. This "Marine Debris: Origins to Oceans" course offers a sequential class experience comprised of lectures, interactive activities, and volunteer field efforts. The goals are to increase awareness about marine debris, build positive and meaningful connections with coastal watersheds, and encourage stewardship amongst older residents. This 6-week course was piloted fall 2017 and is expected to launch January 2018. This session will focus on the course structure and messaging strategies, along with key challenges and successes that may shed light on future efforts to effectively communicate marine debris issues to aging populations globally.

Effective Marine Debris Messaging

"Talking Trashy: How the NOAA Marine Debris Program Approaches Marine Debris Messaging"

Krista Stegemann, NOAA Marine Debris Program

ABSTRACT

Prevention is the ultimate solution to the marine debris problem, and so effectively communicating about the subject is extremely important. Communication must inspire positive action if it is to lead to marine debris prevention. In order to achieve this desired approach, the NOAA Marine Debris Program (MDP) focuses on positive and hopeful messaging, using success stories and offering solutions to empower an audience to become marine debris stewards. The topic of marine debris can easily become heavy or depressing, discouraging potential advocates from becoming involved. Using the proper combination of resources to engage an audience in the topic and emphasize the importance of the problem, and resources that focus on a hopeful approach, is vital. The MDP works within the scope of a government agency to predominantly address a very large and general audience within the United States about marine debris. This session will discuss the MDP approach, what resources they utilize, and the challenges that can be associated with addressing such an undefined audience.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"A long-term study and series of awareness raising activities for marine debris reduction : Case study of participatory multi-sector approach from southern Thailand"

Phusit Horpet, Marine and Coastal Resources Management Technology (CRM) program

ABSTRACT

This paper illustrates education programs for raising community awareness on the marine debris issues, some of which have included active learning activities with undergraduate student CRM projects since 2007. Each batch of students has hands-on experience to work with coastal communities nearby Walailak University. We have proposed 3 important days for local marine conservation, beach, and mangrove cleanup including 1) Local World Dolphin Day (14 April); 2) Local World Oceans Day (8 June); and 3) Ko Kra Archipelago Day (Local Ramsar Site) (12 August). Up until now, many events, activities, and campaigns related to research, prevention, and reduction aspects of marine debris issues have been successfully conducted on these days and throughout the year. These efforts involved many stakeholders, namely village heads, religious leaders, government officers, researchers, local administrative organizers, villagers, teachers, and especially primary school students. Outreach and education were given on the impacts of marine debris, microplastic on coastal and marine species, habitats, economic, human health and safety, and social values to encourage social behavior changes. It was expected for increasing public awareness of marine debris issues and social responsibility to mitigate these impacts. Villagers started to realize their roles in taking care of their home and surrounding environments, and the young generation has taken part in the movement towards fostering a sustainable concept of their community cleanliness. Ultimately, we try to establish a strong network with local coastal communities in marine debris management with the objective of expanding to regional and international cooperation.

Keywords: marine debris, university-community engagement, local participation, awareness activities

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"An effective University – Municipality partnership on K12 training aiming to reduce the marine litter and biodiversity loss of Mersin, Turkey"

Alison Margaret KIDEYS, Middle East Technical University, Institute of Marine Sciences
Ahmet Erkan KIDEYS, Middle East Technical University, Institute of Marine Sciences
Bülent HALISDEMIR,
Ali Cemal GÜCÜ,
Barış SALİHOĞLU,
Meltem OK,
Yeşim Ak ÖREK,
Kerem GÖKDAĞ,
Batuhan Çağrı YAPAN,
Merve KURT,

ABSTRACT

"I Know and Protect My Seas" (DTK) is a marine science outreach program aiming to help reduce marine litter and biodiversity loss. It was first initiated in 2012 by the Institute of Marine Sciences (IMS) of the Middle East Technical University in Mersin, southern Turkey. Since 2015 it has been supported by and run in conjunction with the city of Mersin Greater Municipality. Whilst the Municipality provides transport, funding for training expenses and manages logistics of the program, Institute academic staff and personnel volunteers undertake the student training, utilizing their particular scientific knowledge, results and expertise. The program which to date has provided training to over 5000 students, aims to reach and educate a diverse range of local schoolchildren. The consequences of anthropogenic activities with particular reference to biodiversity loss and marine litter are explained through visual presentations, an interactive panel-board team game, short videos and demonstrations during a hands-on mini workshop. Students complete questionnaires at the beginning and end of the half-day training period (as well as after 1 month later) in order to evaluate levels of knowledge acquired during attendance of the "DTK" program. Preliminary analysis of responses suggests that DTK is very effective in initiating a change of behavior towards reducing littering and to appreciate biodiversity. Establishment of our University-Municipality partnership has resulted in a well organized and efficiently run DTK program thereby decreasing the workload for scientist volunteers. Such a university-municipality partnership could be a very good model for other cities throughout Turkey and abroad.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"Communicating for a Clean Future: Creating a Public Service Announcement Competition for Students"

Susan Bixler, Ohio State University
Sarah Lowe, Freestone Environmental Services

ABSTRACT

The Ohio Marine Debris Challenge connects high school students with marine debris science and the Great Lakes. This competition is a unique cross-sector partnership between public and private organizations including The Ohio State University Stone Laboratory/Ohio Sea Grant, the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program, Ohio's 9th Congressional District, and Cedar Fair Entertainment Company. After learning about marine debris in the oceans and Great Lakes from the provided lessons, students develop a public service announcement, which focuses on inspiring others to acknowledge marine debris and be part of the solution. Winners of the competition are hosted by Cedar Point Amusement Park during Physics, Math, and Science Week, where they receive a certificate from their Member of Congress, and other recognition for their work. The contest is in our third year, with many lessons-learned on the creation of this unique competition and the establishment of strong community partnerships. These lessons-learned as well as information on adapting marine competitions to freshwater environments will be shared with attendees to encourage creation of similar education initiatives in other locations.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"Creating Marine Debris Stewards Among Low Income Youth"

Dan Haifley, O'Neill Sea Odyssey

ABSTRACT

The State Water Quality Control Board, under the federal Clean Water Act, requires communities to reduce runoff pollution including marine debris – the source of 80% of ocean pollution - through tools including education for school children. O'Neill Sea Odyssey (OSO) provides stewardship education to prevent pollution from entering runoff that flows through storm drains, watersheds, and ocean. California's future majority will be people of color, many low to moderate income, and the capacity exists to create ocean stewardship. A poll released by the Public Policy Institute of California indicated that non-white Californians were more likely than whites to perceive air pollution and climate change as serious threats, and favor fixing the problems. Applied Survey Research's most recent evaluation of OSO's student surveys found a majority of its students are ethnic minority and that lower-income youth "caught up" with their higher income peers in knowledge and behaviors. Joint Venture/Silicon Valley, and the Community Assessment Project for Santa Cruz County, found that low-income youth are less likely to be encouraged to become involved in their communities: to volunteer, vote, or to engage in environmental practices. Only 30% of youth said they experience a caring neighborhood; 24% have access to positive role models, and 15% felt valued by their community. Yet, 69% act on their convictions and stand up for their beliefs. Over two-thirds of these youth could become environmental and community stewards. A 2013 San Jose State University study found that 75% of students who participated in OSO 5-7 years before had retained knowledge about non-point source pollution taught by the program.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

“Equipping students to be the change they want to see”

Marti Martz, Pennsylvania Sea Grant

ABSTRACT

The Center for Great Lakes Literacy, (CGLL), strives to “Develop a community of Great Lakes literate educators, students, environmental professionals, and citizen volunteers, dedicated to improved Great Lakes stewardship”. (www.CGLL.org). Engaging students and educators on the issue of microplastics and marine debris has been an especially rewarding task. Plastic is all around us and it’s easy to see how much of it makes its way into the environment. A partnership between the Great Lakes Sea Grant Network and the US Environmental Protection Agency, CGLL provides the science and tools to engage basin residents in active stewardship of Great Lakes resources. Gathering fact based information and working with others in their communities, be it their families, school boards or local government, to implement what they’ve learned are critical skills for the next generation of decision-makers, stakeholders, educators and scientists. In Pennsylvania, CGLL provides a link from the lab to the classroom along with the resources to promote engagement and stewardship. Our staff shares the science, provides lessons from vetted sources such as NOAA’s Marine Debris program, and supports field and lab experiences for students that inform their service projects which they share with peers, families and communities. This experiences allows students to become content experts and agents of change in their communities. This presentation will share methods of educator/student engagement that promote an in-depth understanding of the issue of plastic pollution along with examples of projects students have undertaken to build a community discussion around single-use plastics.

"From New England to England: a Tale of Traveling Disks"

Jennifer Kennedy, Blue Ocean Society for Marine Conservation
Rebeca Murillo, Blue Ocean Society for Marine Conservation
Michael Toepfer, University of New Hampshire Cooperative Extension

ABSTRACT

In 2011, more than 4 million biofilm chips ("disks") were accidentally released from the wastewater treatment facility in Hooksett, New Hampshire into the Merrimack River. The Merrimack River empties into the Gulf of Maine, and soon the disks were being found all over New England. After 6 years, the disks continue to wash up, not only in local coastal areas, but as far away as England. Since 2011, Blue Ocean Society for Marine Conservation has been tracking the disks through beach cleanups and anecdotal reports, and using the information in educational programs to illustrate how trash travels. In 2017, we worked with University of New Hampshire Cooperative Extension to create an ArcGIS Story Map to tell the story of the disks, collate and coordinate sightings reports and encourage citizen scientists to photograph and report their disk sightings. This presentation will discuss the story of the traveling disks, the creation and use of the Story Map, lessons learned, and the potential use in educational programs.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"Non-Profit Collaborations: Ecotourism to Create Partnerships to Inspire the Behavior Change Needed for Plastic Pollution Reductions."

Wayne Sentman, Oceanic Society
Dianna Cohen, Plastic Pollution Coalition
Pamela Longobardi, Georgia State University
Kip Evans, Mission Blue

ABSTRACT

Ecotourism can play a vital role in connecting an international audience to the conservation consequences of increasing amounts of plastic pollution in the marine environments that tourists frequent. International ecotourism operators can be an overlooked stakeholder, a voice in support of regional plastic pollution reduction measures. Ecotourism designed with positive conservation impact in mind can help reinforce and motivate local efforts to garner public and governmental support to address plastic pollution prevalence in a specific ecosystem. Experiential ecotourism expeditions, when designed by multiple non-profits collaborating can offer a unique method to amplify that impact and support on-the-ground NGO's by connecting a diverse global community to help precipitate the behavior changes desired regionally to reduce sources of plastic pollution.

In November 2016 US-based non-profits Oceanic Society, Plastic Pollution Coalition, Mission Blue, and Drifter's Project worked with an Indonesian NGO, The Coral Triangle Center, designing the "Dragons to Debris" Expedition, to explore the impacts of marine pollution on the diverse coral reef habitats found between Bali and Komodo. The collaborative effort fielded a multi-generational group from 6 continents; made up of scientists, filmmakers, representatives of the media, visual artists, students, naturalists, philanthropists, and environmental activists. With this expedition, the combined skills and reputations of our organizations could be brought to bear to promote the value of sustainable marine tourism in support of local governments, NGOs, schools, and other stakeholders, all eager to engage with the mission of identifying plastic pollution sources and reducing its entry in to the marine environments by promoting "Blue Habits" or pro-ocean behavior changes.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

“Robots, drones & 3D printers: going beyond cleanups for education and inspiration”

Rachael Miller, Rozalia Project

ABSTRACT

Eight years, thousands of people of all ages (mostly kids) and hundreds of volunteer educators are what make up Rozalia Project's experience with marine debris education. In this session, we will share our best, our worst and our take-aways as we've developed our marine debris program from an ROV-centered experience to a data cleanup-centered experience to what we are delivering today: a program that utilizes, but goes beyond cleanups. The goal of the education program in Expedition STEM for the Ocean is a process with the goal to end with solutions - locally relevant and developed by the participants themselves, addressing the problems that move them to action; while inspiring young, coastal residents to get excited about STEM fields...for the ocean. We will also share some of our perspective on what engages adult audiences throughout the hundreds of presentations we've given on Rozalia Project, the problem of marine debris and how people can be part of the solution..

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"Shareholder Engagement on Ocean Plastic Pollution"

Conrad MacKerron, As You Sow

ABSTRACT

As You Sow is a non-profit that uses shareholder engagement to educate large publicly traded consumer goods companies about the potential risk to their brands posed by brand packaging that is swept into waterways, and to challenge them to improve related policies and practices. It is the only shareholder oriented group specializing in ocean plastic pollution, waste, and recycling issues.

In 2014, As You Sow began to engage and educate corporate management of large consumer brands like Procter & Gamble about the threat posed to oceans by brand packaging. Non-recyclable packaging is more likely to be littered and swept into waterways. A study by the Global Environment Facility concluded that one cause of debris entering oceans is "design and marketing of products internationally without appropriate regard to their environmental fate or ability to be recycled…" We asked companies to take an initial step towards stemming the flow of ocean pollution by making packaging more recyclable. A shareholder proposal we filed at P&G received strong support by one-quarter of shareholders at their annual meeting, asking for an assessment of the environmental impact of using non-recyclable packaging. The company responded swiftly and positively, agreeing to make 90% of its packaging recyclable by 2020. Another large consumer brand, Colgate-Palmolive committed that all packaging in three of its four operating divisions would be recyclable and that it would use 50% recycled content by 2020. We are now in discussion with McDonald's Corp. to phase out harmful polystyrene cup use globally.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"Talking Trash & Taking Action: Interactive Activities to Engage Anyone, Anywhere"

Allison Schutes, Ocean Conservancy
Sarah Kollar, Ocean Conservancy

ABSTRACT

What exactly is "ocean trash" and how does it get there in the first place? How does trash travel and how does it impact the ocean animals we love? As the directing organization of the International Coastal Cleanup (ICC), Ocean Conservancy has been confronted with questions like these for over thirty years. Youth, especially, are interested in the issue and are eager to get involved. Building off experience from the ICC and the rich dataset that tells the ocean trash story by numbers, the Trash Free Seas Program® at Ocean Conservancy has developed Talking Trash & Taking Action, a marine debris education partnership with the NOAA Marine Debris Program. The program is built around what we do best: cleanups –and takes it a step further, providing easy-to-understand and scientifically sound information and activities for before, during and after a cleanup. Made with flexibility in mind, any educator can pull activities and modules that suite their specific audiences' age and education levels in any amount of time. Session attendees can partake in two short activities from the program. We welcome feedback as we continue to build upon our own materials and aim to act as an international hub for marine debris education materials that can augment any cleanup experience.

Equipping The Outreach Toolbox: Experts Share Their Most Successful Activities, Tips And Tricks

"The Mobile Beach Cleanup Unit: Bringing the Public to New Depths"

Dari Alhuwail, Kuwait Dive Team
Rebecca Farnum, Kuwait Dive Team

ABSTRACT

In 1986, a small group of Kuwaiti friends began using their interest in scuba diving to help protect the beautiful habitats they discovered underwater. During the 1990-1991 Gulf War - devastating to marine as well as terrestrial ecosystems and infrastructure - the Kuwait Dive Team's work became emergency post-conflict rebuilding. 25 years later, much of the Gulf's underwater has been restored, thanks to extensive salvage and rescue operations, artificial reef installations, and regular underwater monitoring. The Dive Team has begun cleaning up the everyday pollution of picnickers' rubbish and industrial dumping rather than aftereffects of war. This has led to an increasing concern over sustainability - and how to not 'simply' clean up the seas, but prevent them from becoming harmed to begin with. A passionate group of master divers, the Team debated how to bring their work in the ocean's depths to communities on land. Sustaining the seas will require the active commitment of many more than those lucky enough to spend their days underwater surrounded by majestic reefs, after all. The Mobile Beach Clean-Up Unit was born. Each week, 100 Kuwaiti students come to a beach as part of their school day. Divers treat the students to an interactive lecture about marine biology and ocean ecosystems. students are then sent to the beach with equipment to remove rubbish, participate in an animal rescue simulation, and release live fish for population restock. The model leverages students' love of being outdoors and competitive natures to encourage Kuwait's young people to learn about and take better care of marine ecosystems. This session will present the story of Kuwaiti schoolchildren's engagement with the Dive Team and engage attendees in discussions about how youth can best be integrated in this vital educational work.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"A Cross-Cultural, Interdisciplinary Approach to Marine Debris Education."

Christine Parfitt, Bottle for Botol

ABSTRACT

Australians who travel to Indonesia are shocked by the plastic waste they witness on the streets, walk past on the beach, and paddle through in the ocean. In Australia, we have relatively effective waste-management schemes in place that hide the plastic problem from the public eye, making it difficult to communicate to students the scale of the global problem.

Bottle for Botol works with students in Australia and Indonesia to tackle this problem. Through Indonesia-Australian school partnerships, students learn about each other's waste practices, and how technical, socio-cultural and economic factors affect these practices. Students communicate about innovative ways to reduce single-use plastic consumption and work together to keep our shared oceans clean. Our program aims to inspire students to collaborate across cultures and disciplines.

Bottle for Botol runs a train the trainer model, providing practical, enjoyable and informative lessons designed collaboratively by teachers and marine scientists in Australia and Indonesia. Our Indonesian program directly tackles gaps in knowledge and removes barriers to environmentally responsible behaviours: specifically targeting single-use plastic cups of water. In contrast, our Australian program has been much more flexible, allowing teachers to incorporate our activities into all areas of the curriculum in junior and high school. This presentation will collate the work that our Australian teachers have created and provide examples of how they have addressed the plastic pollution problem in their classes within subjects as diverse as Student Leadership, Art, Indonesian, and Businesses Studies.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Education to Inspire Behavioral Change and Activism"

Doorae Shin, Kokua Hawaii Foundation
Natalie McKinney, Kokua Hawaii Foundation

ABSTRACT

Plastic Free Hawaiʻi is a program of the Kōkua Hawaiʻi Foundation, a nonprofit organization founded in 2003 by Kim and Jack Johnson to support environmental education in Hawaiʻi schools and communities. Plastic Free Hawaiʻi (PFH) seeks to minimize single-use plastics in Hawaiʻi by educating and empowering schools, businesses, and community members. We offer a solutions-based approach to tackle plastic pollution.

On top of traditional presentations that emphasize the power of leading by example, Plastic Free Hawaiʻi work with students and youth to launch campaigns in their schools and communities to reduce single-use plastics. This includes campaigns to eliminate single-use plastics from being used in cafeterias or banning the sales of plastic water bottles on school campuses. PFH has worked with students who have convinced their schools to switch to reusables in their cafeterias. PFH also empowers students to be active in legislative efforts by offering workshops in partnership with Surfrider Foundation. The first of its kind is called "Civics is Trending," reaching 200 high school and college students so that they can actively advocate for bills to prevent plastic pollution in Hawaiʻi. A parallel event, called Civics is Sexy, is in its 4th year with very successful turnouts to train the public on getting involved in legislative advocacy. Another educational offering include the annual PFH School Mural Contest, which encourages students create murals out of marine debris and bottle caps that share a vision of a Plastic Free Hawaiʻi.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Empowering Communities to Reduce Land-Based Sources of Marine Debris in the U.S. Virgin Islands"

Kristin Grimes, University of the Virgin Islands
Carrie Jo Bucklin, Southern Utah University
Sennai Habtes, University of the Virgin Islands
Howard Forbes, Jr., Virgin Islands Marine Advisory Service
Marcia Taylor, Virgin Islands Marine Advisory Service
Cait Goodwin, Oregon Sea Grant
Sydney Nick, University of the Virgin Islands

ABSTRACT

In the U.S. Virgin Islands (USVI), land-based sources of marine debris result from high residential waste production, lack of large-scale recycling, scarcity of bulk waste disposal locations, and inefficient roadside waste collection and transport to local landfills, leading to illegal dumping and habitual littering of surrounding hillsides. With funds from the National Oceanic & Atmospheric Administration's Marine Debris Program, we developed a targeted, ridge-to-reef educational and outreach program on the islands of St. Thomas and St. Croix in 2016-2017 to change knowledge and attitudes towards marine debris and lead to its reduction. We hosted a professional development workshop for 27 educators, 10 University of the Virgin Islands (UVI) Masters of Marine & Environmental Science (MMES) students, and additional, territorial stakeholders with marine debris, STEM education, and inclusion interests. The workshop introduced new, USVI-specific curricula adapted from Oregon Sea Grant's "Marine Debris STEAMSS" that highlights Caribbean ecosystems and local research. Seven Community Transfer Projects (CTPs), co-developed by educators and UVI MMES students, were funded and implemented during Spring 2017 to engage USVI youth and the broader community in creative, culturally-relevant projects to reduce land-based sources of marine debris in the Territory. CTPs model place-based, knowledge-to-action best practices for underserved populations that may serve as useful examples for others. The USVI were greatly impacted by Hurricanes Irma and Maria, two Category 5 storms that devastated the islands during September 2017. These storms magnified marine debris issues in the Territory, but present an opportunity to highlight solutions and challenges to this important economic, environmental, and community issue.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Heirs To Our Oceans' Empowerment Learning: The Next Generation Taking The Ocean Crisis Into Their Own Hands"

April Peebler, Heirs To Our Oceans

ABSTRACT

Heirs To Our Oceans are youth leaders who are dedicated to inspire awareness, responsibility and action amongst youth worldwide to protect the waters of our Blue Planet for them and for future generations.

Heirs To Our Oceans are committed to showing the world that human impact on our oceans today affects the health of our planet not only today but also that it will affect future generations, their children. These young world changers hold themselves out as leaders in ocean conservation. They are empowered and taking charge for their generation as they see what is happening to the oceans right in front of them and are determined to do something about it.

The Heirs study these real world issues through which they are developing their problem solving and critical thinking skills. As junior scientists, they engage in independent learning as well as in customized, interdisciplinary learning where all major subject matters are tied to the theme of tackling the ocean crisis.

The Heirs delve deeply into their areas of focus include the importance of keystone species, marine botanicals, role of top predators, cetaceans and coral reefs, as well as the detriments of plastics and other marine debris in our oceans, ocean acidification, warming waters, overfishing and improper fishing practices, and endangerment of so many species. The Heirs work with expert researchers and scientists, conservationists, mathematicians, policy makers, and more to learn more about the ocean matters today and for decades to come.

The Heirs are starting a global movement from the ground up through holding youth empowerment and human impact awareness camps and through starting H2OO chapters for ages 9-17. Heirs also speak out publicly on the ocean crisis.

Heirs To Our Oceans are creating the next generation of environmental leaders.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Lessons learned from a nationwide Citizen Science Project about Marine Debris in Germany as a tool for educating school classes in science"

Tim Kiessling, Kiel Science Factory
Katrin Kruse, Kiel Science Factory
Dennis Brennecke, Kiel Science Factory
Alice Nauendorf, Kiel Science Factory
Ilka Parchmann, Leibniz Institute for Science and Mathematics Eduction IPN
Martin Thiel, Facultad Ciencias del Mar
Tim Kiessling, Kiel Science Factory

ABSTRACT

Kiel Science Factory, Germany, is a school and teaching laboratory, which breaches the gap between school education and university research. Since opening in 2012, about 20.000 schoolchildren and teachers joined different programs. The combination of research and learning is very effective to attract young people to pursue scientific careers, communicate science and increase teacher interest in current science. In two nationwide plastic samplings in German rivers and streams (to attract midland people) in 2016 and 2017 we used a citizen science approach to (i) generate relevant litter information, and (ii) teach sustainable development about littering and marine debris. A booklet for schoolchildren (step-by-step guide to conducting the project, including preparation and follow-up work) as well as learning materials and worksheets for teachers (suitable for educational work in curricular and extra-curricular settings) was provided. The biggest challenge to work with teachers and schoolchildren as volunteers in Citizen Science projects is to attract and motivate them to participate and then upload their data on the webpage. Therefore special effort is needed – a win-win-situation for teachers, students and scientists has to be offered. More than 1600 schools in Germany ordered the booklets and materials. The experiences with this project setting (strength: e.g. huge amount of data and public interest, and weakness: e.g. high workload; compromises required) as well as practical advice and recommendations (e.g. conduct teacher trainings to improve data flow and quality) are offered and reflected in the presentation. All materials are available in German and English and free for download.
Financial support: Kiel Science Factory, German Federal Ministry of Education and Research, 'The Future Ocean', Lighthouse Foundation.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Making environmental care an integral part of the school environment; an example from the Balearic Islands"

Brad Robertson, Asociación Ondine
Silvia Frey, OceanCare
Marijana Gutic, Asociación Ondine

ABSTRACT

Convinced that the only way to approach the root cause of any human created problem and reach lasting results is to involve those same humans into the solution of it, Asociación Ondine has developed three separate yet interrelated initiatives to tackle the issues of plastic pollution together with local communities in the Balearic Islands. Through the Dos Manos Beach Clean ups, School Programme and Partners Programme, the organisation works with households, schools, companies and event organisers to stop the issue at its source by facilitating reduction of single-use-plastics and creating a community-driven movement for positive change.

The Dos Manos Schools Programme, provided free of charge, explores the issue of plastic in the marine environment. Students study the impact of plastic pollution on marine ecosystems, the connectivity between human behaviour and the marine environment, and where responsibility lies. They conduct a Dos Manos beach clean up, undertake a scientific survey, analyse results and invent solutions to the problem.

Since the project launch in 2017 several schools have opted to reduce their single-use-plastics. Moreover, the Dos Manos Projects Guidebook is developed for teachers. It consists of 10 projects with a clear call to action and allows students to solidify themselves as active change-makers. To help shape an environmentally conscious and pro-active young generation, an annual competition and a Dos Manos "Schools Portal" to encourage shared learning and build an international "ideas bank" for positive solutions to plastic pollution are being developed and the integration of the programme within existing grant funding programmes for entrepreneurial students and local school curriculums are planned.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Marine Debris STEAMSS Curriculum Engages Students"

Tracy Crews, Oregon Sea Grant
Cait Goodwin, Oregon Sea Grant
Kerry Carlin-Morgan, Oregon Coast Aquarium
Ruth McDonald, Oregon Coast STEM Hub

ABSTRACT

Communities in the U.S. Pacific northwest have been increasingly aware of and concerned about marine debris, especially given an influx of new materials washing ashore since the 2011 tsunami in Japan. To help educators teach about marine debris issues, we developed a Marine Debris STEAMSS Curriculum in Oregon for students in grades 4 through 12. Integrating the subject areas of Science, Technology, Engineering, Art, Math, and Social Studies (STEAMSS), the curriculum focuses on experiential, hands-on activities in the classroom and in the field. The collected teacher-tested resources enable educators to create in-depth, project based learning units, work across disciplines, and help students engage in stewardship actions.

Development of the curriculum was funded by the NOAA Marine Debris Program and created by Oregon Sea Grant in partnership with Oregon Coast Aquarium and Lincoln County School District. Partners gathered and organized existing and new curricular materials relating to the topic of marine debris, and shared the materials with teachers through a professional development workshop. Teachers implemented activities with their students, provided feedback on the effectiveness of the lessons, and modifications were incorporated into the curriculum prior to its publication on the Oregon Coast STEM Hub website: http://oregoncoaststem.oregonstate.edu/marine-debris-steamss/

Lessons are grouped into three grade bands of Upper Elementary, Middle, and High School, and are aligned with Next Generation Science Standards. Materials are grouped into four categories that scaffold understanding of the issue of marine debris. From Composition/Abundance and Sources/Transport, to Impacts and Solutions, students explore a complex, real-world problem with local relevance and global implications.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Monterey Bay Aquarium's Ocean Plastic Pollution Summit"

Mary Whaley, Monterey Bay Aquarium
Beth Callaghan, Monterey Bay Aquarium

ABSTRACT

This Summit, for 3rd-12th grade teachers and their students, is designed to address plastic pollution issues in watersheds and marine environments by reducing single-use plastic consumption.Our focus is on action--changing buying and consumption behaviors of teachers, students and their families to choose alternatives to disposable plastics.With their teachers' guidance, students are encouraged to implement action projects in their local community to reduce single-use items. Each action project is a unique, community-based approach, defined by the participating teacher(s) and their students.

The main program elements are three events at MBA and student-driven action projects. The first two events aim to assist teachers in developing community relevant plastic reduction projects with their students. The final event is to celebrate and share the accomplishments of those projects.

Fall Kick-off:The series begins with an evening keynote session and conservation exhibitors at the Aquarium. Teachers sleep over in the Aquarium and participate in breakout sessions the following day. Teachers hear from researchers, scientists and past participants to learn about strategies to reduce pollution sources in their communities. They learn about types of plastic pollution, with an emphasis on single-use plastics, and discuss impacts of single-use plastics on animal and human health.

Winter Networking Event: Teachers committed to engaging students in single-use plastics reduction projects meet to exchange ideas, learn more about the issues and get an opportunity to troubleshoot project implementation with colleagues, Aquarium staff and expert speakers.

Spring Symposium: Teachers are invited to bring five students to present at an MBA sleepover. The event includes a young,inspirational speaker with messages of youth empowerment.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Plastic Pollution: The Gateway to Effective Environmental Education"

Katie Allen, Algalita Marine Research and Education

ABSTRACT

It's become clear that previous generations failed to foresee the impending plastic pollution crisis. We must ask ourselves: in retrospect, why didn't mankind fear the consequences of such a persistent and polluting synthetic material? Why did we fail to thoughtfully design products to fit within a circular model of production?

Answers to these questions are complex; however, fundamental to the response is an understanding of how the lack of effective environmental education has deprived our population of the critical thinking skills necessary for identifying, deploying, and maintaining systemic solutions. As millions of tons of plastics continue to accumulate in our ocean each year, we have no choice but to admit that we've acted irresponsibly.

Driven by a commitment to preparing youth to take on the challenges ahead, it's paramount that we stop marginalizing environmental subjects and begin infusing them into existing academic curricula at all levels. Using the issue of plastic pollution as a gateway, we'll explore what a healthy integrated collaboration among educators, NGOs, and government could ideally look like. We'll discuss how such partnerships have worked in the past as well as potential strategies to overcome political, economic, and cultural barriers.

Solving plastic pollution, among other environmental issues, is possible, not through utopian idealism, but through a strategic and guided paradigm shift with its first spark within the framework of our current educational system.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Preliminary lessons from the Integrated Plastic Pollution Curriculum"

Anika Ballent, Algalita Marine Research and Education

ABSTRACT

As the global issue of plastic pollution develops, educational resources that engage individuals on a personal level are in high demand, because personal engagement and investment in this issue is key to promote effective changes in an individual's relationship to plastic and their environment.

To address this, Algalita Marine Research and Education provides youth education and leadership programs around plastic pollution. Algalita's Integrated Plastic Pollution Curriculum (IPPC) brings together scientific, political, social, and economic lessons through hands-on activities and student-led projects. The IPPC is designed to be easily updated, integrated by educators and engaging for students. It approaches the topic of plastics pollution from both the individual's perspective and the global systems perspective; it focuses on changing people's perceptions of plastic as a resource and increasing people's understanding of the complexities of the issue.

To thoughtfully evaluate the effectiveness of first version of the curriculum, 10-15 public school, K-12 educators will pilot the lessons and provide feedback through surveys and direct discussion around several evaluation themes. The evaluation and feedback themes will include topics such as: What challenges were faced in implementing this curriculum? How can this curriculum be better adapted to meet standards and other regulations? How well did this curriculum engage students personally at the level of long-term commitment and behavioral shifts?

The findings of the primary trial will be discussed in this session to provide educators with information and ideas to bring into their own classrooms.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"The role of an action-oriented MOOC in addressing the worldwide marine litter pollution."

Ansje Löhr, 1Faculty of Management, Science & Technology, Department of Science, Open University of the Netherlands
Raoul Beunen, Faculty of Management, Science & Technology, Department of Science, Open University of the Netherlands
Carolien Kroeze, Water Systems and Global Change Group, Wageningen University, The Netherlands
Marco Kalz, Faculty of Management, Science & Technology, Department of Science, Open University of the Netherlands
Ad Ragas, Faculty of Management, Science & Technology, Department of Science, Open University of the Netherlands
Bernardo Tabuenca, Escuela Técnica Superior de Ingeniería de Sistemas Informáticos. Universidad Politécnica de Madrid
Frank Van Belleghem, Faculty of Management, Science & Technology, Department of Science, Open University of the Netherlands
Charlotte Verburg, Faculty of Engineering Technology, Department of Water Engineering & Management, University of Twente, The Netherlands

ABSTRACT

Since the 1950's the amount of plastics in the marine environment is gradually increasing. Worldwide there is increasing concern about the risks and possible adverse effects of (micro-) plastics to marine and aquatic organisms, and human health. Moreover, plastic litter pollution is seriously threatening the availability of clean water, a key issue in meeting the Sustainable Development Goals. There are many worldwide initiatives and strategies aiming at action for reduction and prevention of marine litter for example by the Global Partnership on Marine Litter (GPML), the Clean Seas Campaign or the G7 countries. Most initiatives are committed to priority actions and solutions to combat marine litter both on land and at sea. They also stress the need to address education as one of the tools to inspire action and guide policy change. The Massive Open Online Course (MOOC) on Marine litter was developed within the framework of GPML and the Clean Seas Campaign and sponsored by UN Environment. MOOCs are a revolutionary concept in higher education, whereby course content is delivered online and free of costs to participants around the world. The MOOC on Marine Litter was created in order to spread knowledge, stimulate leadership and offers opportunities for actionable and change-oriented learning. This presentation deals with the role and effectiveness of the MOOC in addressing marine litter pollution and reducing and preventing marine litter. The MOOC enhances (international) cooperation, reaches different stakeholders and helps to form a global network of actors actively involved in addressing marine litter challenges.

Introducing A Real-World Interdisciplinary Approach To Marine Debris Education

"Washed Ashore's Integrated Arts Marine Debris Curriculum: Combining Art and Science"

Patrick Chandler, Washed Ashore
Angela Haseltine Pozzi, Washed Ashore

ABSTRACT

The Washed Ashore Project believes that by combining science and art, we change the world. Art enables us to move beyond what we know. It engages the creative, imaginative, and intuitive parts of brain that must be used to find innovative solutions that will recreate the future.

Under the guidance of professional artist and director, Angela Haseltine Pozzi, our project works with thousands of volunteers to create giant sculptures made from marine debris to spark changes in consumer habits. With NOAA support, Washed Ashore has worked to create a curriculum based on the goals of our project. The lessons bring together art and science to help students understand plastic pollution and communicate about it using the language of the arts. Core competencies in science, writing, visual arts and social studies are also linked to lessons to enable the curriculum to cross subject boundaries.

In this session co-authors Patrick Chandler, Education Consultant, and Angela Haseltine Pozzi, Executive Director, will introduce the Integrated Arts Marine Debris Curriculum (IAMDC) to educators so that they can bring these lessons back to their own classrooms. The curriculum is a twelve-lesson unit designed for fourth through sixth grade students. However, activities can also stand alone and can be modified to suit the needs of formal and informal educators teaching to any level. The curriculum provides a unique approach to teaching about science through the arts and offers innovative ways to discuss the issue of marine debris for both students and educators.

Performing Arts In Education For Stopping Marine Debris

"A summer school on Environmental Education and Performing Arts: Stop Microplastics"

Hrissi K. Karapanagioti, Department of Chemistry, University of Patras
Mare Galani, Education Department of Primary Education, University of Patras
Stavroula Kordella, Department of Geology, University of Patras

ABSTRACT

The Department of Chemistry, in cooperation with the Department of Primary Education and the Department of Geology of the University of Patras, Greece organized a Summer School on "ENVIRONMENTAL EDUCATION AND PERFORMING ARTS: STOP MICROPLASTICS" at the University Campus. The event was aiming to educate and inform local active teachers of primary and secondary education system and university students of the University of Patras. The school included both theoretical powerpoint presentations and practical training on the topics. The first day, the instructors presented the theory of microplastics and performing arts. Then, graduate students worked with teams and work on laboratory exercises aiming in identifying microplastics in sand samples as well as determining the plastic density and behavior. Then, the participants gathered in a cycle and worked on rhythms using different earth materials and plastic as well as body movements resembling all these materials. The second day, there were presentations and experiment demonstrations related to marine debris museum exhibitions and water pollution. There were also exercises related to creative writing. Finally, there was a presentation and some video demonstrations related to actions on plastic bag usage reduction. The third day, a 3-hour seminar took place that was presented by an actor and theater and cinema director related to the microplastics that cloud the ocean of our mind. The evaluation results of this summer school will be presented.

Performing Arts In Education For Stopping Marine Debris

"From Trash to Treasure: Creative Interventions in Relationships with Plastic as a Method for Addressing Marine Debris"

Jennifer MacLatchy, Dalhousie University

ABSTRACT

Because of the abundance and variety of marine debris, many artists are using it as the materials and focus for a variety of forms of art. In addition to directly contributing to removing plastics from the ocean and remediating shorelines, these works create visual and cultural objects that serve to engage and educate the public by considering the ways in which we interact with the many plastic objects that pass through our hands every day. Using artist Aurora Robson's sculpture Kamilo as a starting off point, this paper will examine the ways in which we might shift our relationship with plastic from one that treats it as worthless and disposable, towards one that treats it as something of value that is worthy of care and respect. By paying attention to and highlighting all kinds of different pieces of marine debris objects as their materials, Robson's work asks us to consider the stories in each tiny piece of plastic ocean pollution, in order to trace their journeys back to our own mundane daily actions for which we may not have given enough thought.

This ascribing value to the items that comprise plastic pollution comes not from a denial of their devastating impacts; rather, it comes from an immediate and deep understanding of this, and of the ways in which we are all complicit in this pollution. By more deeply understanding this, this paper will argue that we might move towards decreasing the volume of marine debris through a shift in human relationships with the plastic objects in our everyday lives. This shift is being explored and enacted through art that makes use of marine debris in ways that treat it as something other than trash, and thus reinscribe the material with beauty and wonder, and perhaps also possibilities for thinking about how we might act differently towards the plastic items that we consume.

Performing Arts In Education For Stopping Marine Debris

"Grate Art and the Recycling Rooster"

Doug Woodring, Ocean Recovery Alliance

ABSTRACT

Art for awareness, and characters that can inspire, can cut across communities, nationalities and ideologies, and can be used very effectively in inspiring change. Grate Art is a progam initiated in Hong Kong, working with six local artists, and two from China, to create ceramic plaques that are put on the streets near storm drains to remind people not to dump in drains. The engagement of artists, or other non-government "art/messaging" individuals, is what has the power to spread this message further than a simple government reminder. Art for Awareness has reached thousands, and could be replicated in most places in the world in some way, shape or form.

Plays, puppet shows and music also have the ability to inspire change in creative and fun ways. "Uncle Roo - the Recycling Rooster" was written with village children in mind, but can be used anywhere in the world to teach youth (and adults) about the benefits of recycling, proper waste management, water quality improvements, and environmental protection. Most villages in the world have roosters, and this is where the power of this play/puppet show comes in as an incredible tool for education on this topic. The performance is now in five languages, and has been performed in the Philippines, Guatemala and soon in Japan and Malaysia as a shadow puppet show. Come learn the incredible power of nature, and the rooster, and how this can help to drive improved prevention of plastic in our waters and communities.

Performing Arts In Education For Stopping Marine Debris

"The Marine Debris Awareness and Solutions Student Art Projects"

Suzanne Frazer, Beach Environmental Awareness Campaign Hawai`i (B.E.A.C.H.)
Dean Otsuki, Beach Environmental Awareness Campaign Hawai`i (B.E.A.C.H.)

ABSTRACT

The Marine Debris Awareness Student Art Project was developed and implemented by an all volunteer, non-profit organization to help increase awareness in schools and the community of the impacts of marine debris on marine life and the environment. This integrated marine science/art project involved students and teachers from many different schools and subject areas in learning about marine debris impacts such as ingestion, entanglement and habitat destruction, through powerpoint presentations, films, photographs, discussions and hands on learning with marine debris. Students then chose an issue that they are most concerned about and created a painting or drawing to help educate the community and inspire support for actions that will help reduce and prevent marine debris. The project was conducted in thirty schools from 2008 to 2010 and resulted in more than twenty-five public displays of artwork by more than 1400 students in grades K-12. Following the month long exhibitions of artwork, books of selected pieces were created to provide on-going learning and access to the work (such as in library collections) long after the projects had finished. Following the success of this project, an additional project was developed: The Marine Debris Solutions Student Art Project in which students learn about impacts as well as solutions to plastic marine debris in a similar way to the previous project. The students created paintings about specific solutions to reducing the plastic load on the environment including what to recycle, reuse and reduce. The artwork was displayed in public for the community to be inspired. This project took place from 2011 to 2012.

Performing Arts In Education For Stopping Marine Debris

"Weaving the Tides: An artist Process of Creating Marine Debris Sculptures"

Katie Peck, Chapman University

ABSTRACT

Entering my postgraduate artistic practice, I continue to ask myself how to address the major issues affecting our country through my artwork. Within my creative process, found objects and crowd sourcing materials have played a major role in my artwork which has lead me to focus on the marine debris impact on Southern California beaches. As an answer, I created a sculpture initiated through my participation in beach cleanups along the California Coast. By experimenting with my new medium and utilizing plastic debris, beer bottles, as well as other objects, I found the importance of the aesthetic nature of my artwork. Through the sculpture's playful presents, it engages the community to reflect on the objects found within the life sized, blue crashing wave. It is now my mission to highlight artwork addressing marine debris within the art world and to promote green artists' practices.

The Aquarium Conservation Partnership (Acp) And The Role Of Aquariums In Reducing Plastic Pollution

“Aquarium Conservation Partnership's Plastic Pollution Initiative”

Aimee David, Monterey Bay Aquarium
Dale Schmidt, National Aquarium
Nicole Minadeo, John G. Shedd Aquarium
Noah Chesnin, Wildlife Conservation Society's New York Aquarium

ABSTRACT

Panel Overview: The Aquarium Conservation Partnership (ACP) is a collaboration of AZA-accredited public aquariums across North America committed to advancing conservation and advocacy of the world’s oceans, lakes and rivers. Together, member aquariums work to advance science-based conservation goals by leveraging our unique assets, including our scientific expertise, our visibility with the public, our business relationships, and our credibility with decision makers.

The session will focus on ACP’s strategies including its consumer campaign to reduce demand for single-use plastic, what aquariums are doing to help influence and change policy, and what it takes to make a commitment to reducing single-use plastic in our retail and food service operations.

Speaker 1/Moderator: Aimee David, Director of Ocean Conservation Policy and Initiatives, monterey Bay Aquarium Aquarium Conservation Partnership Overview

Speaker 2: Dale Schmidt, Senior VP and Chief Operating Officer, National Aquarium Marrying Mission with Operations – The Quest to Eliminate/Reduce Single Use Plastics

Speaker 3: Nicole Minadeo, Director, Communications and Public Relations, John G. Shedd Aquarium “In Our Hands” Campaign

Speaker 4: Noah Chesnin, Policy Program Manager, Wildlife Conservation Society’s New York Aquarium The Role of Aquariums in Influencing Policy

"Acute need of Legal Framework for management of marine debris and Microplastics in India"

Shwetal Shah, Government of Gujarat

ABSTRACT

India is the second most populous country of the world. One sixth of humanity exists in India and it is the fastest growing major economy of the world. Very high density of population puts a big pressure over country's natural resources. Everyday India produces around 175,000 metric tons of solid waste, 65% of it gets collected, 15% of the total waste gets treated, 50% of the total waste is dumped into the low-lying areas and in landfill sites and 35% remains scattered in the environment. The scattered waste is the major reason of contamination of air, land and water bodies including ground water and marine waters. Plastics comprises 7 to 10% of total solid waste by volume, with increasing income of average Indian, plastics will be 25% of total solid waste by 2030. The present annual consumption of plastic in India is around 13.4 million metric tons which will grow to 22 million metric tons by 2020. The average per capita plastic consumption in India is 11 kg per annum against world average of 28 kg. The basic studies about concentration and abundance of micro-plastics in Indian rivers and oceans are not available. However, based on random studies, it is evident that microplastic contamination is increasing drastically in Indian marine environment. In absence of scientific treatment of solid waste and lackadaisical approach in enforcement of legal provisions about solid waste management in India, it pauses a big challenge for future. In this paper it is projected that potential concentration of micro-plastics in Indian marine environment will be significantly higher than the global average and if it is not addressed in scientific and timely manner, it will be one of the major roadblock on sustainable development of not only of India but also of the whole humanity. India has articulated Water (Prevention and Control of

Advancing Policy And Legislation Changes Regarding Microplastics

"Policy and legislation for plastic litter should match the scale of the problem and be informed by science"

Chelsea Rochman, University of Toronto
Stephanie Borrelle, Auckland University of Technology
Max Liboiron, Memorial University of Newfoundland
Alexander Bond, Ardenna Research
Amy Lusher, Norwegian Institute for Water Research
Hillary Bradshaw, Memorial University of Newfoundland
Jennifer Provencher, Acadia University

ABSTRACT

An estimated 4.4 - 12.7 million metric tonnes of plastic enter the oceans from land annually. As a consequence of increasing plastic production, growing demand for single-use plastics, leaky waste management, and the durability of plastic, plastic litter has infiltrated all levels of the food web, including food for human consumption. Plastic is also found in unexpected and remote places like deep sea trenches and Arctic sea ice. Plastic pollution is clearly a global issue, but is largely managed locally (e.g., bag bans, waste management strategies, educational campaigns). But plastic pollution does not observe borders, so why should policy? This summer, The Ocean Conference held at the United Nations headquarters in New York highlighted plastic pollution as one of the top issues for conservation. Sustainable Development Goal 14 includes a target to reduce global emissions of plastic pollution into the oceans. In order to achieve such goals, which have been repeated time and time again since the United Nations Conference on Sustainable Development (Rio+20 Summit), international policy instruments are required. With an interest in understanding what policy occurs at an international level, we scanned policy documents and agreements regarding plastic and other pollution issues. We conclude that to reduce plastic pollution we need international policy instruments that have defined reduction targets, signatories from member states, and a global fund to provide resources for mitigation and implementation. Here, we highlight existing international policy documents around plastic and other pollution issues, the state of the science regarding plastic's effects on biota and ecosystems, and how together they may inform future large-scale mitigation.

"Progressing legal and policy frameworks towards upstream solutions at a regional and international level to prevent harm environmental and human from plastic products and waste"

Karen Raubenheimer, ANCORS

ABSTRACT

Policy intervention has historically viewed the issue of marine plastic litter as a failure of solid waste management services. In acknowledging that these services are the frontline response to the problem, recognition is increasingly being given to the need for 'upstream' solutions. The Polluter Pays principle and Extended Producer Responsibility are often included in binding and voluntary instruments. But how can these be further elaborated meaningfully into policy that result in effective reductions in pollution of the marine environment by plastic litter and microplastics? Marine plastic litter is a symptom of a multitude of bad management practices in multiple sectors throughout the lifecycle of plastics, both on land and at sea. The international framework establishes a clear duty to prohibit pollution of the marine environment from the deliberate dumping or disposal of wastes contain plastics, including fishing gear. But the duty to prevent such harm from land-based sources of plastic waste, both to the environment in general and to public health, is less prescriptive at the international and regional level. This session explores the possibilities to extend current policy measures to regulate the activities of industry, from design to end-of-life treatment, and to improve the current framework in this regard. An important element of any policy intervention is consideration of industry trends and initiatives, including international trade in plastic products and waste. Regional approaches are important, but the globalisation of the lifecycle of plastics must also be considered in regional strategies. This discussion aims to marry the efforts at the international and regional levels and identify gaps and areas for strengthening regional approaches in progressing towards a holistic lifecycle approach to the issue.

Advancing Policy And Legislation Changes Regarding Microplastics

"Scotland: A small country tackling the big problem of marine plastic litter with legislation and creative policies."

Morag Campbell, Scottish Government

ABSTRACT

In 2014, Scotland published a Marine Litter Strategy with a clear purpose: to develop current and future measures to ensure that the amount of litter entering the marine and coastal environment is minimised to bring ecological, economic and social benefits.

To deliver this strategy, the Scottish Government is encouraging behaviour change at public and business levels with policy and supporting this with legislation. All marine litter is targeted by the strategy, however, there is a more recent focus on plastic, big and small.

Scotland introduced a plastic bag charge in 2014, resulting in an 80% drop in the number used by customers and a comparable reduction in the number of plastic bags collected in beach cleans. Following this success, research into a nation-wide deposit return scheme for drinks containers was commissioned and final scheme designs are to be put to public consultation shortly. Work has also begun to study further fiscal and other measures to boost the circular economy including imposing a levy on single-use items such as disposable cups. Legislation has been developed to ban the manufacture and sale of rinse-off personal care products containing plastic microbeads in 2018. Further legislation is being considered to ban plastic cotton buds and to regulate the manufacture, transportation and handling of pre-production plastics, or 'Nurdles', which make their way into our seas through accidental spillage in the form of pellets or powders. It is hoped that nurdle handling regulation will provide brands and retailers with an accreditation system for their containers, demonstrating responsible production.

Conservation and Community: a Binational Approach to Environmental Stewardship in the United States and Mexico

"MPA Watch: monitoring Human Use of Marine Protected Areas"

Angela Kemsley, WILDCOAST

ABSTRACT

California's coastal and marine ecosystems are some of the most iconic and treasured resources in the state and contribute greatly to California's history, identity, and economy. Unfortunately these same ecosystems are also some of the most exploited and, without proper care, their long-term health is in jeopardy. Designed to protect the diversity and abundance of marine life while still maintaining recreational access for people, MPAs now protect over 16%, or 850 miles, of the California coast.

Robust monitoring of the effectiveness of MPAs to conserve biodiversity is crucial to the continued success of the MPA network. Numerous efforts have been undertaken to monitor ecological change in MPAs, but none have monitored how humans are using the coastline. To this effect the MPA Watch program was created as a statewide citizen science monitoring program aimed at observing and collecting unbiased data on coastal and marine resource use.

MPA Watch is comprised of nine organizations which have collected over 17,000 surveys between San Diego and Mendocino. These data are used by organizations such as the Ocean Science Trust, Department of Fish and Wildlife, and local government officials to inform science, management, and policy decisions. The MPA Watch network model is applicable across a wide range of locations and the data collected is valuable to anywhere humans are using coastal or marine resources.

Conservation and Community: a Binational Approach to Environmental Stewardship in the United States and Mexico

"Por un mar libre de plásticos"

Lizz Gonzalez Moreno, Pronatura Noroeste

ABSTRACT

Garbage in the seas is one of the biggest problems worldwide, affecting the biodiversity, the economy and the health of the population. 8 million tons of garbage are dumped every year in the world. In Baja California each inhabitant generates 850 grams of garbage, which does not undergo any separation process. The uncollected garbage is incinerated and the rest is disposed of in unsuitable places. In the holiday season, the main beaches generate 10 to 12 tons per day, much of this garbage usually end up in the sea affecting the various marine species and the tourism sector, one of the main economic activities of the region. The main waste found on beaches is plastic such as cigarette butts, bottles, bags and disposables, mainly visitors and residents who come to these sites. This situation is very similar in the northwestern states of Mexico (Baja California, Baja California Sur, Sonora, Sinaloa and Nayarit), where, in addition, there is little infrastructure for the culture of waste separation.

Given this situation, Pronatura Noroeste developed the initiative Por un mar libre de plasticos (see free of plastic), aimed at teachers which is composed of a series of didactic materials that provide teachers with the tools necessary to be implemented with their students in the classroom of classes a brief workshop with information on the contamination by plastics, the negative effects of these on nature and one of the main solutions to tackle this problem: Workbook for the student, Manual for the teacher, audio-visual capsules, among others. The initiative seeks to promote the separation of waste in schools, disuse of plastic bags and disposables in schools, composting. The initiative also seeks to promote a communication campaign called: Sin Bolsa Por Favor, which promotes simple actions to reduce the use of plastic and ot

Conservation and Community: a Binational Approach to Environmental Stewardship in the United States and Mexico

"Waste-Tire Recovery and Recycling Project in the California-Baja California Region"

Paloma Aguirre, WILDCOAST

ABSTRACT

The U.S.-Mexico border Pacific Ocean coastline is home to 18,987 protected acres of some of the most ecologically significant coastal and marine ecosystems in the region. This area includes the 2,293-acre Tijuana River National Estuarine Research Reserve, recognized as one of 23 wetlands of international significance by the Ramsar convention; the 1,800 acre Tijuana River Valley Regional Park Preserve, which provides habitat for over 300 bird species, and the 1,930 acre Tijuana River Mouth State Marine Conservation Area, which provides critical habitat for leopard sharks, bottlenose dolphins and the California spiny lobster. These areas also provide much needed nature-based recreational opportunities for some of the lowest-income communities in San Diego County. Yet, these sensitive coastal ecosystems and the health of the border region community are under threat from California-generated waste tires. Approximately one million waste tires that originate in California are exported to Mexico each year. In Tijuana, once they are discarded, they are carried with the rains impacting United States county, state and federally protected areas such as Border Field State Park, Tijuana River Valley Regional Park, Tijuana River National Estuarine Research Reserve, and the Tijuana River Mouth State Marine Conservation Area.

Through WILDCOAST's waste-tire recover and recycling project, a total of 40,000 waste-tires were prevented from entering the United States and impacting the sensitive riparian and estuarine habitat of the Tijuana River Watershed. The state of California saved over $500,000 by not having to remove these tires in the U.S. and the building blocks for a tire-derived market were created.

Marine Debris Action Plans: Development, Implementation and Lessons Learned

"Coordinating Action in Hawai'i: Successes and Challenges from the Seven Years of the Hawai'i Marine Debris Action Plan"

Mark Manuel, U.S. National Oceanic and Atmospheric Administration, Marine Debris Program

ABSTRACT

The Hawaiian Archipelago is one of the longest and most remote island chains in the world and are prone to significant accumulation of marine debris due to its proximity to the North Pacific Subtropical Convergence Zone. Annually, thousands of pounds of marine debris from domestic and foreign sources impact the shorelines, coral reefs and wildlife across the island chain.

The NOAA Marine Debris Program (MDP) has been combating marine debris in Hawai'i since 2005 through cooperative partnerships across the US and international countries. In order to prioritize Hawai'i marine debris issues, coordinate projects and create a strategic plan of action, the MDP partnered with the US Environmental Protection Agency to host the first planning workshop in January 2008. The workshop brought together over 30 representatives from government, academia, nongovernmental organizations and private sector to address the issue of marine debris in Hawai'i. In 2010, the MDP hosted the official roll out and declaration signing of the first Hawai'i Marine Debris Action Plan (HI-MDAP) with over 70 elected officials and partners present. The structure and goals of the HI-MDAP align to those of the Honolulu Strategy, which allows the local marine debris community to strategically plan and track actions while contributing to a larger global strategy. The HI-MDAP was built by community involvement at all levels and is continually assessed every two years to ensure feasibility and applicability. Now in its 7th year the HI-MDAP has been updated in 2012 and 2014 with a complete transformation in 2016.

This presentation will review the marine debris action planning process in Hawai'i, suggest best practices, and share lessons learned.

"Creating Marine Debris Action Plans in Oregon and Washington"

Nir Barnea, NOAA
Briana Goodwin, Oregon Surfriders
Kara Cardinal,

ABSTRACT

Marine debris has been plaguing the Oregon and Washington coast and nearshore waters for many years. Over time, organizations in both states have done remarkable work to prevent and remove marine debris. Building on the collaborative Task Forces and partnerships created to address the Japan tsunami marine debris, and learning from other regions, marine debris partners in the region joined with the NOAA Marine Debris Program to create marine debris action plans, first in Oregon and later in Washington State.

In both states, the partners' interest was first assessed, and the response was an enthusiastic yes. Local action plan coordinators were hired to facilitate the involved effort, and planning teams were established to advise and enrich the process. The teams formulated an inclusive invitation list of marine debris partners from agencies, Tribes, NGOs, academia, and industry, and a survey was sent out to the partners requesting input on existing projects they are involved with, as well as marine debris priorities for the region. A first workshop was then conducted to discuss the goals and strategies of the action plan, and using the survey results as guidance, list future actions the partners would like to execute.

Following the first workshop, an interim marine debris action plan was drafted and circulated for review. Using the draft as a basis, a second workshop was conducted to finalize the action plan, agree on plan terms – including duration, update cycles, and communication – and, most importantly, sign up leads and partners to execute the actions.

This presentation will review the marine debris action planning process in Oregon and Washington, suggest best practices, and share lessons learned.

"Development and Implementation of the Florida Marine Debris Reduction Guidance Plan (FMDRGP)"

Jennifer McGee, Florida Fish and Wildlife Conservation Commission
Ann Lazar, Florida Department of Environmental Protection
Kent Smith, Florida Fish and Wildlife Conservation Commission
Tom Matthews, Florida Fish and Wildlife Conservation Commission
Phil Horning, Florida Fish and Wildlife Conservation Commission
Savanna Christy, Florida Department of Environmental Protection
Charles Grisafi, National Oceanic and Atmospheric Association
Sarah Latshaw, National Oceanic and Atmospheric Association
Jason Rolfe, National Oceanic and Atmospheric Association
Leonardo Mata, CCMAR-Centre for Marine Sciences

ABSTRACT

The FMDRGP is the result of a 4 year collaborative planning process involving over 100 experts from 14 governmental agencies/organizations and 14 non-governmental organizations throughout Florida, facilitated by NOAA's-Marine Debris Program. This effort stemmed from a need for a comprehensive statewide Plan that identified priority marine debris issues addressing both everyday marine debris, orphan and emergency debris, and debris generated by severe weather. The purpose of the FMDRGP is to serve as a guidance document, or central point of reference for improved collaboration and coordination, to avoid duplication and optimize the efficiency and efficacy of marine debris reduction efforts. The document is not intended to be regulatory or specifically binding in nature, but rather serve as a living document that can be updated based on successes and challenges in tackling marine debris issues. The objectives and strategies identified in the Plan are the product of the goals established by each of the 5 FMDRGP work groups focusing on the following: Consumer Debris, Emergency Debris, Abandoned and Derelict Vessels, Derelict Fishing Gear, and Wildlife and Habitat Impacts. Currently, and continuing with the collaborative theme of this Plan, representatives from the 3 lead agencies (NOAA, FDEP, and FWC) are working with the 5 work groups to coordinate and facilitate implementation of the identified strategies. This presentation will focus on the importance of collaborations in tackling such a widespread and complex issue such as marine debris, and the status of implementation efforts such as those involving abandoned and derelict vessel removal and other post storm emergency response activities, a task that has been increasingly important as demonstrated by Florida's 2016-2017 hurricane seasons.

"Emergency Response to Marine Debris: Regional Response Planning"

Jessica Conway, Genwest Systems Inc.

ABSTRACT

In recent years, the intensity of natural disasters is on the rise. Hurricanes and tropical storms, tsunamis, and landslides can be an overwhelming source of marine debris because high winds, storm surges, and heavy rains drag large amounts of land based debris into surrounding waterways. This debris can be a hazard to navigation, damage habitat, and pose a pollution threat.

To mitigate these impacts, the NOAA Marine Debris Program has been facilitating response planning efforts in U.S. coastal states since 2014. Through a collaborative process with local, state, and federal agencies and organizations, response guidance documents are being developed with the goal of improving preparedness and facilitating a coordinated, well-managed, and immediate response to emergency marine debris incidents. This effort works to outline existing response structures at the local, state, and federal levels, capturing all relevant responsibilities and existing procedures into individual state guidance documents for easy reference.

"From "Source to Sea": Building governance and management framework for marine litter management in the Northwest Pacific region"

Lev Neretin, Northwest Pacific Action Plan (NOWPAP) of the UN Environment

ABSTRACT

Existing governance and management frameworks applied to environmental protection and sustainable development on land are often disconnected from those addressing impacts of these activities in the coastal and marine environment, thus undermining efforts to promote sustainability. The "source-to-sea" (S2S) conceptual framework provides a useful guidance to assess and design initiatives that work to achieve greater sustainability in the S2S continuum, including management of marine litter problem (Granit et al., 2017). S2S systems addressing key flows such as marine litter flows need governance arrangements that balance economic development objectives across sectors and are capable of coordinating and integrating across various management objectives. The presentation will showcase existing practices in governance and management of marine litter flows in the S2S continuum at various scales (sub-national, national and regional) using examples from the Northwest Pacific region (Japan, P.R. China, R. Korea, and the Russian Federation). The application of S2S framework provides useful conceptual framework for designing relevant policies and programs addressing marine litter as will be demonstrated using examples from the Northwest Pacific.

"Lessons-Learned from the Great Lakes Marine Debris Action Plan"

Sarah Lowe, Freestone Environmental Services

ABSTRACT

Marine debris is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes. Throughout the Great Lakes, marine debris threatens wildlife, natural resources, and the environment. Coordinated by NOAA and launched in 2014, the Great Lakes Land-based Marine Debris Action Plan is bringing science, government, industry and NGOs together in a regional partnership to clean up the Great Lakes. The plan's five-year goal: to research the problem of marine debris, guide science-based policies and management decisions, and coordinate actions to prevent and reduce marine debris. The action plan consists of 53 actions which are to be completed within five years (2014-2019). Throughout the development and implementation of this regional plan, valuable lessons have been learned in regard to partner participation and process. Additionally, monitoring of progress within the plan is key to understanding success. Information will be shared which highlights the Great Lakes monitoring plan and maintaining participant engagement.

"Leveraging the Virginia Marine Debris Reduction Plan to Advance Regional Ocean Planning"

Katie Register, Clean Virginia Waterways of Longwood University
Kim Hernandez, Maryland Department of Natural Resources Chesapeake & Coastal Service
Laura McKay, Virginia Coastal Zone Management Program

ABSTRACT

Starting in 2012, the Virginia Coastal Zone Management Program undertook a participatory and collaborative planning process that culminated in the development of the Virginia Marine Debris Reduction Plan. The Plan – the first on the US east coast – charts a course to measurably reduce marine debris in Virginia's coastal rivers, bays and Atlantic Ocean, focusing on specific actions that are politically, socially, and economically feasible. The Plan outlines the problem and provides a roadmap for Virginia's nonprofit organizations, local governments, state agencies, regional partners, researchers, and industries to work together on sustained approaches to reducing the flow of plastics and other trash items into inland, coastal and ocean waters. This presentation will cover the early implementation of Virginia's Plan, and how it has informed a concurrent regional ocean planning initiative.

In December 2016 the National Ocean Council certified the first ever Ocean Action Plan for the US Mid-Atlantic region - which includes waters offshore New York, New Jersey, Delaware, Maryland, and Virginia - and is the result of years of historic collaboration among states, tribes, Federal agencies, the Mid-Atlantic Fishery Management Council, and marine stakeholders. One of the actions is to develop a regionally appropriate strategy to reduce marine debris. In early 2017 the Mid-Atlantic Regional Planning Body Marine Debris Work Group kicked off this work by developing an inventory of existing marine debris reduction and prevention efforts in the region, and has since hosted workshops and sought grant funding to advance prevention projects. The ultimate goal is to expand on Virginia's successes and lessons learned to build capacity across the region to address the problem of marine debris in the Atlantic Ocean.

"Marine Plastic Debris Management Program in Indonesia"

Safri Burhanuddin, Coordinating Ministry for Maritime Affairs of the Republic of Indonesia
Nani Hendiarti, Coordinating Ministry for Maritime Affairs of the Republic of Indonesia
Andreas Hutahaean, Coordinating Ministry for Maritime Affairs of the Republic of Indonesia
M. Saleh Nugrahadi, Coordinating Ministry for Maritime Affairs of the Republic of Indonesia
Ridha Yasser, Coordinating Ministry for Maritime Affairs of the Republic of Indonesia

ABSTRACT

Marine plastic debris is a global problem that also poses a threat to Indonesia's rich marine ecosystems, navigational safety, even to human health and the economy. As it pollutes the environment and causes hazard to many levels of marine life, the health of the ocean in general suffers. Due to a large number of population lives along the coastlines, and the lack of proper waste management, Indonesia is perceived to be one of the most probable to leak a large quantity of plastic debris into the ocean. Surveys in 15 different cities across the country and research on plastics consumed by fish shows that plastics in our water is hazardous to our wellbeing. Government of Indonesia is committed to clean up its water. During the G20 Summit in Humburg, President Joko Widodo has announced a target to reduce marine plastic waste as much as 70% by 2025, and has pledged $1 Billion to support the cause. Meanwhile, the National Plan of Action (NPOA) launched during the UN Ocean Conference in June 2017, has taken off to a good start. The NPOA is combatting marine plastic wastes through promoting behavioral change, reducing both land-based and sea-based leakages, as well as reducing plastic production and use. Measures are taken starting at an early stage, as early as inclusion of clean and healthy oceans in school curricula, all the way to reinforcing R&D's to better equip policy reforms and law enforcement towards the ambitious target for clean ocean by 2025. Clean up actions as well as public education and campaign has gradually shape up coastal environment, while marine plastic waste for road asphalt mix also helps bring up hope that the bolt target is within reach. This presentation provides an overview of the NPOA and its progress, in support of the sustainable marine ecosystem through better-managed plastic wastes.

"Stocktaking of Regional Action Plans"

Karen Raubenheimer, Australian National Centre for Ocean Resources and Security
Alistair McIlgorm, Australian National Centre for Ocean Resources and Security

ABSTRACT

Of the eighteen Regional Seas, seven have developed regional action plans specific to marine litter. One action plan is currently under review and an additional six regions are in the process of developing new marine litter action plans. An examination of the successes achieved as a result of measures adopted within current marine litter action plans, including the processes and information that contributed to their success, is therefore timely for those regions developing new or revising existing instruments.

Three regional action plans have been in place for a decade and four have been adopted since the development of the Honolulu Strategy in 2011. UN Environment, in conjunction with the University of Wollongong, Australia, is conducting a stocktake of the seven action plans in place. This assessment provides an opportunity to share experiences gained throughout the process of, inter alia, identifying priority issues, negotiating harmonized measures, overcoming implementation challenges, monitoring progress and reviewing overall effectiveness. Emerging issues and principles are reflected in more recent action plans and developments in these areas must be closely monitored and progressed in new action plans.

The information gathered will inform the development of a design guide to assist in the review or design of new marine litter action plans for the Regional Seas. The findings as at March 2018 will be presented for discussion.

Marine Debris Action Plans: Development, Implementation and Lessons Learned

"The California Ocean Litter Strategy: Addressing Marine Debris from Source to Sea"

Holly Wyer, California Ocean Protection Council

ABSTRACT

The California Ocean Litter Strategy: Addressing Marine Debris from Source to Sea was developed through a collaborative process that is similar to other state and regional Marine Debris Action Plans in the United States. The new California Ocean Litter Strategy was developed through a partnership between the state and federal government, and is an update and expansion of the 2008 document "An Implementation Strategy for the California Ocean Protection Council to Reduce and Prevent Ocean Litter." This presentation will discuss the opportunities and challenges in developing an updated Strategy/Action Plan in California, lessons learned and success stories from the progress made on the first Implementation Strategy, and the priorities of the new California Ocean Litter Strategy.

"The Implementation of the UN Environment/MAP Regional Plan on Marine Litter Management in the Mediterranean: Status, Work Plan and Further Steps"

Christos Ioakeimidis, UN Environment/Mediterranean Action Plan
Tatjana Hema, UN Environment/Mediterranean Action Plan
Gaetano Leone, UN Environment/Mediterranean Action Plan
Jelena Knezevic, UN Environment/Mediterranean Action Plan
Francois Galgani, UN Environment/Mediterranean Action Plan

ABSTRACT

The UN Environment/ MAP Barcelona Convention was the first Regional Sea Programme to approve a legally-binding Regional Plan on Marine Litter Management (RPML) in December 2013, providing for a set of programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment. It includes innovative and traditional measures of a policy, regulatory and technical nature, addressing different aspects of marine litter prevention and management from land and sea based sources. The Regional Plan measures impose clear obligations regarding the waste management hierarchy, closure of illegal dumping/dumpsites, shift to sustainable consumption and production patterns, removal of existing marine litter using environmental sound practices e.g. fishing for litter, clean up campaigns, port reception facilities at possibly no special fees, and monitoring, assessment and reporting on implementation of measures as well as enforcement of national legislation.

UN Environment/MAP and its MED POL programme is implementing the EU-funded Marine Litter MED project to support Southern Mediterranean countries to implement key common measures provided for in the RPML. The main focus of the project is to: a) enhancing the implementation of selected ML policy/regulatory prevention and reduction common measures at sub-regional/national levels and sharing of related best practices; b) develop and apply regionally harmonized approaches, guidelines and tools to ensure effective implementation of selected measures; c) establishing regional coordination mechanisms for marine litter prevention and management in the Mediterranean; and d) establish regional coordination mechanisms for marine litter with other regional actors and European Regional Seas Conventions.

Marine Debris Action Plans: Development, Implementation and Lessons Learned

"Tools and Strategies for Reducing and Managing Marine Debris in MPAs"

Gabrielle Johnson, Marine Protected Areas Center- Office of National Marine Sanctuaries
Lauren Wenzel, Marine Protected Areas Center- Office of National Marine Sanctuaries
Anne Nelson, Marine Protected Areas Center- Office of National Marine Sanctuaries

ABSTRACT

Marine debris is a universal concern and a common threat that coastal and marine resource managers are facing in addition to other threats. The International MPA Capacity Building Program provides practical tools and strategies to assist coastal and marine resource managers in engaging in effective management of marine protected areas. In many of the geographies where we work, marine debris has become one of the top threats facing managers. We will present an array of tools and strategies to assist coastal and marine resource managers in reduce and managing the effects of marine debris in their sites. In addition, we will include lessons learned from the field consisting of both successes and challenges.

"BLASTIC – plastic waste pathways into Baltic Sea"

Eva Blidberg, Keep Sweden Tidy

ABSTRACT

Marine litter knows no boundaries and can end up far from its original source. The impacts are environmental, economic and social. In the Central Baltic region marine litter constitutes of plastic (60%) and packaging material is the dominating fraction. Land-based sources count for 80% of the marine litter and urban areas are important litter contributors. Coastal cities have common challenges to reduce waste to become marine litter and the most effective actions will be to target sources on land. In 2016, started the three-year EU-project BLASTIC. The main aim with BLASTIC is to facilitate for municipalities to work against marine litter on a daily basis. The main activities of the project are; 1) to develop a new methodology/approach for mapping marine litter sources and pathways, 2) to develop a monitoring method in rivers/watercourses, and 3) a list of identified and prioritized measures to reduce litter streams from land to sea. The new approach is to take regional and national strategies (Marine Strategy Framework Directive; HELCOM Marine Litter Action Plan) into practice on a local level. Real data on sources and pathways from four municipalities in the region (Södertälje, Sweden, Turku, Finland, Tallinn, Estonia, Leipaja, Latvia) will be used to develop a comprehensive and concrete guidance that despite their different conditions can be used in all costal municipalities around the Baltic Sea.

"EU Marine Strategy Framework Directive - interfacing Science & Policy"

Georg Hanke, European Commission Joint Research Centre
Francois Galgani, IFREMER
Stefanie Werner, German Federal Environment Agency
Michail Papadoyannakis, European Commission Directorate General Environment
TG Marine Litter MSFD GES Techncial Group on Marine Litter,

ABSTRACT

The European Marine Strategy Framework Directive (2008/56/EC) is considering Marine Litter as one of the 11 Descriptors for the Environmental Status of the European Seas. As marine litter is an emerging issue, scientific research is intensively ongoing, while policy needs to provide measures based on scientifically sound prioritizations and evaluations.

Therefore, within the common implementation strategy for the EU Directive, a technical group has been set-up, which includes, besides EC services, experts from EU Member States as well as from Regional Sea Conventions and scientists related to specific projects. The group is chaired by France, Germany and the EC JRC. Through this forum, information exchange across all EU coastal States and the provision of agreed advice and guidance are performed, facilitated through meetings and an on-line discussion platform.

The TG Marine Litter has provided guidance, advice and recommendations on general marine litter related topics, especially on suitable monitoring methods including for riverine litter, source attribution, and the biological and socioeconomic harm caused by litter, accompanying the implementation of the MSFD and assisting EU Member States to choose harmonized approaches to address marine litter. The testing of scenarios for baselines setting, identification of top litter items and the setting of threshold values are among the topics that are currently being discussed with the aim to provide a coordinated view across EU.

Policies, Other Initiatives And Technical Support Of The European Union Against Marine Debris

"EU policy framework and contribution in international collaboration to fight marine litter"

Michail Papadoyannakis, EU Commission
Michel Sponar, EU Commission

ABSTRACT

The European Union (EU), with 28 Member States, home to more than 500 million people and with approximately 66,000 km of coastline, is tackling the plastic and microplastics marine pollution already through the implementation of marine environment, waste management and port reception facilities legislation. Moreover, a variety of EU funds support and promote scientific research and technological development, including on harm caused by litter and microplastics, also considering human health. A Strategy for Plastics will be presented by the EU Commission in 2017 addressing, inter alia, leakages of plastic waste and microplastics to the marine environment; it could outline new initiatives on single use plastic products, litter from fishing and aquaculture, restrictions in the use of microplastics in products and measures to curb releases of microplastics from textiles, tyres, pre-production plastic pellets and waste water treatment plants.

The EU and its Member States are coordinating closely with their neighbours within the Regional seas Conventions around Europe and at global level, and participate actively in the implementation of Action Plans at international level (e.g. G7 and G20), including through development aid. The EU and its Member States also plan dedicated projects to help reducing plastic waste and marine litter in East and South East Asia and stand ready to engage fully in taking forward global agreement on actions, expected to be adopted at the United Nations Environment Assembly in December 2017, in relationship to plastic marine litter and microplastics.

Policies, Other Initiatives And Technical Support Of The European Union Against Marine Debris

"Marine Litter baselines in Europe"

Anna M Addamo, European Commission - Joint Research Centre
Georg Hanke, European Commission - Joint Research Centre
TG Marine Litter MSFD GES Technical Group on Marine Litter,

ABSTRACT

The EU Marine Strategy Framework Directive provides through Descriptor 10, one of eleven Descriptors of the Environmental Status of the European Seas, the commitment to ensure that litter does not cause harm to the marine environment. This requires monitoring of litter quantities, distribution, and identity. Quantitative baselines of litter are needed in order to provide comparable assessments and to monitor the progress of reduction measures.

JRC, in close collaboration with 24 EU Member States, 4 Regional Sea Conventions, Non-Governmental Organizations and several scientific projects, has therefore compiled all available beach litter data in Europe from 2012-2016. More than 4000 beach litter surveys on ca. 300 beaches are included.

Template incompatibilities and unbalance reporting effort at temporal and spatial scale are the main challenges in creating the first comprehensive European database of marine litter. Here we are describing the strategy used to overcome such problematics and are discussing the role and need of "baselines", including their impact on science and policy.

The harmonized final database is used to test and apply scenarios with different spatial and temporal settings for baseline settings in order to derive a commonly agreed methodology for baselines setting across EU.

Policies, Other Initiatives And Technical Support Of The European Union Against Marine Debris

“Seafloor litter in the Mediterranean sea: quantities, distribution and typology in the French marine waters”

Olivia Gérigny, Ifremer
Mélanie Brun, Ifremer
Marie-Claire Fabri, Ifremer
Corinne Tomasino, Ifremer
Angelique Jadaud, UMR MARBEC
Francois Galgani, Ifremer

ABSTRACT

Seafloor litter have been studied on the continental shelf of the Gulf of Lion (northwestern Mediterranean Sea- french marine waters). A data set has been collected during scientific survey conducted between 1994 and 2016, and analyzed to assess the general trend. The annual mean values ranged from 0.29 items/ha (2005) to 2.90 items/ha (2015) and, on the average, plastic was found at 75 %. A more detailed analysis of data was performed using data collected during the last four years, using a more precise protocol, as defined for the Marine Strategy Framework Directive's monitoring Program. The results show that the French Mediterranean continental shelf is polluted by different types of debris such as plastic, mainly bags, food packaging and undefined sheets, and in a lesser extent by metallic objects and glass. Fishing gears, as a consequence of local fishing activities, were also found as an important part of the litter. Analysis of the results revealed the influence of geomorphologic factors, local anthropogenic activities, riverine inputs, and a high spatial variability. The marine litter abundances presented a variability on the continental shelf of the Gulf of Lion, impacted by the main flux of Liguro-Provencal current and the Rhone River. Besides, in situ data was collected with ROVs along the slopes and submarine canyons. The results indicated an average value of 3 items.km-1 and highlighted the importance of plastic objects found in all canyons. Typically, the canyons of the Ligurian Sea, closer to the coastline, were more impacted than those of the Gulf of Lion where the continental shelf is larger. Overall, the results provided a scientific and technical background and are discussed in terms of possible management measures for further monitoring.

Policies, Other Initiatives And Technical Support Of The European Union Against Marine Debris

"Trends in the Amount and Composition of Litter Ingested by Sea Turtle: The INDICIT Project"

Marco Matiddi, Italian National Institute for Environmental Protection and Research (ISPRA)
Jesus Thomas, Marine Zoology Unit, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia
Giuseppe Andrea de Lucia, Institute for Coastal Marine Environment-National Research Council (IAMC-CNR)
Christopher Pham, Institute of Marine Research and MARE-Marine and Environmental Science Centre
M Bradai, Institut National des Sciences et Technologies de la Mer
H Kaberi, Hellenic Centre for Marine Research (HCMR)
Yakup Kaska, Pamukkale University, Sea Turtle Rescue and Rehabilitation Centre (DEKAMER)
Francoise Claro, Museum National D'Histoire Naturelle
Ana Loza, University of Gran Canaria
Claude Miaud, Centre for Ecology and Functional Ecology CEFE-CNRS-EPHE

ABSTRACT

The Marine Strategy Framework Directive (MSFD) aims to achieve the protection of marine biodiversity and the sustainable use of the marine environment across Europe, with the objective of achieving the Good Environmental Status (GES) by 2020. Marine litter (Descriptor 10) is one of the most important anthropogenic pressures on marine environment. The Indicator "trends in the amount and composition of litter ingested by marine organism" is one of the target for the monitoring of GES for D10. The INDICIT project, financed by the EU, is based on a 10 partners consortium from the public sector established in EU and non-EU countries, being all contracting parties of the OSPAR and/or Barcelona Conventions. The INDICIT actions aim to obtain a precise definition of this indicator (e.g. threshold values, biological criteria, temporal and spatial scales of use). Starting from the Fulmar EcoQO and the MSFD guidelines, a harmonized procedures of collection and analysis of plastic ingested by loggerhead turtles Caretta caretta have been elaborated. Marine litter is subdivided in categories and sub-categories, counted and weighed. Data are collected according to a specific datasheet with basic and optional parameters in order to better understand the biological constraints. The analyses are performed both on dead turtles and on hospitalized ones. Moreover, local training has been performed in each participating country with the aim of creating national networks. Similar activity enlarged to the Mediterranean basin was performed with a special training course held in Italy, involving UNEP/Map delegates from the South Mediterranean Countries. Mediterranean and European researchers and sea turtle rescue centres are invited to contact INDICIT partners in order to join the international network.

A Tale Of Two Cities' Marine Trash Removal Efforts: Baltimore, MD USA and Rio de Janeiro, Brazil

"Baltimore's Trash TMDL: cause, effect and recommended actions for all the world's port cities"

Robert Summers, KCI Technologies, Inc.
Thomas Sprehe, KCI Technologies, Inc.

ABSTRACT

Waterborne trash, including plastics and micro-plastics is a world-wide problem that is growing rapidly. Plastic debris is accumulating in all of the world's oceans in gyres resulting from natural ocean currents and is having profound effects on ecosystem and human health. Recent estimates are that 80% of the debris is coming from runoff from the land. In the U.S. waterborne trash is classified as a pollutant and is regulated by the Clean Water Act. A growing number of U.S. cities are beginning to address the problem and in 2015, the EPA approved a Total Maximum Daily Load (TMDL) for portions of Baltimore Harbor. Since then, Baltimore has developed a plan and begun taking steps to: install debris collection to capture trash within public storm system; enhance mechanical street sweeping, preventive inlet cleaning, and routine waterway cleaning; and encourage litter reduction and increased recycling. A very visible and popular part of Baltimore's trash collection efforts is the Water Wheel Trash Interceptor -- "Mr. Trash Wheel". The large amount and types of trash collected by the wheel provides valuable information that is being used to help focus trash intervention actions in Baltimore. This presentation will cover ongoing trash reduction efforts and a recent proposal to expand Baltimore's trash reduction efforts by engaging the private sector property owners that most benefit from a more aesthetically appealing, trash-free harbor. The presentation will provide an overview of Baltimore's Trash TMDL, recommended actions that can be widely implemented to address trash and marine debris and describe methods being developed to quantitatively document progress on controlling water-borne trash that are applicable to many parts of the world that are beginning to address this significant global issue.

A Tale Of Two Cities' Marine Trash Removal Efforts: Baltimore, MD USA and Rio de Janeiro, Brazil

"Control of Trash and Marine Debris in Guanabara Bay, Rio de Janeiro Brazil"

Robert Summers, KCI Technologies, Inc.
Marlus de Oliveira, Secretaria de Estado do Ambiente

ABSTRACT

In the years leading up to the 2016 Summer Olympics, held in Rio de Janeiro Brazil, control of pollution in Guanabara Bay by sewage and floating trash was a major focus of effort by the State of Rio de Janeiro. Uncontrolled landfills were closed and collected trash was directed to modern sanitary landfills with recycling facilities. "Eco-barriers" were placed at the mouth of major rivers discharging to the Bay to capture trash and collect it prior to being discharged to the Bay. As a last line of defense, a fleet of "eco-boats" was deployed to collect trash and floating debris in the Bay, with particular emphasis on the areas of the Bay where the Olympic sailing events and training and time trials were being held in the years leading up to the Olympics in August, 2016. Photos of floating debris and participants' concerns about fast-moving boats crashing into large debris or being slowed by snags on keels and rudders were widely reported by the media leading up to the events. This presentation will focus on a description of the measures taken and the challenges that each part of the effort faced. monitoring and measurement of the impacts of each of the control measures will also be reported. Despite the challenges faced, the effort was very successful and no major injuries or other incidents occurred during the Olympics. The Rio de Janeiro waterfront has been transformed in preparation for the Olympics, opening up the Bay and its beauty to the general public and tourists alike, as exemplified by the Museum of Tomorrow on the Bay waterfront in downtown Rio. The trash control measures are still in place and being maintained to continue the legacy of improvements brought to Rio by the Olympics.

California Dreaming - Lessons Learned from Nearly Two Decades of On-Land Trash Control Programs and Monitoring Efforts

"Control of Trash Entering Waterways in California"

Jonathan Bishop, California Waterboard
Gayleen Perreira, California Waterboard

ABSTRACT

The presence of trash in surface waters, specifically coastal and marine waters, is a prevalent issue in California. The State Water Board has listed 73 water bodies as impaired due to the presence of large amounts of trash. Trash discarded on land is frequently transported through storm drains to waterways and the ocean.

The State Water Board and Regional Water Quality Control Boards (collectively The Water Boards) have attempted to control trash through permits that limit the amount of trash and other pollutants allowed to discharge to water bodies. The Los Angeles Regional Water Board led the way by with the adoption of ten trash and debris Total Maximum Daily Loads, or TMDLs, in the Los Angeles River Watershed, and subsequently including trash discharge limitations in their National Pollutant Discharge Elimination System (NPDES) Phase I municipal storm water permit. NPDES permits are permits authorized by the federal Clean Water Act but are adopted and administered by the Water Boards. The San Francisco Bay Regional Water Board followed this lead by adding trash discharge limitations into their NPDES Phase I municipal storm water permit.

The above approaches, although highly effective regionally, were not being carried out consistently throughout the state and ongoing and worsening trash problems continue to exist across the state. On April 7, 2015 the State Water Resources Control Board (State Water Board) adopted amendments to the Water Quality Control Plans for the Ocean Waters of California (Ocean Plan) and the Inland Surface Waters, Enclosed Bays, and Estuaries of California (ISWEBE Plan) to control trash. These trash amendments apply statewide to all most of the populated portions of the state that are regulated by NPDES permits. The Trash Amendments provide the necessary consistency in governing trash control statewide.

Cross-Sectoral Collaboration For Rapid Solutions: Providing Sustainable Waste Management In Developing-Economy Cities

"Looking to innovation and collaboration to enable comprehensive resource recovery in informal settlements."

Heather Troutman, EAP Consult Ltd

ABSTRACT

Globally, waste management is an urban service provided by municipal governments and paid for with taxes, which are often augmented with utility fees. However, the majority of the world – in terms of population and landmass – are currently experiencing rapid urbanization, most of which is happening informally. Unfortunately, these mushrooming informal settlements are frequently found on the coastline and in the flood zones of rivers, on their way to the sea. Due to the very characteristics of informality – such as extreme poverty, unplanned settlements and chocking density – these settlements cannot be serviced by municipal waste management, in the conventional sense, not only due to inability to afford services but also because of inaccessibility of the urban areas. The result is that the rivers providing the guiding structure of these settlements is very often used as a waste bin; taking thousands of tons of municipal waste directly to the sea every day. In Ghana, we are exploring ways to greatly reduce the cost of waste management services by employing particularly vulnerable community members to assist in collecting source separated materials from households by paying customers to deliver clean, high value material for recycling. We are learning that a silver bullet in stopping urban pollution from mismanaged wastes is less about providing expensive collection systems and disposal options, and more about establishing enterprises that can purchase waste materials for re-manufacturing into valuable products to be sold locally and internationally. This option creates jobs, generates tax revenue, drastically extends the life of expensive traditional waste management infrastructure and complements the existing characteristics of the communities it serves.

Cross-Sectoral Collaboration For Rapid Solutions: Providing Sustainable Waste Management In Developing-Economy Cities

"Reducing trash while reducing flood hazards: a case study from Tijuana, Mexico"

Kristen Goodrich, Tijuana River National Estuarine Research Reserve
Ana Eguiarte, Tijuana River National Estuarine Research Reserve

ABSTRACT

Los Laureles Canyon is a sub-watershed of the Tijuana River Watershed in Tijuana, Mexico. Rapid and unplanned growth in the canyon has manifested in urbanization occurring before public infrastructure was planned and built, resulting in an absence of paved roads, sewers, storm drainage, and other services, including waste services. There are many challenges to waste management in this case study: irregular services; cost of services; lack of recycling programs; loose or no containment, and terrain. These obstacles, among other drivers, have resulted in excessive trash being dumped into eroded channels presenting public health risks and other threats to quality of life. Additionally, and of focus of this talk, during rain events, this trash compromises flood conveyance channels and exacerbates flood hazards, while resulting in marine debris and other environmental consequences at the end of the channel. Non-profit organizations, academia, flood risk managers, and emergency managers have partnered together to explore training and technical assistance opportunities to address the trash condition while concurrently reducing flood risk. Results from in-depth interviews and lessons learned from conducting cross-sectoral training and other innovative approaches to improve the social ecological condition in a developing economy community will be discussed.

Cross-Sectoral Collaboration For Rapid Solutions: Providing Sustainable Waste Management In Developing-Economy Cities

"Solid Waste Collection Improvements with Independent Waste Collectors in Danpasar, Indonesia"

Kathryn Youngblood, University of Georgia
Olivier Pouillon, Gringgo
Jenna Jambeck, University of Georgia

ABSTRACT

Environmentalists worldwide will confirm that humanity in the modern age has reached unprecedented levels of global influence on the ecosystems that sustain life on our planet. The importance of plastic to the conveniences of modern life are undeniable, but the continual influx of plastic into our oceans demands improved waste management systems on a global scale. Those countries especially prone to mismanaged waste are middle-income areas with rapidly expanding economies that have thus far lacked the time and resources to develop adequate infrastructures to address the increase in waste generation tied to economic growth; of these countries, Indonesia falls second on this list, behind only China in terms of annual contribution to ocean plastic pollution. In response to such findings, the Indonesian government has proactively committed to large investments in improved waste infrastructure to preserve the beaches and coral reefs of the island nation. There does, however, already exist a large informal network of waste pickers and recycling centers that can perhaps be leveraged to combat ocean plastic. In this study, we conducted a study of the informal waste sector already in existence in the city of Denpasar in Bali, Indonesia, to better inform timely efforts to improve waste management systems in the region. We utilized geospatial analysis software to map the physical networks of waste pickers in Denpasar, waste depots and waste banks (pre-sorted recyclables). The informal waste sector provides a critical social service in developing economies, but because the network develops organically, it may not be efficient at preventing ocean pollution. A geographic map of the waste pickers will serve to demonstrate where plastic may be slipping through the cracks in the system.

"Transforming Marine Debris into a Valuable Resource"

Chloe Dubois, The Ocean Legacy Foundation

ABSTRACT

The Ocean Legacy Foundation has been developing practical solutions to collect and process all marine debris materials with the goal of zero waste. Marine debris acts as a bridge catalyzing cross-sectoral collaboration and it is within this spirit that Ocean Legacy has assisted in bringing together hundreds of non-profits, artists, government, scientists, industries, businesses, schools and concerned citizens. In 2016, Ocean Legacy opened one of the world's first Marine Debris Solutions Centres and has accepted more then 1000 cubic yards of material. We have developed an incredibly detailed sorting program which engages a very broad community and has resulted in a more then 90% recycle rate by weight of debris materials. Partnering with large companies like Lush Cosmetics, Resynergi Inc, and Foam Only we have been able to develop unique methodologies which allow marine debris to re-enter the value chain as new forms of packaging, plastic to fuel sources and upcycled construction materials. Ocean Legacy's unique on-line mapping program enables a platform for a global audience to report plastic polluted hotspot areas so that cleanup efforts can be organized. Large scale remote cleanups are then organized to remove materials from the natural environment which are then brought back to the Solutions Centre for processing. A unique feature is the development of a one-tonne mobile plastic to fuel machine using Resynergi Inc.'s technological design and equipment. This removes plastic from the waste stream and converts it into valuable fuels like petroleum, diesel or kerosene. Ocean Legacy's long-term vision is to open Marine Debris Solution Centres around the world enabling land-based waste solutions to revolutionize the waste industry and provide training for communities to manage their wastes and natural environment.

"Waste Management Index: Strengthening ICT Data Waste Management Platform"

Mohamad Bijaksana Junerosano, Greeneration Foundation
Vanessa Letizia, Greeneration Foundation

ABSTRACT

Greeneration Foundation view two highlighted problem of waste management system in Indonesia are 1) lack of reliable data/information and 2) no integrated collaboration platform to address waste management for a larger scale of impact. As a result from lack of data; regulation, budgeting, operational technique, monitoring and evaluation development will not be accurate even more implementable. To answer those needs Greeneration Foundation has developed and integrated ICT Platform for Waste Management. We have developed two platforms namely Bebas Sampah.ID (BSID) and Bergerak untuk Indonesia Bebas Sampah. ID (BIBS). BSID platform is focused on data collection, decision support system and knowledge management. Currently BSID platform is still a prototype platform where we've mapped out assets related with waste management with Bandung, Bekasi and Jakarta as pilot locations. We have mapped a total of 1428 assets including temporary waste disposal, collector, waste bank, compost, business unit and service facility. The rationale from asset mapping is that it can be a decision support tool for policy makers and also it can be used for collaborative solution by linking potentials available from different waste management assets. BIBS platform on the other hand is an open source public driven ICT platform aiming to become avocation platform for multi-stakeholders to collaborate actions in reaching zero waste goal by 2020. Stakeholders can identify themselves spatially in this platform and share their activities, lesson learns, and even team up with others for larger impact. It facilitates multi-stakeholders actions to address challenges of waste management issues across Indonesia. BIBS is accessible for public and now has over 9000 stakeholders joining in over 250 District/Cities across Indonesia.

"From Your Block to the Bay: Innovative Solutions to Trash Pollution in Baltimore"

Julie Lawson, Trash Free Maryland
Leanna Wetmore, Waterfront Partnership of Baltimore

ABSTRACT

As a post-industrial city with a declining population, Baltimore, Maryland, faces numerous challenges. Development of trash removal regulations (TMDL) for the Inner Harbor in 2014 spurred additional investment in preventing and cleaning up trash pollution in the water, but the blight of litter is also a major community concern, diminishing quality of life and contributing to infrastructure issues.

Through extensive partnership and innovation, the city now has a nearly complete system of interventions to address litter and marine debris through behavior change, community engagement, and technology.

Trash Free Baltimore is a novel, research-based behavior change campaign to change the culture of littering. Through formative research, the project team identified recovery as a key motif to any public-facing campaign, and began a partnership with substance abuse treatment centers and health clinics around the city to develop a clinical protocol connecting litter pickup with rehabilitation from heroin/opioid addiction.

Concurrently, the Waterfront Partnership's Healthy Harbor Initiative organizes residents in highly distressed neighborhoods to rehabilitate alleys and reconnect neighbors to each other through trash cleanup and public art.

Baltimore's famed Mr. Trash Wheel, and newly installed Professor Trash Wheel, have made a splash on social media and generated significant attention both locally and globally, educating people about trash pollution while removing more than a million pounds of debris from Baltimore's rivers.

Land-Based Strategies to Address Marine Debris: Vietnam Case Study

"A Local Perspective on Challenges, Opportunities, and Existing Efforts to Combat Marine Debris in Vietnam"

Ngoc Pham Anh, Center for Environment and Community Research
Hoang Anh, Centre for Marinelife Conservation and Community Development (MCD)

ABSTRACT

In 2017 the Trash Free Seas Alliance worked with The Dow Chemical Company, through Dow's Leadership in Action program, and many organizations in Vietnam to better understand the waste management challenges in areas surrounding Hanoi. During this time, there were strong relationships built with a number of local organizations active in environmental and marine debris initiatives. The Center for Marinelife Conservation and Community Development (MCD) and the Center for Environment and Community Research (CECR) are two organizations that are doing incredible work in this space and can bring incredible perspectives to this session.

MCD: With a focus on marine and coastal issues, MCD is uniquely positioned to share information on the challenges facing coastal communities in Vietnam. With a prominent role in the local engagement in Ha Long Bay Alliance, the interprovincial coordination of World Biosphere reserves in Red River Delta, and a long standing International Coastal Cleanup leader, MCD has demonstrated strong knowledge about the challenges on the ground as well as the opportunities and needs for coastal communities.

CECR: Devoted to environmental protection projects based on community participatory approach to maximize social benefits, CECR has long-standing experiences in water governance, institutional analysis, and recommending solutions to change management practices, restoration and protection of the environment. CECR works closely with six provinces in Vietnam, mobilizing the participation of the local authorities, communities, scientists, entrepreneurs, and the media to control water pollution and water debris, and gradually restore polluted water bodies. CECR is currently applying this approach in a project in Danang, Central Vietnam to eliminate marine debris and increase plastic recycling.

"Coastal Clean Ups in Vietnam – Looking Backwards and Facing Forward"

Trang Nguyen Thi Thu, Centre for Supporting Green Development - GreenHub
Boris Fabres, Centre for Supporting Green Development

ABSTRACT

Since 2000 Vietnam has implemented numerous coastal and beach cleanup events. These have involved local communities, youth, students, government agencies and were mostly coordinated by Vietnamese and international non-governmental organizations, more recently with involvement of the private sector. On the positive side, these operations have stimulated much enthusiasm, especially among youth and provided a very useful overview of the diversity of coastal litter. This has helped to grow interest and concern about the state of litter pollution in Vietnam. At the same time, the inconsistency of coastal clean-up practices and incomplete data collection and lack of an overall marine litter program in the country to unite marine litter initiatives have compromised the value of these occasional events. This presentation and paper will review and summarize past clean-up events, lessons learned and specifically how these experiences may help to guide future corrective actions in Vietnam. It will also identify the main players in Vietnam that include coastal and marine litter activities in their work programs, relationships to wider waste management challenges, and issues of plastic pollution. The waste management, marine litter and plastics environmental, gender community and networking program initiatives of the new Vietnamese NGO, GreenHub – Centre for Supporting Green Development (website: greenhub.org.vn) will be presented.

Land-Based Strategies to Address Marine Debris: Vietnam Case Study

“Trash Free Seas Alliance Exploring Waste Management Challenges in Vietnam”

Eric DesRoberts, Ocean Conservancy

ABSTRACT

Vietnam has been identified as one of the top countries contributing to plastic waste leakage into the ocean. This is largely a result of a relatively rapidly growing economy with a waste infrastructure that has not been able to keep pace. In 2017 the Trash Free Seas Alliance worked with The Dow Chemical Company, through Dow’s Leadership in Action program, and many organizations in Vietnam to better understand the waste management challenges in areas surrounding Hanoi. As this work comes to a close (officially in November of 2017), we are left with some interesting findings, including a new understanding of material flows and waste processing in areas surrounding Hanoi, confirmations on some of our research assumptions heading into this project – specifically around some of the challenges around waste collection and processing, new insights into the incredible efforts of many of the local organizations working to address these challenges, and additional questions that we had not considered.

During this panel, I would like to discuss this research experience, but more importantly I would like to include this in the context of building the relationships with the other panelists (tentatively MCD and CECR). Both are NGOs based in Vietnam and have active environmental and marine debris initiatives. Through this work and the newly established relationships, we hope to highlight opportunities for engagement to measurably reduce marine debris.

Marine Debris Networks: Reasons, Impacts And Challenges

"African Marine Waste Network building the partnerships to reduce litter in Africa"

Anthony Ribbink, Sustainable Seass Trust

ABSTRACT

The African Marine Waste Network (AMWN) is the first network of its kind to focus on finding solutions to marine waste for Africa. After South East Asia, Africa leaks more debris into the oceans of the world than any other continent. Predictions are that the problem will grow over the next decades as population growth, rates of urbanization and economic development are expected to increase, but significant alleviation of poverty is not likely to occur.

The AMWN is providing an active platform for collaboration, resource and knowledge sharing between stakeholders within countries and across borders in Africa, and it collectively seeks to find solutions that cater to African circumstances and cultures. The challenge is to reach and appeal to all 38 coastal and island nations of Africa and to create constructive collaboration between stakeholder groups with varied approaches and priorities.

Most rivers of Africa are heavily polluted and are principal conduits carrying debris from land to the sea. This is especially true of those rivers which have heavily populated catchment areas, sometimes with more than one town in their catchments. The AMWN is focusing increasingly on rivers and their catchments, in which high quality research, including innovative leap-frogging technology, is planned. It is also placing a high priority on capacity building, education and awareness, harnessing the circular economy (particularly in impoverished communities), networking in Africa and globally and policy and management.

"Indonesian Waste Platform - promoting and facilitating cross-sector collaborations to tackle marine debris"

Nina van Toulon, Indonesian Waste Platform
Jella Kandziora, Freelancer

ABSTRACT

Indonesia belongs to one of the countries with highest waste inputs into the sea worldwide. Due to growing household consumption and accelerated business activities marine litter already is and will pose a mounting challenge in Indonesia. In order to tackle marine debris impacts the building of an Indonesian waste stakeholder network started in 2010 and led to the foundation of the Indonesian Waste Platform (IWP) in 2015. IWP is a marine debris network and a country hub promoting and facilitating cross-sector collaboration as well as the need for a common-shared vision, strategy, and action. The hub is a waste think tank, which is coordinated by Nina van Toulon, three other hubmanager and a team of experts from all sectors and regions who share their knowledge as voluntary contribution. The aim of IWP is to function as a backbone organization, promote synergies between existing programs and to support the dissemination of stakeholder engagement in Indonesia´s Plan of Action on Marine Plastic Debris 2017 - 2025 in collaboration with the Coordinating Ministry for Maritime Affairs and Ministry of Environment and Forestry.

Its activities are based on a collective approach. The hub is constantly in motion, responding to stakeholders' requirements, following latest developments and act on that. Current activities include monitoring and data collection aiming at introducing a marine debris tracker and continued collaboration with other country hubs. By presenting IWP we also want to call attention on one of the main obstacles of marine debris networks and country hubs: sufficient funding.

Marine Debris Networks: Reasons, Impacts And Challenges

"Marine Litter Network – A Resource Providing the Status of Marine Litter Work Around the World"

Jenna Jambeck, University of Georgia
Abigail Smith, University of Georgia - Young Dawg
Amy Brooks, University of Georgia
April Crow, Crowd Advisors

ABSTRACT

The Marine Litter Network is a web platform for global marine litter information that began in 2011. The platform is an initiative by the Global Partnership on Marine Litter to support knowledge sharing and coordination. In 2017, the site and platform was revitalized by the Center for Circular Materials Management at the University of Georgia and expanded to reinvigorate engagement and partnerships http://marinelitternetwork.com/. It remains a source for timely articles on marine litter, marine debris and microplastic, e.g., the front page is dynamically loaded daily with current news articles. The resource includes a searchable map of over 230 global projects addressing marine litter and an initial database of Best Available Technologies, which is expected to grow over time. The site also compiles UN reports, legal information, as well as regional and national action plans. In this study, we report on an assessment of the topics covered on the platform with qualitative coding software and GIS to capture geographic trends and major themes that emerge. This assessment can provide a context and baseline with where to fit in global and local solutions to the marine debris issue.

"Portuguese Marine Litter Association – promoting marine litter outreach, awareness and collaborative work among stakeholders"

Patricia Louro, Portuguese Marine Litter Association
Joao Frias, APLM
Flávia Silva, APLM
Sofia Quaresma, APLM
Paula Sobral, APLM

ABSTRACT

Since its establishment in 2013, that the Portuguese Marine Litter Association (APLM) has been working to increase public knowledge about ocean literacy including marine litter and thus contribute to prevent and reduce its hazardous effects and impacts that affect the global environment.

Several actions have been carried out to disseminate the issue of marine litter, particularly: outreach and awareness-raising campaigns to prevent beach littering; reducing the use of single-use plastic bags in supermarkets and also information about microbeads in cosmetics. Other initiatives include riverine and beach cleanup actions; participation in workshops, seminars, exhibitions, social media and video reporting events; collaboration with public and private entities; technical support at schools and communities and developing pilot projects with fisherman and fishing industries, amongst other initiatives.

Aligned with the goals of the Global Partnership on Marine Litter, the Portuguese Marine Litter Association has also been working to create the Portuguese Partnership on Marine Litter, as a means to promote co-responsibility among national stakeholders and to provide more efficient management solutions for marine litter. Thus, APLM continues to engage with other Portuguese speaking countries and to establish the basis to create and promote the Portuguese Speaking Countries Partnership on Marine Litter. So far, activities have been carried in two countries, East Timor in 2016 and São Tomé and Principe in 2017, to build bridges and promote national and international partnerships on the topic.

This work provides detailed information about recent achievements of APLM particularly stakeholder engagement, beach cleanups and monitoring efforts through citizen science.

Marine Debris Networks: Reasons, Impacts And Challenges

"The Australian Marine Debris Initiative - a national partnership platform"

Heidi Taylor, Tangaroa Blue Foundation

ABSTRACT

Tangaroa Blue Foundation is the leading marine debris organisation in Australia. Our motto is — if all we do is clean-up, that's all we will ever do. Stopping litter at its source is our aim, and through collaboration and partnerships with community government and industry, we can help achieve this at both a local and national scale Tangaroa Blue Foundation created the Australian Marine Debris Initiative (AMDI) in 200 with a focus of removing and preventing marine debris across the country. The AMDI platform has engaged more than 1000 partner organisations, including indigenous rangers, local schools, community organisations, government agencies and industry bodies. The AMDI network contributes data collected with consistent methodology into the AMD Database which is then used to identify what items are impacting specific sites. Once we know what is there, we can then start tracking those items to the source, engaging relevant stakeholders and partners to find practical solutions that prevent the release from occurrin in the first place.

Tackling marine debris and litter as a whole is overwhelming - where do you start? The AMDI Database provides scientific evidence of what items to start with, and by tackling marine debris and litter one item at a time, you can then solve this immense issue, one step at a time. This presentation will explore the AMDI platform, specific Source Reduction Plans that have been created based on data collected during clean-up activities, and how this citizen science data has contributed to numerous government policy submissions, including state plastic bag bans, container deposit legislation and the Australian Government's Threa Abatement Plan.

"The German Round Table Marine Litter"

Stefanie Werner, German Environment Agency (Umweltbundesamt)

ABSTRACT

The German Round Table Marine Litter was established to develop, coordinate and implement activities to combat marine litter in the North and Baltic Sea. Around 130 stakeholder are involved representing the Federal Government, Federal States and various relevant stakeholders inter alia the shipping, fishing, waste, sewage and tourism sectors, the plastics, cosmetic and tire industries, retailers, NGOs, science and other public authorities. The overall aim of this network is that "Marine Litter does not cause harm to the marine and coastal environment" – a goal required by the European Marine Strategy Framework Directive (MSFD - 2008/56/EU) to be achieved by 2020. The Regional Seas Conventions OSPAR and HELCOM have been adopted Regional Action Plans on Marine Litter in 2014 and 2015, respectively. The German Round Table Marine Litter serves both, the implementation of the mandatory national measures under the MSFD as well as the regional actions where Germany is in lead, e.g. addressing improved waste management and the reduction of single-used items as well as microplastics use and emissions.

The work is carried out in two working groups targeting the relevant land- and sea-based sources including options for removal and outreach and is based on monitoring activities in the marine compartments and biota generating evidence on amounts, distribution, top findings and ecological as well as socioeconomic harm caused by marine litter. The presentation intends to introduce into the German Round Table Marine Litter, give an overview of the current state of play and an outlook on future developments.

“Amounts, trends and types of marine LItter in the North East Atlantic”

Jen Godwin, OSPAR Commission
John Mouat, OSPAR Commission

ABSTRACT

For the first time the amounts, types and trends of marine litter in the North East Atlantic have been assessed at the regional scale. Three marine litter indicators on beach litter, seabed litter and plastic particles in fulmars stomachs were assessed as part of OSPAR's Intermediate Assessment 2017 giving a comprehensive assessment.

Beach litter data from 76 beaches was assessed to describe its abundance and composition. Trends in particular items were assessed on 19 beaches with longer datasets covering the period 2009–2014. Seabed litter was assessed for the first time, using monitoring based on fisheries survey trawls, providing a first picture of the distribution of litter on the seabed within North Sea, Celtic seas and Bay of Biscay. The distribution of floating litter and the potential impact on wildlife in the North Sea was also considered through the indicator on plastic particles in fulmars stomachs. Litter levels were assessed against OSPAR's long-term goal of less than 10% of fulmars exceeding a level of 0.1 g of plastic in their stomachs.

These three assessments also provide a key input to OSPAR's Regional Action Plan on Marine Litter allowing the assessment of the effectiveness of measures to reduce marine litter and to identify any new items of concern.

Preventing And Reducing Marine Litter In The North-East Atlantic

"Can we fix it? Yes we can!"

Sue Kinsey, Marine Conservation Society

ABSTRACT

The OSPAR countries have been collecting marine litter data since 2001 with responsibility for the data and data collection initially being passed from one country to another.

In 2012 the Marine Conservation Society, a UK NGO took over hosting and design of the OSPAR marine litter data portal for the OSPAR countries to supply a consistent, reliable and user friendly system for data entry of both beach information and litter survey data.

We look at how this transfer came about, how the database functions, problems encountered along the way and the methodology behind it. We also look at the history of marine litter data collection in the OSPAR region and its extensive and effective use of volunteers to collect such data.

The portal and the data it holds has increased in importance since the inception of the EU Marine Strategy Framework Directive and currently 12 countries use it to enter marine litter data for their litter monitoring programmes.

We also look at the uses the data has been put to, in particular how it meshes with extra data collected by the Marine Conservation Society for the UK.

Preventing And Reducing Marine Litter In The North-East Atlantic

"Fishing for Litter - Cleaner seas, safer fishing"

Ryan Metcalfe, KIMO International

ABSTRACT

Fishing for Litter is an imaginative yet simple initiative that aims to reduce marine litter by involving one of the key stakeholders – the fishing industry. The project is designed to reduce the amount of litter in our seas by physically removing it, and to highlight the importance of good waste management amongst the fleet. Participating vessels are given hardwearing bags to collect marine litter that is caught in their nets during their normal fishing activities. Filled bags are deposited on the quayside and disposed of by harbour staff. Since 2011 over 500 vessels have removed more than 2,500 tonnes of waste from the north-east Atlantic.

"Marine litter in the Netherlands, Green Deals and crossing OSPAR borders"

Lex Oosterbaan, Rijkswaterstaat
Mareike Erfeling, Rijkswaterstaat
Willem van Loon, Rijkswaterstaat
Hermien Busschbach, Ministry of Infrastructure and Environment

ABSTRACT

Lex Oosterbaan, Mareike Erfeling, Willem van Loon (Rijkswaterstaat, Ministry of Infrastructure and Environment, the Netherlands) Hermien Busschbach (Ministry of Infrastructure and Environment, the Netherlands)

Within OSPAR countries work successfully together with NGOs and the private sector to develop a better knowledge base for marine litter and to implement effective measures. The Dutch approach to marine litter has always been an international one. Although the main driving force to tackle marine litter has been the EU Marine Strategy Framework Directive, the OSPAR Regional Sea Convention has played a pivotal role in this by developing regional (common) marine litter indicators and assessment tools and by adopting the Regional Action Plan on Marine litter. Cross border cooperation is crucial in combating marine litter. How does this work? In what way does OSPAR's work help the Dutch government in achieving their ambitions to reduce marine litter?

This presentation will present the relation between the national and the OSPAR work, the successes and challenges. Starting point has been the same: litter items most commonly found on beaches and identifying their most likely sources. The next step, developing measures together with stakeholders to substantially reduce the amounts, turns out to be easier at a national than at a regional level. In the Netherlands, Green Deal agreements with sectors like fisheries, shipping and beach tourism have been adopted to exchange best practices and develop pilot measures. These national experiences are fed into the implementation of OSPAR's collective actions in the RAP ML in order to increase the scale and effectiveness of the measures. The experiences with this approach and how progress is assessed

“Options addressed within OSPAR to reduce leakages of pre-production pellets in the environment”

Sarah Sananes, Ministère de la Transition Ecologique et Solidaire
Stefanie Werner, German Environment Agency (Umweltbundesamt)
John Mouat, OSPAR Secretariat
Laure Dallem, Ministère de la Transition Ecologique et Solidaire

ABSTRACT

Pre-production pellets are small plastic particles/granulates (diameter<10mm) used in the manufacturing of ordinary plastic products. They regularly leak out during production processes, of transportation trucks and of containers lost at sea, to end up directly or via sewage treatment plants in the marine and freshwater environments in varying concentrations, causing environmental as well as socio-economic damage.

OSPAR, through its Regional Action Plan on Marine Litter, identified a need to study this source of primary microplastics and analyse its pathways into the marine environment in order to take concrete measures to reduce these leaks.This includes the necessity to setup a dialogue with representatives of the entire plastic industry supply-chain (producers, transporters, convertors) and the various NGOs following up the surveillance of pellets losses in the environment.

This presentation will focus on the work conducted within OSPAR and addressed the main options to act which are under consideration. Several options can be taken into account like technical improvements, voluntary agreements by the plastics industry or more or less binding regulations.

This overview aims to define some key recommendations that could be implemented not only within OSPAR but also in the European Union as part of the upcoming EU Plastics Strategy.

Preventing And Reducing Marine Litter In The North-East Atlantic

"OSPAR Regional Action Plan on Marine Litter – State of affairs and outlook"

Stefanie Werner, German Environment Agency (Umweltbundesamt)
John Mouat, OSPAR Commission

ABSTRACT

The OSPAR Regional Action Plan on Marine Litter (RAP ML) is designed as an instrument for efficient horizontal multi stakeholder involvement. By considering the top marine litter items found in the OSPAR marine region and their implications for the marine environment, as the ultimate sink, the plans adds weight to existing sectoral approaches of other regimes and legal frameworks. The RAP ML outlines a comprehensive set of actions targeting the major sea-based and land-based sources. Prevention measures including education and outreach are key to the plan, removal actions for the different marine and river compartments have also been formulated such as passive Fishing-For-Litter schemes, which are meanwhile widely applied in the OSPAR region.

The defined actions often need to be addressed to third parties. The current voluntary phase out of the use of microbeads in personal care products is inter alia based on close OSPAR dialogues with the cosmetics industry. Other examples for cooperation include the ongoing dialogue with Riverine Commissions to prevent litter inputs and joined work with plastics producers and the waste management sector to identify gaps leading to waste turning into marine litter as well as with the shipping sector to assist in improving Port Reception Facilities.

Delays are also apparent in the implementation of the plan often caused by lack of sufficient resources and funding to support the individual actions. The presentation intends to introduce into the OSPAR RAP ML, give an overview of the current state of play and an outlook on the further implementation process.

“Citizen data is the key to fighting "trash blindness"”

John Rizzo, Let's Do It Foundation

ABSTRACT

Most laypeople still have "trash blindness" - they do not notice trash that they encounter every day take no interest in trash statistics. There are three issues:

1) Data and analysis results are not translated into everyday language. The gap between professionals and public is significant.

2) The lack of data makes it harder to educate about the problem of trash.

3) Trash data collected by agencies and NGO's around the world is not easily shared or accessible to other groups. The bits and pieces of data do not create a global picture of what the world's trash situation truly is.

There are three ways to solve the problem:

- Citizen science. Let's Do It Foundation has shown that people are more interested when they participate in the collection and analysis of data. The results are more understandable because they are translated into non-scientific language.

- Massive collection of data. Lay people are not always precise in describing data, but when the data is "crowd-sourced" on a large scale, it is more accurate and up-to-date. The consolidation of many data sources also helps significantly.

- An open trash database platform available for any organization to use. The goal is to bring various sets of data together, opening it up, making it comparable and analyzable, and creating tools that all can use.

Let's Do It Foundation is promoting World Cleanup Day on September 15, 2018, when millions of volunteers around the world will come out to collect data and clean up trash. Secondly, Let's Do It Foundation together with other organizations is building an open global trash database platform. The data comes from many sources, most using ordinary people to collect it. The scientists chip in with their knowledge and strengthen the conclusions. This will result in more data, more understandable data, from around the world.

Citizen data is the key to fighting "trash blindness"

"Global Alert - Reporting Trash Hotspots In our Waterways"

Doug Woodring, Ocean Recovery Alliance

ABSTRACT

In many coastal and upstream communities near waterways, local government agencies often do not have the capacity, resources or knowledge to respond with monitoring programs, waterway clean-ups, or trash-capture devices. Plastic pollution is a global challenge, and for scaled improvements, it is critical that we can collectively slow the flow of material out of our waterways before it reaches the sea.

In order to engage and activate communities, local governments and business-sector stakeholders, Ocean Recovery Alliance has developed a citizen-powered global monitoring solution: Global Alert, for reporting trash hotspots near our waters. The high-impact potential of Global Alert rests in two unique innovations for managing this environmental problem: 1) integrated information collection, sharing, and analysis, on a macro scale, helping to initiate cleanups and prevention programs 2) giving a visual snapshot of the situation with datasets that can be downloaded by relevant stakeholder groups. By engaging international citizens, either locally, or when traveling, Global Alert empowers communities to collate, share, and analyze data on floating trash in rivers and on coastlines. These contributions are integrated into the Global Alert database, charting submissions on an online map, describing their nature and intensity, and identifying trends. This allows for immediate sharing of findings and the potential to identify hotspots of activity as they emerge. It also facilitates both the discovery of the pollution source, and the creation of strategies and solutions to manage and pre-empt it, including increased inter-watershed communication and integrated catchment management. In effect, a global "neighborhood watch" for floating trash is created, allowing communities to first measure and then manage the problem.

Citizen data is the key to fighting "trash blindness"

"The potential contribution of the World Clean Up Day to Citizen Science and to define strategies to curb and mend the issue"

Enzo Favoino, Let's Do it Foundation

ABSTRACT

With its initiative on a global clean up (World Clean Up Day), Let's Do It targets the following goals:

1) Fighting "trash blindness" and get people (and the public opinion) focused on the nature and magnitude of the problem.

2) Collecting data (mostly during the mapping stage which should inform the clean-ups) on nature, frequency, distribution of various waste types; info will subsequently be made available (Citizen Science) to other platforms and related research programmes.

3) Defining post clean up strategies and proposals to promote a more sustainable management of resources and discards (the "Keep it clean plan") with the overarching principle of "minimising leakage of materials from circular models". In order to support this, we have also defined a "Waste Index" which sums up key info on waste management and frequency of trash points in various Countries.

On account of its inherent nature of a global movement aiming at involving campaigners from across the world, the collection of data may require a trade-off between representativeness and user-friendliness of the UI of the dedicated app. Also, in a result-oriented approach, one may consider focusing efforts on most sensitive areas which may be considered as largest contributors to dispersion of debris in the environment and water bodies (e.g. riverine areas).

The foregoing will be presented and discussed in order to frame actions required to maximise the added value of one of the largest civic mobilisation events in the history of mankind.

"A combined approach on surveying marine litter in Arctic Greenland"

Jakob Strand, Aarhus University
Lis Bach, Aarhus University
Thomas Juul-Pedersen, Greenland Institute of Natural Resources

ABSTRACT

The global pollution of plastic in the ocean has today also made their clear marks in the Arctic marine environment adding on to the local sources. This study on the first systematic analyses of amounts and composition of marine litter in Greenland provides the first baseline information useful for assessments of the most important sources including the potential long-range transport into the Arctic region. In a combined approach conducted in 2016-2017, we studied environmental indicators for beach litter, plastic particles ingested by northern fulmar (Fulmarus glacialis) and microplastic in a gradient from an urban area using sediments and biota. Microplastic characterization has been supported by FTIR analyses. Relatively high amounts and the composition of beach litter in West Greenland indicate the importance of local sources whereas litter in East Greenland mostly originates from sea-based activities and potential long-range transport. Data from fulmars from two sampling locations also indicates a relative high impact with 35 % of birds that contained more than 0.1 g plastic in their stomachs dominated by polymers with densities < 1 g cm-3 indicating main contribution from floating plastics. Microplastic studies showed a clear gradient from local urban sources and in sediments it was dominated by polymer materials with densities > 1 g cm-3. The data can potentially be used as a first input for establishment of baseline levels used for future spatial and temporal trend assessments in the region. Project outcome has been disseminated to the Greenlandic EPA and political commissions and potential local actions towards combatting local sources have been discussed.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

“A wooden, scientific "message in a bottle" - German university team researches sources and dispersal of macroplastics through large-scale public participation experiment”

Rosanna Schoeneich-Argent, Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University Oldenburg
Holger Freund, Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University Oldenburg
Frank Hillmann, Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University Oldenburg
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ABSTRACT

Regular beach cleanups provide insight into quantitative and qualitative changes of litter over time, and are a tool to raise public awareness. Yet there is agreement that it is necessary to combat plastic waste at its sources. Since mid-2016, an interdisciplinary project (Macroplastics Pollution in the Southern North Sea – Sources, Pathways and Abatement Strategies) from the Carl von Ossietzky University Oldenburg, Germany, has been researching the input and dispersal of macroplastics. Combining numerical models with monitoring, experimental field work, stakeholder analysis and citizen science, it aims to identify the origins of plastic pollution along the German North Sea coastline, the major tributaries Ems, Weser and Elbe, and in the German Bight. The goal is to provide governmental and non-governmental organisations with solid data and improved knowledge of the sources, pathways and accumulation areas of marine debris in order to devise acceptable and effective abatement strategies. A core component of this project is the release of wooden drifters – 9,000 to 10,000 per season – over a 2-year period at selected locations which are likely plastic litter source points (Fig. 1). Each drifter is branded with an individual ID and a message in German and English, inviting every finder to report ID, date and location via the project website (Fig. 2). Almost 50 % of the >24,000 drifters released so far have been registered from places in Germany, the Netherlands, Denmark and Norway. These data are used to validate and improve drift models, identify litter hotspots, and infer the possible sources of beached litter due to the known release points of the wooden drifters (back-tracking). Here we present initial, GIS-based results of report patterns and experiences from this unique, large-scale public participation experiment.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

“Accumulation and distribution of marine debris on barrier islands across the northern Gulf of Mexico”

Katie Swanson, Mission Aransas NERR
Caitlin Wessel, Dauphin Island Sea Lab
Tracy Weatherall, Mission Aransas NERR
Just Cebrian, Dauphin Island Sea Lab

ABSTRACT

Marine debris is an economic, environmental, human health and aesthetic problem posing a complex challenge to communities around the globe. Coastal communities specifically are among the most seriously impacted with increased expenses for beach cleaning, public health and waste disposal issues, as well as a loss of income from decreased tourism. To better document this problem we monitored the occurrence and accumulation rate of marine debris at 43 sites on 9 barrier islands from North Padre Island, TX to Santa Rosa, FL. Surveys were conducted using the NOAA Marine Debris Shoreline Survey Guide and consisted of 100m-long transects along the shoreline extending from the water edge to the upland shoreline limit. All debris larger than 5 mm, including cigarette butts, was collected and sorted by material type and placed into predetermined categories. Each category was counted and measured for dry mass. With this information we are investigating three specific questions: (1) what are the major types and possible sources (land or ocean based) of shoreline debris; (2) does the rate of debris deposition onto the shoreline show seasonal oscillations; and (3) how does debris deposition change from east to west in the nGoM? Over the two-year study period several trends emerged. Greater amounts and different types of trash consistently washed up on the ocean side compared to the sound side of islands, suggesting the debris washed onto nGOM shorelines from the ocean containing a combination of ocean and land-based sources. A significant increase in the amount of debris collected on the shoreline during tourist/boating season (May to September). In addition, we observed a drastic increase in the amount of trash at the western nGoM sites, with accumulation rates more than 10x greater in Texas.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Amounts, types, sources and distribution of marine debris derived from a statistical analysis of US data"

George Leonard, Ocean Conservancy
Nicholas Mallos, Ocean Conservancy
Allison Schutes, Ocean Conservancy

ABSTRACT

Within the United States, clean-up campaigns and repeated surveys are carried out to both clean up the beach but also quantify the amount of debris on the coastline and near waterways. However, to date, a statistically-robust evaluation of the amount of debris and the relative contribution of particular items to ocean trash had not been done. To address this knowledge gap, we used the coastal clean-up data collected by Ocean Conservancy's International Coastal Cleanup (ICC), as well as two different surveys led by NOAA's marine debris program to estimate the amount of debris on the U.S. coastline. We supplemented these data with a new random survey of debris along the entire U.S. west coast. We developed a statistical model to uncover pattern and process in marine debris at a range of scales, developed a baseline for marine debris in the United States and provided preliminary insights into the effectiveness of some policy interventions. Our findings indicate there are between 20 million and nearly 2 billion pieces of plastic present on the US coastline at any given time. Hotspots of debris at the state level include Texas, Idaho, Illinois and the mid-Atlantic states, with some evidence of higher debris loads near urban centers. Oceanographic transport also appears to be a significant contributor to patterns of marine debris at relatively large spatial scales. An analysis of plastic bottle and cap data suggests that container deposit legislation (i.e. bottle bills) is an effective policy to reduce littering of these problematic items. Our analysis confirms that efforts such as the International Coastal Cleanup and NOAA's marine debris surveys provide information that is critical to developing strategies to reduce the threat of debris to coasts, oceans and waterways.

"Assessment of seabed litter in the Northern and Central Adriatic Sea (Mediterranean) over six years"

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Sasa Raicevich, Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Loc. Brondolo, 30015 Chioggia, Italy
Anna Nora Tassetti, Istituto di Scienze Marine (ISMAR), Consiglio Nazionale delle Ricerche (CNR), L.go Fiera della Pesca, 2, 60125 Ancona, Italy
Alessandra Spagnolo, Istituto di Scienze Marine (ISMAR), Consiglio Nazionale delle Ricerche (CNR), L.go Fiera della Pesca, 2, 60125 Ancona, Italy
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ABSTRACT

Temporal and spatial occurrence of anthropogenic debris on the seabed is much less investigated in respect to the sea surface and shores, due to sampling difficulties and costs. However, detecting marine benthic litter is fundamental for developing policies aimed at achieving the Good Environmental Status (GES) in European Seas by 2020, as requested by the Marine Strategy Framework Directive (MSFD).

In this context, this study aimed to estimate seafloor litter abundance, composition, spatial distribution and main sources in the North-Central Adriatic Sea (GSA 17) over a six-year period. It represents the longest data set available on this issue up to date in the basin.

The sampling area has a surface of 36,742 km2 and extends from the Italian coast to the 12 mn limit of the Croatian national waters. Six surveys were conducted in fall from 2011 to 2016 and 67 stations were sampled each year, distributed over the area following a depth-stratified random design (0-30 m; 31-50 m; 51-100 m).

Litter items were collected using a ''rapido'' trawl, a modified beam trawl commonly used by the Italian fishermen to catch benthic species. Marine litter in the catches was classified in 6 major categories (plastic, metal, glass, rubber, wood, other). Plastic was dominant in terms of weight. The highest concentration of litter was found close to the coast likely due to high coastal urbanization, river inflow, extensive navigation and the morphological-hydrological features of the basin.

These data provide useful information to implement necessary measures to manage marine litter in order to minimize this type of anthropogenic pollution in the Adriatic region. The systematic monitoring of marine litter, on regional scale, may be also useful to evaluate the effectiveness of national and international regulations.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Citizen science: divers survey marine debris on the seabed of the Israeli Mediterranean coast"

Galia Pasternak, a Department of Maritime Civilizations, The Leon H. Charney School for Marine Sciences, University of Haifa,
Boaz Mayzel, The Israeli Diving Federation
Sarah Ohayon, The society for the protection of nature in Israel
Christine Ribic, US Geological Survey, Wisconsin Cooperative Wildlife Research Unit, Department of Forest and Wildlife Ecology, University of Wisconsin, Madison

ABSTRACT

Public participation in scientific research, citizen science (CS), has long been used to tackle research questions that would otherwise not have been addressed due to lack of resources, time or geography. Marine debris survey programs worldwide is a good example of information collection relying on CS. In 2015, the first author teamed with the Society for the Protection of Nature in Israel and The Israeli Diving Federation to establish the divers' volunteer program "Mishmar Hayam" (Sea Guard), which supports marine conservation through citizen science. From March 2016 - July 2017, 11 surveys were conducted in seven different sites in the northern part of Israel. Additional data was collected during 20 supervised underwater cleanups. Surveys found that plastic was the most common material on the seafloor, up to 84% of the items. Debris at four sites was primarily fishing-related debris and all the sites are used for recreational fishing, suggesting that most debris originates from the adjacent coast. The information collected by the divers will help document the extent of marine debris along the Israeli coast, and is crucial to understanding debris sources and finding solutions for the problem

"Marine Debris Monitoring On Heavily Impacted Remote Beaches"

Chris Pallister, Gulf of Alaska Keeper

ABSTRACT

The results and lessons learned from a 10-year remote marine-debris monitoring project in the Gulf of Alaska will be discussed. Utilizing a combination of volunteers and professionals, this long-term project tracks 150 categories of marine debris on 17 road-inaccessible remote beaches scattered along 400 miles of the Gulf of Alaska coast. This monitoring project has been valuable not only for documenting the annual accumulation and type of marine debris, but also for tracking the impacts of distant natural disasters such as tsunamis and typhoons. The project has also identified and tracked the distribution of marine debris from shipping spills. The importance to policy makers of marine-debris monitoring data will also be discussed

"NOAA's Marine Debris Monitoring Protocol in Action: Lessons Learned on Virginia's Coastal Beaches"

Christina Trapani, Christina Trapani Consulting
Katie Register, Clean Virginia Waterways
Mark Swingle, Virginia Aquarium & Marine Science Center

ABSTRACT

A new project, Monitoring Marine Debris in Virginia's Coastal Zone, was initiated in 2014. The project partners (VA Coastal Zone Management Program, VA Aquarium, Clean VA Waterways) have a history of engagement in marine debris reduction efforts in Virginia, including balloon debris monitoring programs, data collection through the International Coastal Cleanup, cigarette litter prevention campaigns, and social marketing studies. During the first Virginia Marine Debris Summit in 2013, it became apparent that there was a need for high-value data about the quantity and types of debris on Virginia's beaches. While extensive "snapshot" data existed, this information needed to be supplemented with data collected using more rigorous protocols. Since April 2014, four coastal beaches in Virginia have been monitored monthly using the Marine Debris Shoreline Survey protocols developed by the NOAA Marine Debris Program. Implementation of the marine debris monitoring project has involved many aspects: site selection and accessibility; recruiting and training volunteers; overcoming scheduling challenges (weather, bird nesting seasons, volunteer availability, the 28+or- day requirement); data management and entry; data analysis; and managing site-specific challenges, such as visitors who remove litter from survey sites. Data collected from monthly monitoring is expected to serve as a baseline against which Virginia can evaluate the effectiveness of the Virginia Marine Debris Reduction Plan that was completed in October 2014. In this presentation, researchers will share results and findings from the data, including lessons learned and responses to challenges, and describe how the project is strengthening partnerships with pollution-prevention nonprofits, ocean advocacy organizations, the U.S. Fish and Wildlife Service, and others.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Optimization of Urban Waste Design"

Sydney Barnes-Grant, University of Washington
Margaret McCauley, U.S. Environmental Protection Agency

ABSTRACT

Most people take less than two seconds to consider where they put their trash. With 80% of trash in the ocean coming from land, a strategic plan for implementing trash receptacles in the right places, designs, and ratios has the potential to be a key trash management tool. EPA's Region 10 Trash Free Waters will present results obtained from a Seattle-based study conducted in partnership with University of Washington (UW). EPA's UW Capstone intern created a protocol based on California's Urban Rapid Trash Assessment methodology to locate and track urban litter hotspots. Strategic bin placement is a critical component of aquatic trash prevention. The data from this research demonstrates the importance of public receptacle type and placement as well as the pitfalls of insufficient bin supply. Using ArcGIS technology, litter hotspots in three water adjacent neighborhoods in Seattle, WA were mapped and characterized according to prevailing waste sorting policy. This type of monitoring can be used to inform city planning by integrating consideration of land-use and aquatic trash prevention into bin placement criteria as an upstream solution to marine debris. The study revealed ways to predict trash generation and target bin placement based on business and census data layers.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Preliminary management recommendations based on marine litter research on Turkish northeastern Mediterranean beaches"

Ahmet Erkan KIDEYS, Middle East Technical University
Kerem GÖKDAĞ, Middle East Technical University
Olgaç GÜVEN, Middle East Technical University
Bülent HALISDEMIR, Mersin Greater Municipality

ABSTRACT

Several Turkish beaches along the northeastern Mediterranean were sampled for litter analyses in November 2015, April 2016 and August 2016. Beach litter studies revealed not only the composition and abundance of the litter accumulating on the beaches but also their sources for different seasons. Direct deposition at the beaches was identified as the most important vector compared to transportation from other regions. Litter abundance was higher either in areas of close proximity to debris-polluted waters or to the city center. In all cases plastics constituted the bulk of total litter. Among plastics, PET (PolyEthylene Terephthalate) bottles and their lids were the most prominent items especially during the summer tourist season. Manufacturing was found to be the main sector producing litter compared to others through the percentage of general snack packaging and fishing related items collected. Cigarette smoking related litter items were also estimated in high quantities. Results from the present study combined with those from marine litter literature, as well as other relevant studies and activities (on protected areas, protected turtle species, awareness programs etc.) enable us to suggest region-specific management recommendations for decreasing the litter problem. These include deposit schemes to reduce PET bottle consumption, the expansion of public drinking water fountains; deployment of innovative cigarette stub collectors, establishment of litter collectors in rivers and most importantly large-scale awareness raising programs, especially incorporating local scientific community knowledge. Therefore, close cooperation between scientists and decision-makers are increasingly important in producing swift managerial actions.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Quantifying debris type and the spatial and temporal trends in marine debris density in coastal waters of the 4-island region of Maui, Hawaii"

Jens Currie, Pacific Whale Foundation
Stephanie Stack, Pacific Whale Foundation
Jessica McCordic, Pacific Whale Foundation
Gregory Kaufman, Pacific Whale Foundation

ABSTRACT

The 4-island region of Maui, Hawaii lies within a protected marine sanctuary where recreation, tourism, and marine species coexist. Located within the subtropical convergence zone, the Hawaiian archipelago is subject to high debris loads, receiving in excess of 52 metric tons/year. Here we present the first study to determine the spatial and temporal trends of debris density within the Maui 4-island region. Line transect surveys were conducted from April 2013 to September 2017 and all floating debris encountered were collected and photographed. From Maui's leeward waters 2,097 items were removed, of which 89% were plastic. The majority of debris (84%) could not be identified as originating from land or ocean based sources, however, of the items that could be sourced, 5% originated from land and 11% originated from ocean. Results from these surveys found temporal and spatial trends in debris densities; indicating a relationship between environmental factors and local trade winds and eddies. Biofouling was present on 70% of the collected items, of which nine items contained species not native to Hawaiian waters. Foreign writing allowed for assessment of country of origin for 41 items, which were assigned to the following regions: Japan 46%; China 27%; Korea 12%; other 15%. The introduction of potential invasive species via marine debris could be detrimental for the local biota. The results of this study demonstrate the importance of monitoring and collecting baseline information which can be used to guide and steer further research. Understanding the sources of debris items will allow mitigation measures to be implemented at the point of origin, where the greatest impact will occur.

Marine Debris Monitoring Programs: Applying Data To Answer Research Questions, Advise Management, And Inform Policy

"Quantities of marine debris along the coastline line in South Korea have significantly decreased"

Sunwook Hong, Korea Marine Litter Institute
Jongmyoung Lee,
Jong Su Lee,
Daeseok Kang, Pukyong National University
Shin Yeong Park, Korea Marine Litter Institute

ABSTRACT

Korea National Marine Debris Monitoring Program (KNMDMP) has been conducted since January 2008. Trained citizens have bimonthly monitored the quantities, composition and types, and sources of marine debris at 20 sites along the Korean coastline nationwide. Surveyors collected all debris items larger than 2.5 cm from 100 m length of coasts and identified 100 sorts of debris and recorded the origin of debris (domestic/overseas). Total number, weight, and volume of domestic marine debris showed statistically significant decrease for 9 years. The expanded polystyrene buoy item used to show the highest number during the first four years has significantly decreased. It is likely to be affected by governmental policy intervention such as encouraging replacement into durable buoys since 2009. However, overseas marine debris has not significantly decreased.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Citizen involvement in a HotSpot Survey about pathways of marine debris"

Christian Aden, University of Oldenburg
Katharina Stephan, University of Oldenburg

ABSTRACT

The project "Macroplastics Pollution in the North Sea" funded by the Lower Saxony Ministry of Science and Culture aims to investigate pathways and hotspots of macroplastics at the coast and along the shorelines of north-west Germany. An interdisciplinary consortium of physical oceanographers, physicists, geologists, biologists and environmental scientists, brings together different methods for modelling pathways of marine debris through data on currents, waves, wind and other environmental parameters on the one hand and citizen involvement in data collection on the other hand. For data collection we started the release of nearly one hundred thousand uniquely marked wooden drifters into the North Sea by October 2016, combined with a survey provided by the web-based Geospatial Content Management System HotSpot (GeoCMS). The GeoCMS offers a variety of modules for spatial data management, GIS-based analysis, OGC-based data provision as well as tools for data collection. A focus lies on the techniques and open source software used to develop the system and to provide the web-based report tool, the methods used to ensure data quality by an intelligible form of map-based reporting and the way to inform citizens via maps of release sites and reported drifters as well as dynamically processed cluster and heat maps of observations. After one year of citizen involvement and the release of 24.400 wooden drifters, the free accessible web-portal has been used for the submission of 12.144 observations (9772 unique IDs) from the coastlines of Norway, Denmark, Germany and the Netherlands. The coordinates of release sites and observations now are to be used by project partners to model hotspots of marine debris and to improve backward movements models which may lead to possible sources of marine litter.

"Citizen Science for Better Management: Lessons Learned from Three Norwegian Beach Litter Data Sets"

Jannike Falk-Andersson, Norut Northern Research Institute

ABSTRACT

Increased plastic production and poor waste management have resulted in marine litter representing an ever increasing threat to the marine environment. monitoring of beach litter has been implemented to guide and evaluate effective mitigation measures with the aim of reducing the amount of litter entering the environment. Using data based on two citizen science protocols as well as OSPAR monitoring of Norwegian beaches, this study 1) identifies the most abundant litter, 2) compares the 'professionally' registered OSPAR data with citizen science data 3), examines how information from citizen science data could give more management relevant information, and 4) suggests some recommendations that enhance the relevance and reliability of citizen science data. Three groups of litter sources are identified as most abundant; food and drink related items, fishery related items, and unidentifiable plastic pieces. Considering litter composition and magnitude, data from citizen science are found to be comparable and consistence with OSPAR data over time and across space. One of the citizen science protocols were tailored for the litter situation in the area, significantly reducing the number of unidentified plastic pieces. This highlights how small adjustments in the protocols can give more management relevant data. The same dataset also differentiated between Norwegian and foreign drinking bottles. This provided a unique indicator on the degree to which the sources are national or global. The major limitation of the citizen science data was the lack of explanatory variables, but this could be significantly improved by recoding GPS positions.

"Citizen scientists reveal: marine litter pollutes Arctic beaches and affects wild life"

Melanie Bergmann, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
Birgit Lutz,
Mine B. Tekman,
Lars Gutow,

ABSTRACT

Recent data indicate accumulation areas of marine litter in Arctic waters and significant increases on the seafloor over time. Beaches on remote Arctic islands may be sinks for marine litter and reflect pollution levels of the surrounding waters particularly well. We provide the first quantitative data from surveys carried out by citizen scientists, which participated in sailing cruises around Svalbard in 2016. Litter quantities on six beaches varied from 9 - 524 g m-2 and were similar to those from densely populated areas. Plastics accounted for > 80% of the overall litter, most of which originated from fisheries. Photographs provided by citizens show deleterious effects of beach litter on Arctic wildlife including polar bears (Ursus maritimus), which is already under strong pressure from global climate change. Our study highlights the potential of citizen scientists to provide scientifically valuable data on the pollution of sensitive remote ecosystems. Similar programmes could be adopted in other poorly sampled areas of the world to increase our knowledge base and to stimulate a sense of connectedness with the environment visited.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Dive Against Debris®: Lessons Learned, Challenges and Future Opportunities"

Hannah Pragnell-Raasch, Project AWARE

ABSTRACT

Significant data gaps exist regarding quantitative information on the extent of marine debris, particularly for the underwater realm. In order to close that data gap, in June 2011 Project AWARE® launched Dive Against Debris®, a global marine debris survey focused explicitly on yielding data on underwater debris from the seafloor. Scuba divers are engaged in the removal and reporting of debris items encountered at dive sites across the globe, building critical quantitative evidence about the types and quantities of marine debris. Additionally, the impacts marine debris has on marine life is captured including entanglement, injury and death. Debris-free sites are also reported.

Project AWARE has developed an array of online and offline tools to recruit, retain and train participants from a global community spanning a variety of demographics, geographic locations and cultures: through more than 5,000 surveys, over 25,000 scuba divers have participated in Dive Against Debris across 65 different countries.

The web-based interactive Dive Against Debris map and the Dive Against Debris mobile app are examples of two strategic innovative technological tools developed to support education and outreach as well as scientific program goals.

To accommodate the varying degrees of commitment, a range of engagement tactics have been developed: from providing additional training through the Dive Against Debris Distinctive Specialty through to the Adopt A Dive Site™ initiative exemplifying the highest level of commitment whereby participants are required to conduct at least one Dive Against Debris survey at their adopted site per month.

In this presentation we highlight lessons learned from the past 6 years of the program to help inform current and future marine debris data collection efforts involving citizen scientists.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Exploring motivations, recruitment, and retention of participants in COASST"

Hillary Burgess, University of Washington
Yurong He, University of Washington
Julia Parrish, University of Washington

ABSTRACT

The Coastal Observation and Seabird Survey Team (COASST), a rigorous and successful citizen science program established in 1999 to monitor beachcast seabirds along the northwest coast of the United States. In 2013, COASST began developing a new data collection module focused on marine debris and the program launched in mid-2016. These two modules, developed with the same model, approach and philosophy, present an opportunity to examine several questions and challenges relevant to broader growth and development of citizen science programs, namely: What motivates participants in each module? Will recruitment and retention factors be the same? How can we ensure that relevant, high quality data are collected while balancing participant interests and abilities? Here, we present lessons-learned from running a long-term project, developing a new one, and preliminary results from a series of evaluative pre and post participation surveys that elucidate challenges and opportunities for tackling environmental problems through public participation in scientific research and monitoring.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Exploring the Australian Marine Debris Initiative"

Heidi Taylor, Tangaroa Blue Foundation

ABSTRACT

Tangaroa Blue Foundation (TBF) is the leading marine debris organisation in Australia. Our motto is — if all we do is clean-up, that's all we will ever do. Stopping litter at its source is our aim. TBF created the Australian Marine Debris Initiative (AMDI) in 2004, gathering data from clean-ups around the country to create a databank of evidence on which to base solutions. The AMDI helps communities look after their coastal environment by providing resources and support programs, and collaborates with industry and government to create change on a large scale.

To date, over 10 million individual items have been logged during 10 000 plus clean-up events across Australia, harnessing more than 90 000 citizen scientists and partners.

The effort and impact of the AMDI and its citizen scientists is enormous. The database is the largest and longest running database of marine debris in Australia and has assisted in the creation of more than 100 individual Source Reduction Plans, stopping marine debris before it enters the environment.

The success of this long-term program hinges around changing volunteers' perception of their clean-up activities. By providing them with skills, knowledge and a framework, volunteers are no longer rubbish collectors, instead they become citizen scientists that are contributing to real change in their communities and across the country.

This session will explore the AMDI framework, resources and database, successes and challenges in stopping marine debris at the source using a national collaborative network of partners and citizen scientists.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Increasing Volunteer Engagement in an Agency-Led Citizen Science Initiative: Lessons Learned From Six Years of the NOAA Marine Debris Monitoring and Assessment Project"

Sherry Lippiatt, NOAA Marine Debris Program
Carlie Herring, NOAA Marine Debris Program

ABSTRACT

The Marine Debris Monitoring and Assessment Project, or MDMAP, is a NOAA citizen science initiative that engages partners and volunteers in documenting the amount and types of shoreline marine debris (2.5 cm and larger). Each partner in the MDMAP network selects a nearby shoreline monitoring site to survey and submits data to NOAA's MDMAP Database (https://mdmap.orr.noaa.gov/login). monitoring data can be used to identify the most common debris items, assess trends over time, and evaluate the effectiveness of debris prevention efforts. The MDMAP was launched in the US Pacific States as part of the NOAA response to debris generated by the 2011 earthquake and tsunami in Japan. Since 2012 over 300 shoreline sites have been surveyed, and the program is expanding to other regions. In order to continue to engage volunteers as concern about tsunami debris has waned, in June of 2016 NOAA launched an online toolbox (https://marinedebris.noaa.gov/research/monitoring-toolbox) with resources for new and existing MDMAP partners and volunteers. This presentation will provide an overview of MDMAP resources, lessons learned, and challenges with volunteer engagement in the absence of on-the-ground staff.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Marine LitterWatch - citizen science-based app"

Štefan Trdan, Institute for Water of the Republic of Slovenia
Ana Tejedor, European Environment Agency
monika Peterlin, Institute for Water of the Republic of Slovenia

ABSTRACT

Litter, plastics in particular, is accumulating in our seas and coasts, mainly due to current unsustainable consumption and production patterns, poor waste management, and the lack of public awareness. The European Environment Agency launched Marine LitterWatch (MLW) in 2014, as a citizen science-based platform to help fill data gaps on beach litter and support community engagement in tackling the problem of marine litter. The European Union is addressing the problem of marine litter through the Marine Strategy Framework Directive (MSFD), which requires Member States to monitor the state of our seas and take the measures needed to reach or maintain its 'Good Environmental Status' by 2020. MLW aims to collect data on marine litter on beaches relevant for the MSFD, to support official monitoring, with the help of interested citizens and communities. It also allows the collection of data from non-official initiatives, such as clean-ups. MLW builds on the MSFD monitoring guidelines , developed by the Technical Group on Marine Litter, a group of experts established to support the MSFD implementation. By the end of 2017, around 30 actively involved communities and citizens collected 655.320 items during 1.407 litter collection events from across Europe´s seas. The one-month pilot (The Marine Litter Watch month) deployed a harmonised methodology for carrying out beach surveys, using monitoring protocols (DeFishGear, 2016), that are in line with the Marine Strategy Framework Directive (MSFD) monitoring guidelines. MLW month took place on 33 European beaches from 17 September to 16 October 2016.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Participatory Sensing Marine Debris: The Marine Debris Tracker Mobile App"

Katherine Shayne, University of Georgia
Jenna Jambeck, University of Georgia
Chris Wilcox, CSIRO

ABSTRACT

Marine Debris Tracker (MDT) is a mobile app and citizen science program originally sponsored by the NOAA Marine Debris Program and launched in 2011. At the time, MDT was the first app of its kind, allowing users to report litter anywhere in the world. In its more than 6 year timeframe of use, the app and program has helped collect data on over 1 million debris items across the globe. Besides collecting data, the app itself serves as an outreach and education tool, creating an engaged participatory sensing instrument. Also, important to Marine Debris Tracker is open data and transparency. A web portal provides data that users have logged allowing immediate feedback to users and additional education opportunities. The engagement of users through a top tracker competition and social media keeps participants interested in the Marine Debris Tracker community. The MDT community and dataset continues to grow daily, including into the open ocean with adoption of use by the Volvo Ocean Race and onto land in countries like Vietnam. We will present current usage and engagement, participatory sensing data distributions, areas of active tracking, and statistical analysis of the opportunistic data collected by the app, which has proved to be a challenge to analyze. We will also share lessons learned and discuss future technologies and platforms that can be used by others to expand data collection, analysis and citizen engagement.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"The Global Microplastics Initiative: Engaging Outdoor Recreation Citizen Scientists in Monitoring of Microplastics to Affect Change"

Katie Holsinger, Adventure Scientists
Abigail Barrows, Adventure Scientists

ABSTRACT

Since 2013, the montana-based conservation organization Adventure Scientists has mobilized a large team of citizen scientists to expose the alarming numbers of microplastics entering our waterways worldwide. To understand the breadth and depth of the microplastics problem facing marine systems, Adventure Scientists assembled a team of outdoor recreationists—capable adventurers committed to conservation—and trained them with a rigorous protocol as microplastics sample-collectors. To-date, over 1,000 volunteers have collected microplastic water samples as a part of the Global Microplastics Initiative. By engaging the outdoor community on this topic, we have been able to compile the most diverse, if not also largest, dataset representing microplastic pollution worldwide, including coverage over remote parts of the globe. Our partner scientist, Abigail Barrows, analyzes these samples for the quantity and type of microplastic particles—information essential to knowing the severity of the problem, and that may offer insight on how to address it. The primary goal of our Global Microplastics Initiative is to compile a dataset that can connect missing links in terms of our scientific understanding of microplastic pollution. This is made possible by meaningfully engaging our team of citizen science volunteers - from recruitment to training to monitoring - to ensure data quality and scientific rigor so that our data may be used confidently in decision-making. We consider our volunteers a vital component to our overall goal of understanding and addressing microplastic pollution and, through the experience we provide, we empower many as issue-advocates and community leaders.

Monitoring By The People For The People: Citizen Science And Marine Debris Solutions

"Understanding Marine Debris in Belize through Citizen Science and Participatory GIS"

Ashley Little, Georgia State University
Christy Visaggi, Georgia State University
Timothy Hawthorne, University of Central Florida
Lain Graham, University of Central Florida
Christine Munisteri, Skidmore College
Nicholas Altizer, University of Central Florida
Caleb Ball, Ohio State University
Hannah Bonestroo, Macalester College
Saraneh Fitzgerald, Clark University

ABSTRACT

As part of a National Science Foundation Research Experience for Undergraduates (REU), our work combines Geographic Information Systems (GIS) and citizen science to gather and analyze baseline data including perceptions of marine debris by community members. Participatory GIS (PGIS) and sketch mapping were used to assess both natural and anthropogenic marine debris in the village of Hopkins, Belize. Quantitative and qualitative data collection methods were utilized in addition to tablets, drones, and an open access geodatabase. The type and function of debris items were characterized and sampled using quadrats both along transects and at random. In addition, debris hotspots were recorded by walking the beach as well as by asking community members in interviews where they perceived hotspots to be. Sampled debris sites were compared with community members' perceptions of debris locations. Differences were identified between where the community perceived problematic areas to be and where debris was in fact documented at high concentrations, which has implications for litter prevention and clean up efforts. Use of PGIS for addressing marine debris offers underrepresented communities tools of empowerment to engage in the research process. Future goals of this research aim to build upon existing data through citizen science and to provide a platform upon which future data can be collected and updated. This community-based approach and open access format using GIS allows local stakeholders to collaborate in the research process and affect change in working with prospective policy makers to advocate for mitigation. Our combined approaches including the incorporation of perception data in analyzing marine debris using GIS has implications for replicability in citizen science efforts for coastal communities worldwide.

Opportunities, Considerations, And Challenges In Debris Monitoring Within Coastal Environments

"Aerial Imagery and Machine Learning to Advance Trash Monitoring Methods"

Tony Hale, San Francisco Estuary Institute
Pete Kauhanen, San Francisco Estuary Institute

ABSTRACT

Recent advances in capability and availability of new technologies can greatly improve current monitoring and management of our natural resources and human impacts on it. In order to leverage these new opportunities, we are investigating how Unmanned Aerial Systems (UAS) research and research projects compare to traditional monitoring methods.

This research will focus on the benefits and limitations of utilizing a UAS in a monitoring context. By using UAS, we are able to capture significantly larger datasets, across a broader geographical scope, allowing for more complete and potentially useful monitoring datasets that may be applicable to multiple monitoring questions. In particular, this study will focus on the improvements to analytical capabilities, streamlined workflow, broader scope and vision for monitoring projects. It is also important to document the relevant constraints and limitations this technology may yet bear for specific applications.

Our presentation will provide an early insight into our plans and projects in progress related to aerial imagery collection and analysis. Most recently, the SF Geospatial workgroup concluded a pilot project to determine levels of precision in using aerial imagery to detect trash. By pairing aerial imagery with artificial intelligence, we can more easily process large datasets to derive monitoring information critical to trash detection, characterization, and quantification. We are currently partnering with SCCWRP to determine how we can automate trash detection locally, regionally, and statewide through imagery. We plan to monitor trash in several habitats and varying geographies to identify the new opportunities and challenges.

"Cultivating Santa Barbara Channel Stewards: A Marine Debris Removal Project on the Northern Channel Islands"

Michaela Miller, California State University monterey Bay
Clare Steele, California State University Channel Islands
Robyn Shea, California State University Channel Islands
Stephen Whitaker, National Park Service
Geoff Dilly, California State University Channel Islands

ABSTRACT

The persistence of plastics and other marine debris in coastal and marine ecosystems has become an issue of global concern. In the Santa Barbara Channel, marine debris accumulates on mainland and offshore island coastlines from multiple sources including the commercial fishing industry, storm water discharge, illegal dumping, beachgoers, vessels, etc. The highly populated mainland coast and the vast stretches of isolated beaches on the remote California Channel Islands lead to highly variable types and abundances of marine debris. We collected data on the types and relative density of coastal marine debris from seven Northern Channel Island beaches (Santa Rosa and Santa Cruz Islands) and two mainland beaches in Oxnard, CA to document the extent of marine debris in this region. These data were compared with historical data on marine debris accumulation within Channel Islands National Park during the early 1990s. Preliminary results suggest that there has been a change in the composition of island marine debris over the past 30 years, with an increase in derelict fishing gear. In addition to documenting marine debris trends, we developed a best management practice used to remove marine debris from ecologically and culturally sensitive remote island beaches. We are currently assessing the abundance and ecological effects of microplastic pollution at our study sites, and we are implementing marine debris curriculum in local K-12 schools. The ultimate goal of this project is to cultivate a new community of Santa Barbara Channel stewards by building a collaborative professional network of local agencies and resources that engage the commercial fishing industry and underrepresented students in marine debris removal, research, education, and outreach.

"Marine Debris Visual Identification Assessment"

Zachary Angelini, University of New Hampshire
Justin Thibault, University of New Hampshire
Philip Ramsey, University of New Hampshire
Kenneth Fuld, University of New Hampshire
Nancy Kinner, University of New Hampshire

ABSTRACT

Estimates of marine debris are often based on beach surveys. Few studies have documented the veracity of these observations and the factors that may affect accuracy. Our laboratory-scale experiment identified potential sources of error associated with visual identification of marine debris (1-2 cm long) during shoreline surveys of sand beaches. Characteristics of the survey site (beach characteristics), observer (personal characteristics), and debris (color and size) may be important factors to consider when analyzing data from shoreline surveys. The results of this study show that the ability of individuals to accurately identify plastic fragments depends on the plastic and sand color, and density of shell fragments, as well as the time taken on the survey. Most suggestively, the high accuracy of blue plastic counts (95%) and the under-counting of white (50%) and clear plastic counts (55%) confirmed the hypothesis that a significant amount of clear and white plastic fragments may be missed during shoreline surveys.

Opportunities, Considerations, And Challenges In Debris Monitoring Within Coastal Environments

"Microplastics Baseline Surveys at the Water Surface and in Sediments of the North-East Atlantic"

Thomas Maes, Cefas

ABSTRACT

Microplastic contamination was determined in sediments of the Southern North Sea and floating at the sea surface of North West Europe. Floating concentrations ranged between 0 and 1.5 microplastic/m3, whereas microplastic concentrations in sediments ranged between 0 and 3,146 particles/kg dry weight sediment. In sediments, mainly fibers and spheres were found, whereas at the sea surface fragments were dominant. At the sea surface, concentrations of microplastics are lower and more variable than in sediments, meaning that larger sample sizes and water volumes are required to find detectable concentrations. We have calculated the widths of the confidence intervals (CI) for different sample sizes, to give a first indication of the necessary sample size for a microplastic survey at the water surface. Higher concentrations of floating microplastics were found near estuaries. In sediments, estuaries and areas with a high organic carbon content were likely hotspots. Standardization of monitoring methods within marine regions is recommended to compare and assess microplastics pollution over time.

Opportunities, Considerations, And Challenges In Debris Monitoring Within Coastal Environments

"Monitoring Challenges in Coastal Environments"

Shelly Moore, Southern California Coastal Water Research Project
Holly Wyer, California Ocean Protection Council

ABSTRACT

Trash has become a focal point of both management and the public as it has come to the forefront as both an aesthetic problem and a danger to aquatic organisms. Recent policies put in place by state and local governments in California will soon necessitate more robust methods for measuring the amounts of trash in various habitats to both determine how much is in the environment and how effective the policies have been at limiting or reducing trash in the environment. Policies such as the regional Total Maximum Daily Loads (TMDLs) and the state Trash Amendments both limit the amounts of trash allowed in waterways leading to the ocean, and require trash capture methods to curtail trash from making it into waterways. There are currently no standard methodologies, used by many, allowing for comparability of trash levels both within and among regions. Many methodologies providing detailed information have been deemed cost restrictive because of the needed resources, through both staff time and equipment. Other methodologies, which leverage efforts off other studies, may not provide the most accurate information. New technologies, such as drones, may provide more efficient and cost realistic alternatives to looking at trash in the environment. Here we summarize challenges and talk about a new project funded by the Ocean Protection Council and supported by the California State Water Resources Control Board to develop new or modify existing technologies and methods to provide a standardized set of tools to be used by all levels of researchers.

"Rapid assessment of marine debris in coastal areas using a visual scoring indicator"

Jongmyoung Lee, Korea Marine Litter Institute
Sunwook Hong,
Jongsu Lee,

ABSTRACT

Information on the spatial distribution and standing stock of marine debris in coastal areas is a prerequisite for efficient cleanup and management. We conducted a rapid assessment on marine debris in coasts of South Korea using a visual scoring indicator. The indicator consisted of a table and photos representing 10 pollution levels that were quantitatively tested. Locations at every 10 km were selected along the natural coastline for a total of 382 locations, and a length of 100 m at each location was assessed. Approximately 40 participants were trained, and each participant assessed the pollution levels using a newly developed smartphone application programs. We found that approximately 50 ~ 60% of the marine debris was accumulated over 10% of the coastline. The amounts of the marine debris stock in coast were higher in summer than in other seasons.

Opportunities, Considerations, And Challenges In Debris Monitoring Within Coastal Environments

"Standard Trash Monitoring Methods for California"

Terra Miller-Cassman, Amec Foster Wheeler
Ted Von Bitner, Amec Foster Wheeler
Theresa Sinicrope Talley, California Sea Grant

ABSTRACT

The new California Trash Amendments highlight the need for standardized trash monitoring protocols that can be easily implemented by any co-permittee in a variety of receiving water systems. Existing protocols largely focus on particular systems, such as MS4, beaches or rivers. A state-wide data collection method, applicable to all systems within watersheds and receiving waters, is needed to form a truly comparable dataset for long-term trash monitoring and management. Protocols developed and refined with public and private partners in the San Diego Bay watershed over the past five years allow for rapid collection of site information, trash abundance and composition across seasons and a variety of systems, including seasonal and perennial creeks, coastal wetlands, sandy beaches, armored shorelines and open water. Collection of semi-quantitative site information and documentation of all trash along replicate transect areas allowed for direct, unbiased assessments of trash abundance, composition and associated factors across all surveyed areas. For example, trash composition across habitats was highly varied, suggesting that receiving water monitoring should consider the transport mechanism and unique environmental influences. Of note was that beaches, often the target of community cleanup efforts, had the least amount of plastics of any of the systems sampled thus informing the prioritization of regional efforts. The simplicity of this method allowed for community involvement with limited resources, making it ideal for collection of Trash Amendment baseline assessments across California.

"World War II Cultural Heritage Sites as Marine Debris: Developing an Environmental Assessment Methodology in Guam"

Kalle Applegate Palmer, HTH

ABSTRACT

This study investigated how the natural environment on and around historically protected marine debris from World War II in Guam may be documented to understand the impact of such debris on the ecosystems they are in as well as which monitoring methods are best for citizen scientists. World War II marine debris in and around Guam includes but is not limited to Japanese and American vessels, amphibious attack vehicles, planes, and construction equipment. There are federal and local protections in place for this debris. monitoring the natural environment may give insight to how protected marine debris serves as an artificial reef by documenting biotic, abiotic and human use descriptors. It may reveal trends in habitat conditions, historical and recreational management applications, connection between physical disturbances and their role in structure reduction, as well as reef complexity and resiliency. The survey was designed to be conducted by citizen scientists that do not have biological or taxonomic expertise but are stakeholders in the sites. The monitoring protocol was introduced with a visual presentation of key data points for non-biologist citizen scientist surveyors. The next steps for this study include further surveying within the tropical Pacific and the establishment of a centralized database for survey findings which would also include tools for prospective surveyors and findings for researchers.

Quantification Of Floating Marine Macro Litter

"Estimating the abundance of floating plastics at sea – lessons from beach surveys"

Peter Ryan, FitzPatrick Institute of African Ornithology
Coleen Moloney, Marine Research Institute

ABSTRACT

The density of floating plastics and other anthropogenic debris is notoriously variable at local scales, linked to convergence zones. Dispersal and dispersion of floating items is further influenced differentially by currents and winds, depending on the buoyancy of the items. As a result, estimating the abundance of floating plastics at sea is a non-trivial exercise, requiring large sample sizes if the goal is to detect spatial or temporal differences in debris abundance. Sampling strategies also have to take cognisance of the wide range of sizes of marine debris, and be structured accordingly. We attempted to estimate the entire population of plastic items stranded on a remote South African beach, using a variety of sampling approaches to capture macro-, meso- and microplastics, both on the beach surface and buried to a depth of 150 mm. This revealed highly contrasting patterns between the abundance and mass of debris; more than 99% of plastic items were <5 mm, but these accounted for only 2% of the total mass of plastics. Among macroplastic items, only 25% were visible at the beach surface, but most of the buried items were small, accounting for only 7% of the total mass of plastics. These differences between mass and number would be even more extreme if we had expanded our macro-litter sampling sufficiently to capture a representative sample of megaplastic items. Comprehensive data for floating plastics at sea are not available, but indications from various studies suggest that similar patterns exist. Accordingly, it is important to sample the full size spectrum of floating debris, using tools ranging from bulk water sampling (microplastics), neuston nets (mesoplastics) and direct observations (macroplastics). Adequate sampling of sub-surface plastics, especially macro litter, poses a significant challenge.

Quantification Of Floating Marine Macro Litter

"Floating marine macro litter monitoring in the Black Sea: EMBLAS II experience."

Maria Pogojeva, Moscow State University
Nino Machitadze,
Nino Gelashvili,
V. Gvakharia,
Kakha Bilashvili,

ABSTRACT

Floating macro litter is the fraction of marine litter to which marine wildlife is directly exposed at sea, potentially leading to ingestion and entanglement. Litter floating in the sea surface is therefore part of the assessment criteria under the EU Marine Strategy Framework Directive.

In the frame of the EMBLAS II project ('Improving environmental monitoring in the Black Sea') basin-crossing multinational exploration surveys (Joint Open Sea Surveys, JOSS), specific national surveys (National Pilot monitoring Studies, NPMS) and surveys from ships-of-opportunity, all including opportunistic monitoring of floating litter, were performed during 2016-2017 in the Black Sea. The surveys involved scientists from Georgia, Russia and Ukraine, while scientists from Romania, Bulgaria and Turkey participated to accompanying workshops and training.

As methodologies for monitoring of floating macro litter are still under development, the EMBLAS II surveys provided opportunities for discussion, testing approaches and contributing to the further development of the monitoring tools. The harmonization of monitoring and the providing of guidance is essential, as operationally defined parameters are being quantified. Litter was monitored during the EMBLASS II surveys by trained observers, acquiring georeferenced data through a tablet computer application, developed by JRC.

The presented observations results have been acquired on multiple surveys, covering both coastal waters in Ukraine, Russia, Georgia and the open Black Sea. Concentrations of floating macro litter were found to be highly variable, ranging from ca. 20 items/km^2 to above 300 items/km^2. These first basin wide results contribute to a holistic assessment of marine litter and the assessment of the environmental state of the Black Sea.

Quantification Of Floating Marine Macro Litter

"Modeling incidental marine debris bycatch in the Hawaii-based pelagic longline fishery"

Amy Uhrin, NOAA Marine Debris Program
Jon Brodziak, NOAA Pacific Islands Fisheries Science Center
William Walsh,

ABSTRACT

The remoteness of the North Pacific Ocean hampers at-sea detection and removal of marine debris. Commercial longline fishing gear, with its array of suspended hooks, can snag marine debris and may provide an opportunity to assess floating and mid-water marine debris abundance and distribution at a regional scale. Observations of species-specific catch and other operational details from vessels participating in the Hawaii-based pelagic longline fishery were initiated in 1994 as part of NOAA's Pacific Islands Regional Observer Program. In 2007, onboard observers began additionally recording longline encounters with marine debris. We used an existing zero-inflated negative binomial model developed for standardizing catch-per-unit effort (CPUE) of bycatch species to explore incidental "catches" of marine debris in this fishery from data spanning 2008-2016. Data collected from 128 vessels (457 trips) yielded 966 marine debris encounters dominated by derelict nets and associated gear from other fisheries. Mean CPUE (catch per 1000 hooks) for marine debris was four times greater in the shallow-set sector of the fishery (targeting primarily swordfish) versus the deep-set sector (targeting primarily bigeye tuna). There was no temporal trend in debris CPUE but CPUE was higher at higher latitudes. There was a significant effect of observer experience; observers averaging 2.5 years of experience prior to 2008 reported more debris than observers with less experience. Marine debris observations from the Hawaii-based pelagic longline fishery can provide an opportunistic, yet regular, mechanism for assessing the distribution and abundance of derelict fishing gear. Some longline fishermen voluntarily haul snagged debris from the ocean. Thus, incentivizing at-sea removal may elicit further cooperation.

Quantification Of Floating Marine Macro Litter

"Monitoring the abundance of floating macro-debris in the marine environment: a comparison between distance sampling and fixed-width strip-transect techniques"

Giuseppe Suaria, CNR-ISMAR
Andrea Pierucci, Università degli Studi di Cagliari
Veronica Padula, University of Alaska
Stefano Aliani, CNR-ISMAR
Peter Ryan, FitzPatrick Institute of African Ornithology

ABSTRACT

Ship-based visual surveys are a powerful and inexpensive tool to monitor the abundance of floating macro-litter (FML) in the marine environment, however the comparison among different studies is often hampered by substantial differences in counting techniques. At present, two main methods are commonly used: distance sampling (line-transect) and fixed-width strip-transects, although the efficacy of these two protocols has never been compared in the field. We report the results of a comparison exercise carried out during the Antarctic Circumnavigation Expedition (ACE) and along a latitudinal gradient in the eastern Atlantic Ocean onboard the R/V Akademik Tryoshnikov which sailed from Bremerhaven (Germany) to Cape Town (South Africa) in Nov-Dec 2016, circumnavigated the Antarctic continent and sailed back to Bremerhaven in Mar-Apr 2017. A total of 301 half-an-hour transects were performed in parallel by two different observers. During each transect the number of floating objects was recorded independently by both observer using one of the two techniques. The densities of FML were then computed for each transect according to both methods and the results were compared across a wide range of litter concentrations. Preliminary results suggest that the method to be chosen will mainly depend on the local abundance of floating litter, as the performance of distance sampling techniques seems to decrease in high-concentration areas, while the strip-transect method appear less effective in detecting floating items in low-concentration areas, such as the Southern Ocean. This information provides a valuable contribution to the urgent need of standardized monitoring protocols, which is paramount for a better understanding of temporal and spatial patterns in the off-shore distribution of floating marine debris.

Quantification Of Floating Marine Macro Litter

“Settings methodologies for monitoring floating marine macro litter: the MEDSEALITTER effort”

Antonella Arcangeli, ISPRA
Fabrizio Atzori, Capo Carbonara MPA
Asuncion Borrell, University of Barcelona
Gaëlle Darmon, Cnrs-cefe
Léa David, EcoOcean Institut
Nathalie Di Meglio, EcoOcean Institut
Stefania Di Vito, Legambiente
Natalia Fraija-Fernández, University of Valencia
Antonio Raga Juan, University of Valencia
Morgana Vighi, University of Barcelona

ABSTRACT

Although the Mediterranean Sea is one of the largest biodiversity hotspots, it is also one of the most polluted seas worldwide. Concentrations of floating litter in the Mediterranean Sea are suspected to be very high, though current data do not allow yet their complete assessment and the identification of sources and accumulation areas.

In this context, a priority issue is the development of widely agreed standardized monitoring protocols to be implemented under the Marine Strategy Framework Directive, supporting Marine Protected Areas (MPA).

MEDSEALITTER project is actively investigating methodologies for monitoring floating marine macro litter. The approach aims at networking representative MPAs, scientific organizations and environmental NGOs for developing and testing efficient and cost-effective protocols to monitor and manage litter impact on biodiversity. Different experimental designs were conducted to implement protocols at two spatial scales: i) in pilot large scale areas, using synoptic surveys from ferries; ii) in pilot MPAs, using a) visual surveys conducted from commercial vessels, sailing vessels and aircrafts and b) analyses of automated photographs obtained from aircrafts and drones surveys. Results allowed a comprehensive assessment of the effect of various observation parameters on the sighting probability of floating marine litter. Overall, the accurate determination of the settings needed to draft consistent monitoring protocols will take into account spatial scale surveillance, type of survey (visual/automatic), detectability and platform used.

The common protocol will be tested in 2018 in pilot areas representing various Mediterranean ecological environments.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

“Entanglements and Ingestion of Marine Debris of Marine Mammals in South Carolina, USA”

Wayne McFee, NOAA/National Ocean Service
Tiffany Humphrey, Coastal Carolina University

ABSTRACT

Entanglements in and ingestion of marine debris in marine mammals occurs in nearly all species worldwide though the extent is unknown. Further, the impact at the population level is inhibited because of inconsistent record keeping from various marine mammal stranding networks, inadequate population assessments of many species, and difficulties in discerning abandoned, lost, or otherwise discarded fishing gear (ALDFG) from actively fished gear. A 25 year monitoring effort in South Carolina of strandings and photo-identification studies has provided good baseline data on the occurrence of marine debris entanglements and ingestion in marine mammals, particularly bottlenose dolphins, pygmy sperm whales, and beaked whales. Most entanglements involve rope/line or monofilament line in bottlenose dolphins and are more common than ingestion, though incidents of marine debris interaction appear to be low (2.7% occurrence). Ingestion of marine debris appears to be more common in pelagic species such as the pygmy sperm whale (7.6% occurrence) and is likely far greater than reported. Difficulties in assessing the impacts of marine debris on marine mammal populations will be discussed using current research on marine debris occurrence in cetaceans in South Carolina.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

"Is Entanglement a relevant indicator of the impact of marine litter on biota ? The contribution of INDICIT european project."

Francoise Claro, Museum National D'Histoire Naturelle
Christopher PHAM, Institute of Marine Research and MARE-Marine and Environmental Science Centre
Jesus TOMAS, 9. Marine Zoology Unit, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia
ANA LIRIA LOZA, 7. I. ECOAQUA – University of Gran Canaria

ABSTRACT

Marine litter is known to impact biota mainly through ingestion and entanglement. The Marine Strategy Framework Directive (MSFD) of the EU has included a specific descriptor on marine litter (descriptor 10) for achieving Good Environmental Status (GES) by 2020. Although an indicator of debris ingestion is already being developed/considered by the EU and two Regional sea conventions (RSCs), no indicator related to entanglement has been proposed to date for long-term monitoring programs in the framework of environmental policies. In order to evaluate the relevance of a new indicator, the European project INDICIT (« Indicator Impact Turtle », EU project 11.0661/2016/748064/SUB/ENV.C2 ; https:// indicit-europa.eu) included as an aim a review and a feasibility study on "Entanglement with debris by marine biota" at the project area scale. Targeted species were evaluated and the feasibility of implementing an entanglement indicator was assessed through a survey involving stranding/rescue networks, biologists and field naturalists. Cetaceans, sea birds, marine turtles, sharks but also benthic invertebrates were tested as indicator species. The main constraint for using vertebrates was linked to the difficulty to distinguish entanglement caused by active gears or by ghost fishing gears. The use of benthic invertebrates as a potential indicator of interactions between marine organisms and litter, monitored through Remotely Operated Vehicles, is also discussed.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

"Looking without landing – using Remote Piloted Aircraft (RPAs) and citizen science to monitor the prevalence of marine debris entanglements in fur seals"

Rebecca McIntosh, Phillip Island Nature Parks
Ross Holmberg, Phillip Island Nature Parks
Peter Dann, Phillip Island Nature Parks

ABSTRACT

Marine debris is causing large-scale ecosystem impacts across global oceans and has triggered significant mitigation measures. Macro-debris entangles wildlife and alters habitats, breaking down into ever smaller particles that enter the food chain with potentially devastating follow-on effects. Fur seals provide an excellent species for research of marine debris, because they breed and rest on land where they can be observed.

Reliable data are vital to understanding the impacts of marine debris. At Seal Rocks, Victoria, we have identified 441 individual entanglements of Australian fur seals (Arctocephalus pusillus doriferus), from Dec 1997-Sept 2017 and removed 50% of those entanglements. However, these data underestimate the scale of the problem because landing at Seal Rocks causes the fur seals to flee into the water, preventing accurate estimates of prevalence and reliable trend analyses.

Using Remote Piloted Aircraft (RPA), we can obtain data with greater precision and accuracy than ground-based methods to determine the prevalence of marine debris entanglements in fur seals. With appropriate testing and ethical consideration; for many situations, RPAs can also perform surveys with increased frequency and less disturbance than typical methods, improving the robustness of the datasets, and decreasing negative impacts on the animals.

In this talk we demonstrate that RPAs provide higher, more accurate and more precise prevalence counts for marine debris entanglement in fur seals than traditional ground-based methods. We also outline a web-based portal through which citizen scientists are recruited to count fur seals, providing replicate counts as well as an opportunity to inspire and educate global citizens.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

"Oceanic manta rays and plastic pollution in the Mexican Pacific Ocean."

Tania Pelamatti, CICIMAR-IPN
Edgar Mauricio Hoyos Padilla, Pelagios Kakunjá
Lorena M. Rios Mendoza, University of Wisconsin Superior
Iliana Araceli Fonseca Ponce,
Felipe Galván Magaña, CICIMAR-IPN

ABSTRACT

The oceanic manta rays, Mobula birostris, filter big volumes of water while feeding on zooplankton. Thus, they are potentially exposed to the growing threat of plastic pollution. Ingested plastics can leach adsorbed toxic pollutants and plastic additives (e.g. phthalates, used as indicators of plastic contamination in animal tissues) that are recognized as endocrine disruptors and toxic for many species. The oceanic manta ray populations of the Gulf of California have been drastically reduced in recent decades, making the Revillagigedo Archipelago and Banderas Bay its last refuge and aggregation areas in the Mexican Pacific Ocean. Samples have been collected from the sea surface using a manta net: floating plastics were found in both areas, we determined the size and polymer composition of the plastic debris through Fourier transform infrared spectroscopy (FT-IR). Small tissue samples (skin and muscle biopsies) of manta rays have been collected during scuba and freediving using a spear pole and will undergo chemical extraction and subsequent analysis to measure the concentration of phthalates. Chemical analysis of these plastics collected in the area has been carried on to quantify polychlorinated biphenyls, pesticides and polycyclic aromatic hydrocarbons that were adsorbed on the surface of plastic debris. Measuring phthalates in manta ray biopsies is a valid non-lethal method to investigate possible plastic ingestion occurrence in this species, that is considered vulnerable to extinction by IUCN and protected in Mexico. This research is a baseline study for plastic debris contamination in the area and for possible ingestion by oceanic manta rays.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

"The effect of Marine Litter on the Mediterranean Marine Biota: the development of a monitoring strategy for IMAP Candidate Indicator 24"

Francois Galgani, IFREMER
Lobna Ben Nakhla, 2 Specially Protected Areas Regional Activity Centre (SPA/RAC)
Christos Ioakeimidis, UN Environment/Mediterranean Action Plan
Khalil Att, Regional Activity Centre for Specially Protected Areas (SPA/RAC)

ABSTRACT

In the Mediterranean, marine litter poses a critical problem because of its great quantity and effects on marine fauna. To deal with this problem, the UN Environment/Mediterranean Action Plan Barcelona Convention adopted the first ever legally binding Regional Plan on Marine Litter Management in the Mediterranean. One of the steps identified in the Regional Plan was linked to the implementation of the Integrated monitoring and Assessment Programme of the Mediterranean Sea and Coasts and Related Assessment Criteria (IMAP) and its 10th Ecological Objective i.e. Marine Litter, partly based on the Candidate Indicator 24 "Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles".

Currently, UN Environment/MAP and its Specially Protected Areas Regional Activity Centre (SPA/RAC), in the framework of the EU-funded Marine Litter MED project are working on this aspect with aim to improve knowledge of on the impact of marine litter on marine fauna and also to develop the IMAP Candidate Indicator 24. This particularly involves the work of selecting the most representative species to be used for the development and assessment of the IMAP Candidate Indicator 24, the development of a specific protocol on monitoring the amount of litter ingested by or entangling the selected species, harmonize methods and data collection, capacity building, assess data to propose GES targets, develop an operational strategy for monitoring the amounts of marine litter ingested by or entangling marine organisms, and create and/or improve a Mediterranean network of institutions on monitoring and exchange of best practices.

Tools And Constraints In Monitoring Interactions Between Litter And Megafauna

"Which marine debris do the Mediterranean megafauna prefer?"

Matteo Baini, Department of Physical, Earth and Environmental Sciences, University of Siena
Matteo Galli, Department of Physical, Earth and Environmental Sciences, University of Siena
Cristina Pedà, ISPRA, Institute for Environmental Protection and Research, Laboratory of Milazzo
Ilaria Bernardini, Department of Physical, Earth and Environmental Sciences, University of Siena
Teresa Romeo, ISPRA, Institute for Environmental Protection and Research, Laboratory of Milazzo
Cecilia Mancusi, ARPAT, Environmental Protection Agency of Tuscany Region
Fulvio Garibaldi, Department of Earth, Environment and Life Sciences, University of Genoa
Michela Podestà, Museum of Natural History of Milan
Cristina Panti, Department of Physical, Earth and Environmental Sciences, University of Siena
Maria Cristina Fossi, Department of Physical, Earth and Environmental Sciences, University of Siena

ABSTRACT

Marine debris can harm biodiversity in different ways, ingestion is one of the most noxious impact on marine organisms and it has been documented in highly polluted areas such as the Mediterranean Sea. However, the published data are not collected homogeneously and this makes it difficult to make a comparison among different species and studies. The objective of this study is to implement and apply a standardized protocol for the quantification and characterization of marine debris in five Mediterranean megafauna species to properly evaluate the rate of marine debris ingestion and to obtain information about the sources of ingested debris. Gastro intestinal content of 85 bluefin tunas (Thynnus thynnus), 84 swordfishs (Xiphias gladius), 95 blue sharks (Prionace glauca), 76 loggerhead sea turtles (Caretta caretta) and 13 sperm whales (Physeter microcephalus) were sampled along the Italian coast. GI tract were examined for the analysis of ingested marine debris following the MSFD Descriptor 10 standard protocol developed for sea turtles. An additional analysis was performed to better understand the composition and origin of the debris ingested, using Fourier transform infrared (FT-IR) spectroscopy technique. Marine debris was found in all the five species with a percentage of occurrence ranging from 9.5% in swordfish to 76.9% in sperm whale. The characterization and the polymers analysis provide useful information about the sources of marine debris. The polyethylene and polypropylene sheet like user plastics, widely used as packaging material, are the most ingested debris in all species investigated. The results achieved constitutes an important advancement in the knowledge of this issue in the Mediterranean Sea and provide the background information for future mitigation measures.

"Composition and abundance of marine debris stranded in beaches of Sri Lanka: Results from the first national survey"

Yong Chang Jang, Kyung Nam University
R R M K P Ranatunga, University of Sri Jayewardenepura
Jin Yong Mok, Korea Maritime Institute
Kyung Shin Kim, Korea Maritime Institute
Su Yeon Hong, Ocean Research Institute
Young Rai Choi, Florida International University
A J M Gunasekara, Marine Environment Protection Authority

ABSTRACT

Sri Lanka regards one of the top-ranked countries with mismanaged marine debris. No studies have been conducted to find the status of the marine debris and rationale for such a ranking. This study provides the first assessment of marine debris washed ashore on 22 beaches along the coast of Sri Lanka. There were 4.1 large (>25mm) and 158 small (5mm-25mm) debris per square meter of the beach. By usage classification, packaging material (55%) dominated the consumer products (25%) and fishing gear (20%). Plastic was the highest contributing (93%) material. Beaches close to a river mouth, city or with a barrier had greater debris accumulation. Eastern coast had significantly higher small debris density possibly due to strong north-eastern monsoon currents. Findings show that the Sri Lankan beaches are moderately polluted with marine debris compared to other Asian countries and sound policy based debris management mechanism is essential. Strong marine debris management program is needed for Sri Lanka with sound policy measures to address the debris issue. Findings showed no exceptional accumulation of marine debris on the beach though Sri Lanka ranked 5th among worst marine debris polluters.

Towards A Global Monitoring Plan For The World Oceans

"Defining the baselines and standards for microplastics analyses in European waters (JPI-O BASEMAN)"

João Frias, GMIT
Gunnar Gerdts, Alfred Wegener Institute
Jesus Gago, IEO
Martin Hassellöv, University of Gothenburg
Tanja Kögel, NIFES
Christian Laforsch, University of Bayreuth
Soledad Muniategui Lorenzo, Universidade da Coruña
Barbara Scholz-Böttcher, ICBM

ABSTRACT

Since the middle of last century rapidly increasing global production of plastics has been accompanied by an accumulation of plastic litter in the marine environment. Large plastic items degrade and become fragmented over time and together with micro-sized primary plastic litter from consumer products these degraded micro-fragments lead to an increasing amount of small plastic particles, so called "microplastics" (MP). Although awareness of the potential risks is emerging, the impact of MP on aquatic ecosystems is far from being understood. A fundamental issue precluding assessment of the environmental risks arising from MP is the lack of standard operation protocols (SOP) for MP sampling, detection and analysis. Consequently there is a lack of reliable data on MP-concentrations and polymer-composition in the environment. Comparability of data on MP concentrations is hampered by a huge variety of different methods, each generating data of extremely different quality and resolution. Although MP are recognized as an emerging contaminant in the environment, currently neither sampling, extraction, purification nor identification approaches are standardised, making the increasing numbers of MP studies hardly -if at all- comparable.

BASEMAN is an interdisciplinary and international collaborative research project that aims to overcome this problem. BASEMAN teams experienced scientists (from different disciplines and countries) to undertake a profound and detailed comparison and evaluation of all approaches from sampling to identification of MP. BASEMAN's project outcomes will equip policy makers with the tools and operational measures required to describe the abundance and distribution of MP in the environment. Such tools will permit evaluation of member state compliance with existing and future monitoring requirements.

"Making the grade: Deriving a standardised marine litter pollution index"

Krista Verlis, Macquarie University

ABSTRACT

Several approaches to evaluate the broader impacts of marine litter pollution have been designed. These include the OSPAR convention in Europe that uses marine litter beach surveys and plastic ingestion by seabirds as indicators for loads and speculative impacts. Some studies have developed indices for evaluating marine litter loads such as the "clean coast index", while others have suggested the use of key indicator items to monitor changes over time. There are however, limited working examples that currently record marine debris levels and provide a comprehensive risk-based approach to monitoring this pollutant over time.

We describe a marine litter pollution assessment scheme that will evaluate and assign a score to the degree of pollution specific to a region. Based on litter survey data, this assessment focuses on selected key indicator items relevant to the region (e.g. plastic bags, beverage containers, and cigarette butts), their number, and perceived hazardous nature. This scoring system follows a risk-based assessment, utilising the traffic light system of green, orange and red, that prioritises the need for management action. This approach could also be used to support environmental health assessments and broader water quality report carding for a region.

Our presentation will describe the step-based approach we have designed in addressing this multi-faceted problem and from which preventative or reduction strategies can be measured against. The versatility of this marine litter pollution assessment scheme and the applicability to a range of stakeholders will be discussed.

"Microplastics in beaches in the Peninsula of Baja California, Mexico"

Teresita de Jesus Piñon-Colin, Universidad Autonoma de Baja Calfornia
Fernando Toyohiko Wakida, Universidad Autonoma de Baja California
Ruben Rodríguez-Jimenez, Universidad Autonoma de Baja Calfornia
Eduardo Rogel-Hernandez, Universidad Autonoma de Baja California
Miguel Angel Pastrana-Corral, Universidad Autonoma de Baja California

ABSTRACT

Twenty one beaches in the Baja California Peninsula in Mexico were sampled to evaluate the microplastic concentration. The extraction of the microplastics was conducted by the density method using a sodium chloride solution and the identification using infrared spectroscopy. The median abundance was 99 particles kg-1, with a range between 13 and 266 particles kg-1. A median concentration of 147 particles kg-1 was found in the sites located on the Pacific Ocean, being higher than the concentration of the sites of the Gulf of California (84 particles kg-1). This is due to a higher population density in the Pacific Ocean coast of the Peninsula and probably due to marine currents. As expected the micro plastic concentrations were in those beaches located in urban areas. Being fibers the most frequent microplastic morphology found in the samples with a 92% of the total. The chemical composition found with FTIR-ATR identified on beaches was poliacrylic, polyacrylamide, polyethylene terephthalate and a type of nylon polyamide. The microplastics are mainly from discharges of treated wastewater, tourism and fishing activities.

"Simultaneous assessment of macro and micro marine litter pollution in different compartments in the central Adriatic Sea, central Mediterranean sea"

Andreja Palatinus, Slovenian Water Agency
Manca Kovač Viršek, Institute for Water of the Republic of Slovenia
Mateja Grego, National Institute of Biology, Marine Biology Station Piran
Oliver Bajt, National Institute of Biology, Marine Biology Station Piran
Jasna Šiljič, Institute of Oceanography and Fisheries
Ana Hace, Morigenos – Slovenian Marine Mammal Society
monika Peterlin, Institute for Water of the Republic Slovenia

ABSTRACT

Marine litter in the Adriatic sea has gotten attention in recent years, but still facing lack of data on quantities, composition, fate and sources of marine litter. A research expedition using a sailing boat was organized in the Croatian waters of the central Adriatic sea, with the aim to collect combined data on marine litter pollution. An 8-day expedition,was organized by the Slovenian Institute for Water in collaboration with four other research organizations from Slovenia and Croatia. The aim of the expedition was to perform simultaneous sampling of macro and micro litter in different compartments (sea surface, sea bottom, beach) in order to quantitatively and qualitatively assess pollution with litter, especially in comparison between open waters and enclosed channel waters. At the same time marine mammals and turtles presence was being obesrved. The applied methodology of macro and micro litter sampling and analysis was regionally synchronized under the scope of the Derelict Fishing Gear Managament System (DEFISHGEAR) project, co-funded by the European Union, prior to this expedition and successfully used in practice. Marine LitterWatch mobile application, developed by the European Environment Agency was used for beach litter assessment. In total, 17 floating marine litter surveys were made, 3 beaches were analysed for macro litter presence, 27 samples were collected using the manta net and samples subsequently analysed in the laboratory for microplastic presence, 21 sea bottom samples were collected with the Van Veen grab and subsequently analysed for microplastic presence in the laboratory.

Towards A Global Monitoring Plan For The World Oceans

"The use of beached bird surveys for marine plastic litter monitoring in Ireland"

Heidi Acampora, Marine & Freshwater Research Centre, Galway-Mayo Institute of Technology
Ian O'Connor, Marine & Freshwater Research Centre, Galway-Mayo Institute of Technology

ABSTRACT

Governments all around the world are being urged to monitor litter sources and inputs, and to mitigate the impacts of marine litter, which is primarily composed of plastics. Seabirds are highly susceptible to entanglement and ingestion of litter at sea. The aim of this research is to investigate the feasibility of using Northern Fulmars (Fulmarus glacialis) and/or other potential species of seabird as an indicator for floating marine debris in Ireland. From the inception of the project to date (45 months), 226 birds comprising 20 different species have been collected and subsequently investigated. The research has evolved from relying on beached birds to also investigating availability of birds at seabird colonies during the breeding season. As a result, of the 226 individuals examined, 157 were beached and 69 were collected at colonies during fieldwork or by wardens. In total, 19% (n=43) of 14 different species were found to ingest litter, mainly plastics. Ninety three percent (n=16) of Northern Fulmars sampled had ingested litter. When comparing beached vs colony collected birds; for beached birds (19 species, 157 individuals) 22.9% (n= 36) ingested plastic litter. The average mass was 0.1944 g and average number of pieces was 6.4. In birds collected at breeding colonies (11 species, 69 individuals) 10.1% (n= 7) contained plastics. The average mass was 0.0040 g and the average number of pieces was 1.04. These preliminary results show that multispecies of seabirds in Ireland are ingesting marine litter, mainly plastics, as in many other countries in the world. monitoring seabird litter ingestion has the potential to form part of a wider marine litter monitoring programme that can help to inform mitigation and management measures for marine litter.

Engineering Effective Marine Debris Interception

"Basins and Booms: An Effective Model for Marine Debris Capture in the Tijuana River Watershed"

Bronti Patterson, Tijuana River National Estuarine Research Reserve

ABSTRACT

The Tijuana River National Estuarine Research Reserve and the Tijuana River Valley comprise the largest intact coastal wetland system in Southern California, despite stressors associated with being situated on an international border between two major metropolitan areas of San Diego and Tijuana, Mexico. Since the early 1980's, increasing volumes of debris originating in Mexico flow through the Tijuana River Valley during flood events and are discharged into the Pacific Ocean. During these flood events large quantities of this debris are deposited in alluvial wash habitat, riparian habitat, tidal channels, salt marsh habitat, and near-shore dune habitats of the Reserve. In 2005, the Goat Canyon Sediment Basin was constructed at a cost of nearly $6 million dollars, in order to capture 60,000 cubic yards annually of sediment and debris directly impacting estuarine and ocean habitats associated with the Reserve. The Sediment Basin contain two floating trash boom systems designed to capture floating debris such as plastics and foam. Through a broad partnership, the Sediment Basin and trash boom systems have effectively captured 500,000 cubic yards of debris and sediment from entering the Tijuana Estuary and Pacific Ocean. The Goat Canyon Sediment Basin serve as a potential model effort toward alternative and sustainable natural resource maintenance in both the U.S. and Mexico.

Engineering Effective Marine Debris Interception

"Implementing a Trash Diet for the Anacostia River, Washington, District of Columbia, USA"

Matt Robinson, DC Department of Energy and Environment, Watershed Protection Division

ABSTRACT

The Anacostia River is a tidal freshwater tributary to the Potomac River, one of the largest tributaries to the Chesapeake Bay. The river has a watershed approximately 176 square miles in size and flows through portions of the District of Columbia (Washington, DC) and the State of Maryland. In 2006, the District listed the Anacostia River as impaired for trash followed by the State of Maryland in 2008. The river is perennially impaired by loadings of plastic debris and other trash from stormwater runoff, combined sewer overflows, and illegal dumping. In 2010, both jurisdictions developed a total maximum daily load (TMDL) for trash for the river. This "trash diet" requires both jurisdictions to install controls to prevent or remove over 1 million pounds of trash per year. Examples include the installation of trash traps; establishment of a five cent fee on single-use plastic bags; banning the use of expanded polystyrene foam food products; and installation of large underground tunnels to capture combined sewer overflow. This presentation will include a summary of the kinds of data used to develop the TMDL, as well as other types of data that have been collected and used to inform policy decisions (e.g. establishment of a plastic bag fee). Practical considerations for the installation of various trash reduction best management practices (BMPs), and efforts to monitor progress will be presented. This work will hopefully inspire jurisdictions to adopt similar approaches to reduce the amount of trash in the nation's waterbodies.

"Prioritizing debris interception versus other management methods"

Thomas Sprehe, KCI Technologies
John Kellett, Clearwater Mills

ABSTRACT

An extended 1.25 hr presentation will focus on the engineering elements of marine debris interception in streams and rivers. A diagnostic consideration of the main problem elements will be presented. The rationale for urgently prioritizing debris interception as opposed to other management methods, including regulatory policy (e.g., polystyrene and bag bans, etc.), increased recycling, imposing circular economy strictures such as reverse logistics, etc., is based on the relative ability of such interception to be implemented quickly versus the extended time to implement more sustainable solutions, while acceleration of the marine debris loading compounds the enormous threat to our oceans. Since the majority of solid waste marine debris originates as illegal or improper dumping or litter, and travels to the ocean via water flowing off of the land, the focus of prevention should be to efficiently intercept the waste at the most efficient points. This vector to the ocean is more prominent near urban centers, where stormwater runoff runs to streams and rivers flowing to the ocean. Non-point source litter becomes a concentrated point source at the mouth of a river, and it's the last practical chance to intercept it. So from a triage perspective those become the arteries at which to stop the bleeding of plastic to the ocean. Next, the importance and challenges of data collection will be discussed as well as several innovative methods currently being implemented. Engineering design considerations for marine debris interception will be presented, as well as alternatives for structuring the operational responsibility, and funding of CAPEX and OPEX. The effectiveness of such measures can be easily communicated to the public in a way that encourages implementation sustainable solutions upstream.

"Global Toolkit for the successful adoption of policies and regulation to source reduce single-use plastic"

Jane Patton, Plastic Pollution Coalition
Miriam Gordon, UPSTREAM Policy
Joan Marc Simon, Zero Waste Europe
Von Hernandez, Break Free From Plastic Movement

ABSTRACT

Multiple non-governmental environmental organizations will introduce a Global Toolkit, an international web-based resource for source reduction of commonly littered single-use plastic. The Toolkit is meant to share best practices and be a "go-to" resource for accessing the collective experience and knowledge of peers engaged worldwide in plastic source reduction actions. The Global Toolkit is intended to empower advocates and regulators in both the Global North and Global South (including LDCs and SIDs) and at various levels of government (local, state, federal, national). The Global Toolkit will include a full spectrum of actions for the adoption of source reduction policies and laws by regulators and advocates: existing ordinances and statutes, regulatory effectiveness information, current scientific support, legal resources, and community engagement tools. An implementation and training team will ultimately be assembled to support community level advocates and government officials in their use of the toolkit, and to ensure continual updating. The March 2018 presentation of the first phase of the Global Toolkit will premier plastic bags and polystyrene section; the emerging science of climate change impacts of single-use packaging; and connections to resources to defend single-use bag bans against legal preemption strategies by industry. Ensuing 2018 phases of Toolkit development will include sections on microbeads and microfibers, cups/lids/straws, bottled water, smoking-related items, and other take-out items, as well as a producer responsibility section, and completion of the online resource.

"Source Reduction through Policy Victories in Hawaii"

Doorae Shin, Kokua Hawaii Foundation

ABSTRACT

Plastic Free Hawai'i is a program of the Kōkua Hawai'i Foundation, a nonprofit organization founded in 2003 by Kim and Jack Johnson to support environmental education in Hawai'i schools and communities. Plastic Free Hawai'i has been an active member of the Plastic Pollution Coalition, and our team works closely with many policy advocacy groups in Hawai'i from Surfrider Foundation Hawai'i Chapters to Sierra Club Hawai'i Chapter. In Hawai'i, much has been accomplished to reduce plastic pollution at the source. From policies such as statewide plastic bag bans to EPS foam bans in two counties, advocates in Hawai'i are leading by example to tackle plastic pollution. With cigarettes being the #1 item found at beach cleanups, Hawai'i also has a policy banning cigarette smoking at all public beaches, parks and bus stops. Advocates in Hawai'i can offer contributions to the global toolkit that enhance efforts of advocates around the world to achieve similar victories with their local governments.

Life-Cycle Considerations To Addressing Marine Debris – Reflections On Municipal Waste

"A systems perspective on plastics and ocean waste"

Alix Grabowski, WWF

ABSTRACT

There is an urgent need to stop the flow of waste into our oceans, and the private sector has a critical role to play in this endeavor. At the same time, the problem is complex and tied not only to waste management but also to material and design choices. It is imperative to understand the trade-offs that different design choices have for both the environment and people, so that transparent, evidence based decision making is possible. Without this transparency, we run the serious risk of transferring the environmental burden from one area to another, and falling short of achieving our goals. On this panel, I will discuss the mechanics of common material trade-offs, and illustrate why cooperation both along the supply chain and across the private and public sector is necessary in order to address this challenge.

"How Life Cycle Assessment Can Inform Solutions to the Problem of Marine Debris"

David Allaway, Oregon Department of Environmental Quality
Peter Canepa, Oregon Department of Environmental Quality
Peter Spendelow, Oregon Department of Environmental Quality

ABSTRACT

Municipal solid waste is the tail end of a large and complex industrial system of materials. Life cycle assessment (LCA) is a widely used method of better understanding the environmental impacts of these materials, including some of the impacts of waste. Biological impacts of marine debris are typically not included in most life cycle assessments, although other impact categories that affect oceans are, including global warming, eutrophication, and marine ecotoxicity.

Solid waste – and especially marine debris – is highly visible to the public. But for many environmental impact categories, the upstream processes related to resource extraction and material production typically dwarf the impacts of municipal solid waste. This can lead to surprising environmental conflicts when marine debris stakeholders advocate for solutions (e.g., compostable packaging, bioplastics) that may reduce marine debris impacts while increasing other ocean-related environmental impacts in ways that are less obvious but no less real.

This presentation will explore current limitations in LCA related to marine debris, and introduce several studies from Oregon and elsewhere that illustrate the benefits of using LCA to understand and better manage these types of hidden trade-offs. We will also explore the issue of geography – given significant differences in waste management systems, different solutions to the problem of marine debris are more or less relevant in different regions of the world.

"THE INCLUSION OF MARINE PLASTIC MISMANAGED IN LIFE CYCLE ASSESSMENT"

Naiara Casagrande, Federal University of Santa Catarina

ABSTRACT

The consumption of plastic has increased since its production has started in the year 1975. Otherwise the investments in infrastructure, management and even population conscious for the correct disposal of the debris haven't followed the large numbers of production and consumption, mainly in developing countries. It has brought environmental problems, as the anthropogenic marine debris accumulating in estuarine and coastal environments around the world causing damage to human health and biodiversity. In the Life Cycle Assessment methodology is common to consider landfill, recycling or incineration as the modelling scenarios at the end-of-life for plastics. Impacts indicators for plastic debris without management is lacking in LCA. Therefore the aim of this study is to highlight this deficit in Life Cycle Assessment studies, identifying and characterizing the potential environmental impacts caused by unmanaged plastic and contribute for the development of a new indicator. This paper evidences the scenario of mismanaged plastic, indicating the flow of these material in the environment until it entrys to the ocean, the estimated proportion of the unmanaged plastics that goes to the ocean, impacts caused by these debris and a modest indication of where it would be included in Life Cycle Assessment.

"Examining utility and functional aspects of remote, line-Free Lobster and crab fishing systems with modelling and prototype development for reduction of marine Mammal Foraging habitat impact and reduction of marine debris."

Richard Riels, S.M.E.L.T.S.
Daniel Greenberg, R & D Consult, LLC

ABSTRACT

Modelling of Atlantic Right Whale population habitats indicate an impact by buoy set bottom fishing from the crustacean industry. Development and deployment of Line-Free bottom fishing systems reduces underwater navigational and debris hazards.

Line-Free systems added to standard recreational or commercial crab or lobster pots involves the integration of economical remote underwater telemetry, active GPS monitoring, autonomous flotation equipment and robust electronics; allows for reliable, Line-Free fishing. Removing miles of fishing lines from recreational and commercial fishing gear has the potential to significantly reduce navigational hazards for marine mammals and shipping and reduce yearly marine debris by many tons and many miles of gear. Line-Free fishing equipment mounts directly to existing crab or lobster pots, is rechargeable and reusable, driving costs down, providing reliability with system redundancies.

Experimental data and practical experience with this novel integration of standard and upgraded fishing technologies indicates commercial and recreational fishing opportunities. This system provides deployment time savings and opens up previously unreachable rocky and reef type fisheries. By removing buoy lines, Line-Free fishing provides the industry with a methodology for delivering a less environmentally invasive fishing process while retaining standard crab and lobster pots.

Initial prototype models deployed from research vessel utilize a 36"D x 16"H three hole crab pot, providing mid depth data with a deployed integrated equipment package including: activated sonar signals, automated inflation, recovery with LED beacon and standard davit block. Initial life cycle test provides data encouraging deployment of commercially available systems sized to any bottom set fishery worldwide.

Lose The Loop: Global Collaboration To Reduce And Prevent Pinniped Entanglement In Marine Debris

"Marine debris in harbour porpoises and seals from German waters"

Bianca Unger, TiHo
Miriam Hillmann, Institute for Terrestrial and Aquatic Wildlife Research, University of Veterinary Medicine Hannover, Foundation, Germany
Kornelia Wolff-Schmidt, Institute for Terrestrial and Aquatic Wildlife Research, University of Veterinary Medicine Hannover, Foundation, Germany
Peter Wohlsein, Department for Pathology, University of Veterinary Medicine Hannover, Foundation, Germany
Ursula Siebert, Institute for Terrestrial and Aquatic Wildlife Research, University of Veterinary Medicine Hannover, Foundation, Germany

ABSTRACT

For investigating the impacts of marine debris on harbour porpoises (Phocoena phocoena), harbour seals (Phoca vitulina) and grey seals (Halichoerus grypus) inhabiting German waters, data collected within the framework of stranding schemes were analysed. This includes the coastlines of the German Federal States of Schleswig-Holstein and Mecklenburg-Western Pomerania. A total of 6,587 marine mammals collected since 1990 were verified for marine debris. Altogether 37 debris items were documented. They were found in 31 carcasses including 14 external findings (entanglement) and 17 internal findings (ingested items). The share of fishing related debris, including fish hooks, netting and baits, was highest (64.9 %). In both, external and internal findings, items made out of synthetic materials dominated (73 %) compared to metals and wooden items. Furthermore, more findings were made in animals inhabiting the Baltic Sea compared to the North Sea. Concerning the species mostly seals were affected, especially grey seals showed the highest prevalence in both, external and internal interactions with marine debris. Regarding the age classes, mostly juvenile individuals were impacted. This study provides first information on debris burdens of marine mammals in German waters. The results of the analyses contribute to information needed for assessing the Good Environmental Status as required by the the Marine Strategy Framework Directive (MSFD).

Lose The Loop: Global Collaboration To Reduce And Prevent Pinniped Entanglement In Marine Debris

"Marine debris is the most frequently encountered anthropogenic threat to pinnipeds in central California: a comparative review of two decades of marine mammal stranding cases"

Daniela Barcenas, The Marine Mammal Center
Eugene De Rango, The Marine Mammal Center
Shawn Johnson, The Marine Mammal Center
Claire Simeone, The Marine Mammal Center

ABSTRACT

Marine debris is an important cause of injury and mortality in marine species around the globe. Twelve years of marine mammal stranding cases in central and northern California were analyzed, and trends compared to a previous study. Between January 2003 and September 2015, 617 of 11,162 total stranding cases (6%) had evidence of anthropogenic trauma (AT). Fifty-six percent of all AT cases were caused by marine debris.

Marine debris entanglement has become the most frequently encountered type of AT among pinnipeds in this region, replacing gunshot injury (27%) which had been documented as the most common type of AT from 1986 to 1998. When further analysis were made to isolate cases of fisheries interactions, direct fisheries interactions represented 50% of all AT cases, while 17% were caused by non fishing-related materials, 27% by gunshot wounds, and 5% were related to boat collision.

California sea lions comprised 83% of all AT cases, but threatened Guadalupe fur seals had the highest prevalence of entanglement in marine debris, as 13.2% of all rescued Guadalupe fur seals were affected by marine debris. Efforts to mitigate sources of marine debris are vital to address this increasing threat to marine mammals.

Lose The Loop: Global Collaboration To Reduce And Prevent Pinniped Entanglement In Marine Debris

"Packing Bands Entangling Pinnipeds Around the World: Policy and Practical Solutions"

Elizabeth Hogan, World Animal Protection

ABSTRACT

Marine debris is a significant and detrimental source of entanglement for marine animals around the world. Entangling debris includes packing bands, fishing gear, and plastic bags (other items) and can lead to serious injury, suffocation, and even death. In addition to reducing the ability or likelihood of individual animals to survive and reproduce, entanglement can be a threat to the recovery of small populations. Among pinnipeds, an estimated 58 percent of seal and sea lion species are known to have been affected by entanglement.

Analysis of entangling debris assessed in this study suggests that there are some commonalities in the physical characteristics of packing bands found entangling pinnipeds around the world (i.e., color, size). In some cases, these observed patterns are likely due to manufacturing practices, but they can nonetheless inform future steps and strategies for reducing the prevalence of entangling debris, including implementing regulations, realigning economic incentives, establishing industry best practices, and developing innovative alternative materials. Here we present a global review and analysis of packing band material retrieved from seals and sea lions submitted by stranding response practitioners from around the world.We hypothesized that our sample of packing bands would have a range of characteristics and that compiling such a collection could lead to further understanding of their shared features, if any, that might explain their prominence as entangling debris.

The implementation of prohibitions and voluntary guidelines for disposing of packing bands is a positive step toward minimizing this threat.

Lose The Loop: Global Collaboration To Reduce And Prevent Pinniped Entanglement In Marine Debris

"Pinniped Marine Debris Entanglement Response: Best Practices and Lessons Learned – A Panel Discussion"

Kim Raum-Suryan, NOAA/NMFS Alaska Region, Protected Resources Division
Lauri Jemison, Alaska Department of Fish and Game
Kate Savage, NOAA/NMFS Alaska Region
Michael Williams, NOAA/NMFS Alaska Region, Protected Resources Division
Shawn Johnson, The Marine Mammal Center
Rebecca McIntosh, Phillip Island Nature Parks
Kristen Patchett, International Fund for Animal Welfare
Lynda Doughty, Marine Mammals of Maine

ABSTRACT

Safely capturing and removing entangling materials from pinnipeds is a challenging but rewarding endeavor. Certain species are small enough to capture and manually restrain on shore while others can only be safely handled under sedation. Advances in remote chemical immobilization have now made it possible to safely capture and disentangle large pinnipeds, even if they enter the water. With each entanglement response and capture, responders learn many valuable lessons that could help other scientists who plan to embark upon this method. Many factors impact the success of a capture including the feasibility of rescue response; location, size, and position of the animal; communication and decision making among responders; experience of responding personnel; adaptive techniques when the unexpected occurs; weather, tidal, and other environmental conditions; capture equipment and satellite tag application; and the response of the target animal after darting. This panel will bring together experts with experience in responding to and disentangling different pinniped species. Each panelist will succinctly explain their top three best practices and lessons learned followed by a full panel question and answer period with the audience. The session will conclude with ideas for innovative solutions and next steps in increasing entanglement response.

Lose The Loop: Global Collaboration To Reduce And Prevent Pinniped Entanglement In Marine Debris

"Understanding the impact of marine debris entanglements on pinniped health: a 10-year study of entangled California sea lions rescued along the central California coast."

Elsa María Coria-Galindo, The Marine Mammal Center, 2000 Bunker Road, Sausalito, California 94965, U.S.A.
Claire A. Simeone, The Marine Mammal Center, 2000 Bunker Road, Sausalito, California 94965, U.S.A.
Shawn P. Johnson, The Marine Mammal Center, 2000 Bunker Road, Sausalito, California 94965, U.S.A.

ABSTRACT

California sea lions (Zalophus californianus) are the most common pinniped in California, and are the species most frequently affected by entanglement in marine debris along the central California coast. The purpose of this study was to review stranding and medical records of entangled California sea lions rescued by The Marine Mammal Center between 2006 and 2016, to better understand this complex situation and to inform solutions and mitigation efforts. These results provide valuable information to the new Pinniped Disentanglement Program starting in Sonora, Mexico. Entanglement in marine debris is a significant threat to sea lions along the Sonoran coast, and San Jorge Island, near Puerto Peñasco has an estimated 1.7% prevalence of entangled sea lions.

Of all live rescues (n= 6632), 2% had active entanglements (n= 147). Males were more affected (66%) than females, and yearlings and juveniles were the most frequently affected age classes. monofilament was the most common type of marine debris entanglement (75% of known entanglement types). The majority of entanglements were single wounds around the neck (84%). Animals required a rehabilitation stay between 1 and 9 days for 42% of entanglement cases, while 23% were disentangled in situ and were not hospitalized.

We found a direct correlation between body condition and survival. Of the sea lions in good body condition, 99% survived and were successfully released. As body condition deteriorated, survival decreased. Of the total entangled sea lions, 56% had one or more co-morbidity (malnutrition and pneumonia were most frequent). Two-thirds of all entangled animals were able to be released following disentanglement and/or rehabilitation. These data highlight the importance of rapid disentanglement, as well as efforts to prevent entanglements in monofilament.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

"A new analytical approach for the detection of micro-sized fibers from textile laundry"

Jasmin Haap, Hohenstein Insitut für Textilinnovation
Edith Classen, Hohenstein Insitut für Textilinnovation

ABSTRACT

The abundance of microplastic in freshwater environments and marine habitats, its sources as well as the pathways are not fully known to date. However, micro-sized synthetic fibers released from textile laundry are known to contribute to the microplastic problem. In fact, there is still a gap of knowledge regarding the extend of fiber discharge and the main influence factors. Detailed investigations on the release of micro-sized fibers require precise and reproducible analytic methods. Frequently used analytics for microplastic fiber detection in wastewater are often based on filtration combined with subsequent visual analysis of the particles (e.g. microscopy). This workflow is time consuming and prone to human errors. Due to the non-spherical shape of the fibers or the turbidity of the wastewater, commonly applied particle detection systems (e.g. light scattering, laser diffraction) are limited.

This study highlights the application of a new analytical approach to wastewater samples from laundry. Dynamic image analysis is utilized to analyze suspended textile fibers and particles in the wastewater. This optical detection system allows for a fast and non-destructive measurement of fibers and particles covering a broad range of particle dimensions (10 – 3500 µm) without the need of a pretreatment. Furthermore, it enables statistical analysis regarding various fiber characteristics like diameter, length and shape. In addition, this system provides quantitative information on the number of fibers per wash load and the corresponding size distribution. For the distinction of synthetic and natural fibers, dynamic image analysis is a promising tool regarding the chemical fiber identification of mixed laundry loads or blended fabrics.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

"A wastewater utility's attempt to optiomize extraction and identification of microplastics in secondary Waste Water Treatment Plant (WWTP) effluent"

Artem Dyachenko, EBMUD
Nirmela Arsem, EBMUD

ABSTRACT

A regional effort to optimize sampling, extraction, identification and quantitation of microplastic particles in secondary Wastewater Treatment Plant (WWTP) effluent is presented. The study found that wastewater samples require special handling in order to remove inherent organic material-related interferences. Sequential wet peroxide oxidation (WPO) digestion leads to cleaner extracts with significantly reduced amounts of major wastewater related interferences such as cellulose and fatty acids. An attempt to count and type microparticles extracted from secondary wastewater effluent has been made and results were extrapolated using WWTP's average daily flow rates. Findings reveal significant discrepancy in microparticle count in extracts obtained from 2-hour sampling at peak flow and 24-hour composite sampling events. The vast majority of microparticles could be categorized as fragments whereas pellets or beads appear to contribute less than 10 % of the overall microparticle count. Many microplastic particles in wastewater are not homogenous with traces of other compounds present and visual microscopic identification alone is not sufficient in determining microplastics presence which should be confirmed with an appropriate spectroscopic technique (e.g. micro-FTIR). Normal handling of some microplastic particles during analysis led to fragmentation which could bias the final results. The need for a robust screening and quantitation of micorplastics with the tools accessible to wastewater laboratories and challenges of current methodologies are discussed.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

“Micro plastic and fibres in the marine environment of Svalbard, Norway”

Dorte Herzke, NILU
Jan H. Sundet, IMR, Institute of Marine Research
Maria Jenssen, IMR, Institute of Marine Research

ABSTRACT

Due to the great connectivity between the Arctic Ocean and adjacent seas through the Fram Strait and the Bering Strait, the problem of plastic litter most likely extends into the Arctic Ocean, but is highly understudied in this region. To understand the distribution of plastic litter in the Arctic, knowledge of local sources within the Arctic is as important as an understanding of the transport pathways from more densely populated areas further south. Besides the five known ‘great garbage patches’ of the world oceans, a sixth litter patch is predicted for the Barents Sea, based on calculations from drifter buoy data (van Sebille et al., 2012), but to date this accumulation of debris has not been observed in situ. Besides these litter patches, a large number of coastal areas and inland waters suffer a high plastic pollution, also in the Arctic (OSPAR, 2014).

Between 2015 and 2017, IMR and NILU sampled wastewater effluent, sediment, seawater and filter feeders in several locations along the coast of Svalbard, including Longyearbyen, Adventfjorden, with the aim to establish a baseline of micro plastic abundance in the Norwegian Arctic. The first year of the project was used to establish a method for sampling and sample treatment as well as to assess the impact of a major settlement on Svalbard to the marine emissions. In the second year, we sampled locations along the western coast of Svalbard to assess the abundance of micro plastic reaching Svalbard from long distances. In 2017 we investigated the fibre emissions caused by the waste water effluent more closely, including the effect of a fibre reducing device. Micro plastic and fibres were found in all years and the results will be presented at the conference.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

"Microplastic distribution in environmental matrices (water-sediment) in Todos Santos Bay, Mexico."

Nancy Ramírez-Álvarez, Instituto de Investigaciones Oceanológicas-UABC
Lorena Margarita Rios-Mendoza, University of Wisconsin Superior
José Vinicio Macías-Zamora, Instituto de Investigaciones Oceanologicas-UABC
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Lucero Oregel-Vázquez, Facultad de Ciencias Marinas-UABC
Félix Augusto Hernández-Guzmán, Instituto de Investigaciones Oceanológicas-UABC
José Luis Sánchez-Osorio, Instituto de Investigaciones Oceanológicas -UABC
Charles J. Moore, Algalita Marine Research Foundation
Hortencia Silva-Jiménez, Instituto de Investigaciones Oceanológicas-UABC
Luis Felipe Navarro-Olache, Instituto de Investigaciones Oceanológicas-UABC

ABSTRACT

Microplastics (MP) represent a great threat to the marine environment because evidence suggests its ubiquity. In Mexico, this line of investigation is emerging and, therefore, also the knowledge of them in coastal zones. The goal of this research is to evaluate the impact of MP in Todos Santos Bay (TSB) by analyzing the type of synthetic polymers found in surface waters and sediments, as well as evaluating one of its main sources, the Wastewater Treatment Plants (WWTPs) effluents. Eleven surface water samples were collected by Manta trawl, as well as nine samples of sediment with a Van Veen grab (0.1 m^2). Also, four samples were collected in each WWTP effluents (n = 3) with discharges in TSB. Preliminaries results showed that MP in surface waters in TSB were 0.01 to 0.65 plastic particles per m^3, with a high presence of fibers in the samples (40 - 80%). In the sediment, MP were counted between 850 to 20,000 plastic particles per m^2, with a mean value of 22% of fibers. A preliminary estimate suggests that the effluents from the WWTPs could introduce 18×10^6 to 47×10^6 plastic particles per day in TSB. The incidence of the plastic fibers in the WWTP effluents were between 60 to 90% in the samples. The main synthetic polymers of MP found in the surface waters (approximately 10% of each sample) were polyethylene, polyethylene-propylene, polypropylene co-polymer, and polypropylene. Currently, we are determining the type of MP polymers present in the sediments and the effluent WWTPs samples. According to the preliminary results, we found that there is a greater accumulation of MP in the sediments than in the surface waters from BTS, which could interact with organisms such as macro invertebrates. Finally, the WWTP effluents are an important source of MP in TSB.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

"Microplastic Particle Morphology and Categorization: Implications for Managing Sources to the Great Lakes"

Paul Helm, Ontario Ministry of the Environment and Climate Change
Erin Nicholls, Ontario Ministry of the Environment
Courtney Miller, Ontario Ministry of the Environment and Climate Change

ABSTRACT

Contamination by microplastic particles (MPPs) is well-documented in marine, and more recently, freshwater environments. Sampling in urban streams, wastewater effluents, and nearshore waters of the Great Lakes has shown that there are numerous types of MPPs entering the lakes. Typical reporting of MPP research and monitoring results includes the listing of abundances (counts per unit area, volume, or mass) and grouping of types of MPPs into broad categories such as fragments, film, foam, fibers, and pellets/beads. However, such broad categories may be insufficient for directing management actions for MPPs reductions and to measure the success of such actions. We present morphological characteristics of MPPs which can be used to expand their source-type categorization/classification. For example, rigid plastic particles resembling shavings, cuttings, and trimmings clearly generated by mechanical means, normally categorized as "fragments", are indicative of commercial plastic activities. These "commercial fragments" comprised a significant portion (>50%) of the up to 19 million MPPs / sq. km found in Humber Bay along the waterfront of Toronto, Canada. Our 2015 sampling of nearshore waters, streams and wastewater effluents in this region of the Great Lakes demonstrates the influence of more specific sources when detailed categories are used to characterize MPP profiles. Emissions of MPPs, likely from plastic product manufacture and recycling, are indicated to be a significant source to western Lake Ontario, and these findings form the basis for advice to resource managers regarding strategies to reduce to the occurrence of MPPs in the Great Lakes.

Microplastics in Wastewater Treatment Plants -- A totally preventable source

"Microplastics in Wastewater Treatment Plants"

Nikolaos Mourgkogiannis, Department of Chemistry, University of Patras
Ioannis K. Kalavrouziotis, School of Science and Technology, Hellenic Open University
Hrissi K. Karapanagioti, Department of Chemistry, University of Patras

ABSTRACT

Marine pollution by microplastics, plastic particles in the size range 1 nm to 5 mm, is a recognized emerging issue. Wastewater treatment plants (WWTPs) although they remove the solid waste arriving to their screens, they are not designed to remove microplastics. There are a few studies measuring the concentration of microplastics in the effluent. It seems that the concentrations are low but the actual amount ending up in the sea is quite significant. The present study is an extensive study surveying 101 WWTPs in various areas throughout Greece. Based on the results, the total amount of solid waste arriving to these 101 WWTPs is calculated equal to 3.7 108 L per week. This amount is collected by screens but 94% of the WWTPs have screens with gaps larger than 5 mm. This suggests that microplastics are passing through preatreatment to the main WWTP. Indeed, 89% of the WWTP managers observed microplastics anywhere in the plant. Cotton swabs are identified as the most common microplastic found in WWTPs and the surrounding marine and coastal areas of the effluent pipes. Informing the public as well as operators and engineers about this problem is necessary.

"Plastic Pollution IS an Environmental Justice Issue"

Marce Graudiņš, Azul
Jane Patton, Plastic Pollution Coalition
Genevieve Abedon, Ecoconsult
Stiv Wilson, The Story of Stuff Project
Yvette Lopez, Pacoima Beautiful
Rosa Furumoto,
Irma Munoz, Mujeres de La Tierra
Amanda Ford, Environmental Justice Coalition for Water
Von Hernandez, Break Free From Plastic

ABSTRACT

Low-income communities across the world are oftentimes hardest hit by the forces that drive our global (and growing) dependence on single-use plastic. Disadvantaged communities and communities of color are often even targeted for placement of infrastructure that perpetuates this system, from extraction to waste disposal. Yet rarely are the voices of these groups included in discussions about solutions, and concerns of environmental justice are often relegated to separate conversations rather than being integrated into every discussion.

Every conversation about plastic pollution and marine debris must be driven by principles of equity. Each conversation at local, national, and international levels must include the values, expertise, experiences, and on the ground efforts of the most adversely affected communities, especially as we plan for innovative solutions and ways to approach the major forces degrading our environment worldwide. These solutions are for the benefit of all, and must include input from all.

This panel will propose best practices for including principles of community organizing and equity in environmental actions, policy recommendations, and solutions development to the plastic pollution problem. A group of diverse representatives of energized but typically under-engaged communities will discuss how to include and elevate the solutions coming out of these front-line communities, and will recommend methods for building relationships and including those voices in agenda-setting and goal definition within conversations about solutions to marine litter and plastic pollution now and in the future.

Reducing Marine Plastic Pollution Through Innovation And Entrepreneurship And Leveraging The Social Enterprise

"A Regenerative Solution for Ocean Plastic Pollution and Organic Waste"

Andrew Falcon, Full Cycle Bioplastics
Jeff Anderson, Full Cycle Bioplastics
Dane Anderson, Full Cycle Bioplastics

ABSTRACT

Full Cycle Bioplastics tackles ocean plastic pollution and climate change by transforming organic matter into a compostable, marine-degradable alternative to oil-based plastics. Our up-cycling technology keeps organic waste out of landfills and introduces a bio-benign alternative to oil-based plastics. We maximize the value from food waste, mitigate greenhouse gas emissions, and reduce ocean plastic pollution and toxicity effects--creating system level change for a sustainable, circular economy.

Full Cycle's proprietary solution transforms organic matter into PolyHydroxyAlkanoate bioplastics (PHAs) . PHAs are naturally occurring material made intra-cellularly by bacteria, and decompose harmlessly in soils and in oceans. At the same time, they are quite flexible and can be used in a broad range of traditional plastic processes and applications. At end of life, PHA bioplastic can be reintroduced into a Full Cycle system and be upcycled again into virgin PHA.

Full Cycle's technology allows for production of PHA at costs that are competitive with traditional oil-based plastics; expanding the addressable market for PHA and improving the profitability of organic waste management. While Full Cycle's technology enables a regenerative, circular solution at the system level, it also scales down to a level that allows for regional deployment and closed loop solutions...providing a key pathway to adoption, scale and impact.

"Circular Economy and Circular Materials Management: An Application and Case Study in a US City"

Amy Brooks, University of Georgia
Jenna Jambeck, University of Georgia
April Crow, Crowd Advisors

ABSTRACT

The circular economy has been suggested as a solution to plastic being discarded into our environment and entering our oceans globally. But how does this translate to reality, on-the-ground, in a community? The circular economy concept is not new, but what can be very helpful from this concept is that it encourages material and product designers to think about a product's end-of-life in the design process. Historically, and almost exclusively, solid waste management has been reactive to materials and products that "come down the pipe" and so we encounter many challenges to solid waste management. How do you recycle a product made of thin film composite metallic polymers? While materials and products need to meet technical, aesthetic, safety and other specifications, we argue that specifications for the waste management system are critical to the concept of circular materials management, and we use our local community of Athens-Clarke County and the University of Georgia (UGA) embedded in it as an example to evaluate. Previous waste audits completed for Athens-Clarke and UGA, as well as interviews of local community members and solid waste leaders were compiled to assess the community on circular materials management, "leakage" from the system (e.g., litter), and identify data gaps. This kind of information is needed to be able to bring this concept to scale in other communities. As we move forward in the circular economy, there will be environmental and economic benefits from the elimination of materials that cause problems in the solid waste stream. In addition, the increase in the value of the materials as commodities will mean that more materials can be collected and processed

"Plastic Disclosure Project - How Do You Know What to Circulate if You Don't Measure It First?"

Doug Woodring, Ocean Recovery Alliance

ABSTRACT

With the growing awareness of plastic pollution, and the increasing discussions of moving towards circular economies with materials, plastic is one of the toughest materials to handle and solve for, due to its wide variety of types, melting points, colors and properties. In order to create scale for recycling, and also to create "pure", non-contaminated feedstock streams, we must separate or know what materials we are working with. When companies want to know their own waste footprints or plastic footprints, they need to measure what they create, recover, waste and how much recycled content, or biomaterial content they might be using.

The Plastic Disclosure Project (PDP) is a global voluntary program which allows companies and institutions to gain better management knowledge of their own plastic use baseline. This information then allows them to move materials into a circular economy in a better, more efficient way, reducing their plastic/waste footprint and impact along the way as they reduce their waste, increase recycled content, increase reusability, or introduce new biomaterials that have end-of-life options.

The PDP is one of the only global programs that exists which companies, governments and stakeholders can use, in any country, and without the need for bans, taxes or legislative changes, meaning that the impacts and benefits can be felt immediately - today. Resource management is an important issue for any senior management staff, as well as the analysts and fund managers who invest with growing Environmental and Social Governance (ESG) metrics. Learn how your company, institution and community can benefit from being part of the PDP Program.

Reducing Marine Plastic Pollution Through Innovation And Entrepreneurship And Leveraging The Social Enterprise

"Reducing marine plastic pollution through innovation and entrepreneurship and leveraging the social enterprise"

Daniella Russo, Think Beyond Plastic
Anne Warner, Think Beyond Plastic

ABSTRACT

There is unprecedented concern about plastic pollution and its impact on ecosystems, world oceans, and human health, along with a notable lack of strategic, scalable, long-term solutions. A new approach that embraces design thinking and builds the economic engine to support systemic, permanent reduction of plastic pollution is required.

Think Beyond Plastic is an innovation accelerator leading a multi-disciplinary effort to advance innovation and entrepreneurship eliminating plastic pollution and its impacts. We identify innovation, accelerate commercialization, strengthen the investment engine, and reduce reliance on philanthropy and public funds. In 5 years, we are proud to have accelerated 32 businesses, ranging from consumer and business products to bio-benign, sustainably-derived materials to the Internet of packaging.

We believe that disruptive innovation should be directed toward key problem areas where consumption is highest and market failures are greatest. Negative externalities associated with the rapid increase in plastics consumption are especially visible in island communities with limited waste infrastructure and economic resources. In 2015, we launched our Mesoamerican Reef Project in the Bay Islands of Honduras. The long-term vision is to create and showcase a replicable model that is economically viable, shows measurable reduction of disposable plastic items, is permanent and financially sustainable, promotes community health, and generates local economic opportunities. Similar projects are being developed in Indonesia and other regions.

We will present our progressive and holistic approach to the plastic pollution problem; share our Mesoamerican Reef Project; discuss pilot projects in Indonesia; and highlight factors for success – infrastructure, investment, and collaboration with local partners.

Strategies For Preventing Trash Before It Starts

"Oregon's Experience Moving Up the Hierarchy to Waste Prevention"

Peter Spendelow, Oregon Department of Environmental Quality
David Allaway, Oregon Department of Environmental Quality

ABSTRACT

For more than 30 years, the US and many US states and local governments have adopted an "integrated waste management hierarchy" that prioritizes waste prevention and reuse above recycling and composting. But with few exceptions, the top of the hierarchy has been given little more than lip service. One exception is the US State of Oregon. Recognizing the limitations of recycling and the importance of prevention, Oregon has worked to move up the hierarchy and give greater emphasis to preventing waste at the source.

This presentation will introduce three discrete but related topics. First, we will explore the importance but also the limitations of recycling (with a focus on plastics), both from a marine debris and a broader environmental perspective. Second, we'll contrast recycling with prevention and provide compelling evidence of the importance of prioritizing prevention. Third, we'll summarize several actions the State of Oregon has taken to advance waste prevention more broadly. These include the development of strong statutory waste generation goals (distinct from recovery or landfill avoidance goals); reorienting a grants program to give greater priority to prevention-related projects; and recent legislation (SB 263, 2015) that adds new waste prevention and reuse requirements of larger counties and cities. We will also introduce Oregon's 2050 Vision for Materials Management, which takes a life cycle approach to managing materials, including discards.

"Plastic Free July – A case study in behaviour change best practice"

Rebecca Prince-Ruiz, Plastic Free July Foundation

ABSTRACT

Marine debris is an issue of growing public concern around the world. What's often missing is the connection between concern about the marine debris problem and consumer behavior and choices. Plastic Free July is a campaign to nudge citizens into changing their consumer behaviour in favour of avoiding single-use plastics. It started in 2011 as a personal initiative developed in a local government waste education team in Perth, Western Australia. Plastic Free July rapidly grew to engage tens of thousands of people. The success of Plastic Free July was achieved on minimal budget and the viral spreading of the message via the internet and social media. In 2017 the West Australian Waste Authority funded Plastic Free July to research and develop a behaviour change toolkit and conduct an evaluation of campaign outcomes. Discover how the Plastic Free July challenge used behavioural insights to make a measurable difference in waste behaviours in a campaign which reached an estimated 2 million people from 159 countries in 2017.

Strategies For Preventing Trash Before It Starts

"Plastics Reduction Policies in California- Past, Present, Future"

Miriam Gordon, Upstream Policy

ABSTRACT

The California environmental community has helped usher in several plastics reductions policies in California to date, including over 150 plastic bag bans a state-wide ban on plastic bags, over 100 polystyrene foam container bans, a state-wide micro-bead ban for personal care products, and local bans on single use plastic water bottles in government facilities. But the majority of marine litter in California comes from food and beverage packaging and cigarette related litter. New policy initiatives at the state and local level in California are focused on addressing these key sources. From state legislation to eliminating the filter on cigarettes and polystyrene foam packaging, to local policies aimed at reducing food and beverage packaging, we will review what's happening now in California and other policy initiatives flagged for the future and what some neighboring regions are doing to prevent waste at the source.

"ReThink Disposable: Stop Waste Before it Starts"

Samantha Sommer, Clean Water Action and Clean Water Fund

ABSTRACT

Clean Water Fund's (CWF) ReThink Disposable program aims to inspire measurable behavior change in food businesses and institutional dining operations at the source. CWF California has a track record of reducing disposable food and beverage packaging, which according to our 2011 study, is a primary component of street litter in busy commercial districts (67%) impacting water quality. This upstream pollution prevention approach conserves resources, prevents waste and greenhouse gas emissions, saves businesses money, protects public health, reduces plastics that become litter and pollute local waterways and the ocean, and alleviates the burden placed on municipalities from managing all of this waste.

The program creates win-win opportunities for businesses and the environment by identifying money saving practices to reduce single-use packaging. By partnering with local government stormwater and zero waste agencies, Auditors work with participating businesses and institutions to voluntarily implement our Best Practices for source reduction. All packaging targeted for reduction is tracked and measured through an audit process where program impacts such as the quantity of disposable packaging eliminated, waste prevention, greenhouse gas reductions, payback period, and cost savings are calculated. To date, the program has engaged 125 food businesses and five institutions in California to eliminate over 15 million disposable items and preventing over 100 tons of waste each year. This session will discuss the barriers and opportunities to changing behavior in an industry where disposable packaging designed for single use application is ubiquitous. Case studies and business video testimonials will be highlighted. Learn more at www.rethinkdisposable.org.

"The success of waste campaigns and policies at reducing plastic waste into the marine environment"

Kathryn Willis, University of Tasmania
Clementine Maureaud, Supagro University of Advanced Agricultural Agronomy and Rural Management
Chris Wilcox, CSIRO
Britta Denise Hardesty, CSIRO

ABSTRACT

Plastic production is increasing globally and in turn we are seeing a rise of plastic waste lost into the coastal and marine environment. To combat this issue, there is an increase in policies that target specific types of plastic waste (such as microbeads and plastic shopping bags). Given that such anthropogenic waste have environmental impacts, reduce the tourism income of an area and result in human health issues, identifying effective abatement policies is imperative to reducing waste and litter before it enters the ocean. Within Australia, state and local governments employ a plethora of policies, campaigns and strategies to target abatement and reduce litter and waste inputs to the environment. We compared awareness-raising campaigns (such as 'Don't be a Tosser', Clean Up Australia and Bin your Butts cigarette campaign) and state-enacted policies (e.g. Plastic Shopping Bag Ban, Zero Waste Strategy and Recycling Strategy) aimed at targeting human behaviour to reduce waste. Investments in campaigns led to larger reductions of waste in the environment than did investment in policies. Illegal dumping, litter prevention, recycling, education and Clean Up Australia programs all significantly reduced waste along a council's coastline. Additionally, we found councils that invested in a coastal waste management budget had fewer littered or waste items on the coastline within their jurisdictions.

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

"Addressing marine debris as a coastal hazard: opportunities and awareness"

Carla Elliff, Universidade Federal da Bahia
Gerson Fernandino, Universidade Federal da Bahia

ABSTRACT

The definition of hazard by the United Nations International Strategy for Disaster Reduction encompasses dangerous human activities that may cause loss of life, injury or other health impacts, loss of livelihoods and services, social and economic disruption, or environmental damage. While marine debris are most frequently associated with low environmental quality, their impact is not restricted to the natural environment. Human health, wellbeing and economic activities can be seriously hindered due to this form of pollution. Despite the obvious threats that marine debris pose to these important areas of human development, they are rarely included in coastal management plans, especially in developing nations. The beaches in the metropolis of Salvador, Brazil, represent this conflict clearly: while economic activities ranging from upper class hotels to informal street vendors depend on tourists and beachgoers, marine debris diminish the quality of their recreational experience, significantly affecting lower income populations who rely on scenic quality to attract customers. By addressing marine debris as a coastal hazard, the issue would gain notability within coastal management strategies, broadening the scope of actions that could be implemented. Thus, vulnerable communities would be able to demand more pressing responses from the public sector, becoming more resilient against the risks.

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

"Favelas and stilt houses contributing to floating marine litter in an estuarine environment in the coast of São Paulo, Brazil"

Gerson Fernandino, Universidade Federal da Bahi
Carla Elliff, Universidade Federal da Bahia

ABSTRACT

Thousands of families live in favelas and stilt houses under extreme poverty conditions within the Santos-São Vicente estuarine system, state of São Paulo, Brazil. They mainly dwell in wooden houses that lack minimum sanitation conditions, and are often not benefitted by public waste collection and sewage network. It is common to see both solid waste and wastewater being directly discharged in natura into estuarine waters. Once in the water, litter items, especially plastic, tend to float. Some of it becomes trapped in the roots of mangrove trees and some is transported by tidal currents along the estuary channels to the Bay of Santos, where the items can be deposited on beaches. Floating marine litter was evaluated, monthly, through visual censuses onboard a small vessel at six specific stations distributed along the estuary channels for periods of 30 min. Litter observation was opportunistic while monitoring sea turtles in the area. Plastic was the most abundant item recorded (89%) and most items came from domestic activities (54%), confirming the deficiency in the basic sanitation system of the favelas/stilt houses area. The occurrence of this type of litter threatens marine and estuarine life, such as sea turtles and coastal birds, and, when deposited on beaches, poses risks to beachgoers. This form of pollution also reflects in costs to the public administration, compromises scenic beauty and, therefore, cause losses to the tourism sector.

"Global Flow of Plastic: Imports and Exports of Plastic Scrap Around the World"

Amy Brooks, University of Georgia
Shunli Wang, University of Georgia
Jenna Jambeck, University of Georgia

ABSTRACT

With approximately 300 million metric tons of plastic scrap produced annually and an average 9% recycled worldwide, increasing recycling is one of the goals to move us closer to a circular economy and keep plastic out of the ocean. But what happens when the flow of plastic is transboundary? In July, China announced to the World Trade Organization that it plans to ban the import of 24 types of solid waste, including plastic scrap. Scrap and waste is the sixth largest U.S. export to China, worth 5 billion dollars. While it is fairly well-known that China has been the largest importer of plastic scrap globally, in this study we examine the trends over time and over geographic regions of the global import and export of plastic scrap. With data documented by the United Nations Statistical database, we compile time trends by country, region, economic status and other classifications for three polymers polypropylene, poly vinyl chloride, and polystyrene. We will discuss the waste management and economic implications of this significant change in plastic scrap flows around the globe.

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

"Management of Homeless Encampments"

Christine Flowers, Valley Foothill Watersheds Collaborative
Rob Hutsel, San Diego River Park Foundation

ABSTRACT

CA has the over 225 of the homeless population of the US and San Diego has the fourth largest population of homeless in the US. in 2016, of the 118,142 people experiencing homelessness in California, 66% (78,390 people) were without shelter. This presentation will showcase efforts of the The San Diego River Park Foundation's (SDRPF) Healthy River, Healthy Communities Program which is its signature volunteer stewardship program and efforts in the Sacramento Region to address the environmental justice issues and environmental impacts of homeless encampments in riparian corridors.

SFRPF's Healthy River, Healthy Communities program which includes documentation and cleanup of homeless encampments has five components:

1. The Clean and Green Team coordinating large scale clean-ups each month based on needs identified through RiverBlitz trash data.

2. During River Blitz each year two volunteer field surveys of the River are completed. Trained volunteers document the River's condition using surveys with GPS units and cameras to map location, types, and amounts of trash, invasive species, and park amenity issues.

3. River Rescue volunteers support the large scale clean-ups by scouting sites prior to and following large clean-ups to make sure we get all the trash out, as well as targeting smaller trash sites that are too small or remote for large scale clean-ups.

4. River Assessment Team has a staff person with volunteers scout for trash and other issues through weekly surveys on the 2nd, 3rd, and 4th Tuesday each month, marking the locations and notes on maps for future clean-up.

5. RiverWatch Volunteers coordinate groups for monthly water quality testing and nutrient monitoring at sample sites along the length of the River, tracking the effects of clean-up efforts and identify water quality

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

"Resilience Initiative for Coastal Education (RICE): Engaging Vulnerable Human Populations Impacted by and Contributing to Marine Debris"

Albert Gorge, South Carolina Aquarium

ABSTRACT

Sea level rise, storm surge and marine/aquatic debris constitute a serious threat to human health and safety, commerce and culture, and wildlife and natural habitats alike. The goal of the Resilience Initiative for Coastal Education (RICE) is to develop a coordinated resilience strategy for the communities and shoreline of the southeastern Atlantic bight region. In 2016, the South Carolina Aquarium launched the Resilience Initiative for Coastal Education (R.I.C.E.) in collaboration with the Gullah Geechee Cultural Heritage Corridor Commission, SCETV, Allen University, Medical University of South Carolina and the U.S. Department of Energy Environmental Justice Program to develop a model for community resilience education and outreach that could further serve as a potential national model for how to engage and remove barriers for under-served communities on the topics associated with coastal resilience. Critical to the success of this effort is the ability to develop meaningful partnerships with those community organizations that have established relationships with the desired targeted at risk populations. As part of this process, we have collaborated not only with the Gullah Geechee Cultural Heritage Corridor Commission but also with organizations like the Sandalwood Community Food Pantry that feeds over 800 families in Beaufort County South Carolina.

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

“Sustainable alternatives and marine focused education to combat plastic waste in Indonesian schools”

Cassidy Fitzclarence, Bottle for Botol P/L

ABSTRACT

Indonesia is suffering from a plastic waste epidemic primarily caused by complex social issues associated with vulnerable populations. Large, densely populated communities obtain their essential items such as drinking water and rice, packaged in single-use plastics. With insufficient waste management systems to collect, centralise and recycle this plastic, monsoonal rainfall and poor urban infrastructure transports plastic waste through run-off to the ocean. These waste issues are replicated throughout Indonesian schools where drinking water is only available through the sale of plastic bottles and drinking cups, which are disposed of haphazardly.

After a year-long consultation with local teachers and NGOs, Bottle for Botol commenced engaging with schools in 2013 to implement a program to break this cycle. A targeted education curriculum on the harms of plastic waste in marine environments was implemented along with water refill stations in school canteens and reusable stainless-steel water bottles for students. By replacing the sale of single-use plastic cups from one school canteen, Bottle for Botol has prevented over 140,950 plastic drinking cups from entering Indonesian waste streams and inspired students to lobby against the sale of plastics in their school. The model has now been replicated in schools across Bali, and plans are underway to reach other islands in Indonesia. This presentation will address some of the key program successes, constraints and discuss plans for the future.

The Elephant In The Room: Addressing Vulnerable Human Populations Impacts By And Contributing To Marine Debris

"The San Diego River: A case study in strategies to address urban encampments as a significant source of marine debris"

Rob Hutsel, San Diego River Park Foundation

ABSTRACT

In 2017, San Diego received national and international attention for a Hep A outbreak. Largely attributed to a growing homeless population, the outbreak brought a heightened awareness of the significant homeless encampments along the 52 mile long San Diego River. In a one year period, The San Diego River Park Foundation documented an 84% increase in these encampments, representing more than 10% of the City's unsheltered homeless population. The San Diego River Park Foundation also documented that 98% of the trash in the riverbed was sourced to these encampments.

Studies have shown that approximately 80% of marine debris comes from land-based sources. It is also estimated that one million lbs. of trash enters the lower San Diego River annually.

This presentation will share details of a six month initiative to achieve a trash-free San Diego River through a partnership between the nonprofit San Diego River Park Foundation and the City of San Diego.The initiative brought together landowners, public agencies and non-governmental organizations.

Specific strategies will be discussed including the adaptation of a comprehensive adaptive field assessment program utilizing a mobile application developed by The San Diego River Park Foundation. This program known as "RAFT" empowered community members to be essential partners.

Bringing Value to Marine Debris

"Commodifying Plastic Marine Debris as Art Supplies"

Bette Booth, Splash Trash Intl.

ABSTRACT

If research assures that it is safe, plastic marine debris has enormous potential to be commodified as art supplies. The number of artists using plastic marine debris as their medium is increasing exponentially every day. Recent public art installations alone, such as whale sculptures in London, the Philippines and Costa Rica, used thousands of pounds of repurposed marine debris. The quality and variety of current marine debris art indicates that plastic marine debris would be an interesting medium for a variety of other artists and craftspeople as well. See video of sample marine debris art supplies. https://www.youtube.com/watch?v=qpPQL1EwnQE&feature=em-upload_owner

Two potential marine debris markets include:

• Expanding and 'professionalizing' specialized marketing to artists working in plastic marine debris as their primary medium: Several artists already ask local beach cleaners to collect specific materials for an envisioned art piece, for example, twenty pounds of black plastic or a bucket of microplastics. This market could be expanded and commodified, putting a value on the plastic that includes the collector's labor, materials and overhead.

• Introducing plastic debris as art supplies in retail stores: For example, small and medium-sized plastic pieces could be packaged in in different colors for mosaic artists; rope and net could be packaged for weavers and other fabric artists; and interesting plastic items such as soldiers, farm animals or doll parts could be packaged for use in collages or mixed-media art.

This paper describes, analyzes and provides recommendations for commodifying plastic marine debris as art supplies in these two markets.

Bringing Value to Marine Debris

"Community Based Waste Management and Up-cycling Enterprises – Watamu, Kenya"

Steve Trott, Watamu Marine Association

ABSTRACT

This initiative, developed by Watamu Marine Association brings multiple stakeholders together in a collective effort to reduce threats caused by plastics and other marine debris pollution, impacting the Watamu Marine Park beaches and marine environment.

The purpose is to help provide clean beaches and a solid waste free environment for the benefit and welfare of the local community, the local tourism industry and the marine environment. Small business enterprises have been created from recycling, reuse and upcycling of plastic and glass waste which are sourced from beaches, hotels and residents.

A plastic recycling facility operates a plastic crusher machine and provides part time employment to 25 local community group members as beach cleaners, waste collectors and recyclers. Their income is provided by sales of processed plastic to recycling industries and through Watamu tourism industry sponsorship.

Artwork and sculptures are also created from plastic and other marine debris and sold in local shops and hotels boutiques. Another innovation is up-cycling glass and plastic bottles to make building blocks for constructing walls.

The enterprises are an example of successful cooperation between community organisations and the local tourism industry in creating solid waste value chains. The results are cleaned up beaches and reduced environmental threats and employment opportunities for women and youth.

The enterprise has received national and international acclaim and awards and is set to become a regional showcase for a combination of best waste management and environmental practices, social enterprise and sustainable tourism.

By creating dynamic waste value chains, local communities in African coastal resort towns can play a significant role in waste management and reducing marine pollution in their local area.

Bringing Value to Marine Debris

"Creating Value Through Emotional Connections To Marine Debris"

Brittany Webster, Planet Love Life
Rob Webster, Planet Love Life

ABSTRACT

Planet Love Life upcycles salvaged ALDFG from beach & ocean cleanup projects around the world. Our wearable marine debris products are a physical and visual reminder of the marine debris issue. Each bracelet represents a different marine animal that is negatively affected by marine debris and can be used as a platform to create positive conversations leading to solutions of these issues. By providing a connection between marine debris and specific animal species of marine life, we are then able to create an emotional connection with consumers and the impact their actions have on the marine environment. The sales and profit from of our products can help to fund local cleanups and provide a fundraising tool for non-profit organizations.

"Eco Innovation"

Cyrill Gutsch, Parley for the Oceans
Michael Long, Parley for the Oceans

ABSTRACT

Cyrill Gutsch, Founder, Parley for the Oceans

As scientific understanding of marine plastic pollution deepens, public awareness grows. Although the threat has risen in the global consciousness, solutions remain elusive. Recognizing the complexity of the issue, Parley for the Oceans set forth a new approach: a strategy driven by creative collaboration and eco innovation, based on the fact that every second breath we take is generated by the oceans. The strategy — Parley AIR: Avoid, Intercept, Redesign — is shifting the conversation and driving change across industry, government, and in the creative communities that mold reality.

Designer and strategist Cyrill Gutsch founded Parley in 2012 to provide a collaboration network where creators, thinkers and leaders come together to raise awareness for the beauty and fragility of our oceans and collaborate to end their destruction. Parley is known for renaming sustainability into 'Eco Innovation,' a concept realized through high-caliber collaborations and the introduction of Ocean Plastic™, a range of premium materials for the sports, fashion and luxury industries made from upcycled plastic debris collected on high seas, beaches and in remote coastal communities.

Parley understands current plastic is a design failure, seeing the long-term solution for marine plastic pollution not in recycling, but in the redesign of the harmful material, processes and thinking. As a catalyst innovation, Ocean Plastic™ provides an immediate replacement for new, virgin plastic that raises awareness of the issue while also providing a funding mechanism that allows for the implementation of the Parley AIR Strategy in four key areas: Communication and Education, Direct Impact, Research and Development, and Eco-Innovation.

"Sustainable Coastlines Hawaii – Making waves in Hawaii, seeing ripples in your home town. Increasing Awareness Internationally."

Katherine Ziemann, Sustainable Coastlines Hawaii
Kahi Pacarro, Sustainable Coastlines Hawaii
Sarah-Jeanne Royer, Sustainable Coastlines Hawaii

ABSTRACT

At Sustainable Coastlines Hawaii (SCH) our mission is to inspire local communities to care for their coastlines through hands-on beach cleanups. Located in Hawaii, a world-famous tourist destination, SCH saw the opportunity to raise awareness beyond our local communities. Marine debris is a global problem, people all over the world want to visit Hawaii, so why not raise awareness and inspire people from around the globe?

In 2017 SCH launched a voluntourism program that hosts travelers from around the world. Our guests pay a very economical rate in exchange for an all-inclusive volunteer program. SCH provides airport pickups, accommodation, meals, orientation, and transportation to and from volunteer projects monday through Friday. The primary focus of our IVHQ program is raising awareness of plastic pollution through beach cleanups, analyzing the collected debris, discussing solutions, and working in the upper watershed to identify connections.

One of our goals is to emphasize the message that clean beaches start at home. This experience inspires our international volunteers to change their lifestyles and consumption patterns while in Hawaii and encourages retention upon returning home. In addition to cleaning beaches, we partner with local non-profits upland in our watershed to show how water flows to the oceans so visitors consider the many ways they can take action in their hometown even if they don't live on a beach. One of the successes of this program is seeing many of our visitors share what they've learned upon returning home to an even larger audience and raising awareness world-wide.

Bringing Value to Marine Debris

"Treating marine debris as the resource that it is: Sorting and recycling after cleanups"

Doorae Shin, Kokua Hawaii Foundation
Natalie McKinney, Kokua Hawaii Foundation

ABSTRACT

Being "wasteful" is defined as "using or expending something of value carelessly, extravagantly, or to no purpose." The wasteful culture of modern humans is a huge source of the plastic pollution crisis, but marine debris and all plastics are valuable resources. The rampant use of plastics originated in excitement for the qualities of its durable, lightweight and waterproof nature. This convenient and low-cost material is clogging rivers and streams and washing up on beaches around the world. As millions of global citizens clean their coastlines and find massive amounts of plastic, we can partner with businesses and organizations to create value from the countless tons of plastic pollution. Kōkua Hawaiʻi Foundation collaborates with Sustainable Coastlines Hawaii, other local organizations, and national companies to make this happen.

With a large percentage of marine debris from Hawaiʻi beach cleanups now being recycled through the Parley for the Oceans program in partnership with Adidas, there is great potential for coastal communities around the world to increase sorting and recycling efforts following river, stream and beach cleanups. These efforts greatly reduce the need for incineration and landfilling and allow these valuable resources to continue circulating through our economies, which creates jobs and reduces demand on the production of virgin plastics. Sorting and recycling programs at river, stream and beach cleanups empower and inspire volunteers while giving businesses opportunities for innovation to offer solutions to global issues. Sorting also allows for data collection that can inform international reporting and ultimately help achieve the overall goal of more extended producer responsibility. A short video is available that highlights the sorting and recycling efforts at Hawaiʻi's beach cleanups.

Bringing Value to Marine Debris

“Waste To Wonder”

Brodie Neill, Waste To Wonder

ABSTRACT

Designer Brodie Neill is passionate about the need to reframe the conversation on ‘waste’ and has developed a new architectural and design material from ocean plastic composite that he has called ‘Ocean Terrazzo’.Working with an international network of scientists, researchers, environmental experts, beachcombers, engineers, artisans and manufacturers to collect and reconstitute small fragments of plastic washed-up on the shores around the globe to produce a terrazzo like composite. Brodie launched the reconstituted material in 2016 at the inaugural London Design Biennale where he brought the global issue of ocean plastic the round table of the international design forum.Brodie has since developed the Ocean Terrazzo into a range of furniture pieces titled Flotsam that were recently launched as part of his Drop in the Ocean exhibition at the London Design festival 2017. With ongoing research led projects in the field of ocean plastic debris that can be shared in an insightful and inspirational format Brodie will present an array of development imagery and the final objects that elevate microplastics from waste to wonder.

"Differences in perception and reaction of beach users` groups to beach marine debris that can influence a loss of tourism revenue in coastal areas"

Allan Paul Krelling, Federal Institute of Education, Science and Technology of Paraná
Allan Thomas Williams, University of Wales
Alexander Turra, University of São Paulo (USP)

ABSTRACT

Human pressure over coastal resources compromises the quality of the environment and threatens local coastal economies. Marine debris is the most conspicuous pollutant that makes beaches aesthetically unappealing to users. The perceptions and reactions of beach users to stranded litter were compared between second-home owners and users (SHOU) and non-recurrent tourists (T). Socio-economic characteristics; assessment of the overall beach quality and perception of beach litter pollution (perception); hypothetical scenarios of marine litter pollution and deterrence (reaction); and potential alternative destinations in the case of deterrence (economic effect) were obtained through a questionnaire. Questionnaires (n = 319) were applied at two Brazilian beaches, with different physiographical settings (Pontal do Sul, PS, estuarine beach; Ipanema, I, open-ocean beach). Beach users' groups differed regarding daily expenses (T>SHOU), period of permanence per trip (SHOU>T) and trip frequency (SHOU>T). Marine debris generation was mainly attributed to local "beach users", in the open-ocean beach (I). "Marine" (or nonlocal) sources were four times more frequently cited in the estuarine beach (PS). Perception on actual litter pollution and litter deterrence scenarios, did not vary between beaches or groups. More than 85% of beachgoers would avoid a beach visit if a worst scenario (> 15items/m2) occurred and most users would choose a neighboring state beach destination. Stranded litter may potentially reduce local tourism income by 39.1%, representing losses of up to US$ 8.5 million per year. These figures are proxies to support the trade-off local authority's make between investments to prevent/remove beach litter and the potential reduction in income from a tourist destination change.

Estimating The Economic Impacts Of Marine Debris

"Ecosystem-Service Scaling Techniques to Evaluate the Benefits of Marine Debris Removal"

Adam Domanski, ECONorthwest
Amanda Laverty, NOAA

ABSTRACT

While knowledge is continually advancing on the ecological impacts of marine debris, methods to evaluate the comparative scale of these impacts are less well developed. Understanding how the benefits of marine debris removal efforts relate to other types of restoration can allow resource managers to direct limited restoration funds to projects that produce the greatest gains in ecosystem services. We propose a framework for evaluating marine debris removal projects in an ecosystem service equivalency analysis framework and use it to evaluate the comparative benefits of past marine debris removal projects. By drawing on existing spatial and temporal data on the habitat (e.g. scouring) and resource (e.g. ghostfishing) impacts of marine debris, we demonstrate how a resource manager can quantify the ecosystem service benefits of a removal project in present value terms. We apply this framework to a sample of past NOAA-funded removal projects and rank them based on ecosystem service gains and cost-effectiveness.

Estimating The Economic Impacts Of Marine Debris

"Examining derelict trap impacts on harvest in the commercial blue crab Callinectes sapidus fishery"

James DelBene, Virginia Institute of Marine Science at William and Mary
Donna Bilkovic, Virginia Institute of Marine Science at William and Mary
Kirk Havens, Virginia Institute of Marine Science at William and Mary
Andrew Scheld, Virginia Institute of Marine Science at William and Mary

ABSTRACT

The Chesapeake Bay blue crab Callinectes sapidus fishery is responsible for 35-50% of U.S. blue crab commercial harvests valued at $150-200 million annually. Crab traps are the primary commercial fishing gear used to harvest blue crabs, and it is estimated that 12-20% of approximately 600,000 licensed traps in the Chesapeake become derelict each year. Ghost fishing impacts on valued bycatch species are well documented, yet further analysis of derelict trap impacts on blue crab harvest is necessary to support a profitable and ecologically sustainable fishery. Analysis evaluating the 2008-2012 Marine Debris Location and Removal Program that employed watermen to remove derelict traps in the Chesapeake suggests removal of 10-15% of derelict traps increased harvest by 22 million pounds. To verify these findings, preliminary experimental data collected from the Mobjack Bay, VA, in 2017, analyzed blue crab harvest in a control group of actively fished traps (baited) without derelict traps (unbaited) present and a treatment group of actively fished traps with derelict traps present. Blue crab harvest was significantly lower in the treatment group where derelict traps were present. On average, 4.9 crabs per trap per day (SD = 2.7) were harvested from the control group, compared with 3.3 crabs per trap per day (SD = 2.0) harvested from the treatment group. This finding further supports the claim that derelict traps create an uncontrolled inefficiency in the blue crab fishery that decreases the harvest of blue crabs, requiring a larger investment of time and resources from watermen to reach harvest limits. Better understanding of derelict trap impacts informs management agencies on effective development and implementation of best management practices to ensure a sustainable and profitable fishery for all stakeholders.

Estimating The Economic Impacts Of Marine Debris

"The Cost to West Coast Communities of Dealing with Trash, Reducing Marine Debris"

Barbara Stickel, Kier Associates
Andrew Jahn, Kier Associates
Bill Kier, Kier Associates

ABSTRACT

Under contract to the United States Environmental Protection Agency (EPA) the Kier Associates team contacted a random sample of U.S. West Coast communities in California, Oregon and Washington located in watersheds which drain into the Pacific Ocean. Also included were data from 15 California cities collected in a separate, initial study begun at EPA in 2011. From the data received from these 90 different communities, which ranged in size from just over 200 residents (Ukiah, Oregon) to over 4 million residents (Los Angeles, California), the team found that, regardless of the distance from the ocean or the number of residents, West Coast communities are spending approximately $13 per resident per year to combat and clean up trash, much of which would otherwise end up as marine debris. Cost information was sought for six different activities related to trash management, namely: beach and waterway cleanup, street sweeping, installation of storm-water capture devices,

storm drain cleaning and maintenance, manual cleanup of litter, and public anti-littering campaigns. Extrapolated, these direct costs amount to more than one half billion dollars each year to combat litter and curtail marine debris.

Estimating The Economic Impacts Of Marine Debris

"The costs of marine debris in the marine economy- practical considerations for future policy action"

Alistair Mcilgorm, ANCORS, University of Wollongong
Karen Raubenheimer, ANCORS, University of Wollongong

ABSTRACT

The economic costs of marine debris are not just the direct and indirect costs of damage, but in considering policy options, costs are inherently linked to the benefits from marine debris control. Marine debris is an "avoidable cost" and prevention is cheaper than cure. The costs of direct damage from marine debris to other users in the marine economy are an externality and an economic loss and can be measured. Indirect damage requires more information on vectors and damage functions, enabling physical damage to be valued. The second use of costs is for remediation, which generally consider density dependence and the net benefits from cleanup. All this discourse has yet to really be gathered into a global approach to future policy action and economic priorities. The economics of prevention versus clean-up may stack up globally in theory, but the local municipality spends to clean up their beach. In the marine economy this translates into capital investment into beach cleaning equipment, as opposed to capital being directed to larger scale prevention schemes. Other eccentric proposals direct precious capital into unrealistic open ocean cleaning exercises that have unproven technical and economic viability. A Coasian approach to reducing marine debris is undermined by a lack of rights in the ocean. So what is the answer? And who wants it? Going forward, countries wanting to prevent marine debris entering the ocean require improved governance regimes and an investment framework where the capital required for prevention can be applied wisely. This will likely cost more than we think!

Estimating The Economic Impacts Of Marine Debris

"The social costs of marine litter along European coasts"

Roy Brouwer, The Water Institute, University of Waterloo
Dariya Hadzhiyska, Denkstatt
Christos Ioakeimidis, UNEP
Hugo Ouderdorp, Vrije Universiteit

ABSTRACT

This is the first study to assess the social costs of marine debris washed ashore and litter left behind by beach visitors along different European coasts. Three identical surveys were implemented at 6 beaches along the Mediterranean Sea in Greece, the Black Sea in Bulgaria and the North Sea in the Netherlands. Beach visitors are asked for their experiences with beach litter and their willingness to volunteer in beach clean-up programs and their willingness to pay (WTP) an entrance fee or increase in local tax to clean up marine litter. Significant differences are found between countries. Assessing how responsible beachgoers feel for beach litter they partly leave behind themselves and to what extent they are willing to pay for their clean-up compared to litter washed ashore provides important information for priority setting in coastal policy and management. Public perception was measured in terms of public annoyance and whether the presence of beach litter is a reason to not visit a beach. Cigarette butts were reported as the main marine litter type, followed by plastic bottles and plastic bags. The clean-up of the latter was valued highest by beach visitors, followed by glass bottles and cigarette butts. The estimated WTP welfare measures are used as indicators of the social costs of marine litter. Actual or potential clean-up costs can be directly compared to these estimates to assess the economic welfare effects of clean-up actions in a cost-benefit framework. Applying the same study design across 3 different countries provides furthermore important insight into the spatial distribution of the social costs of marine litter across European states and the extent to which these costs differ across locations depending on public perception of marine litter and socio-economic and demographic profiles of beach visitors.

Global Plastics Alliance Efforts To Address Marine Debris

"'Brazilian Plastics Sectoral Forum – For a Clean Ocean' – achievements and challenges"

Alexander Turra, Oceanographic Institute

ABSTRACT

The Brazilian plastic industry, represented by Plastivida – The Socio-environmental Institute of Plastics, in partnership with the Oceanographic Institute of University of São Paulo (IOUSP) has been acting in order to engage the private sector to combat marine litter. In 2012, after becoming a signatory of the 'Declaration of the Global Plastics Associations for Solutions on Marine, Plastivida signed a partnership with IOUSP in order to carry out a technical-scientific program on the issue. A great deal of scientific studies and activities has been carried out in Brazil. In addition, a series of activities and meetings allowed the internalization of the environmental issues related to marine litter. The launching of the 'Brazilian Plastics Sectoral Forum – For a Clean Ocean' in June 2016 is a milestone in this process, representing the result of a social learning process that is changing the approach of the sector from a reactive to a proactive manner. This resulted in an organized and structured integration within the sector and with different publics – population, industries and government. The Forum gathers companies, associations and unions and has been acting with the aim to contribute to change the current marine pollution scenario. The Forum created an online platform (www.porummarlimpo.org.br) that has been grouping information regarding environmental education, prevention, collection and recycling, becoming a useful tool for the sector actions. Among the challenges, the Forum is planning to adapt and implement the "Zero Pellet" program and take part of the Brazilian National Plan to Combat Marine Litter.

Global Plastics Alliance Efforts To Address Marine Debris

"Combating Marine Debris, The Philippine Experience"

Crispian Lao, Philippine Plastics Industry Association

ABSTRACT

In 2015, Jambeck, et. al. ranked The Philippines as the no. 3 source of Global Marine Plastic Pollution. The Ocean Conservancy reports entitled Stemming the Tide and The Next Wave pointed to waste management from land source as the main source and highlighted the need to finance solid waste management solutions.

Waste Generation data adopted by the Philippine National Solid Waste Management Commission revealed that the country generates over 40,000 tons of waste per day. 36% of barangay units established Material Recovery Facilities and 30% of the population has access to Sanitary Landfills as mandated under The Ecological Solid Waste Management Act of 2000.

As early as 2006, the Philippine Plastics Industry Association (PPIA) initiated programs aimed at reducing plastic waste to the environment through a JICA funded program on the recovery and collection of plastic bags from different barangays for recycling through an exchange system. PPIA also partnered with the Department of Science and Technology for the local development of small scale technology solutions (e.g. Plastic Melting Oven, Mixed Waste Plastic to Asphalt Roads). The talk with discuss these and other programs supported by PPIA, including the recently established Philippine Alliance for Recycling and Material Sustainability (PARMS), which brings together stakeholders in the recycling value chain, including manufacturers, industry groups, retail groups, waste consolidators and haulers, recyclers, and non-government and government entities to develop and implement a holistic and comprehensive program to increase resource recovery and reduce landfill dependence towards zero waste.

Global Plastics Alliance Efforts To Address Marine Debris

"Plastics SA - Taking Action on Plastics Marine Debris"

Douw Steyn, Plastics SA

ABSTRACT

Plastics SA became a signatory to the Declaration of the Global Plastics Associations for Solutions on Marine Debris in 2011 and represents the plastics industry in South Africa and provides strategic leadership to the industry on sustainability issues. Most plastics on the South African beaches and ocean are from land-based sources. Three "River Catchment Projects" has been identified: eThekweni River Catchment (Durban, Kwa Zulu Natal); Zwartkop River Catchment (Port Elizabeth, Eastern Cape); Black River Catchment (Cape Town, Western Cape). The following activities were undertaken to address marine litter. (1) Waste Management and Recycling: Research is conducted to determine the state of waste management and recycling and the opportunities to establish plastics recovery and recycling infrastructure. Training is provided to plastics collectors, recyclers and waste managers. (2) Education: Schools and communities in the river catchment areas are trained on plastics and recycling and provided with education materials. Marine organizations such as Marine and Coastal Educators Network are supported with workshops. AS a founding member and supporter of the African Marine Waste Network, Plastics SA is supporting the development of a "Best Practice Guideline for Africa" on marine pollution. (3) Litter booms: To prevent plastics entering the ocean, extensive research are undertaken to develop the most suitable litter boom to catch plastics floating downstream, and then be collected. (4) Clean-up campaigns: Clean-up events are supported such as Water Week, World Environment Day, World Oceans Day, Clean-up and Recycle SA Week, Recycling Day and International Coastal Clean-up Day. Sport events such a Two Ocean Marathon and Cape Argus Cycle Race in Cape Town are supported with plastics waste management.

"Biodegradation of plastic bags: A technological alternative for preventing marine debris"

Ivan Balic, Universidad Arturo Prat
Sergio Diez, Universidad Arturo Prat
Yassets Egaña, Universidad Arturo Prat
Patricio Nuñez, Universidad Arturo Prat
Juan Carlos Rios, Universidad Arturo Prat
Rocio Tijaro-Rojas, Universidad Arturo Prat

ABSTRACT

Globally, we produce 1.3 billion tons of waste per year. The daily contribution person is approximately 1.2 kilograms, which is projected to double by the year 2025. Approximately 11% of this waste is plastic, which frequently ends up in the oceans. Plastic pollution is disastrous for oceanic environments, affecting important species and ecology, and also the coastal economic activities in different parts of the world. Plastic waste produced at land affects oceanic ecosystems, due to its durability remains at the sea, been confused as food by animals. Not only wild species are affected, also human consumption resources.

Our research focuses on isolating, genotyping and optimizing microorganisms that use plastic waste as food source to construct dynamic bio-reactors or purify enzymes that can help manage in a faster way the present plastic waste before it gets to the oceans. Preliminary results, under laboratory conditions, has shown an improved degradation of polyethylene when three species of bacteria and three of fungi act on the selected plastic material.

"Clean Tax Cuts and the Opportunities to Drive Innovation Across Countries for a Plastic Circular Economy"

Doug Woodring, Ocean Recovery Alliance

ABSTRACT

One of the commitments Ocean Recovery Alliance made at the UN Ocean Conference in June, 2017, along with Mission Blue, The Grace Richardson Fund, and the IUCN, was to create a regime plan for the introduction of Clean Tax Cuts (CTC) for innovations in plastic sustainability. These are supply-side tax cuts which target primarily capital tax rates investors pay on debt and equity in clean investments (defined as those which reduce waste, inefficiency and negative externalities). Targeting capital tax barriers accelerates capital to and demand for clean solutions simultaneously, by increasing profits and reducing costs of both capital and outputs for those solutions and technologies. CTC employs carrots, not sticks, and picks metrics, not winners or losers. CTC employs only positive (rather than negative) feedback loop mechanisms to reward and accelerate all profitable, sustainable technologies that reduce or monetize waste. This simple, positive design helps CTC align conservative, progressive, consumer and business interests on energy, environmental protection, and economic growth.

Seven other green sectors are being examined as well, including applications for the following sectors and markets: green bonds, electric power, transportation, clean tech, farming and forestry, oil & gas, and energy efficiency in real estate. The potential for CTCs to play a role in driving much needed innovation and technology in the plastic pollution space is significant. CTCs may help drive a variety of plastic waste reduction solutions: source reduction strategies, new, cleaner waste-to-fuel technologies, use of alternative biodegradable materials, and circular economy solutions that make waste plastic a valuable feedstock for other products and fuels, to incentivize plastic waste collection and recycling.

"De-Risking Ocean Plastic for Major Consumer Brands"

Rob Ianelli, Ocean Works Inc.

ABSTRACT

About: Ocean Works is an organization focused on reducing the plastic flowing into our oceans. We harvest plastics from coastal areas where plastic waste is mismanaged and turn that material into durable, long lasting goods. We also support efforts of re-utilization to help turn the tide on the tide of ocean plastics.

How? Ocean Works was born out of Norton Point, an eyewear company that launched a line of ocean plastic sunglasses in June of 2016. Funded on Kickstarter in an astonishing six days, the project raised awareness of ocean plastic worldwide. The products are currently in stores and online. It was the pursuit of this project that opened our eyes to the many disparate elements that needed to be woven together to create a project that makes a difference.

What happened next? Upon the success of Norton Point we were inundated with companies reaching out asking us how to incorporate ocean plastic into their product collections. To our dismay many had already tried to assemble the supply chain pieces themselves and/or do their extensive research. However, major consumer brands were coming to us and essentially stumped, frustrated and ready to give up.

We know immediately the real opportunity for our role in ocean plastics was to make it EASIER and more EFFICIENT for corporations to integrate ocean plastic into their products. That is why we have built the world's first ocean plastic platform to be a turn-key solution for major global brands.

What's happening now? Ocean Works will be debuting a number of key apparel brand partners (think: ocean plastic buttons) and various other elements to the footwear industry and many more! All of our ocean plastic parts and finished goods have traceability built into the molds (material type, coordinates of plastic collection, and the year of manufacturing).

Innovation For A Clean Ocean: R&D, Unique Programs And Initiatives That Are Leading The Way Into The Solutions Phase Of Marine Debris Action

"Harnessing the Power of Sport to Tackle the Issue of Ocean Plastic"

Michelle Carnevale, 11th Hour Racing

ABSTRACT

In the US, it is estimated that 16% of people follow science, while over 70% follow sport. Utilizing sports and fan engagement to shine a spotlight on environmental issues and sustainability is an emerging trend, aimed at raising awareness among new audiences. This presentation will highlight how one sport is being used to amplify the threat of plastic pollution in our oceans.

Sailors have a special connection to the natural world, as they use the ocean as their workplace. They rely on the oceans for their sport and livelihood; they see living systems as deeply interconnected and can advocate for ways we can improve industries and practices to rapidly reduce the impact of human activities on land and at sea.

The sport of sailing provides a unique opportunity to engage wide audiences around a common area of interest, and concern, and promote positive change among fans, stakeholders and the future generations of leaders and world citizens.

11th Hour Racing, a program of The Schmidt Family Foundation, establishes strategic partnerships within the sailing and maritime communities to promote collaborative, systemic change benefitting the health of the ocean. Since 2010, 11th Hour Racing has been harnessing the power of sport with an innovative and comprehensive approach through three primary areas of engagement: Grants, Partnerships and Ambassadors.

This presentation will highlight 11th Hour Racing's unique approach to raising awareness to the issue of marine debris, promoting behavior change and innovative solutions through a unique platform. Highlights will be shared from our partnerships in the Volvo Ocean Race, America's Cup, and local grant projects tackling marine debris. They also showcase how embedding sustainability in a top-level professional sports team can drive performance, efficiency and innovation.

Innovation For A Clean Ocean: R&D, Unique Programs And Initiatives That Are Leading The Way Into The Solutions Phase Of Marine Debris Action

"MantaRay II: A second generation autonomous real-time sampling instrument for the quantification of marine microplastic debris"

Ethan Edson, Northeastern University
Mark Patterson, Northeastern University

ABSTRACT

MantaRay II is an autonomous sampling instrument designed to measure microplastics concentrations in bodies of water. It filters water through an optical detector that sizes particles using a line sensor, and then characterizes detected particles using Raman spectroscopy and machine learning. MantaRay II captures microplastics particles on an internal filter cassette with 30 plates that allows programmable event-triggered sampling. When MantaRay is physically recovered, these collected particles can be further analyzed, e.g., for toxin adsorption. The system fits in a watertight housing that floats at the surface or can be used for vertical distribution studies down to 200 feet. MantaRay has an integrated GPS receiver with Iridium satellite modem connectivity allowing collection of real-time data. Further planned development includes size reduction of the instrument so that it can be integrated onto Remotely Operated Vehicles (ROVs), Autonomous Underwater Vehicles (AUVs), or attached to ships of opportunity around the world. Autonomous technology like MantaRay will help to fill in data gaps on microplastic concentration and bring the overall cost of data collection down for scientists and the regulatory community going forward.

"What screams at you? An unique education and innovation program to address marine debris."

Rachael Miller, Rozalia Project
Ashley Sullivan, Rozalia Project

ABSTRACT

While on the whole people do not like marine debris, often one part of the marine debris problem doesn't just speak to people, but really screams at them - such as straws, balloons or single use beverage bottle. There is value in using that specific reaction and emotion to drive solutions. Rozalia Project experienced this firsthand with the problem of microfiber pollution. It screamed at them, so they came up with a human-scale solution, the Cora Ball. The next problem to scream at them was lobster buoys, so they are currently working on a sustainable lobster buoy. During these experiences, Rozalia Project's educators realized that instead of asking people to help work on the problem of marine debris on the whole, or asking them to work on a problem Rozalia Project thought was important, but perhaps wasn't that important to them, there is a better strategy.

For the last two years, Rozalia Project has been piloting a new program that brings participants of all ages through a program that starts with a data cleanup but continues past that data cleanup to include data analysis, discussing behavior change, figuring out what part of the marine debris problem screams at people and then working to brainstorm implementable solutions. This session will share more than Rozalia Project's physical innovations, but include how they've taken the experience of developing the Cora Ball and sustainable lobster buoys and parlayed them into an education program that ends in inspired, meaningful and implementable solutions.

Local To Global Partnerships: Overcoming Debris Barriers Through Collaboration

“32-years of Community: The International Coastal Cleanup”

Nicholas Mallos, Ocean Conservancy
Allison Schutes, Ocean Conservancy

ABSTRACT

In 1986, Ocean Conservancy launched the International Coastal Cleanup (Cleanup), an annual day of action through which volunteers around the globe mobilize to remove trash from beaches and inland waterways. Since the Cleanup's inception, more than 12 million volunteers have removed in excess of 100 million kilograms of debris while amassing a global database of more than 230 million individual items of trash. Beyond debris removal, the Cleanup has created an unparalleled point of entry for educating people about the crisis of ocean plastics. The foundation on which the Cleanup operates is a global network of national and international Coordinators that oversee cleanups throughout their respective countries and geographies; simply put, without this community of extraordinary individuals the Cleanup could not exist. Because at the heart of it, the Cleanup is about community; it's about coming together and helping our neighbors rid beaches and waterways of trash, or stepping up in the wake of natural disasters to coordinate local response efforts. Time and time again--for more than three decades--the reach, expertise, and dedication of the global Cleanup community has proven what the power of collective action in achieving impact and change.

Local To Global Partnerships: Overcoming Debris Barriers Through Collaboration

"Building the global community of practice: Lessons from five years of the MarineDebris.Info discussion list"

John Davis, MarineDebris.Info, a project of OCTO
Nick Wehner, MarineDebris.Info, a project of OCTO

ABSTRACT

Launched in 2012, MarineDebris.Info (MDI) is the online community of practice on research, management, and prevention of marine litter. The MDI discussion list has over 500 member posts a year, and MDI webinars average 300 registrants per event – the most of any webinar series in ocean conservation. MDI is where the world's marine litter researchers, managers, and activists gather online to share knowledge and strategies.

This presentation will cover:

- Examples of collaborations and cross-cutting work facilitated by MDI
- Trends in how the community is sharing knowledge
- Tipping points in the growth of the MDI community
- Plan for the next five years of promoting partnerships and moving the community forward

MarineDebris.Info is coordinated by OCTO (octogroup.org). OCTO specializes in building robust online communities of practice for ocean professionals. In the past year more than 75,000 practitioners used OCTO's services, which include MarineDebris.Info, OpenChannels.org, MPA News, Marine Ecosystems and Management, the EBM Tools Network, and more. OCTO regularly partners on its projects with other institutions including NOAA, UNESCO, UN Environment, IUCN, the West Coast Marine Debris Alliance, and the University of Washington.

Local To Global Partnerships: Overcoming Debris Barriers Through Collaboration

"Implementing a Volunteer-led Rapid Response Marine Debris Protocol in Oregon"

Briana Goodwin, Surfrider Foundation
Charlie Plybon, Surfrider Foundation

ABSTRACT

A focused strategy in response to marine debris events yields a significantly higher impact for debris removal than the traditional "scheduled" cleanup. Surfrider Foundation, with support from NOAA, developed and implemented a marine debris rapid response protocol for Oregon in 2014. In the inaugural year, volunteers and chapters conducted 17 rapid response cleanups, the majority of which were initiated by requests from Oregon Parks and Recreation Department (OPRD). There were six marine debris rapid response requests, five of which were performed with one cleanup event and one that required 12 cleanups.

For each of the rapid response events, data was collected in accordance with NOAA's Marine Debris Survey Card and a "Rapid Response Form" was utilized in partnership with OPRD to track and plan the cleanup event. Response forms also contain links to photo albums and web posts of the cleanup events as well as additional narrative and reference information. Data collected from these debris events in sensitive habitats help us better understand geographic and oceanographic trends in debris accumulation, thus supporting improved strategies for targeting future cleanup efforts.

Several lessons were learned during the implementation of this program. Due to the nature of volunteer lead cleanups and the requisite scheduling (largely on weekends) as well as coordinating with multiple agencies' staff in sensitive areas requiring their presence and/or special permitting, the strategies of organizing cleanups through a rapid protocol continues to evolve. We continue to streamline our communications and work with agency staff to improve scheduling and efficiency of response.

Local To Global Partnerships: Overcoming Debris Barriers Through Collaboration

"The Global Ghost Gear Initiative – a global multi-stakeholder alliance working together to address the problem of lost, abandoned and otherwise discarded fishing gear at scale."

Ingrid Giskes, World Animal Protection - Head of Campaign, Sea Change

ABSTRACT

In 2015, World Animal Protection (WAP) launched the Global Ghost Gear Initiative (GGGI), after an extensive consultation process that highlighted that cross-sectoral global collaboration was a necessary approach to combat ghost gear. The GGGI brings together a critical diverse group of 12 Governments and 63 stakeholders comprised of private sector, seafood and fishing industry, researchers, intergovernmental and non-governmental organizations. The GGGI has a global approach and reach yet a local and regional application; and drives change through its collective impact model. Its mission is to improve the health of marine ecosystems, to protect marine animals from harm and too safeguard human health and livelihoods through its working groups. Two of its flagship pieces of work – the creation of a global data portal, synthesizing data on the problem of ghost gear worldwide; and the Best Practise Framework, a practical guidance document for the management of fishing gear – have a global applicability. However, prior to their inception, they have benefitted from locally run consultation processes to increase implementation, usability and ultimately uptake. The GGGI also coordinates holistic solution projects in local ghost gear hotspots, bringing together relevant GGGI partners. Projects are reviewed by a cross-sectoral review board and the GGGI Steering Group to ensure that they are sustainable, scalable, and also include elements of embedding best practice and collating data. In my presentation, I will highlight how the GGGI was established and build as an alliance over the last 3 years and how we have managed to make an impact both at local and regional level through our global approach, while also ensuring uptake of data and solutions in the policy arena.

"The Heavy Load: Addressing Creosote and Large Debris in the Salish Sea of Washington State"

Chris Robertson, Washington State Department of Natural Resources

ABSTRACT

Remnant creosote treated wood products and other large marine debris are major contributing factors to decreased ecosystem health within the Salish Sea. The wood preservative creosote is a known carcinogen and a significant source of polycyclic aromatic hydrocarbons (PAH). These chemicals persist in sediments and lead to increased forage fish spawn mortality. PAH impacts are amplified through bioaccumulation and directly impact native salmon runs and resident Orca Whales. There is an estimated 650,000 gallons of creosote currently leaching from the remaining 16,000 creosote treated pilings. The hazardous and technical nature of removing creosote logs and large debris does not lend itself to the capabilities of most state and local agencies, community groups, NGO's, and other volunteer-based removal efforts.

In response, the Washington Department of Natural Resources (DNR) Aquatic Lands Restoration Program has developed a program to partner with these groups and eradicate creosote from the Salish Sea while providing rapid response and removal of large debris. Through a broad network of partnerships, specialized equipment, and training, the DNR has become the lead entity for creosote and large debris removal and disposal throughout the state. Since 2004, the DNR has developed Best Management Practices for removal by land, sea, and air. To date, the program has removed over 52 million pounds of marine debris and 296,922 sq. /ft. of overwater structures. With an estimated 35 million pounds of creosote remaining in the ecosystem, the DNR is exploring new technology and partnerships to reach new shoreline property owners and respond to reports of debris from the public.

Local To Global Partnerships: Overcoming Debris Barriers Through Collaboration

"The West Coast Marine Debris Alliance – the Successes and Challenges of Regional Partnerships"

Eben Schwartz, California Coastal Commission

ABSTRACT

The West Coast Marine Debris Alliance (the Alliance) has gone through several iterations since it was first launched in the fall of 2008. Originally conceived as an "Action Coordination Team," one of eight topic-specific groups called for by the West Coast Governor's Agreement on Ocean Health (signed by the Governors of California, Oregon, and Washington in 2006), the group was tasked with developing coordinated priorities and work plans for the marine debris community across the West Coast. A team of representatives from the three states, representing government, academia, industry, tribes, and the NGO community, was assembled to work collaboratively toward a unified approach to tackling marine debris – a first for the region and a well-intentioned effort to learn from one another and work more productively towards common goals.

The Alliance worked effectively for a number of years, as funding from both the Governors' Agreement and NOAA's Marine Debris Program allowed for the group to meet for three workshops, develop a west coast-wide strategy for tackling marine debris, and even launch an ambitious database meant to collect and synthesize data from the broad range of data collection methods in use across the three states, among other accomplishments. However, as support for the Governors' Agreement eroded at the state level and funding dried up, the Alliance has seen its effectiveness slip, its programmatic achievements dwindle, and its role reduced to a still-vital platform for communication among its members during monthly conference calls. The successes and challenges of the Marine Debris Alliance provide both a road map and a warning sign about the possibilities and promise of creating and sustaining a regional organization of groups dedicated to working collectively.

"Ocean Friendly Restaurants Industry Experts Discussion Panel"

Bill Hickman, Surfrider Foundation
Stuart Coleman, Surfrider Foundation

ABSTRACT

This presentation and panel is geared toward activists, restaurant owners, customers and all those who are trying to reduce the pollution from restaurant single-use plastics. Along with passing legislation to ban plastic bags, polystyrene foodware and other single-use plastics, Surfrider Foundation also developed a new program called Ocean Friendly Restaurants to reduce plastic pollution at its source.

After providing a brief overview of the Ocean Friendly Restaurants program, we will have a panel of industry experts share their views on plastic pollution and how to eliminate. Panelists include:

Aardvark Straws representative Kara Woodring. Aardvark straws is the only manufacturer of paper straws in the United State.

Compostable products manufacturing or distribution representative. The market is flooded with non-plastic food ware choices and it can be tough to tell which are best.

Waste management representative. What can we really recycle and compost from restaurants?

Restaurant owner and server. How can restaurants save money and make money from being an Ocean Friendly Restaurant.

Ocean Friendly Restaurants: Reducing Plastic Pollution One Restaurant at a Time

"Ocean Friendly Restaurants Program Overview"

Bill Hickman, Surfrider Foundation
Stuart Coleman, Surfrider Foundation

ABSTRACT

This presentation is geared toward activists, restaurant owners, customers and all those who are trying to reduce the pollution from restaurant single-use plastics. For years, the Surfrider Foundation's extended network of chapters and youth clubs has worked with our non-profit partners to pass many bills to reduce the millions of tons of plastic pollution entering our oceans each year.

Along with passing bill to ban plastic bags, polystyrene foodware and other single-use plastics, we have also developed a new program called Ocean Friendly Restaurants to reduce plastic pollution at its source. The restaurant industry generates vast amounts of plastic waste, including single-use plastic straws, utensils, plates, cups and many other plastic containers that often end up in our rivers, coastlines and oceans as marine debris. Trying to pass legislative bans can be a long and difficult process that often pits environmentalists against the plastics industry and other businesses.

By contrast, the OFR Program recognizes those restaurants that are voluntarily reducing plastic waste and inefficient uses of energy and water. In order to be certified as an OFR, food establishments meet the four mandatory criteria (no foam or plastic bags, reusable cups/plates/utensils & proper recycling practices) and three of six other optional criteria. This program offers a win-win-win solution for restaurants, customers and those who are trying to protect the environment. This kind of win-win-win scenario could be a model for environmental advocates and everyday customers to work with the private sector to reduce not only plastic waste but also their costs.

Plastic Waste: A New Resource For The Energy Transition

"Challenges to Plastic Up-Cycling in Small Island Communities: A Palauan Tale"

Lark Starkey, Scripps Institution of Oceanography

ABSTRACT

Small island communities are subject to greater quantities of plastics due to the dual inputs of marine plastics via ocean currents and packaging plastics imported for local use. The resulting plastic buildup on islands is often combined with a lack of infrastructure and remoteness, leaving few options for management. However, a number of existing technologies and companies exist to reuse plastic waste as a resource to create a product of greater value, a concept commonly known as "up-cycling." Utilizing these technologies on island to up-cycle plastics or creating incentives to export plastics to other nations for reuse are theoretically beneficial methods to both manage and economically incentivize unwanted marine and local plastics. Yet, up-cycling is often underutilized. The island nation of Palau experiences the common impacts of plastic, yet successfully recycles 50 percent of post-consumer waste in its metropolis Koror. In this study, the primary challenges to up-cycling and plastic management for Palau and similarly structured island nations are uncovered. Challenges can be broken down into the 5 broad categories of geography, society, government, economy, and technology and subsequent recommendations to creatively overcoming challenges are made.

"Moving up the Value Chain - Bringing Solutions Which are Sized for Communities"

Doug Woodring, Ocean Recovery Alliance

ABSTRACT

Plastic pollution is one of the more complex challenges of our time, both due to the material itself, and the societal ways and means we are addressing its collection, prevention and use. The most important part of prevention relates to value creation, and without value, there is no incentive to collect, preserve or prevent material loss in the first place. Much of the problem that exists in the creation of plastic pollution is due to the lack of infrastructure to process the waste material in the first place, and for value, instead of having it send to landfills (legal or illegal), dumped or burned. If communities had relatively simple equipment, allowing them to more easily sort, clean, grind and compress materials, there would be a much higher likelihood of turning those waste resources into something valuable that can be then sold to the next buyer or recycler who now appreciates relatively "pure" and non-contaminated material.

This session will discuss the opportunities, needs and challenges of bringing solutions which are sized to the task, helping to create jobs, while bringing value to today's waste streams.

"Plastic waste : a new resource for the energy transition"

Serge Pittet, Race For Water Foundation
Frédéric Sciacca, Race For Water Foundation

ABSTRACT

Joint action at the global level is urgently needed to address the perils facing our oceans. Our plastic waste to energy model aims at tackling the issue of plastic pollution at the source, by turning off the tap of plastic litter leaking into the ocean. Additionally, our projects will directly improve the health and life of local communities who are often the first victims of this worldwide issue. This presentation will focus on following areas:

1) Assessment and outcomes: In 2015, Race for Water realized its first Odyssey: an environmental expedition of 300 days which sailed across all the Oceans. Plastic pollution is everywhere. A grand-scale clean-up of the ocean is unrealistic, land-based solutions are key to an efficient fight against plastic pollution.

2) Plastic waste is the problem as well as the solution:To tackle this terrible issue, we looked at various existing technologies which could create value out of plastic waste in order to incentivize local population to collect it. The requirements in our search were also to minimize the needs for plastic separation and cleaning. We rapidly moved toward energy recovery.

3) Presentation of the technology: Biogreen® by ETIA : It is an innovative, patented process for continuous thermochemical conversion of waste residue that allows high temperature pyrolysis treatment of various bulk materials including plastic waste. This innovative technological approach demonstrates that remote plastic waste can be an additional resource in energy transition.

4) Pilot projects towards scalability : Currently in production, the first machine will be delivered in the fall for a 6 months' testing period to evaluate its performances and assess its environmental footprint.

“Sustainable Disposal for End-of-Life Fiberglass Vessels”

Evan Ridley, University of Rhode Island

ABSTRACT

Limited traditional disposal options leave end-of-life vessel owners with the task of deciding how to alleviate the financial burden of caring for an aging fiberglass boat. Unfortunately, this sometimes results in a practice in which unwanted vessels become derelict or abandoned, an event that creates potential environmental and navigational hazards for coastal communities.

The recycling and reuse of fiberglass has long been viewed as an unmanageable task, but new advances in chemical engineering and technology have made sustainable composite materials a feasible goal for the future of marine industry. Rhode Island Sea Grant has set a target on developing a strategic plan for the creation of a statewide vessel recycling program, based on a successful model of European fiberglass disposal processes.

Fiberglass is seen as a suitable candidate for recycling and repurposing thanks in part to its chemical composition and high production value. Activity in Germany over the last ten years has shown fiberglass to have significant potential as an “alternative fuel” for cement production in industrial kilns. The value of these alternative fuels lies in their ability to mimic the the thermal and chemical qualities of traditional fossil fuels when they are incorporated at various stages in the production process.

The overarching goal of Rhode Island’s state program intends to create a system that reflects the best methods for reusing a valuable form of solid waste. Rhode Island’s small size and status as a hub of marine industry make it an ideal laboratory for experimenting with a potential international solution. Through collaboration with cement industry members in the U.S., Sea Grant has taken the first steps toward introducing fiberglass derived from end-of-life vessels into the growing stream of American alternative fuel.

"A rapid-screening approach to detect and quantify microplastics based on fluorescent tagging with Nile Red"

Thomas Maes, Cefas

ABSTRACT

A new approach is presented for analysis of microplastics in environmental samples, based on selectiv fluorescent staining using Nile Red (NR), followed by density-based extraction and filtration. The dye adsorbs onto plastic surfaces and renders them fluorescent when irradiated with blue light. Fluorescence emission is detected using simple photography through an orange filter. Image-analysis allows fluorescent particles to be identified and counted. Magnified images can be recorded and tiled to cover the whole filter area, allowing particles down to a few micrometres to be detected. The solvatochromic nature of Nile Red also offers the possibility of plastic categorisation based on surfac polarity characteristics of identified particles. This article details the development of this staining method and its initial cross-validation by comparison with infrared (IR) microscopy. Microplastics of different sizes could be detected and counted in marine sediment samples. The fluorescence staining identified the same particles as those found by scanning a filter area with IR-microscopy.

Pushing the Boundaries Towards the Detection of Very Small Plastic Debris

"Alternative methods for microplastic extraction and identification"

Jeff Wagner, Environmental Health Laboratory, California Department of Public Health
Zhong-Min Wang, Environmental Health Laboratory, California Department of Public Health
Sutapa Ghosal, Environmental Health Laboratory, California Department of Public Health
Stephen Wall, Environmental Health Laboratory, California Department of Public Health

ABSTRACT

This work presents alternative sample extraction and analysis techniques used to identify microplastics as small as 15 um and address previously noted issues with other methods. The removal of biomass matrices using aggressive chemicals can be problematic for the smallest microplastics, sometimes eroding their surfaces and creating reaction products that interfere with analyses. New methods utilizing ultrapure water and pulsed ultrasonic extraction were developed to separate plastics from biomass without dissolving either, thereby preserving plastic surface characteristics and any adsorbed chemical species. These methods have been used to separate microplastics successfully from marine surface trawls, as well as the stomachs of laboratory, marine, and freshwater fish. Particles were identified and characterized in terms of type, size, and morphology using complementary optical microscopy, scanning electron microscopy plus energy-dispersive x-ray spectroscopy (SEM/EDS), Fourier Transform infrared (FTIR) micro-spectroscopy, and Raman micro-spectroscopy (RMS). After optical and SEM/EDS screening, FTIR and RMS were used to identify specific plastic types. Together, these data can be used to better understand microplastic sources and environmental fates. Shell pieces were identified in many fish stomachs that resembled microplastics, as were brittle, degraded plastics that were shattered like shells. Studies that rely on optical microscopy alone are thus prone to false positives and false negatives. Current progress and challenges for automation and optimization of these extraction and identification methods are discussed, including identification of particles smaller than 15 um.

"Are smaller microplastics underestimated? Comparing anthropogenic debris collected in the western English Channel with different mesh sizes."

Penelope Lindeque, Plymouth Marine Laboratory
Alice Wilson McNeal, University of Exeter
Matthew Cole, Plymouth Marine Laboratory
James Clark, Plymouth Marine Laboratory
Tamara Galloway, University of Exeter

ABSTRACT

Microplastic debris (<5 mm) is a prolific pollutant, identified in marine ecosystems across the globe, including the ocean depths, polar waters and mid-oceanic islands far from sources of pollution. Despite their ubiquity, sampling, classifying and enumerating microplastics in marine waters and sediments has proven challenging. Based on existing field data ascertained from global sampling efforts, estimated plastic inputs and calculated fragmentation rates, a large proportion of microplastic appears to be "missing". We hypothesise that some of this "missing plastic" stems from sampling biases. Typically, microplastic sampling is undertaken using nets with a mesh size >335 µm. Therefore, the abundance of smaller (micrometer and nanometer sized) debris remains unclear. Microplastics <335 µm in size are readily consumed by animals at the base of the marine food web (e.g. zooplankton, bivalves, fish), with the potential to bioaccumulate up the food chain. In this study, we investigated whether sampling bias was a cause of the "missing" microplastic by comparing the amounts of microscopic anthropogenic debris collected using 100, 335 and 500 µm aperture nets. Sampling was conducted across 14 sites in the western English Channel, selected with the aid of a hydrodynamic model. Our findings show that as mesh size decreases, the number of anthropogenic microdebris items collected increases. Furthermore, the mean size of items collected was smaller in nets with a smaller mesh size. These results suggest that not only are a significant proportion of microplastics missed using traditional sampling techniques, but that this missing fraction constitutes smaller debris than is usually accounted for.

"Raman microspectroscopy for analysis of microplastic in environmental samples"

Natalia Ivleva, Technical University of Munich, Institute of Hydrochemistry
Philipp Anger, Technical University of Munich, Institute of Hydrochemistry
Alexandra Wiesheu, Technical University of Munich, Institute of Hydrochemistry
Reinhard Niessner, Technical University of Munich, Institute of Hydrochemistry
Martin Elsner, Technical University of Munich, Institute of Hydrochemistry

ABSTRACT

The accumulation of plastic and especially microplastic (<5 mm) particles in marine and freshwater ecosystems is of growing scientific and public concern. This has stimulated a great deal of research on the occurrence of MP, uptake of MP by aquatic organisms, and the resulting (negative) impact of MP. The crucial step in MP analysis is a reliable identification. Appropriate methods for the chemical identification of MP include ATR-FTIR and µ-FTIR spectroscopy as well as Raman microspectroscopy (RM). ATR-IR is applied for the detection of MP particles larger than 500 µm, while µ-FTIR enables an automated analysis of particles in the size range of 20 – 500 µm. RM is so far the only available method for the identification and quantification of environmental MP with a spatial resolution down to 1 µm [1] and thus well suited for analysis of small (50 µm – 500 µm) and very small (1 µm – 50 µm) microplastic particles [2].

Recently we analyzed MP particles from sediment samples in the Lake Garda, Italy and identified MP with a diameter down to 9 µm by means of RM [2]. Apart from MP, we found a large number of pigmented (non)plastic particles with a diameter down to 4 µm. Their size distribution (Fig. 1), suggesting that even smaller pigment particles might be present (down to the nm range). Therefore, further development of methods is needed to assess MP in sub-µm and nm range. For this purpose RM can be combined with techniques for fractionation and concentration of nanoparticles (e.g. AF4). Furthermore, the automatization of RM measurements will enable an efficient analysis of MP down to (sub)µm size in different environmental samples and, hence, will help to assess the risks arising from MP.

[1] Ivleva et al., Angewandte Chemie International Edition 2017, 56, 1720-1739.

[2] Imhof et al., Water Research 2016, 98, 64-74.

Pushing the Boundaries Towards the Detection of Very Small Plastic Debris

"Towards (Semi-)automation of Microplastic Analysis by means of Raman Microspectroscopy"

Philipp Anger, Technical University Munich
Leonhard Prechtl,
Reinhard Niessner,
Martin Elsner,
Natalia P. Ivleva,

ABSTRACT

Microplastics (MP) in limnic ecosystems are a hot topic in public media as well as in the scientific community. Currently analysis of sediments is very tiresome and takes a lot of time. Sampling may take only one workday. But sample preparation lasts more than a week [1]. The final analysis by means of RM requires a few days when done manually.

Within the BMBF-project (Bundesministerium für Bildung und Forschung) MiWa (Microplastics in the water cycle) one aim is to perform reliable quantification of MP down to 1 µm in reasonable time. We therefore develop a new protocol for (semi)-automated Raman microspectroscopic analysis of MP. Different hardware parameters (objective, magnification, dark/bright field) are compared. Also, different software features that help to automate certain steps of the identification process by means of RM are under close investigation. We therefore implemented a software feature that automatically finds particles and generates coordinates that can be used by the WITec alpha300 R system for the acquisition of Raman spectra and or Raman images (figure 1a). We also developed a filter holder that smoothens surface of analyzed filter (figure 1b).

Pushing the Boundaries Towards the Detection of Very Small Plastic Debris

"Use of Imaging Flow Cytometry (FlowCam) in the Study of Microplastics"

Harry Nelson, Fluid Imaging Technologies
Madeyln Woods, Marine and Environmental Research Center
Claudia Lorenz, 3Alfred Wegner Institute, Helmholtz Centre for Polar and Marine Research
Gunnar Gerdts, 3Alfred Wegner Institute, Helmholtz Centre for Polar and Marine Research
David Fields, Bigelow Laboratory for Oceans Sciences
Patricia Matrai, Bigelow Laboratory for Ocean Sciences
Michelle Devoe, Fluid Imaging Technologies

ABSTRACT

Characterizing microplastics(less than 1 mm in size) presents many challenges to the researcher and manager wanting to gain an understanding as to their prevalence, size, composition and ecological effects in the aquatic environment. Responding to the need to automate the characterization of microplastics, researchers have turned to the FlowCam, an imaging particle analyzer that is used worldwide in the research and monitoring of microorganisms in both marine freshwater systems. Here we present an overview of the technology along with data from two research projects that incorporated use of the FlowCam in the study of microplastics. Methods used to identify and count microplastics in aquatic environments, as well as in tissue and feces, along with results and limitations of the technology will be presented. Additionally we will show that the FlowCam can be used for quality assurance of sample preparation as well as to improve the output of spectroscopic analysis.

Remote sensing of marine debris in coastal areas

“Aerial remote sensing for shoreline surveillance: Lessons learned from mapping marine macro-debris throughout the main Hawaiian islands”

Miguel Castrence, Resource Mapping Hawai'i

ABSTRACT

Remote sensing of marine debris poses numerous technological and logistical challenges. Effective shoreline surveillance requires a consistent protocol that includes synoptic data coverage, high level of detail, rapid data collection and processing, and ease of analysis.

In the fall of 2015, we participated in the first attempt to systematically quantify, categorize and map marine macro-debris across the main Hawaiian islands. This project, led by the state of Hawai'i Department of Land and Natural Resources, was funded by the Ministry of the Environment of Japan via the North Pacific Marine Science Organization (PICES) as well as the Japan Gift Fund to the Pacific Coast states, administered by NOAA's Marine Debris Program. This resulted in a unique collaboration between the Division of Aquatic Resources (DAR) of DLNR, NOAA's Marine Debris Program, Resource Mapping Hawai'i (RMH) and the Hawai'i Coral Reef Initiative (HCRI). Our project involved manned-aircraft aerial surveys, photogrammetry, and GIS analysis to study a total of 1,223 miles of coastlines and locate 20,658 individual locations of debris.

We will share the lessons learned from this unique experience and provide recommendations for aerial remote sensing that can be applied to future studies in Hawai'i as well as other regions of the world.

Remote sensing of marine debris in coastal areas

"Classification of riverine floating debris based on true color images collected by a low cost drone system: Case study from the Citarum River, Indonesia"

Elizabeth C. Atwood, RSS Remote Sensing Solutions GmbH
Sabela Rodríguez Castaño, RSS Remote Sensing Solutions GmbH
Sarah Piehl, University Bayreuth, Dept. Animal Ecology I
Muhammad Reza Cordova, LIPI Indonesian Insitute of Sciences, Research Centre for Oceanography
Mathias Bochow, University Bayreuth, Dept. Animal Ecology I
Jonas Franke, RSS Remote Sensing Solutions GmbH
Sam Wouthuyzen, LIPI Indonesian Insitute of Sciences, Research Centre for Oceanography
Christian Laforsch, University Bayreuth, Dept. Animal Ecology I
Florian Siegert, RSS Remote Sensing Solutions GmbH

ABSTRACT

Rivers have only recently begun to receive more attention as an important contributor to the plastic debris accumulating in our oceans, with an estimated 67% of annual global discharge coming from Asia. In Indonesia, there exists little to no rural municipal waste collection system. This leaves people with the options of either burning their waste or disposing of it in impromptu dump sites, often located near to rivers and thus "washed away" during the rainy season. Plastic debris is not only unsightly and a health hazard, it can contribute to stoppage of drainage canals and unnecessary flooding events. We present a low cost system capable of quantifying the amount of floating riverine debris. The monitoring device consisted of a commercial 3DR Solo drone mounted with a GoPro4 Silver camera and a low distortion lens. Seven locations along the Citarum River, Java, were surveyed. Images were post-processed to orthomosaics of at least 90 m^2 per site. A semi-automated hierarchical object-based classification scheme was developed using eCognition software to identify debris objects, which included not only plastic but also organic material such as bamboo and coconut hulls. Classifications were validated against a ground truth dataset created through evaluation of the original images by an independent observer. An overall accuracy of >88% was achieved for images with medium to high floating debris concentrations, regardless of water turbidity levels. Overall accuracy was reduced in the presence of abundant floating water plants and over clear water with relatively little debris. Our method can provide environmental groups or agencies with a low cost, relatively easy to operate system that allows quantification of floating debris, thus supporting monitoring activities aimed at flood control and focus of clean-up activities.

Remote sensing of marine debris in coastal areas

"Debris Detection - Efforts & Lessons Learned"

Peter Murphy, NOAA Marine Debris Program

ABSTRACT

Marine debris is a global problem that impacts marine and coastal resources in many ways. One of the critical needs to better understand marine debris abundance and impacts is to be able to reliably detect, map and assess the debris. This data can inform impact assessments, but also prioritization and planning for removal. Many different tools and technologies have been used in efforts to detect debris – from satellites high above the earth down to in-situ cameras right near the waterline. Each has its own weaknesses and strengths. This talk will give an overview of the different detection technologies used by the marine debris community to detect, assess and map debris as well as lessons learned in those projects.

Remote sensing of marine debris in coastal areas

"Drones for Debris: Utilizing Small Vessel-Launched UAS for Remote Coastal Surveys"

Matthew Pickett, Oceans Unmanned, Inc.
Todd Van Epps, Oceans Unmanned. Inc.

ABSTRACT

While marine debris beach cleanups along accessible beaches and coastlines provide a great opportunity for easy success and community involvement, two of the greater challenges associated with marine debris detection and removal are at-sea identification and interception and shore-cast marine debris accumulated along remote, inaccessible shallow water habitats and beaches.

For the challenge of marine debris and detection along remote, rugged shorelines, small, consumer off-the-shelf Unmanned Aircraft Systems (UAS), or drones, provide a powerful tool to either pre-survey, or real-time survey these locations to target response and cleanup effort and reduce exposure to risky access thereby reducing costs and increasing safety. Stable vessel-launch and recovery capability are now possible with almost all small platforms, and combined with autonomous mapping software and online data processing programs, turn any small vessel and inexpensive drone into a powerful search and mapping combination. A variety of sensors, including dual payload capacity on small platforms, provide potential solutions for identifying a wide variety of debris across a broad spectrum of environments.

Over the past five years, we have tested a variety of platforms and payloads for a range of aerial data collection requirements, and in a broad variety of coastal and marine environments. Real world application of anomaly detection software has been utilized with varying results. While not specifically targeting marine debris, the tools and techniques tested, evaluated, and successfully developed are directly applicable to the detection of marine debris in shoreline and nearshore environments and are ready for implementation.

Remote sensing of marine debris in coastal areas

“Understanding the strengths and constraints of UAV data for monitoring marine debris.”

Serena Lee, Griffith University
Dan Ware, Griffith University

ABSTRACT

Unmanned aerial vehicle (UAV) drone surveys have the capacity to collect data over large spatial domains. Additionally, drones are able to collect data in locations difficult to access. Due to the potential benefit this technology provides, UAV surveys are being deployed to assist collect marine debris data. As UAVs are increasingly employed, it is important to understand the strengths and limitations of the data provided.

In this study we test the capacity of UAV’s to obtain reliable data with respect to marine debris. Two different drones were tested, the Phantom 4 Pro, and Sensefly eBee. By deploying the drones over known beach environments, with known quantity and type of marine debris, sensitivity to flight height (image resolution), debris shape, debris colour, debris size, sun angle, cloud cover, wind speed and background substrate, were evaluated. Additionally, the ability of the Parrot Sequoia multispectral sensor to detect marine debris was evaluated.

The study aims to provide guidance for researchers and coastal managers intending to use UAVs to capture marine debris data. By understanding the strengths and limitations of these data, UAV surveys may be designed to increase efficiency while minimising error. Additionally, the study provides methodology researchers can use to document the accuracy of subsequent UAV surveys. By employing a standardised approach and documenting data error, different UAV studies may be more easily compared. As a consequence, spatial and temporal trends may be better determined.

Remote sensing of marine debris in coastal areas

"Use of Unmanned Aerial Vehicles and machine learning tools for efficient beach litter Monitoring"

Cecilia Martin, King Abdullah University of Science and Technology (KAUST), Red Sea Research Center (RSRC), Thuwal, 23955-6900, Saudi Arabia
Stephen Parkes, King Abdullah University of Science and Technology (KAUST), Water Desalination and Reuse Center (WDRC), Thuwal, 23955-6900, Saudi Arabia
Qiannan Zhang, King Abdullah University of Science and Technology (KAUST), Computer, Electrical and Mathematical Science and Engineering Division, Thuwal, 23955-6900, Saudi Arabia
Jie-Wei Chen, King Abdullah University of Science and Technology (KAUST), Computer, Electrical and Mathematical Science and Engineering Division, Thuwal, 23955-6900, Saudi Arabia
Xiangliang Zhang, King Abdullah University of Science and Technology (KAUST), Computer, Electrical and Mathematical Science and Engineering Division, Thuwal, 23955-6900, Saudi Arabia
Matthew F. McCabe, King Abdullah University of Science and Technology (KAUST), Water Desalination and Reuse Center (WDRC), Thuwal, 23955-6900, Saudi Arabia
Carlos M. Duarte, King Abdullah University of Science and Technology (KAUST), Red Sea Research Center (RSRC), Thuwal, 23955-6900, Saudi Arabia

ABSTRACT

Beach cast litter assessment at a global scale is challenged by the use of low-efficiency methodologies and incomparable protocols that undermine high-scale data acquisition and estimation comparisons. The implementation of an objective, reproducible and time-saving approach is urged to systematically quantify loads of shore-deposited litter and help resolve the mass balance of marine anthropogenic debris, of which beach cast litter is a significant contributor. Here, we demonstrate the application of a likewise methodology coupling remote sensing and machine learning tools. Beach surveys were conducted along the Red Sea Saudi Arabian coast in March 2017 (n=19 beaches) and litter was recorded through image acquisition from an Unmanned Aerial Vehicle (UAV) allowing a beach coverage of 758 ± 90.7 m2 min-1 (mean ± SD). An automatic processing of the high volume of images is required and made possible by the development of a machine learning tool, where a histogram of oriented gradient (HOG) descriptor and a random forest classifier are employed for object detection and categorization, respectively. Standard visual-census beach surveys and a manual processing of drone images are used as efficiency and accuracy controls of the described methodology. Application of the proposed method resulted in 50x faster beach coverage compared to the visual-census approach and 80% accuracy of the machine learning tool in detecting litter. Random forest classification of debris types in ten categories was proportional to the classification obtained from the visual-census approach, further proving the method reliability. Machine learning tool improvements and further surveys will be performed in the coming months, culminating in the first high-scale study of beach litter in the Red Sea.

Remote sensing of marine debris in open ocean

"An innovative machine learning technique to retrieve omni-situ ocean surface currents measurements: a global and high resolution ocean surface circulation schema"

Yann Guichoux, eOdyn
clement le goff, eOdyn
Steve Bennour, eOdyn

ABSTRACT

Our presentation focus on the description of transformative technique allowing omni-situ ocean surface currents measurements relying on environmental data sets and ship motions data analytics. The technology make it possible to retrieve real time and historical ocean surface currents information at a global scale.

First the technique is introduced, how machine learning on environmental data sets and ship motions can produce omni-situ ocean surface currents. Performances are assessed basing on West Brittany, a well-documented area, comparing HF radar measurement with eOdyn products. Technology' fields of application, as well as its limitations and development status are introduced.

Then, the surface circulation in south Africa is investigated using this innovative technique and compared to numerical model outputs and drifters trajectories. A three months omni-situ ocean surface currents climatology is compared to the bottom topography. This comparison clearly shows a good correlation between omni-situ surface currents and bathymetry.

At last, new possibilities allowed by this technique, such as micro-platics drifts analysis, are highlighted.

Remote sensing of marine debris in open ocean

"Hyperspectral airborne shortwave infrared imager captures floating ocean plastics in the Great Pacific Garbage Patch"

Shungudzemwoyo Garaba, The Ocean Cleanup Foundation
Julia Reisser, The Ocean Cleanup Foundation
Jen Aitken, Teledyne Optech Inc
Heidi Dierssen, University of Connecticut
Laurent Lebreton, The Ocean Cleanup Foundation
Robert Marthouse, Teledyne Optech Inc.
Boyan Slat, The Ocean Cleanup Foundation

ABSTRACT

We present one of the first aerial remote sensing expeditions to use state-of-the-art technology for high spatial resolution and spectral observations of floating ocean plastics. An integrated measuring instrument package including a CZMIL bathymetric lidar, a hyperspectral shortwave infrared (SWIR) imager and a high spatial resolution RGB frame camera was mounted on a manned C-130 Hercules aircraft. The aircraft flew over the oceanic accumulation zone known as 'Great Pacific Garbage Patch' (GPGP), located between California and Hawaii, USA. Imagery was gathered over two flights conducted in October 2016, both flights lasting over ten hours with 2.5 hours of survey data collection. Flying at an altitude of 400 m above the ocean a total surface area covering 311 km2, was surveyed at 140 knots speed. Imagery spatial resolution was 0.5 x 1.2 m pixels for the shortwave infrared hyperspectral imager (SASI-600 SWIR, 950-2450 nm, 100 bands, push broom line scanner) and 0.10 m for the Optech CS-4800i, 16 MP RGB frame camera (one frame per second). We investigated debris larger than 0.1 m (N = 118) from the 150 debris automatically identified in the RGB mosaics. Spectral information was retrieved from the SASI SWIR imagery, debris examined had unique features common to synthetic polymers, making it possible to discriminate pixels as containing water, surface reflected glint and ocean plastic. We showcase the capability of airborne remote sensing of plastic debris in the aquatic environment. These findings echo the need for algorithms, spectral reference libraries and tools to advance remote sensing technology for observing, classifying as well as quantifying ocean plastics.

Remote sensing of marine debris in open ocean

"Multi-sensor remote sensing approach to marine litter mapping"

Laia Romero, isardSAT
Juan Baztán, Université de Versailles Saint-Quentin-en-Yvelines
Mathias Bochow, GFZ German Research Centre for Geosciences
Maria Jose Escorihuela, isardSAT
Lucile Gaultier, OceanDataLab
Thierry Huck, Univ. Brest, Ifremer, CNRS/IRD/LOPS
Christophe Maes, Univ. Brest, Ifremer, CNRS/IRD/LOPS
Eduard Makhoul, isardSAT
Mònica Roca, isardSAT

ABSTRACT

While the knowledge associated with the marine litter challenge is increasing rapidly, there are still many unknowns regarding the contribution of satellite technologies to the solution. Complex mapping requirements are withdrawn from the great variety of scenarios where plastic is found in aquatic ecosystems. There is no single technology able to map marine litter alone. Nonetheless, a series of remote sensing technologies exist today that are able to tackle the mapping of marine litter, directly and indirectly. Optical technologies can be used for the direct detection of high densities of plastics in cloud-free areas, and the correlation found between water quality parameters and microplastics motivates indirect assessment. Plastics show significant features in the 0.4–2.8 μm region of the spectrum, where most hyperspectral systems operate, and Fourier Infrared Spectroscopy has been suggested for the classification of plastic composition, while Raman spectroscopy could measure partially submerged debris in shallow waters. Within microwave technologies, SAR sensors are capable of detecting surfactants such as biogenic films, and target-like derelict fishing gear and bigger items, by polarimetry and interferometry; like SAR, altimetry could also detect marine litter as it might have an effect on reflectivity, and radiometers with high temporal resolution can be useful for the tracking of water masses containing debris. A multi-sensor approach is proposed for the mapping of marine litter in a broad sense, according to the characterization of different scenarios. In order to delineate pathways, and to provide information over spatio-temporal gaps in the remote sensing methods, the use of ocean models that resolve the small-scale dynamics of the upper ocean, and backward computations with ground-truth data are proposed.

Remote sensing of marine debris in open ocean

"Optical remote sensing of marine litter: review of mission requirements and current potential detection techniques"

Victor Martinez-Vicente, Plymouth Marine Laboratory
James Clark, Plymouth Marine Laboratory
Penelope Lindeque, Plymouth Marine Laboratory
Stefan Simis, Plymouth Marine Laboratory
Rory Donnelly, Plymouth Marine Laboratory
Paolo Corradi, European Space Agency
Bertrand Chapron, IFREMER
Yi Chao, Remote Sensing Solutions, Inc
Nikolai Maximenko, University of Hawaii

ABSTRACT

At a global scale, there is a need for an accurate description of the distribution of human produced litter. Plastics are the largest component of human produced litter in the aquatic environment (from oceans and coastal waters to rivers and lakes). Any improvement on the global quantification of plastics in the aquatic environment would have a significant impact in addressing both fundamental scientific questions such as improving the quantification of plastic pools and fluxes, validating plastic accumulation models, as well as providing tools for environmental monitoring for the benefit of the society, such as informing on sources and sinks for mitigating action.

It is postulated that global observations of the litter problem could be obtained by using support from remote sensors. Progress in this direction has been encouraged by a number of space agencies. The ESA funded project OptiMAL (Optical methods for MArine Litter detection), reviews different observational scenarios for marine litter detection, focussing on optical remote sensing techniques. In particular, this initial review covers two scenarios for plastic litter detection: microplastics (diameter < 5 mm) in the upper layers of the aquatic environment, and macroplastics accumulated on shorelines.

The microplastics distribution in the oceans has been described using several ocean circulation models, highlighting significant discrepancies in their predictions. OptiMAL explores the model requirements for remote sensing products that would help reduce model uncertainty.

The accumulation of plastics on the shore has been monitored using varying protocols by agencies and citizens, and there is a need to unify quantification methods that can also be used in areas that are remote or difficult to access. Requirements for the operational use of remote sensing.

Remote sensing of marine debris in open ocean

"Progress in remote sensing of marine debris"

Nikolai Maximenko, University of Hawaii

ABSTRACT

This poster presentation is intended to provide concise overview of recent initiatives, studies, and developments that advance applications of remote sensing to all aspects of the problem of marine debris. It will include a short list of past and future meetings and programs that help to build the community of specialists. Additional highlights will be invited from active projects, conducted by the session participants and unrepresented groups.

Remote sensing of marine debris in open ocean

"RESMALI: Towards a better understanding of marine litter signature from space"

Manuel Arias, ARGANS Ltd
Julia Reisser, The Ocean CleanUp
Laurent Lebreton, The Ocean CleanUp
Andres Cozar, University of Cadiz
Jennifer Aitken, Teledyne OpTech Ltd
Shungu Garaba, University of Connecticut
Gullaume Bonnery, Airbus Defence & Space
Paolo Corradi, European Space Agency

ABSTRACT

Marine Litter (ML) is a major environmental issue requiring deeper insights from the scientific community for policy makers and enforcers to manage and mitigate these contaminants. Collection of data is an important step towards solving the ML issue. The scientific community has already pointed out that remote sensing techniques may be the best approach to get a synoptic and routine monitoring. RESMALI project consists on a feasibility study for a mission concept devoted to remotely sense ocean plastics using satellites as platforms. Given that wide range of ML sizes, from microns to meters, remote sensors are likely to only be able to observe ML particles or groups of particles above a certain size. In this regard, it is interesting to know the minimum observable ML plastic/group of ML size and the fraction of the total ML stock that can be observed. Reference curves of the fraction of the total ML stock observed with proposed technologies, once the size limit of each technology is determined, are required. To build some of such curves and define additional mission requirements, the authors are carrying out an experimental set to expand the existing knowledge of plastic ML in the SWIR band by hyperspectral methods. The experiments is performed using both "natural" and "artificial" ML samples with a varied range of sizes and classified by their composition. The data allows for the generation of a spectral library that can be used in numerical simulations via LibRadTran to determine the expected signature of ML at TOA level, depending on concentration and composition. The simulations aid to find out thresholds values for these parameters for a potential passive hyperspectral radiometric instrument what also includes, but is not limited to, optimal altitude, spectral sensitivity, and instrumental viewing angle.

Remote sensing of marine debris in open ocean

"The Debris and Small Object Mapping Active Imaging System"

Delwyn Moller, Remote Sensing Solutions
James Carswell, Remote Sensing Solutions
Brian Pollard, Remote Sensing Solutions
Yi Chao, Remote Sensing Solutions

ABSTRACT

Because of the broad diversity of types of objects, floating on the ocean surface, and sensitivity of observations to many factors, today marine debris cannot be systematically quantified by existing observing systems. Neither sources, distribution, total amount, life cycle, nor sinks of marine debris are currently understood. To address these deficits in understanding, there is interest in the potential of remote sensing from a variety of technologies. For example, a NASA-funded workshop at the University of Hawaii, Manoa (1/2016), assessed existing and emerging remote-sensing technologies with the potential to observe or infer marine debris on the global scale. A workshop recommendation was for suborbital and laboratory experiments to test various methodologies and to prove the concept(s) with future satellite missions in mind.

Aligned with this recommendation, NOAA has funded development of the Debris and Small Object Mapping (DSOM) system, can be configured as a multi-baseline interferometric synthetic aperture radar array for detection and mapping of manmade and natural debris and "small" objects in the maritime environment. The DSOM sensor concept will acquire multi-dimensional (spatial and temporal) measurements that will provide unique information for detecting a broad range of debris types and small objects in marine environments over over a large range of environmental and surface conditions. The DSOM will be deployed and operated in such a way that it serves as an interferometric multiple-aperture SAR simulator. Our data analysis will entail algorithm development and system trades for detection and characterization over a variety of oceanic wind/wave conditions and for a variety of debris materials and surface expressions.

Remote sensing of marine debris in open ocean

"Using Ocean Surface Currents and Winds to Track Marine Debris"

Ernesto Rodriguez, Jet Propulsion Laboratory, Caltech
Dragana Perkovic-Martin,
Alexander Wineteer,
Bryan Stiles,

ABSTRACT

Ocean surface currents and winds play a primary role in the transport and dispersal of marine debris. Satellite altimetry is an approach to estimating ocean currents, which can only estimate the geostrophic component, and must be complimented by modeled wind-driven currents, using scatterometer winds. This is the approach taken by surface current products such as OSCAR (Ocean Surface Currents Real-time). However, it is limited by spatial resolution and cannot represent the small mesoscales, which are responsible for forming attractors that concentrate marine debris.

Here, we present an alternative method for simultaneous mapping of ocean winds and currents using Doppler scatterometry. Doppler scatterometry relies on a coherent radar system with a rotating pencil beam antenna to simultaneously measure the backscattered power and Doppler frequency shift. The two are then converted into vector wind and surface current estimates over wide swaths. JPL/NASA has developed a proof-of-concept instrument called DopplerScatt. It is an airborne Ka-band scatterometer capable of 200-m resolution measurements of winds and currents over a 25 km swath, in a single aircraft pass.

In this talk, we report on the comparison of DopplerScatt measurements and surface drifters from the recent SPLASH (Submesoscale Processes and Lagrangian Analysis of the Shelf) campaign, where about 500 surface drifters (drogued at ~0.75m) were released and measured over a period of weeks. We also report on how this technique can be scaled to a spaceborne measurement, able to produce global simultaneous estimates of winds and currents.

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Achieving Remote Area Cleanup Efficiency: Safety, Cost and Tonnage"

Chris Pallister, Gulf of Alaska Keeper

ABSTRACT

This presentation will examine the safety and efficiency of removing collected marine debris from remote shorelines, such as those in British Columbia and the Gulf of Alaska. Safety issues related to cleanup work on dangerous, road-inaccessible beaches will be discussed. Removal of marine debris by hand and small vessels will be compared to marine-debris removal utilizing helicopters and large sea-going tug and barges. Lessons learned from large helicopter/barge removal projects in the Gulf of Alaska are applicable to remote beach cleanup projects throughout the world.

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Marine Debris Removal on St. Paul Island, Alaska"

Pamela Lestenkof, Aleut Community of St. Paul Island Tribal Government
Paul Melovidov, Aleut Community of St. Paul Island Tribal Government
Aaron Lestenkof, Aleut Community of St. Paul Island Tribal Government
Dallas Roberts, Aleut Community of St. Paul Island Tribal Government
Veronica Padula, Aleut Community of St. Paul Island Tribal Government

ABSTRACT

The Aleut Community of St. Paul Island Tribal Government (ACSPI) has been cleaning up marine debris on the beaches and shorelines of St. Paul Island, Alaska since 1998. St. Paul Island is the largest of the Pribilof Islands, a five-island archipelago in the central Bering Sea. The island supports astonishingly high concentrations of marine mammals, seabirds, fish, and invertebrates. On the Pribilofs, one of the most prominent local impacts of marine debris is the entanglement of northern fur seals or laaqudax (Callorhinus ursinus) in pieces of net, plastic bands, and other synthetic debris. The ACSPI has been actively involved in entanglement research and monitoring since 1995. More recent studies led by the ACSPI have estimated that the juvenile male fur seal entanglement rate on St. Paul Island is between 0.15 and 0.35%. While fur seal entanglements seem to have declined since the 1970s, the ACSPI continues to seek funding for marine debris removal to reduce entanglements for fur seals. In May 2017, the ACSPI removed approximately 21,844 pounds of marine debris from shoreline adjacent to habitat critical for northern fur seals, Steller sea lions, and seabirds. Net and line were the major contributors to the weight of debris collected. Debris composition data was shared with the Sitka Sound Science Center for inclusion in the Alaska Marine Stewardship Foundation (AMSF) statewide marine debris database. A total of 79 super sacks of marine debris were barged off island to Seattle, WA on Coastal Transportation free of charge and transported to the Roosevelt Regional Landfill for disposal.

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Marine Debris Removals in St George Island, Pribilof Islands, Alaska by the St George Traditional Council"

Sally Mercurlief, St George Traditional Council

ABSTRACT

The unique location and geography of St. George Island makes it rich in seabirds, Northern Fur Seals, and the Steller Sea Lions, many of which are endangered. The Pribilof Islands historically is home to one of the largest Northern Fur Seal breeding population in the world, which has declined dramatically over the past 20 years. The Aleut community of St. George has been dependent on seabirds, Northern Fur Seals, and Stellar Sea Lions as a source of food. It has been a part of their culture for many generations and while it's fading from the newer generations' culture, it is still a way of life for many. The Pribilofs sit in a prime fishing area in the Bering Sea making it a high traffic area for fishing vessels and marine debris from this activity and other far--off areas accumulates on our beaches. Marine Debris poses a threat to these mammals, they get curious, they investigate it, causing them to get entangled. Studies have shown that every year many seals and sea lions in Alaska unnecessarily suffer or die from marine debris. Some debris like the white packing bands end up entangled around the seals necks and gets so embedded in them that it cuts them. To help preserve their marine life and culture, the St. George Traditional Council proposed a plan to clean up marine debris on our beaches and rookeries. All of the work is done by hand and debris is sorted, weighed and cataloged then put into supersaks. We partner with NOAA, the Sitka Sound Science Center and the Aleutian Pribilof Island Community Development Corporation and hope to continue these efforts into the future. Shipping collected debris off island remains a significant barrier to our community.

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Native Community Marine Debris Removal in the Bering Sea Critical Habitat"

Scott Anderson, Native Village of Port Heden

ABSTRACT

The coastal beaches of Port Heiden, AK have been cluttered with marine debris for decades. Port Heiden is located within Bristol Bay on the Alaska Peninsula. The Native Village of Port Heiden (NVPH) has been working with federal and local agencies to remove marine debris since 2008. We have a clean-up program using 100% local hire to clean marine debris from the outer coastal beaches of southwest Alaska. A majority of the debris comes from the Bering Sea. Average fishing related debris is 28% Line or Rope and 12% Trawl, Seine & Cargo net. Our program recovers debris from a total of 87 miles of beach within 5 different areas of our community. Our beaches have long runs that are inaccessible by road, so ATV's and trailers are required for access. The beaches are made up of heavy black sands, silty mud, and volcanic pumice. Tides and weather require local navigational expertise and small vessels (32' shallow bottom boats and skiffs) to transport crew and equipment to safe staging camps. Cleanup generally requires laborers use shovels to dig up debris. What looks like just a buoy may be ten fathoms of line, so the right tools, time, and hard work are necessary on every site. We also work hard to stay diligent protecting our surroundings and insure we do not disturb the vegetation line and/or animal habitat. Working with the State of Alaska, we secure permits prior to entering critical habitat areas.

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Southeast Alaska Marine Debris Removal - A Walk on the Beach - Not!"

Kristina Tirman, Sitka Sound Science Center
Victoria Curran, Sitka Sound Science Center
Margot OConnell, Sitka Sound Science Center

ABSTRACT

The Sitka Sound Science Center has been working with local partners to remove marine debris from the rugged outer coast beaches of southeast Alaska since 2007. With 18,000 miles of coastline, southeast Alaska has more coastline than Washington, Oregon, and California combined. Much of this coastline is inaccessible by roads and exposed to the open Gulf of Alaska. The outer coast in front of Sitka includes Cape Edgecumbe, one of the biggest hot spots for marine debris in the Gulf of Alaska. The outer coast is comprised of rugged rocky shore lines, lava flats, cliffs, and pocket coves fringed in large kelp beds. Tides in the area can exceed 4.9 m. Consequently, the SSSC has found partnering with local commercial fishing vessels has been very effective for debris removal from remote locations. These locals are experienced in local navigation and working in challenging weather conditions. The fishing vessels also serve as housing for field crew. Boats are <20 m with a 4-person crew. The larger vessel anchors outside the surf zone and launches smaller skiffs and inflatables to access the beach. Sea state is the limiting factor in access as many of the beaches are steep and rocky where surf creates hazardous exit and entry. Small crews access the shore and work in pairs to clean debris, working to end on a high tide to limit how far debris needs to be moved. All of this work is done by hand. Debris is cataloged and supersaks are used. Saks are either loaded into inflatable pulled out with lines past the surf zone. Trips can last up to 7 days depending on deck space for debris. Debris is recycled when possible, re-purposed or disposed of at the municipal transfer facility. The SSSC has a strong outreach and education program working with k-12 schools, university field courses and 12,000 cruise ship passengers each year

Challenges of community-based removal and disposal from the Bering Sea to the remote Pacific

"Three Decades of Debris Data: What regular cleanup activities reveal about marine debris recovery efforts in Hawai‘i"

Megan Lamson, Hawaii Wildlife Fund
Stacey Breining, Hawai'i Wildlife Fund
Cynthia Welti, Surfrider Foundation Kaua'i
Kevin Brinck, University of Hawai'i at Hilo

ABSTRACT

Hawai‘i Wildlife Fund (HWF) and Surfrider Foundation Kaua‘i (SFK) have over three decades of combined experience removing marine debris from the shorelines and nearshore reefs of the Hawaiian Archipelago. Collectively since 2003, HWF and SFK have removed more than 740,576 lbs. (335.9 m. tons) of debris on three different islands (Hawai‘i, Kaua‘i, Maui) with over 39,289 documented hours of coordinated volunteer effort. Rigorous data collection has been captured for these cleanup efforts since 2008 (Hawai‘i Island, HWF), 2013 (Kaua‘i, SFK), and 2016 (Maui, HWF). Data analysis of these debris activities has revealed a peak efficiency number of volunteers by cleanup type (community beach cleanup vs. large debris and derelict-fishing-gear recovery efforts) for both relatively-accessible and remote debris-accumulation coastlines.

Comparison of debris recovery efforts between islands (Hawai‘i, Kaua‘i, Maui) using rates of recovery by volunteer hours (average = 20.3 ± 13.3 lbs.) and methodologies utilized are examined and may help maximize effectiveness of volunteer power. Well-coordinated volunteer efforts play a crucial role in both removing the threats of and reducing the input of marine debris in our world's oceans and coastlines. In addition, HWF and SFK continually search for the best means of recycling debris collected while minimizing the global carbon footprint of such activities. Authors will share lessons learned over the years from hundreds of cleanup activities, and will also spotlight how cleanup efforts have focused on sensitive sites and highest-impact zones as a way of initiating a "triage" response in times of environmental crises.

It's Not Just Rubber Ducks: Container Ship Spill Prevention, Regulation, Mitigation, Environmental Impact, and Liability

"Flotsam and Jetsam: Evolving a Modern Regulatory Framework for an Acutely Modern Marine Debris Problem"

Selina Lee-Andersen, McCarthy Tetrault LLP
Elizabeth Steele, McCarthy Tetrault LLP

ABSTRACT

The advent of modern plastics has fundamentally defined the way in which we live, work, play and consume goods. From food safety and medical innovations, to the electronics and automotive sectors, plastics are at the heart of almost every industry. However, it is becoming increasingly apparent that our love affair with plastics and the conveniences they bring is leading to some very real world consequences, particularly for our oceans and supporting ecosystems. As the sheer magnitude of the marine debris issue becomes clearer, attention is turning to strategies for reducing the amount of plastics making their way to the oceans and managing their impacts on the marine environment. From a legal perspective, there is little doubt that the existing regulatory framework for marine pollution falls short of being able to tackle the uniquely modern and rapidly growing problem of plastic pollution. With a maze of domestic and local laws, intertwined with international and regional instruments, the current legal framework for dealing with marine pollution is complex to say the least. While the London Dumping Convention, MARPOL Convention and the UN Convention on the Law of the Sea deal with vessel-sourced waste, there are few provisions to deal with land-based sources of pollution. This session will examine the legal mechanisms currently available to manage marine debris and what is needed to fill the regulatory gap. In addition, this session will consider some of the unique legal issues surrounding "blue entrepreneurship", such as rights to the recovery and reuse of marine debris.

It's Not Just Rubber Ducks: Container Ship Spill Prevention, Regulation, Mitigation, Environmental Impact, and Liability

"Shipping Container Spills in the Gulf of Alaska: Environmental Impacts and Liability Issues"

Chris Pallister, Gulf of Alaska Keeper

ABSTRACT

This presentation will discuss the frequency and environmental impacts of shipping container spills in the Gulf of Alaska. The geographic scope of known spills and the potential costs associated with mitigating those spills will also be discussed. The potential liability of parties responsible for shipping spills will be examined.

"Collaborative approaches to removing Abandoned Derelict Vessels: Case studies on US EPA cleanup work with partnering agencies"

Harry Allen, USEPA
Bill Robberson, USEPA

ABSTRACT

Abandoned Derelict Vessels (ADVs) plague US waterways and are very often latent sources of environmental pollution. While ADVs may be disregarded as part of the maritime landscape, a closer look yields discoveries of oil and hazardous wastes almost without exception. These wastes leach into the environment posing ecotoxicity and can impact human health and welfare. In general, US EPA has authority to respond to and direct the removal of such wastes from the environment, however, ADVs are a special case.

Due to the complexity of ADV removal cases, it has been acknowledged that "no one entity can go it alone." Indeed, there have been several highly successful removal projects in EPA Region 9 each requiring significant multi-agency participation and multiple sources of funding. These projects also required extensive consultation on issues ranging from historic preservation to protection of fish habitat. This platform session will review several case studies illustrating agency authorities and funding sources. We will review each of these authorities in turn and discuss gaps. Finally, we will discuss National and state-wide initiatives to abate ADVs and address ADVs before they sink!

“Coordinated Response to Remove Derelict Vessels in Florida Post Hurricane Irma”

Charles Grisafi, NOAA Marine Debris Program

ABSTRACT

Hurricane Irma made landfall in Florida on September 10, 2017, with category four wind speeds and massive storm surges, leaving large amounts of debris in the coastal and marine environment from Key West to Jacksonville. In the wake of this destructive storm, over 3,000 vessels were left displaced throughout the state of Florida. Many of these vessels ended up in sensitive habitats, like seagrass beds and coral reefs, or became tangled in mangroves. Some vessels were also discharging oil or contained hazardous materials. The extent of derelict vessels resulting from Hurricane Irma was unprecedented, necessitating a coordinated response among federal, state, and local agencies. Working under the National Response Framework, as part of Emergency Support Function 10, the United States Coast Guard (USCG) was tasked by the Federal Emergency Management Agency to mitigate potential pollution threats by removing vessels displaced by the storm. The State of Florida, United States Environmental Protection Agency, National Oceanic and Atmospheric Administration, and other agencies assisted the USCG in targeting and assessing vessel locations and pollution threats from vessels, and ensured that impacts to natural and cultural resources were avoided during all removal operations. During the conference, we will discuss the details of this coordinated response, successes, and lessons learned for future response efforts.

"Improving California's Prevention and Response Strategies for Abandoned and Derelict Vessels – a study of the Sacramento-San Joaquin Delta"

Andrea Daly,

ABSTRACT

Abandoned and derelict vessels (ADVs) create environmental, navigational, and public health hazards. Hundreds, if not thousands, of these vessels exist in California and as vessels are removed from the state waterways they pollute, more vessels appear. These vessels pose a significant challenge in California and the state struggles to effectively address this issue. This summer I worked with the California Department of Fish and Wildlife's Office of Spill Prevention and Response (OSPR) to study this problem. While our research focused on the Sacramento-San Joaquin Delta, which is the epicenter of the problem in California, ADVs are a problem state and countrywide. The goal of our research was to increase our understanding of the problem so we could develop strategies to improve the state's response to ADVs.

OSPR conducted an aerial survey of the Delta, collecting data on vessel count, location, and status. After discussions with experts, a series of assumptions were applied to this data set. Using this data set along with data gathered during a subsequent water survey, I developed a cost estimate for the removal of all vessels from the Delta. I also interviewed ADV program coordinators in eight coastal states across the country, seeking to identify common challenges and solutions that might be applicable in California. Additionally, I gathered qualitative data about the state's current ADV program through discussions with program participants. Lastly, working with OSPR staff, I designed a web form for state agencies to use to track ADVs and create a comprehensive ADV inventory, which California presently lacks.

During the conference I would discuss survey findings, the conclusions from my discussions with other states, and my recommendations for improvement of California's ADV response. No paper is being written.

"California Coastal Cleanup Day – a Gateway to a Lifetime of Coastal Stewardship"

Eben Schwartz, California Coastal Commission

ABSTRACT

The California Coastal Commission has been the statewide leader of California Coastal Cleanup Day (CCD) since its inception in 1985. One of the single largest contributors to the International Coastal Cleanup, CCD regularly draws 60,000 – 80,000 people to the state's beaches and inland waterways. Over time, the commission has used the cleanup as an educational gateway for millions of people to enter the world of coastal stewardship. The volunteers, and the people across the state they inspire with their actions, have become a constituency that seeks to change the policies and practices that lead to marine debris, and are a primary reason why California leads the U.S. in laws and regulations that seek to reduce debris at its source.

The cleanup is organized as a partnership with local organizations across the state, and through this structure, the commission has helped build a strong core of groups ready and willing to take action on marine debris, including educating the public and advocating for change. Running through all this work is the cleanup, which remains the foundation of our activities. The commission continues to grow and improve the cleanup; in recent years, we have sought new audiences, such as the boating community, and developed new initiatives, such as our "Bring Your Own" effort to reduce the waste created at the cleanup, all of which have improved the cleanup and spread our messages even further. The cleanup has been, and continues to be, a powerful tool to rid California of its trash, both on a single day and throughout the year.

"Coastal Cleanup Day – A Local Perspective on Coordination and Innovation"

Moriah Saldana, I Love A Clean San Diego

ABSTRACT

For over 30 years, I Love A Clean San Diego (ILACSD) has been coordinating Coastal Cleanup Day locally through a statewide collaboration with the California Coastal Commission. The mission of Coastal Cleanup Day is to engage volunteers of all ages to remove trash and debris from waterways and beaches; to identify the sources of debris; and to ultimately change the behaviors that cause pollution. Marine debris is much more than just an eyesore, and this event offers San Diegans the opportunity to take action in their local communities to make a positive, lasting impact on the environment. ILACSD has used the powerful data and reach of Coastal Cleanup Day educate local constituents and policy makers on the effects of different policies aimed at litter reduction.

Annually, I Love A Clean San Diego mobilizes between 8,000-10,000 volunteers in the San Diego region to remove over 170,000lbs of trash, recycling, and hazardous debris as part of Coastal Cleanup Day, held at 100-115 sites lead by local environmental champions. Each year, approximately 77% of all sites are inland cleanup sites, demonstrating that debris in all areas of our watersheds affect our oceans. ILACSD also supports cleanup efforts in Tijuana for Coastal Cleanup Day, adding a binational layer of coordination to this event. ILACSD continues to expand and advance the event, incorporating zero waste principles like encouraging volunteers to "Bring Your Own" reusable cleanup supplies, using a digital app for data collection in addition to the paper data cards, and through engaging new partners to be new advocates for positive change.

"Every Day is International Coastal Cleanup Day in Miami!"

Dara Schoenwald, VolunteerCleanup.org

ABSTRACT

We'd like to share how our website VolunteerCleanup.org has been an instrumental online tool for organizing ICC in Miami, and how it helped us scale year-round cleanup efforts in South Florida. We created the site to be a central hub for local cleanups that would increase volunteer turnout, expand reach and impact, and reduce duplication of efforts among cleanup organizers. It's now a well utilized digital platform, engaging thousands of volunteers locally to increase marine debris awareness and prevention. Our free site connects those who are organizing cleanups with the volunteers who are looking for one to join. Anyone can post a cleanup to our site and reach our database of volunteers, and any volunteer can find a cleanup to join and register online. They can also sign up for our weekly emails, listing all upcoming cleanups within 15 miles of their zipcode. As the new the organizers of ICC in Miami, we were able to solve the prior organizers biggest pain point: registration for the 40+ cleanups in the Miami program. Using our website for online registration, and capturing volunteer's information, we quickly built a database of thousands of volunteers that we now mobilize and re-engage year round, not just in September. Next, we got many of our ICC Captains to lead regular cleanups, ensuring their success by driving attendance from our database and weekly emails. We have seen significant usage from organizers and volunteers. In South Florida, there are several cleanups on our site for each weekend that are well attended. In just two years, we've facilitated 715 cleanups, 37,096 volunteer hours from 5,000 registered volunteers and an estimated 130,000 pounds of marine debris removed from our local shorelines. We'd like to expand, and invite cleanup organizers around the world to use our website for ICC and beyond!

State and Local Best Practices, Insights, and Innovations to the International Coastal Cleanup Day

"Oregon's "Train the Trainer" Model and Best Practices during the International Coastal Cleanup"

Joy Hawkins, SOLVE
monica Gunderson, SOLVE

ABSTRACT

With 33 years of experience coordinating both one-day and year-round beach cleanup events, SOLVE works with hundreds of local, regional, and international partners each year to improve the environment and build a legacy of stewardship by making it easy for anyone to get outside and make a difference.

The Great Oregon Fall Beach Cleanup was one of the first coastwide, volunteer cleanup efforts in the world. Started on October 13, 1984 as the "Plague of Plastics", the coastwide cleanup has become an Oregon tradition, engaging over 260,000 volunteers who have removed an estimated 1,800 tons of trash from Oregon's beaches. Today, the event is part of the International Coastal Cleanup and includes nearly 100 inland neighborhood, park, and Adopt-a-River cleanup sites, encouraging data collection and debris removal before it flows downstream.

Oregon's coastwide cleanups provide an innovative way for volunteers to become active in their community as volunteers, one-day site leaders, or ongoing region-wide leaders throughout the year. SOLVE's cleanups are based on a "Train the Trainer" model. Each event is coordinated by 18 trained, volunteer "Zone Captains", who in turn, recruit and train up to 75 on-site "Beach Captains". Recently, the cleanups have incorporated new practices, including a successful BYO-Bucket Campaign to reduce plastic bag use, a glass float scavenger hunt, sorting stations, and the creation of an event-specific Social Media Guide. SOLVE looks forward to sharing these experiences and best practices with fellow marine debris leaders across the world.

"State and Local Best Practices, Insights, and Innovations to the International Coastal Cleanup Day"

Marianne Butler, Solano Resource Conservation District

ABSTRACT

Though California's Solano County lies inland, all of its watersheds drain to the Sacramento River or Carquinez Strait, through the San Francisco Bay and into the Pacific Ocean. Solano County commits significant time and resources to cleanup efforts along its waterways, sponsoring three events each year. Two of these events are county-wide efforts, involving collaboration with all of the County's jurisdiction and a suite of private stakeholders who contribute funding, clean-up materials and other services. Each jurisdiction hosts multiple cleanup sites, coordinated by a city-designated manager. The County partners with the local RCD to coordinate events county-wide, providing outreach, multimedia advertising and support. Coastal Cleanup is the longest running cleanup event, and consistently brings out ≈2,600 volunteers, about .61% of the population. The other two events, on the Saturday closest to Earth Day and on World Environment Day, have smaller, but growing participation levels. Components integral to all events:

Zero Waste sensibility: 20 of 60 sites at the 2017 Coastal Cleanup generated no additional waste by volunteers or coordinators. K-12 environmental education curriculum: Inclusion of marine debris and waste reduction stewardship units in programs for third graders, 6th graders and high school students. Use Of CRV funds to support removal events: leveraging State grant monies to get cleanup activities on the ground. Long-term partnerships with local businesses: developing long-term sponsors to increase community buy-in and the number of County cleanup sites. Annual, calendared events: Encouragement of annual participation by individuals, groups and partners, to make cleanup participation a part of the yearly calendar.

Approaches to Ecological and Public Health Risk Assessment from Marine Debris and Microplastic Exposure

"Accumulation of plastic debris and associated contaminants in marine food webs"

Noël Diepens, Wageningen University
Bart Koelmans, Wageningen University

ABSTRACT

Plastic debris and their associated contaminants are considered major pollutants of marine systems, yet the extent to which plastics accumulate in food webs remains unclear. Here, we examine the potential for food web accumulation of plastics and associated contaminants on theoretical grounds, using an Integrated Plastic and Contaminant food web Accumulation model (IPCA). The model can be used as a tool for prospective risk assessments, to generate hypotheses that can be verified experimentally and to trigger the further scientific evolution of risk assessment frameworks for marine plastic debris. The model was implemented for an illustrative case: an Arctic foodweb with polar bear as top predator. Furthermore, we provide scenario analyses to investigate the role of (a) plastic and contaminant concentrations, (b) chemical metabolization, (c) plastic and chemical exposure pathway (i.e. bioavailability), and (d) increased plastic emissions in the future, on food web accumulation of plastic and associated chemicals, as expected from existing knowledge and theory.

"Assessment of microplastic pollution and ecological risk in Korean coastal waters"

Young Kyoung Song, KIOST
Won Joon Shim, KIOST
Soeun Eo, KIOST
Gi Myung Han, KIOST
Sang Hee Hong, KIOST

ABSTRACT

Horizontal and vertical distribution and composition of microplastics were determined in seawater in along the coast of South Korea in July and August, 2016. Each 100 L of top 20 cm of surface water by grab sampling and mid-water column and bottom water by submerged pump sampling at a station was filtered through a 20-μm mesh net. The volume-reduced water samples were filtered through a 5 μm filter paper and all plastic like particles on the filter papers were identified by spectroscopy using micro-FTIR. The microplastic abundance from six regions was in range of 460-5,480 for surface (n=31), 10-1,060 for middle (n=31) and 30-2,200 particle/m3 for bottom (n=31) water. The mean abundance of plastics from surface waters (1,795±1,276 particle/m3) was significantly higher ($p < 0.05$) than those in middle and bottom (394±300 and 441±492 particle/m3). Fragment type of microplastics was dominant (77.6-90.5%) and it was followed by fibers. The microplastics less than 300 μm in size accounted for 84% except for fiber type, while in fibers, size < 300 μm only accounted for 28%. The dominant polymer types were polypropylene in both non-fiber (average; 40%) and fiber (average; 95%) in all depth. The environmental levels of >20 μm microplastics in Korean coastal waters were compared with the exposure levels causing adverse biological effects in laboratory toxicity test including the reported values in the literature. Ecological risk was assessed preliminarily with currently available exposure and effect data.

Approaches to Ecological and Public Health Risk Assessment from Marine Debris and Microplastic Exposure

"Coping with Uncertainty: action level for microplastics in seafood from the north coast of Java, Indonesia"

Inneke Hantoro, Soegijapranata Catholic University
Budi Widianarko, Soegijapranata Catholic University
Ansje Lohr, Open University of the Netherlands

ABSTRACT

A study by Jambeck et al (2015) has indicated that Indonesia is the second largest contributor of mismanaged plastic waste ending up in the ocean. Java, as the most populated island in Indonesia (about 145 million people), contributes 0.116 – 0.145 million tonnes plastics waste per year. This may lead to massive accumulation of microplastics in this coastal area. Seafood from the north coast of Java contained different types of microplastics. Investigation of one strectch of the north coast of Java revealed an alarming result. Our previous research showed that commercial seafood, such as milkfish, mullet, tilapia, blood cockle, and shrimp, contained 3.3 – 7.2 microplastic particles/animal. Microplastic can be considered as a novel food contaminant since it is unintentionally present in food. No safety standard has been set yet for this novel contaminant, and therefore, the qualification of microplastic as a food contaminant is an important first step in food safety based risk assessment. In March 2017, the Indonesian government pledged to reduce marine waste polluting its waters by 70% within eight years. While waiting for this ambitious reduction to take place, the risk for microplastic to enter the food system cannot be omitted and there is a need for an interim regulatory measure. The current absence of regulation regarding microplastic as contaminant in food creates an uncertainty for food safety which has economic consequences. One option to cope with the uncertainty is by setting up a provisional action level. This presentation outlines the derivation steps of the action level based on the principle of unavoidability.

Approaches to Ecological and Public Health Risk Assessment from Marine Debris and Microplastic Exposure

"Estimating the mortality from plastic ingesation - a new method based on stranding data"

Chris Wilcox, CSIRO Oceans and Atmosphere Business Unit
Qamar Schuyler, CSIRO Oceans and Atmosphere Business Unit
Kathy Townsend, University of Queensland
Melody Puckridge, CSIRO Oceans and Atmosphere Business Unit
Denise Hardesty, CSIRO Oceans and Atmosphere Business Unit

ABSTRACT

Plastic in the marine environment is a growing environmental issue. Sea turtles are at significant risk of ingesting plastic debris at all stages of their lifecycle with potentially lethal consequences. We tested the relationship between the amount of plastic a turtle has ingested and the likelihood of death, treating animals that died of known causes unrelated to plastic ingestion as a statistical control group. We utilized two datasets; one based on necropsies of 246 sea turtles and a second using 706 records extracted from a national strandings database. Animals dying of known causes unrelated to plastic ingestion had less plastic in their gut than those that died of either indeterminate causes or due to plastic ingestion directly (e.g. via gut impaction and perforation). We found a 50% probability of mortality once an animal had 14 pieces of plastic in its gut. Our results provide the critical link between recent estimates of plastic ingestion and the population effects of this environmental threat. We discuss extension of this method to cover other species, characteristics of debris, and other key information needs in addressing the threat plastic ingestion poses to wildlife.

Approaches to Ecological and Public Health Risk Assessment from Marine Debris and Microplastic Exposure

"Risk assessment of plastic pollution on the marine diversity in the Mediterranean Sea"

Monetserrat Compa, Instituto Español de Oceanografía
Carme Alomar, Insitituto Español de Oceanografía
Chris Wilcox, Commonwealth Scientific and Industrial Research Organization
Erik van Sebille, Institute for Marine and Atmospheric Research
Laurent Lebreton, The Ocean Cleanup Foundation
Britta Denise Hardesty, Commonwealth Scientific and Industrial Research Organization
Salud Deudero, Instituto Español de Oceanografía

ABSTRACT

Plastic marine litter is an increasing threat to marine biodiversity globally and quantifying the impact across different species has so far been complex. This is especially true when combining species with different ecological traits and occupying different ecological niches. Here, we examine the semi-enclosed basin of the Mediterranean Sea where the inputs of marine litter and its impact on the marine diversity are still widely unknown and often are species and location specific. We analyzed 84 species from six taxonomic classes, integrating inter-specific factors such as ingestion rates, biogeography, life history traits (e.g. motility, habitat, and body size) and reference study quality. Species were modeled to spatially identify and estimate their exposure to marine plastic across the Mediterranean Sea by modeling their ingestion rates based on the estimated exposure to plastics. Our models indicate local and regional motility have an impact on the risk of exposure to marine plastic. Body size was also important, regardless of feeding behavior. Overall results from this study indicate coastal species are at higher risks of ingesting plastic in the marine environment. Due to the spatial coverage and species diversity in this study, the results provide an insight into best management practices in coastal hotspot areas to minimize plastic pollution in the marine environment from harming marine wildlife.

Approaches to Ecological and Public Health Risk Assessment from Marine Debris and Microplastic Exposure

"Why a risk framework for marine debris?"

Britta Denise Hardesty, CSIRO Oceans and Atmosphere
Chris Wilcox, CSIRO Oceans and Atmosphere

ABSTRACT

Applying a systems perspective to understanding the marine debris issue requires a means of conceptualizing the sources, distribution and dynamics of debris in the environment; identifying or quantifying impacts on wildlife, humans and other assets; and identifying and evaluating potential management responses. There is also a significant degree of uncertainty in our knowledge. Resolving this uncertainty can be challenging, given that we are confined to working with largely observational data because experiments at scale are difficult or impossible. To advance this area of research, we suggest applying a conceptual framework that allows us to break the components into smaller parts that can integrate uncertainty and connect variables of interest to outcomes of interest. We identify four specific questions inherent to a risk framework: the first three focus on risk analysis, and the fourth on risk management or mitigation. In this talk, we present examples that are both data rich and data poor and we discuss the value of integrating a systems perspective, connecting sources and drivers to dynamics and distribution to impacts and management responses. We also discuss the precautionary principle and its application to risk management in the plastics pollution issue.

Big Data: Making Meaning From Land And Sea Observations

"Analyzing large scale marine debris monitoring data - challeges, solutions, and patterns"

Chris Wilcox, CSIRO Oceans and Atmosphere Business Unit
Qamar Schuyler, CSIRO Oceans and Atmosphere Business Unit
Denise Hardesty, CSIRO Oceans and Atmosphere Business Unit

ABSTRACT

The study of plastic pollution on land and in the oceans has stimulated a significant amount of monitoring effort, from at-sea trawls to thousands of volunteer cleanups. Researchers are literally at sea in a wash of data. However, many of these data were collected for reasons other than marine debris monitoring. After global efforts to analyze more than 10,000 trawl records, and large scale analysis of data from tens of thousands of surveys and cleanups in the US and Australia, it is clear that there are a number of major issues with the data we have at had to monitor marine debris. Using this data we have been able to identify sources, estimate trends, quantify distributions, and suggest solutions. However, there are a number of fundamental uncertainties that challenge the use of much of the marine debris data that is available. We will address some of the key issues in citizen science and other data types, and conclude with suggestions for how those interested in monitoring plastic pollution might modify their methods to increase their rigor and usefulness.

Big Data: Making Meaning From Land And Sea Observations

"Anthropogenic microparticle distribution in global marine surface waters: results of an extensive citizen science study"

Abigail Barrows, Adventure Scientists
Sara Cathey, Adventure Scientists
Chris Petersen, College of the Atlantic

ABSTRACT

Plastic is a major pollutant throughout the world. It is one of the most prolific materials manufactured globally, with over 322 million tons produced annually. Plastics are cheap, light-weight, and durable—characteristics that have made it an ever-more attractive packaging material and led to its high volume in solid waste streams. Microplastic (plastic particles less than 5 mm in size) residence time and movement along the coast and sea surface outside of the gyres is still not well researched. This five-year project utilized global citizen scientists to collect 1,628 1-liter surface grab samples in every major ocean. Across all ocean basins, open ocean samples (further than 12 nm from land) contained a higher particle average (17.9 L-1) than coastal samples (5.9 L-1). Particles were predominantly microfibers (91%), 100 µm- 1.5 mm in length (77%), smaller than what has been captured in the majority of surface studies. Through µFT-IR we determined material type of 113 pieces, with 59% classified as synthetic and 41% as non-synthetic. Non-synthetic microfibers may pose a new and mostly unconsidered negative environmental and biological impact. Samples came from understudied ocean regions, some of which are emerging as areas of concentrated floating plastic and anthropogenic debris, influenced by distant waste mismanagement and/or airborne particles. Incorporation of smaller-sized microfibers in oceanographic models, which has previously been lacking, will help us to better understand potential fate and transformation of synthetic and non-synthetic microparticles in the marine environment.

"Big data as a source of policy to address plastic marine pollution"

Marcus Eriksen, 5 Gyres
Jamie Rhodes, Upstream Policy
Matt Prindiville, Upstream Policy
Jeff Kirschner, Litterati

ABSTRACT

After many years of surveying the subtropical gyres to document the distribution of plastics of all sizes, we concede that the greatest mitigations are upstream, where the plastic is identifiable, especially to brand. But what of ocean plastic data, trends, characterization of what's there? Is it meaningful toward productive policy? Can we apply the same "Big Data" waste characterization to trash on land? In collaboration with other NGOs, we looked for the most common types of plastic waste in the United States during 2016 to create the Better Alternatives Now list (BAN list). We will use the BAN list as a baseline for measuring the effectiveness of future mitigation efforts, ranging from public awareness campaigns, to brand-engagement initiatives. In taking on this tactic, can big data be an effective tool for change?

Litterati is a mobile application that allows anyone to identify, map, and collect the world's litter. With a community that has grown worldwide, and collected over 1M data points, we are able to provide the public, corporations, NGO and governmental organizations with useful data to locate litter hotspots, identify brands and products, and understand seasonal trends. With improvements in image recognition software, machine and deep learning, and an ever-growing Litterati community, we are poised to tackle the global litter pandemic.

Big data sets provide ample evidence to support policy-driven campaigns to mitigate the problem illuminated by that data. It is essential that big data be validated, and preferably peer-reviewed. Our recent example of the BAN list outlines the top 20 product categories found as trash on the ground across the United States. By assigning brand data to these items, we are able to inform source-reduction campaigns targeted at those companies themselves.

Big Data: Making Meaning From Land And Sea Observations

"Merging Big Data"

Win Cowger, University of California, Riverside

ABSTRACT

Data quality, structure, and hygiene vary greatly in marine debris datasets. Quality ranges from uninformed data collectors with a high amount of random variation, to academic where measurements are made precisely with peer review. Structure can be the sum of everything observed in one unit or a fine grained classification and sampling scheme with multiple data dimensions such as weight, volume, number, shape, color, manufacturer, and size. Intradata hygiene typically has a well thought out scheme. However, in the case of data from Marine Debris Tracker and Clean Swell, intradata merging is complex because they use multiple different types of forms. Interdata hygiene is frequently complex, data is being collected with different devices, in different dimensions or units, is preconditioned with highly specialized models or assumptions, and prepared in complex tabular schemes. Simply adding an "Other" column can make or break a successful data merge. The most difficult thing about merging marine debris data is that a lot of data is not publically available. Sometimes organizations decide not to share it for proprietary reasons, institutions keep it until they publish (this can take years), and occasionally even after publishing individuals decide they will only share their data if they are added as a coauthor on the paper it is used in. The questions we want to answer in marine debris require big data, the only way to move forward is through collaboration to create higher quality data, an emphasis toward more data classifications, homogenization of data sheets and types, and open data.

Degradation Of Plastic Debris In Different Marine And Coastal Environments

"A model study to explore the kinetics of polymer fragmentation in aquatic environment."

Fanon JULIENNE, IMMM
Nicolas DELORME, IMMM
Taco NICOLAI, PCI
Christophe CHASSENIEUX, PCI
Fabienne LAGARDE, IMMM

ABSTRACT

Degradation of non biodegradable polymers in the aquatic environment is a sum of complex phenomena such as photodegradation, thermal oxidation and hydrolysis. Importance of a specific factor such as temperature, biofouling, UV light, polymer chemistry and thickness and kinetics of fragmentation are relatively unknown. To provide a better understanding of these processes and to predict the evolution of microplastics environmental concentrations, laboratories experimentation are needed. The present study aimed to determine the kinetics of abiotic degradation and fragmentation of polymers as a function of environmental conditions. A first insight into the statistical analysis of the size distribution of generated fragments is obtained.

Polymer films were machined by blown extrusion to perfectly control their structure and thickness and were placed during several months in an aging chamber under controlled conditions. During all the experiment, the films were regularly analyzed through spectroscopy (UV-visible, IR, Raman) and water contact angle measurements to investigate kinetics of degradation. SEM and polarized light pictures were also taken to follow the fragmentation.

For polyethylene (PE), it appeared that weathering strongly affected all physico-chemical properties (chemical composition, hydrophobicity, crystallinity). Polymer breakdown occurred faster in water than at air and despite high carbonyl indices, fragmentation did not lead to nano-fragments in noticeable amount. The number of generated micro and milli-sized fragments did not increase linearly vs time. Moreover, some of the PE fragments exhibited an increase in their density leading to a sub-surface position in the water column, which might be of great importance in the mass balance budget of polymers at the oceanic surface.

Degradation Of Plastic Debris In Different Marine And Coastal Environments

"Artificial ecosystem selection for marine polymer degradation"

Robyn Wright, University of Warwick
Matthew Gibson, University of Warwick
Joseph Christie-Oleza, University of Warwick

ABSTRACT

Up to 12.7 million tons of plastics are thought to enter the oceans every year, and this figure is likely to increase. As recalcitrant synthetic polymers, plastics are notoriously difficult to degrade in the marine environment and are therefore expected to persist for hundreds of years. To learn about the likely fate of these synthetic polymers in the ocean, we can investigate the fate of recalcitrant natural marine polymers, which are biodegraded by marine bacteria. Research has shown that microbial communities and consortia degrade environmental contaminants more efficiently than single strains, yet through artificial selection of whole communities, it is possible to attain consortia that are even more efficient at degrading contaminants. Here, we used an artificial selection method to evolve a community (isolated from coastal marine debris) to be better at degrading chitin, an abundant but recalcitrant natural polymer. We found that the evolved community exhibited higher chitinase activity, and therefore higher potential to degrade chitin, than the original community, and may be able to degrade chitin more completely and efficiently than an individual strain. This community is currently being characterised using MiSeq. We are also applying the same method to explore the degradability of the commonly used packaging plastic poly(ethylene terephthalate) (PET). Here, the community that is best at degradation is determined based upon its ability to grow with PET as the sole carbon source. The evolution is monitored via a combination of metabolic and enzyme activity assays, clear zone plates and changes in the chemical composition and weight of PET films exposed to these communities. The results of this study will inform us on the potential for microbial communities to develop the ability to degrade marine plastics.

"Degradation of plastics in term of loss mechanical properties a coastal zone, port of Manzanillo, Colima"

Juan Carlos Alvarez Zeferino, Universidad Autónoma Metropolitana
Alethia Vázquez Morillas, Universidad Autónoma Metropolitana
Margarita Beltrán Villavicencio, Universidad Autónoma Metropolitana
Lidia Silva Iñiguez, Universidad de Colima
Ojeda-Benitez Sara,

ABSTRACT

The plastic wastes are problematic around the world, the problems associated with the environment in special the marine zones have been the center of attention lately from society, government, and academia.

The plastic residues remain for prolonged periods in the environment, causing affectation to the organisms, which can be ingested or entangled. Faced with this problem, new materials have been developed with the aim of reducing the impact on the environment, however, their designs have been developed to biodegrade or degrade under specific conditions and not in marine conditions.

In the present work, we studied the degradation of plastics in three marine conditions (buoy, boulders beach, and sand beach) in the port of Manzanillo Colima, México, for 60 days. We evaluated five different types of plastic: low-density polyethylene (LDPE), high-density polyethylene (HDPE), oxodegradable high density polyethylene (OXO-HDPE), oxodegradable high density polyethylene subjected to weathering (OXO-HDPE-W) and the compostable film ECOVIO® from BASF. The plastics were cut in strips of 1 x 10 cm and 30 samples of each plastic were placed in a PVC mesh cage.

The plastic that showed the major degradation was ECOVIO in all conditions, the beaches of boulders and sand presented the greatest degradation in comparison with the plastics that were in the buoy. The above allows assuming that the friction with sediments is one of the most important factors that contribute to the degradation of plastics

The degradation of plastics in marine environments must be prevented because when exposed to the weather the plastics are converted into microplastics, which are difficult and even impossible to remove.

Degradation Of Plastic Debris In Different Marine And Coastal Environments

"Degradation of the Mulch Plastic in Soil Environment by photodegradation and biodegradation"

Yüksel Ardali, Ondokuz Mayıs University

ABSTRACT

Plastics as polyethylene are widely used in packaging and other agricultural applications. They accumulate in the environment at a rate of 25 million tons per year. Thus, the development and use of degradable plastics was proposed as a solution for plastic waste problem. Because of the ever-increasing use of plastic films, nowadays, biodegradability has become a useful characteristic for plastics. Conversely, the introduction of biodegradable plastics has generated a need for methods to evaluate the biodegradation of these polymers in landfills and solid waste treatment systems such as composting or anaerobic digestion treatment plants. The purpose of this study was to investigate climatic and soil factors responsible for the degradation of biodegradable plastics in soil environment were analyzed in soil 12 months. Degradation was determined every month by collecting sample specimens for the measurement of weight loss, percentage elongation, relative viscosity and FTIR spectrum. The tested plastic samples were found to be degradable in soil but the amount of total carbon, the pH, and the soil texture did not show a good correlation with the degradation of plastics.

"Deterioration of plastics in air and sea water"

Nicolas Biber, University of Plymouth
Richard Thompson, University of Plymouth
Andy Foggo, University of Plymouth

ABSTRACT

Plastic an abundant solid contaminant in the marine environment. Despite their durability, plastics deteriorate into fragments due exposure to UV radiation and mechanical stress. This contributes to the accumulation of microplastics, which are defined as plastic particles smaller than five millimetres. Microplastic particles have been detected in the marine environment on a global scale. The occurrence of microplastic contamination can result from direct introduction of microplasticised pieces, for example form their use as abrasive particles in cosmetics, and from the fragmentation of larger items in the environment. A number of possible deterioration processes, such as mechanical wear and oxidation have previously been described. However, the rate and extent of deterioration of plastics in the natural environment remains largely unknown. This study aimed to describe deterioration of some commonly used types of plastics in the natural environment. Samples of polymers (biothene, polyethene, polystyrene and poly(ethylene terephthalate)) were deployed in seawater and air for 600 days . Subsamples of each material were collected from these environments at intervals over a twenty-month period. Their deterioration was measured through changes in tensile properties and molecular composition. Deterioration occurred much more rapidly in air than in sea water, which was attributed to reduced UV radiation and oxygen availability in water. Deterioration in air led to changes in tensile properties. With materials becoming more brittle their capacity for tensile extension was reduced. Tensile extension also decreased in material samples that were exposed in sea water even though no oxidation was measured. This suggests that the deterioration of plastics in marine environments can result from factors other than UV radiation.

Degradation Of Plastic Debris In Different Marine And Coastal Environments

"Investigating Physical and Chemical Degradation of Plastics using Open Ocean Microplastic Samples and Laboratory and Field Weathering Experiments"

Kara Lavender Law, Sea Education Association
Jessica Donohue, Sea Education Association
Theophilos Collins, Sea Education Association
Katherine Pavlekovsky, Sea Education Association
Julia McDowell, Sea Education Association
Anthony Andrady, North Carolina State University
Giora Proskurowski, MarqMetrix

ABSTRACT

There is currently no method to determine how long microplastics floating at the sea surface have undergone environmental weathering, how quickly fragmentation has occurred, and how these processes might vary according to polymer type in the marine environment. We conducted laboratory and field exposure experiments to address these questions, and also meticulously examined physical and chemical characteristics of more than 5000 open ocean microplastic particles for clues about their weathering history.

Microplastics collected using surface plankton nets by Sea Education Association in the western North Atlantic, eastern North Pacific, Mediterranean and Caribbean Seas since 1991 were analyzed to determine polymer type and particle size, mass and form. We hypothesized that particle characteristics, alone or in combination, are a relative indicator of age (time of exposure), where particles in subtropical gyre accumulation zones differ from those in regions closer to presumed sources, such as coastal areas and in enclosed marginal seas. A subset of collected particles whose original form is known – resin pellets – were also analyzed using FTIR-ATR and other methods for signatures of chemical degradation that are related to physical weathering characteristics. In parallel, exposure experiments on virgin plastic resins were conducted in laboratory experiments with seawater, and in two marine field exposure sites to evaluate changes in physical and chemical characteristics on a known exposure time scale. The major results of these combined studies offer clues to polymer-dependent degradation mechanisms and time scales in the marine environment.

"A comparison of microplastic contamination characteristics among marine invertebrates inhabiting in urban, rural, and aquaculture areas"

Mi Jang, Korea Institute of Ocean Science & Technology (KIOST)
Sang Hee Hong, Korea Institute of Ocean Science & Technology (KIOST)
Won Joon Shim, Korea Institute of Ocean Science & Technology (KIOST)
Gi Myung Han, Korea Institute of Ocean Science & Technology (KIOST)
You Na Cho, Korea Institute of Ocean Science & Technology (KIOST)

ABSTRACT

Microplastics have become a global environmental concern because of their widespread presence in coastal areas, the open ocean, and polar regions. Microplastics in the environment originate from a variety of land- and sea-based sources. Regional industrial and human activities may affect the abundance and contamination characteristics of microplastics in their surrounding environment, which may be reflected to marine species living in its water body and transfer through their food web. This study investigated the contamination characteristics of microplastics in abiotic matrices such as seawater and sediment, and biotic matrices such as oyster, mussel, and lugworm in urban, aquafarm, and rural areas. In abiotic matrices, different polymer composition of microplastic was found among three regions. High diversity was found from urban area, implying diverse sources of microplastic in this area. Polystyrene was relatively abundant in aquafarm area, reflecting well the wide use of expanded polystyrene buoys. In rural area, polypropylene is relatively abundant, probably related with the wide use of polypropylene rope in fishing activity. Microplastic compositions in marine invertebrates followed well those in abiotic matrices. This result implies that the accumulation profile of microplastics by marine invertebrates reflects regional human activities.

Effects Of Microplastics On Fish And Invertebrates

"A long term exposure experiment tests the effects of clean and contaminated microplastics on juvenile blue mussels Mytilus edulis"

Thea Hamm, GEOMAR, Helmholtz Center for Ocean Research
Mark Lenz, GEOMAR Helmholtz Center for Ocean Research

ABSTRACT

Evidence grows that marine benthic filter feeders take up microplastic particles together with their food frequently, while our knowledge about the possible effects of this is still small. In addition to mechanical impacts such as clogging and damaging, microplastics presumably have negative effects because they accumulate persistent organic pollutants. They could therefore serve as vectors that increase the bioavailability of chemical compounds for marine invertebrates. So far, very few experimental approaches investigated this potential role of microplastics over a longer time period and with realistic particle concentrations. Therefore, we are currently investigating the effects of clean and contaminated microplastics (irregularly shaped PVC particles, 20-60 µm) on juvenile individuals of the blue mussel Mytilus edulis over the course of 12 months. For this, we will use particle concentrations of 0, 100, 1000 and 10 000 particles per liter. Furthermore, since marine organisms in coastal waters are commonly exposed to multiple stressors, we will test whether possible negative effects of microplastic pollution are aggravated when heat stress is induced. This will be done by simulating a summer heat wave with a magnitude that is expected for the Western Baltic by the end of the 21st century. We intend to answer two questions: (1) At which particle density and after which time span do effects of clean or contaminated microplastics become detectable in the blue mussel M. edulis? (2) Are possible effects enhanced when they co- occur with a further environmental stressor? We will present first data and would like to discuss our approach with other researchers who focus on the biological effects of microplastic pollution.

Effects Of Microplastics On Fish And Invertebrates

"A New Digestible Fluorescent Coating Method for Quantification of Cumulative Microplastic Ingestion"

Evan Karakolis, University of Toronto
Brian Nguyen, University of Toronto
Jae Bem You, University of Toronto
Percival Graham, University of Toronto
Chelsea Rochman, University of Toronto
David Sinton, University of Toronto

ABSTRACT

The ubiquitous presence of microplastics in the environment makes it imperative to understand their impact. First, we must understand exposure – i.e., how many microplastics are ingested by organisms. This has proved difficult because counting microplastics in the gut content provides only a snapshot in time. Here, we developed a method that uses a digestible fluorescent coating (DFC) to enable the quantification of cumulative microplastic ingestion. The method works by coating microplastic particles with a digestible fluorophore-conjugated protein that is removed from microplastics upon passing through the digestive tract of an organism. When an organism ingests microplastics with a digestible fluorescent coating the peptide bonds in the protein coating are hydrolyzed by proteases in the gut and the attached fluorophore is released allowing identification of an ingested plastic by loss of fluorescence. Our method enables automated enumeration of microplastic ingestion using fluorescence microscopy coupled with particle counting software and the flexibility to track different microplastic types and sizes with distinct fluorescent tracers. The method is compatible with different polymer types, sizes and shapes, in varying water quality parameters and with different species. We demonstrate proof-of-concept with four zooplankton species with varying feeding strategies and different native habitats to confirm the coating is non-toxic and is not preferentially ingested by these species. This method provides a unique and reliable approach to quantify microplastic ingestion over time, and can be used to advance our understanding of the impact of microplastics on wildlife.

"A Platform for High-Throughput Assessments of Environmental Multi-stressors: A first look at the combined impacts of climate change and microplastics on zooplankton"

Brian Nguyen, Department of Mechanical and Industrial Engineering and Institute for Sustainable Energy, University of Toronto
Percival Graham, Department of Mechanical and Industrial Engineering and Institute for Sustainable Energy, University of Toronto
Evan Karakolis, Department of Mechanical and Industrial Engineering and Institute for Sustainable Energy, University of Toronto
Chelsea Rochman, Department of Ecology and Evolutionary Biology, University of Toronto
David Sinton,

ABSTRACT

Marine debris occurs in complex environments. Despite this, most experimental studies do not consider the effects of differing environments. Here, we introduce a platform, compatible with microtiter plates, for measuring complex interactions between multiple stressors, including parameters relevant to climate change and point source pollutants. Our platform (Figure 1) leverages (1) the high rate of purely diffusive gas transport in aerogels to produce well-defined centimeter-scale gas concentration gradients, (2) spatial light control and (3) established automated liquid handling. As a result, hundreds of treatments can be run in parallel with our platform. Previously, we validated the platform by conducting proof-of-concept experiments with single and multi-cellular organisms including: Chlamydomonas reinhardtii, Lemna gibba, and Artemia salina. We are applying our platform to marine debris research by applying it to explore the effect of acidification and warming on microplastic ingestion by the copepod, Tisbe biminiensis. Our initial tests (Figure 2) suggest that ocean acidification potentially increases the ingestion of microplastics by Tisbe biminiensis while warming only increases algae consumption, suggesting that ocean acidification may impact prey selectivity.

Effects Of Microplastics On Fish And Invertebrates

"Distribution and ecotoxicological effects of microplastics in Mediterranean marine organisms"

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ABSTRACT

Microplastics (MPs) are widely diffused in the oceans and their ingestion by marine organisms is raising concern for potentially adverse effects. In this study, the distribution of MPs along Mediterranean trophic webs was evaluated, in approximately 600 specimens representative of the main invertebrate and vertebrate species. MPs were characterized in terms of size, shape and polymer typology trough microscopy and μFT- IR analyses. The results indicated that ingestion of MPs is widespread, with their occurrence in approximately 30% of Mediterranean specimens, and much higher frequencies in some species; fragments, lines, films and pellets are the more represented particles, while polyethylene, polystyrene and polyamide are the dominant polymers. However, no clear relationship with trophic position, feeding strategy or habitat preference can be easily observed.

The ecotoxicological effects of MPs were further investigated in Mediterranean mussels, Mytilus galloprovincialis, focussing on biological interactions of these particles when contaminated by PAHs. After ingestion, MP were observed in different tissues causing a significant bioaccumulation of B(a)P. The analysis of a wide range of molecular and cellular biomarkers, including immunological and antioxidant systems, neurotoxic responses, genotoxic damages and lipid peroxidation showed a different susceptibility of analysed pathways, depending on time of exposure, tissue and treatment typology. Toxicity of MPs alone was slight, but increased for contaminated particles. Even in the absence of strong toxicity, the downregulation of the immune system might have long-term consequences on organisms health status. In conclusion, this study provided new insights on the distribution of MPs in marine food webs, and on the mechanisms for their potential toxicity.

Effects Of Microplastics On Fish And Invertebrates

"Effects of acute exposure of microplastics on the physiology of blue mussels"

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ABSTRACT

As sedentary organisms, suspension-feeding bivalves are particularly vulnerable to anthropogenic contaminants that enter coastal environments. To understand the full range of impacts that contaminants such as microplastics have on these animals, sub-lethal effects must be assessed. In this study we exposed the blue mussel, Mytilus edulis, to microspheres composed of polystyrene divinylbenzene (ca. 3-30 µm; 1500 microspheres ml-1, Bangs Labs) for a period of 12 hours. Prior to exposure, mussels were delivered a microalgal diet for 1 day and then divided into two groups: a microplastic-exposed group and an unexposed control group. Mussels in each group were then placed in individual feeding chambers supplied with the microalgal diets and microspheres as appropriate. After exposure, three physiological parameters were measured including diet absorption efficiency (AE; Conover 1966), oxygen consumption, and ammonium excretion (phenolhypochlorite method). Each mussel was then sacrificed and soft tissues isolated and dried to a constant mass. All physiological parameters were standardized to a 1-g dry tissue mass using appropriate allometric equations. Absorption efficiency of mussels exposed to microplastics (55.6%) was significantly lower than AE of control mussels delivered only the microalgal diet (73.6%). No significant differences in oxygen consumption or ammonium excretion were found between treatments. Results indicate that acute exposure of mussels to polystyrene-divinylbenzene microplastics can have significant impacts on digestive processes, but not on respiration or ammonium excretion rates.

Effects Of Microplastics On Fish And Invertebrates

"Effects of micro- and nanoplastics on fertilization, embryo-larval development and metamorphosis success of the Pacific oyster Crassostrea gigas"

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ABSTRACT

To date, limited information is available for small plastic debris (< 330 µm) concentrations in oceans but recent studies showed significant impacts of small microplastics (< 20 µm) and nanoplastics (< 100 nm) on behaviour, metabolism, reproductive success and physiology of various marine organisms (fish, bivalve, zooplankton, phytoplankton). Thus, it is important to clearly evaluate the risks and define the toxicity thresholds. Here we investigated the effects of micro-sized (500 nm and 2 µm) and nano-sized polystyrene particles (50 nm) on three reproductive steps of the Pacific oyster Crassostrea gigas: (i) Fertilization (ii) Embryogenesis and (iii) Metamorphosis. Plain nanoplastics (no coating) and nanoplastics coated with carboxylic (PS-COOH) and amine groups (PS-NH2) were used to observe a possible charge-effect. All particles were used at four concentrations (0.1, 1, 10 and 25 µg/mL) to identify toxicity thresholds. Impacts on fertilization and embryogenesis were size, charge and dose dependent. Microplastics presented lower toxicity than nanoplastics, while amino-nanopolystyrene exhibited the highest toxicity (PS-NH2 > PS-COOH > PS-Plein). In contrast, no effects of plastic particles were observed on the metamorphosis. Thus, we demonstrated in our conditions that plastic particles may rapidly impair early life stages of oysters, which could have consequences on their overall life cycle. Next goals will be the analysis of the molecular and cellular pathways underlying the nanoplastics toxicity.

Effects Of Microplastics On Fish And Invertebrates

"Effects of plasticizers on the immune system of juvenile salmon."

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Kelly Martins, The College of William and Mary
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Chris Pallister, Gulf of Alaska Keeper
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ABSTRACT

Phthalate esters are commonly used plasticizers that help make polymer products more flexible and durable. They are non-covalently bound to their polymer products and therefore slowly migrate into the environment. Phthalates have been shown to dysregulate the immune system of mammals, birds, and fish. We have shown in a previous study that phthalate exposure reduces the abundance and inhibits the proliferation of rainbow trout (Oncorhynchus mykiss) IgM+ B lymphocytes and expression of secreted immunoglobulin heavy chain mu transcripts in an in vitro culture system. We proposed that phthalates modify the normal B cell activation pathways by accelerating B cell differentiation while suppressing cell expansion, resulting in fewer IgM-secreting plasma cells. This hypothesis was tested here in an in vivo field study of juvenile Dolly Varden (Salvelinus malma) collected from a plastic-polluted lake in the Gulf of Alaska. Fish tissues were analyzed both for phthalate levels, using liquid chromatography-coupled ion trap mass spectrometry, and for changes in immune gene expression, using RT-qPCR. Results revealed that fish with higher accumulated levels of di(2-ethylhexyl) phthalate, di(n-butyl) phthalate, and/or dimethyl phthalate, expressed significantly fewer secreted and membrane-bound immunoglobulin heavy chain mu and Blimp1 transcripts in their hematopoietic tissue. This suggests that chronic in vivo exposure of phthalates in wild juvenile fish leads to changes in expression of B cell-specific genes, and further, that this likely dysregulates normal B lymphoid function and antibody responses. Insufficient production of protective antibodies will make fish more susceptible to infection, and predictably increases their risk for disease and mortality in polluted waters.

Effects Of Microplastics On Fish And Invertebrates

"Exploring the effects of nylon microplastic on the development and energy reserves in coldwater copepods"

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Pennie Lindeque, Plymouth Marine Laboratory
Dag Altlin, Biotrix
Andy Booth, SINTEF Ocean
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ABSTRACT

Microplastic debris is a pervasive and widespread pollutant that poses a risk to aquatic biota and healthy marine ecosystems. Copepods are an abundant and ecologically important class of zooplankton, common to marine ecosystems across the globe. Field studies and laboratory exposures have identified that copepods readily consume microplastic particulates. In the copepod Calanus helgolandicus, prolonged exposure to polystyrene microbeads resulted in significant reductions in feeding, egg size, hatching success and survival. We hypothesise exposure to microplastics reduces feeding in copepods, resulting in energetic shortfalls for which lipids can act as a proxy. The coldwater copepod Calanus finmarchicus is a keystone species, common to the North Atlantic. During maturation, these copepods rapidly build-up their wax-ester store (oil sac); this lipid reserve is essential to the copepod's buoyancy regulation and energetic budget when overwintering, and is of high nutritional value to predators. Following a 48-hour acclimation period, juvenile C. finmarchicus were incubated in natural seawater containing a mixed assemblage of cultured algae (control), with the addition of either nylon granules (10-30 µm) or fibres (10x30 µm) at a concentration of 100 microplastics mL-1. Algal ingestion rates and developmental stage were monitored daily, while prosome length, oil sac size and lipid profiles were assessed following the six-day experiment. No significant differences in growth, sex-ratios or oil-sac size were identified, however we observed juvenile copepods moulted into adults significantly earlier (ANOVA, $P<0.05$) when exposed to microplastic. We discuss the impact microplastic exposure can have on feeding and energetics of animals, in relation to the individual and marine food webs as a whole.

"Hepatic gene expression in the European sea bass (Dicentrarchus labrax) experimentally exposed to PVC microplastics"

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ABSTRACT

The effects of microplastics (MPs; <1 mm) on fish species are still under debate. Few species have shown toxicological or physical impact due to the ingestion of MPs, as liver toxicity or alteration of intestinal tissues. The European seabass (Dicentrarchus labrax) is one of the most consumed fish species in Europe and it is potentially exposed to the ingestion of MPs both in its natural habitat and in the aquaculture plants. We measured, by quantitative Real-Time PCR, the variation of four different early warning signals in the liver of the European sea bass exposed for 90 days to virgin (MPV) and marine polluted PVC (MPI) MPs supplemented with food. The selected genes are: the TNF receptor associated factor 3 (TRAF3), the Peroxisome Proliferators Activator Receptors (PPARα/γ), the Estrogen Receptor alpha (ERα). The mRNA levels were quantified on 66 fish at time 0, after 30, 60 and 90 days of exposure to the two treatments (MPV and MPI) and control. The expression of TRAF3 is down-regulated with increasing time of exposure. The ERα mRNA levels are higher in the control compared to MPI and MPV for all the exposures, suggesting an upregulation of the gene related to contaminated food pellets. On the contrary, the PPARα gene expression increases over the time from 60 to 90 days of exposure. The PPARγ seems to be mostly affected by the MPV exposure, suggesting an effect due to leaching of plastic additives from PVC. This study represents one of the first investigation on the effects of the exposure to virgin and marine polluted PVC MPs on an edible species, which shows an early warning signal on the chemical and physical hepatic stress on this species. Further data are needed to better understand the role of the partitioning of chemicals from and to MPs and the related effects on fish and, potentially, on human health.

"Ingestion of microplastics by zooplankton in the natural environment"

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James Clark, Plymouth Marine Laboratory
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ABSTRACT

Microplastics have been documented in marine environments worldwide where they pose a potential risk to a range of biota. Of particular susceptibility are zooplankton, small ubiquitous marine animals that provide an essential link between primary producers and higher trophic levels (e.g. commercial fish species). Laboratory studies have established that zooplankton, such as copepods, readily ingest microplastics, and that such ingestion decreases their energy budget and negatively impacts reproduction, health and survival. It is imperative to understand the extent to which zooplankton encounter and ingest plastic particles and fibres within their natural environment, as there is potential to not only disrupt the link between primary producers and higher trophic levels but also for trophic transfer and bioaccumulation of microplastics within the marine food web. Hydrodynamic models were developed to identify areas where zooplankton and microplastics were most likely to overlap. Guided by these models, we sampled six sites in the western English Channel over the course of one year. Sampling was conducted using 50 μm nets to target microplastic debris at risk of being ingested by zooplankton, and 200 μm horizontal hauls to sample zooplankton. After each trawl, cohorts of different zooplankton taxa (i.e. copepods, decapod larvae) were enzymatically digested to determine the types and amount of anthropogenic debris ingested. Our results demonstrate that zooplankton routinely encounter and ingest microplastics under natural conditions. Encounter rates resulting from ingestion ranged from 1 particle/every 6-125 zooplankton. The incidence of ingestion of different zooplankton at different temporal and spatial locations and potential impact on the health of the population and higher trophic levels will be discussed.

"Ingestion, bioaccumulation and depuration of nano- and micro-plastic particles by marine bivalves"

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Vena Haynes, University of Connecticut- Avery Point
Bridget Holohan, University of Connecticut- Avery Point
J. Evan Ward, University of Connecticut- Avery Point

ABSTRACT

Plastics debris are introduced into the oceans, through industrial production and as anthropogenic waste. Larger plastics breakdown into nanoplastics (NP) and microplastics (MP) via weathering. Benthic animals, such as suspension-feeding bivalves, are exposed to NP and MP pollutants in coastal waters. MP also are capable of adsorbing dissolved pollutants in the surface waters and transferring them to benthic organisms when ingested. Studies have shown that NP and MP negatively affect marine animals on an organ and cellular level. Despite the potential for exposure and toxicological effects, the uptake, accumulation, and depuration of NP and MP by bivalves is largely unexplored. This study examined the ingestion, bioaccumulation and depuration of fluorescent polystyrene NP and MP by the blue mussel (Mytilus edulis). NP and MP were aged in seawater for 3 days prior to exposure experiments. Mussels were exposed to a 0.1 mg/L/hr concentration of NP or MP for two weeks and then allowed to depurate for one week in filtered seawater. Mussels were fed a standard microalgal diet throughout the 3-week experiment. Whole animals were frozen for later analysis of NP or MP concentrations at the end of each week and feces were collected daily for all 3 weeks and frozen. Tissue and feces samples were analyzed via a scanning fluorescence spectrophotometer for fluorescent plastic quantification. Results from this study will aid in developing biokinetic models of NP uptake and bioaccumulation in shellfish, and help elucidate the potential for these materials to be passed to higher trophic levels including humans.

Effects Of Microplastics On Fish And Invertebrates

"Microplastic fiber uptake, ingestion, and egestion rates in the blue mussel (Mytilus edulis)"

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Margaret Stack, Marine & Environmental Research Institute
David Fields, Bigelow Laboratory for Ocean Sciences
Patricia Matrai, Bigelow Laboratory for Ocean Sciences

ABSTRACT

Microplastics are a ubiquitous contaminant in the marine environment. Microplastic fibers, which make up to 90% of microplastics in coastal systems, are consumed by more than 200 marine species. However, the fate of these fibers and their effects once ingested remain largely unknown. Here, we present the effects of polyethylene terephthalate microplastic fibers (MPF) on blue mussel (Mytilus edulis) feeding rates, using imaging flow cytometry—a tool we have quantitatively adapted and applied to MPF. Mussels were fed a diet of Rhodomonas salina and experimental treatments ranged from 3,000 to 30,000 MPF/L, or 0.0004–0.004% of available seston. Microalgal uptake rates were greatly reduced in mussels exposed to levels of 15,000 MPF/L or higher. Pseudofeces production showed a positive correlation with MPF uptake rates at 30,000 MPF/L. Up to 70 MPF were isolated in a single fecal pellet and an average of approximately 300 to 1000 MPF accumulated in the digestive track. Based on our results, it is possible that mussels act as microplastic sinks in Gulf of Maine coastal waters where MPF concentrations average 10.16±0.54 MPF/L in summer and fall (2014-2017). Depuration times of exposed mussels were also examined to assess MPF egestion rates and may be an important processing step for commercial farmers. Ecological implications of MPF intake and egestion by filter feeders will be discussed.

Effects Of Microplastics On Fish And Invertebrates

“Microplastics on sessile invertebrates in the eastern coast of Thailand: the effect and coastal zone management”

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Gajahin Thushari, Uva Wellassa University
Jayan Senevirathna, Uva Wellassa University
Amararatne Yakupitiyage, Asian Institute of Technology

ABSTRACT

This study assessed the microplastic contamination of 3 most abundant sessile and intertidal invertebrates (Rock Oyster: Saccostrea forskalii, Striped Barnacle: Balanus amphitrite, Periwinkle: Littoraria sp.) in 3 beaches of the eastern coasts of Thailand. The results showed a significant accumulation of microplastics in the invertebrates at rates of 0.2–0.6 counts/g indicating higher pollution levels along the coastline. Filter feeding organisms showed comparatively higher accumulation rates of microplastics. Thus, contaminated bivalves pose potential health risks for seafood consumers. The plastic pollutant prevalence in sessile and intertidal communities was corresponded with pollution characteristics of contaminated beach habitats where they live. Thus, bivalves, gastropods and barnacles can be used as indicators for contamination of microplastics in the areas. This study als demonstrated the need for controlling plastic pollution in Thai coastal areas.

Effects Of Microplastics On Fish And Invertebrates

"The fate of microplastics ingested by the Mediterranean mussel: biochemical biomarkers and histopathology"

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Marta Martins, FCT-NOVA
Paula Sobral, FCT-NOVA
Pedro Costa, FCT-NOVA
Maria Helena Costa, FCT-NOVA

ABSTRACT

The concerns over the effects of microplastics (MP) in marine ecosystems has increasingly emerged in scientific community as shown by the high number of toxicological studies, regarding micro-sized plastics (<5 mm) and marine fauna. Although several studies reported that organisms ingest and excrete microplastics, the potential effects at organ and tissue level remain unclear, especially considering different microplastics sizes and concentrations. The present study investigates the potential toxicological effects of the ingestion of polystyrene microparticles (size range 2 – 10 μm) by the Mediterranean mussel (Mytilus galloprovincialis) over short-, mid- and long-term exposure periods, single and combined sizes, at two concentrations (10 and 1000 MP.·mL-1) using the biomarkers GST, LPO and histology. Overall, the results indicate that microparticles are promplty ingested regardless of size, are detected in the lumen of gut (mostly in midgut region) and, posteriorly, excreted through faeces. After 48h, higher levels of LPO were measured both in the gill and in the digestive gland in mixed size (2, 6 and 10 μm) exposures, and GST response was higher in the digestive gland than in the gill especially for the 2μm particles, but no correlation was found. After 21d exposure histopathological analysis of the whole digestive tract, revealed small foci of haemocytic infiltration in gastric epithelium, though this inflammatory response was not significantly correlated with the ingested microparticles. and no other tissue alterations were detected such as abrasion of the digestive epithelia. After 7 d in clean water microplastics could still be found in the digestive gland of the mussel.

Effects Of Microplastics On Fish And Invertebrates

"Trophic transference of microplastics under a low exposure scenario: insights on the likelihood of particles cascading along marine food-webs"

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Fabiana M. Tavares, University of São Paulo, Oceanographic Institute (IO), Department of Biological Oceanography
Alexander Turra, University of São Paulo, Oceanographic Institute (IO), Department of Biological Oceanography

ABSTRACT

Microplastic (mp) transference and persistence along trophic levels are key processes to understand the risks of this pollutant to marine food webs. The goal of this published work was to asses the potential occurrence of these processes considering a less extreme scenario of predator's exposure than used previously. For that, mps were only present in the hemolymph of prey (mussel Perna perna). Predators were the crab Callinectes ornatus and the puffer fish Spheoeroides greeleyi. The experiment showed the transference of mps from prey to predators but without evidences of persistence after 10 days of exposure. This suggests a reduced likelihood of particle's trophic cascading along the studied food web and low risks of mp impacts on higher trophic levels. However, the simplest transference of mps along food webs is still concerning, despite the particle persistence. We suggest that the risks of mps cascade along food webs are modulated by the concentration of particles in prey and by the predators' depuration capacity and rate.

“Understanding scleractinian microplastic ingestion: size limits, retention, and calcification effects”

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Allyn Duffy, student
Kathryn Drisco, U.S. Environmental Protection Agency

ABSTRACT

The prevalence of microplastics in the marine environment has been of increasing concern in the past decade. Microplastics have been shown to be ingested by aquatic organisms, however the physical and toxic effects of microplastic ingestion in marine organisms, including coral, are not well understood. Two laboratory experiments were conducted on the coral species, montastraea cavernosa and Orbicella faveolata. The first experiment measured calcification rates of corals exposed to three sizes of cured microplastics: 90-106, 425-500, and 850-1000 µm. Both species ingested all size classes, however, O. faveolata did not retain many of the 425-500 or 850-1000 µm size range. Calcification was measured by using the alkalinity anomaly principle per experimental chamber. Calcification was qualitatively lower in corals exposed to microplastics, however there was no significant difference from control treatment. This may be explained by potential species-specific retention times and an artifact of exposing both species at the same time as the amount of microplastics recovered was greater in M. cavernosa than in O. faveolata fragments. Hence, a second experiment was performed to determine retention times of various size classes (425-500 µm, 850-1000 µm, 1.7-2.0 mm, and 2.4-2.8 mm) of microplastic in individual fragments of M. cavernosa and O. faveolata. The largest size range ingested by both M. cavernosa and O. faveolata was 2.4-2.7 mm, with ingestion rates of 100% and 20%, respectively. At 48 hours, the majority of microplastics (>82%) were released by both species. It is clear that there are varying responses of ingestion rates and retention times for different coral species. These results are the first step to providing threshold values for better land-based management practices, especially around coral reef habitats.

"Assessing marine litter in vulnerable coastal ecosystems response to tourism activities"

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ABSTRACT

Human derived-stressors such as maritime transit, anchoring, sewage effluents, fishing and diving activities and marine protected areas have altered the spatial distribution and density of benthic marine communities surrounding the Balearic Islands in the Western Mediterranean Sea. Recent scientific studies have indicated high loads of microplastics and marine litter concentrations in coastal areas demonstrating that pristine areas are polluted with microplàstics, an indication of transport between marine ecosystems. The Western Mediterranean is characterized by oligotrophic waters, partially due to the absence of river discharges, natural characteristics, oceanographic regimens and anthropogenic activities which determine the spatial and temporal distribution of marine litter in this region of the Mediterranean basin. In the absence of important commercial harbors and ports and heavy river discharges, the Balearic Islands have a strong stationary tourism with highest peaks in the summer months. The massive affluence of tourists (1.107,220 habitants in the islands vs 13.241,450 million tourism in 2016) alone with an increase in maritime activities (home port and transit cruises, recreational boats) are expected to foster sewage discharge, overloading waste water treatment plants increasing water treatment and sewage discharges, therefore directly affecting coastal ecosystems. Thus, this increase of tourism and marine litter are assessed and discussed.

"Driving factors determining macroplastic distribution in seafloor habitats around the Balearic Islands, Spain"

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Salud Deudero, Instituto Español de Oceanografía
Beatriz Guijarro, Instituto Español de Oceanografía

ABSTRACT

Scientific surveys around the Balearic Islands, western Mediterranean Sea, have already demonstrated that plastic was present throughout most hauls conducted in a depth range varying from 51 to 800 m and up to 21 nm from the coast. In addition, plastic showed a high variability according to sampling locations with highest values in the western part of the archipelago. It is known that oceanographic regimes and plastic sources are determinant in the distribution and transportation of litter in marine environments. For this study, data from bottom trawl scientific surveys around the Balearic Islands were analyzed for a time series of 15 years (2001 -2015) at mesoscale level. Characteristic submarine geomorphology, geographical settings and bathymetric stratification in this sampling area might have an important role in the distribution of plastics. Thus, four depth strata; B (51-100 m); C (101-200 m); D (201-500 m) and E (501-800 m) along with habitat type (mud, sand, maërl, rhodophytes, crinoids), distance from the coast and currents were considered as potential factors that may determine spatial distribution of the plastic fraction in seafloor habitats. Preliminary results demonstrate that highest abundances of plastic are found in the first layers of the continental shelf (51-100 m). This result is important as it could be a valid indicator of the transfer of plastic from sea surface to the first bathymetric layers, where it accumulates and can be further transported to deeper layers through transportation and cascading processes.

"How to detect the impact of marine debris on Mediterranean biodiversity? The three fold monitoring approach"

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ABSTRACT

The Mediterranean Sea has been described as one of the most affected areas by marine debris, including microplastics, in the world. Recent studies in the different regions of the basin suggested that some areas are affected by important concentration of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on organisms and ecosystems. The information obtained by biondicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of biondicators can allow to measure not only the occurrence of marine litter in the species and its environment but also the threat posed to organisms by the evaluation of contaminants accumulation and any related biological effect. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethal effects to organisms related marine litter ingestion. The gaps pointed out by this research and the bioindicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

Marine litter in the Mediterranean Sea

"Marine Debris in the deep Mediterranean Sea"

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Simonepietro Canese, Istituto Superiore per la Protezione e Ricerca Ambientale (ISPRA)

ABSTRACT

Marine debris is a recognized global ecological concern. Increasing number of studies in the Mediterranean Sea are investigating litter distribution and its influence on deep habitats, but little is still known about the extent of the problem. Litter enters the seas from both land-based and marine sources, and can travel long distances before sinking. Anthropogenic and environmental factors influence litter distribution and can converge it in accumulation areas, such as canyons. Several quantitative assessments of debris present in the deep seafloor (50–2,000 m depth) were carried out and debris abundance ranged from 0 to >15,000 items km^{-2}, depending on location. Plastics typically constitute the most abundant debris, due to the large use and the high resistance to degradation. Plastic related-fishing debris is typically common in hard habitat, subject to intense fishing effort and tradition. The high commercial fishing effort of trawling and long lines fleets mainly operating in the basin represents, in fact, one of the major threat for the rich Mediterranean deep-sea environments, characterized by great diversity and abundance of structuring organisms, such as corals, gorgonians and sponges. In particular, these long-lived species with slow-growth rates and recovery ability play the important ecological role of ecosystem engineers in deep marine environments, creating complex three-dimensional habitats enhancing high biodiversity and ecosystem functioning at every level. The widespread presence of debris is impacting these vulnerable marine ecosystems. Standardized approaches and specific conservation measures are now an international priority and are needed in order to protect unique deep-ecosystems that are progressively disappearing.

"Microplastics in the Adriatic Sea: Occurrence, characterization, distribution and environmental management"

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Giulio Pellini, Coop. "Mare Ricerca"
Pierluigi Strafella, National Research Council of Italy - Institute of Marine Science
Fabio Grati, National Research Council of Italy - Institute of Marine Science
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Gianna Fabi, National Research Council of Italy - Institute of Marine Science

ABSTRACT

Recent years have seen a rapid rise in scientific interest in the occurrence of microplastic particles in the aquatic environment. Much of this research is showing that plastic micro-litter is a global problem, affecting the health status of aquatic ecosystems. At present, accurate assessment of the environmental, economic and societal impact of microlitter is hampered by a lack of standardization in extraction, purification and detection methods used for different environmental matrices. The objective of the present research was to develop a benchmark for the best available extraction, purification and detection technologies for use in seawater, sediment and marine biota samples from both water column and benthic environments. A sequential visual inspection, SEM, EDS, FTIR and μ-Raman microscopy and GCMS-Pyrolysis analysis was performed. The resulting multi-tiered approach, combining the various rapidity, accuracy, sensitivity and execution costs of the benchmarked techniques, is presented to promote the development of an effective microplastics monitoring program framework. The newly gained knowledge has been applied in a monitoring study based in the northern and central Adriatic Sea, a semi-enclosed basin characterized by a low water recirculation rate and elevated anthropic pressure associated with unsustainable fishing and high inputs of environmental contaminants. An extended sampling grid was adopted to provide information on both coastal and off-shore areas with 30 sites sampled for sediments and biota. Within this study emphasis was placed on the occurrence, polymeric relative abundance, plastic additive quantification, spatial and time distribution of microplastics as well as the correlation among plastic occurrence in sediments, water and biota. Presented data review published results and ongoing activities

"Presence of plastics debris in Mediterranean pelagic and demersal fish of commercial interest"

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ABSTRACT

Plastic pollution in the ocean represent one of the biggest worldwide environmental issue, and the toxicity of chemicals associated with them has begun to raise concerns regarding the presence of anthropogenic debris in seafood. Particularly Mediterranean sea is one of the most affected by marine debris pollution.

In this study, we investigated 316 gastrointestinal tracts from demersal fish species (Mullus barbatus, Merluccius merluccius) and pelagic species (Engraulis encrasicolus) for the occurrence of plastic ingestion. Samples were collected in 4 different FAO Geographical Sub Areas of the Mediterranean sea. According to our knowledge, the present study surveyed the largest sample size for European hake and European anchovy ever analyzed in Mediterranean sea. This two species are the most important in term of economic value and quantity for the Italian fleet. Samples were digested using a KOH10% solution and incubated at 60° C overnight in order to analyse microplastics. The extracted particles were microscopically observed, photographed, measured and categorized according to size class, shape and colour. Microplastics were characterized using a stereo-microscope and polymers identified by Fourier Transform Infrared Spectroscopy (FT-IR). Airborne contamination was prevented during all procedures and blanks were performed every two samples. In 19% of total investigated fish plastic particles were detected, a total of 60 plastic debris (95% microplastics) were recorded. The highest frequency (22,5%) was found in European hake. No significant difference for litter ingestion between pelagic and demersal species were found.

These preliminary results represent an important step forward for the assessment of the presence of plastic debris in three of the most important commercial species for the Mediterranean fishery.

Microfibers: Taking Action On What Is Known, Prioritizing Research On The Unknown

"A human-scale solution to Microfiber Pollution: the Cora Ball - conception, research, design and impact"

Rachael Miller, Rozalia Project

ABSTRACT

Microfibers are being found in more than just fish, but in honey, beer, salt and our drinking water - worldwide. Considering the fact that everyone who wears and washes clothes is part of the microfiber problem, the magnitude of this microplastic and anthropogenic marine debris is staggering. Rozalia Project for a Clean Ocean, a nonprofit, learned abut this problem 3 years ago and realized they had to act. For Rozalia Project acting meant developing a consumer-based solution to microfiber pollution - the Cora Ball. This presentation will take attendees through the process Rozalia Project took from learning about the problem to developing their solution (through many iterations) and bringing it to market. This includes sharing their experiences sampling the Hudson River from source to mouth to investigate microfiber in the wild during their design phase (results published in Marine Pollution Bulletin); running a successful Kickstarter campaign (especially successful for a product for the environment); going to Svalbard, a Norwegian island in the Arctic Circle, to test the Cora Ball's effectiveness when used by a whole community and their various failures and successes while developing this solution.

Microfibers: Taking Action On What Is Known, Prioritizing Research On The Unknown

"Confronting microfiber pollution: forging a road map to action"

Nicholas Mallos, Ocean Conservancy
George Leonard, Ocean Conservancy

ABSTRACT

Microfibers have become one of the most common forms of plastic debris found in aquatic habitats. To address this emerging threat, Ocean Conservancy and its Trash Free Seas Alliance, in partnership with the University of California's Bren School of Environmental Science & Management, convened a diverse set of stakeholders to to develop, distribute and promote a consensus research agenda that addresses key research questions to relevant scientists, conservation organizations and industries to inform private sector leadership and action. Summit participants included representatives from academia, NGOs and industry members across supply chains (e.g., apparel, home appliance, etc.). The major output from the summit included an action-oriented road map that reflects cross-sector needs, priorities and opportunities to help guide future research and organize efforts to reduce microfiber pollution and impacts. This convening will help shape the trajectory of a new collaborative effort to identify solutions, research efficacy, and then scale-up actions that will improve environmental and aquatic health.

Microfibers: Taking Action On What Is Known, Prioritizing Research On The Unknown

"Microfibers, a prominent contaminant in fish from the Great Lakes"

Lisa Erdle, University of Toronto
Miriam L. Diamond, University of Toronto
Paul A. Helm, Ontario Ministry of the Environment and Climate Change
David G. Poirier, Ontario Ministry of the Environment and Climate Change
Amila O. De Silva, Environment and Climate Change Canada
Liisa M. Jantunen, Environment and Climate Change Canada
Daryl J. McGoldrick, Environment and Climate Change Canada
Michael T. Arts, Ryerson University
Chelsea M. Rochman, University of Toronto

ABSTRACT

Microfibers make up a large component of microplastic debris found in the environment – especially around urban areas – and are likely found in combination with emerging contaminants (e.g. halogenated and non-halogenated flame retardants (FRs), and perfluoroalkylated substances (PFASs, including PFOS)). Some of these chemicals are added intentionally during synthetic textile manufacturing (e.g., PFAS) and others accumulate on textiles from indoor air and dust (e.g., FRs). Microfibers and associated chemicals are released into water via laundering. Once microfibers enter the aquatic environment, they may accumulate other chemical contaminants from ambient water. While these contaminants are known to enter urban waters from sources such as runoff, effluent and atmospheric deposition, and contaminate aquatic and terrestrial biota including invertebrates, fish and other wildlife, many questions remain regarding the sources, fate and biological impacts of microfibers and associated chemicals. To measure the extent that microplastics (including microfibers), FRs and PFASs contaminate fish in the Great Lakes, and to examine the relationship between microfibers and these contaminants, we quantified microplastics, FRs and PFASs in two trophic levels of fish. Fish were sampled from Lakes Huron and Ontario, nearby and at a distance from waste water treatment plant (WWTP) outfalls. We will quantify microfibers in fish and examine their correlation with FRs and PFASs. These results will be presented here as some of the initial work done in a collaborative effort between agencies to investigate sources, sinks and effects of microfibers in the Great Lakes.

Microfibers: Taking Action On What Is Known, Prioritizing Research On The Unknown

"Science to Inform Solutions – Source, effects and potential solutions for microfibers"

Chelsea Rochman, University of Toronto
Miriam Diamond, University of Toronto
Hayley McIlwraith, University of Toronto
Jack Lin, University of Toronto

ABSTRACT

Microfibers have become one of the most common types of microplastic pollution. They are found in diverse habitats and animals, including in Arctic ice, deep sea animals and our seafood. Scientists are now working hard to better understand sources, sinks and effects. We know that washing our clothing is one source, but is it the only source? We know that textiles include an array of chemicals that are added intentionally, such as dyes, pigments, antimicrobials, flame retardants and water repellents, and that our clothing accumulates chemicals from ambient air and dust. But are microfibers a source of chemicals to aquatic habitats and if so which chemicals and do they transfer to wildlife? We know that microplastics can cause effects in animals, but what are the specific effects from microfibers and are they unique to other plastic types? Increasing our understanding will increase our ability to allow science to inform policy. For example, understanding sources informs managers where to mitigate upstream and understanding their effects can prompt innovation of textiles that are safer and have a reduced shed rate. In this talk, we will discuss the work we have done in our own labs measuring microfibers in the environment, testing how microfibers may be a source of chemicals to aquatic habitats and investigating the benefits of some proposed solutions. We will also discuss work we are doing as a collaborative team of industry, NGOs and academics. Overall, we aim to put this work in context with that of others and talk about future steps for how we can collaboratively advance our understanding and solutions that are guided by the best available information.

"Wastewater treatment plants as a pathway for microplastics: A case study from Mersin, TURKEY"

Ceyhun AKARSU, Mersin University, Faculty of Engineering, Department of Environmental Engineering
Halil KUMBUR, 1Mersin University, Faculty of Engineering, Department of Environmental Engineering
Kerem GÖKDAĞ, Middle East Technical University, 2Institute of Marine Sciences
Ahmet Erkan KIDEYS, Middle East Technical University, Institute of Marine Sciences

ABSTRACT

Copious quantities of microplastics enter the sewage system on a daily basis through household wastewater, eluding the filtration systems at municipal wastewater treatment plants to become an important source of microplastic contamination in coastal waters. Effluent discharges from two secondary-level treatment plants and one tertiary -level treatment plant in Mersin, Turkey were studied during one year at monthly intervals in 2016 and 2017. These 3 plants combined discharge a water volume of about 230.000 m3/day into the northeastern Mediterranean. Based on our initial results, averaging all facilities, 2.6 microplastic fragments were found per liter of effluent amounting to around 600 000 particles per day. The most common type of microplastics were found to be fibers of which the main source could be wastewater of washing machines. The findings to date indicate that the Mediterranean is at great risk from microplastic pollution some of which could be originating from wastewater treatment plants. Recent studies of microplastics found in coastal sediments and the digestive systems of marine fish species from the same region in the Mediterranean support this claim.

Keywords: wastewater treatment plant, microplastics, micropullutants, household wastewater, effluent

Acknowledgement: This research was supported through Scientific and Technological Research Council of Turkey (TUBITAK) grants; CAYDAG-114Y244 ("Estimating the quantity and composition of microplastics in the Mediterranean coast of Turkey; the potential for bioaccumulation in seafood") and CAYDAG-115Y627 ("Impacts of Microplastic Particles and Bisphenol A as a Chemical Additive in Zooplankton Species of Mersin Bay")

"Analysis of microplastic pollution in Slovenian watercourses and lakes"

Mitja Centa, Institute for Water of the Republic of Slovenia
Andreja Palatinus, Institute for Water of the Republic of Slovenia
Manca Kovač Viršek, Institute for Water of the Republic of Slovenia
monika Peterlin, Institute for Water of the Republic of Slovenia

ABSTRACT

Research focused on microplastic sampling in the Ljubljanica River and Lake Bled using three different methods through the entire water column. We have developed and tested the sampling methodology using a water pump for assessing microplastic and mesoplastic concentrations in water column. 38 samples were collected using three sampling methods: a) surface – epi-neuston net, b) water column – water pump, c) sediment – Van Veen grab. Samples were analyzed thoroughly in a laboratory using two different methods according to the sampling method. Microplastics or mesoplastics were separated from the samples and analyzed according to European Master List of litter. Results show that water pump sampling methodology is more suitable in lakes than in watercourses. The comparison of the microplastic sampling results obtained by an epi-neuston net in the Ljubljanica River and Lake Bled with the sampling results in certain watercourses and lakes around the world demonstrates that the results obtained in Slovenia are comparable to the ones around the world. On the basis of the results of this research, it can be concluded that microplastics are already present in Slovenian watercourses and in lakes which leads to potential ecological problems.

"Anthropogenic Contamination of Beer, Sea Salt, and Drinking Water"

Mary Kosuth, University of Minnesota
Sherri Mason, State University of New York at Fredonia
Elizabeth Wattenberg, University of Minnesota

ABSTRACT

The first peer-reviewed papers to document plastic pollution in the natural world were published over forty-five years ago. Since then, a robust body of work has accumulated and the ubiquity of synthetic polymers in the environment is undisputed. From abandoned gillnets hundreds of meters in length to plankton sized fragments, synthetic polymers have been extracted from remote corners of the Earth's biosphere. Plastic have been quantified in marine environments that include segments of the pelagic biome, coastal habitats, deep sea sediments, as well as freshwater lakes and associated tributaries. Particles have also turned up in Arctic sea ice, ambient air, and a plethora of biota such as seabirds, aquatic mammals, fish, and benthic invertebrates. While evidence of plastic pollution in the natural world quickly mounts, few studies focus on synthetic polymer contamination in human consumables. This study investigates the presence of synthetic polymers in three specific consumable products: beer, sea salt, and drinking water. The first two studies (beer and salt) focused on consumables purchased within the United States in order to compare to similar studies conducted in other parts of the world. In the third study, 159 tap water samples were collected from seven geographical regions that span five continents. Results will be presented and discussed.

Plastic Debris Pollution In Freshwater Environments Of The World

"Floating macro litter input from rivers to the European Seas"

Daniel Gonzalez Fernandez, University of Cadiz
Georg Hanke, Joint Research Centre - European Commission

ABSTRACT

Despite the expected high importance of land-based sources of litter to the marine environment, the existing literature shows an important lack of field data and knowledge on this subject. Particularly, riverine litter input data have not been acquired and only estimates are available. Floating macro litter input to the seas is relevant because of its potential direct impact on wildlife through ingestion and entanglement, long range transport and as precursor to microplastics.

The JRC exploratory project RIMMEL was therefore set-up to deliver information about plastic waste entering the European Seas through river systems. A tablet computer application was developed for the harmonized monitoring of floating macro litter. The project operated an international network of scientific observers for field data collection across Europe. Data was acquired by visual observation during monitoring sessions, using the tablet computer application from bridges or other vantage points. The network has collected 800 datasets from 48 rivers in all European Regions over a period of one year, building up a unique database. These datasets correspond to 453 hours of monitoring. This is the first time such data is collected at large scale (17 countries) following a harmonized approach for monitoring and reporting.

Results indicate litter occurrence and type. Most frequent floating macro litter items entering the European seas include plastic fragments and single use items such as plastic bottles and bags. Riverine floating macro litter input over time has a great variability, with an average value of 20 items/hour per river for the whole set of data. These results provide support to European policies such as the Marine Strategy Framework Directive and the EU Circular Economy (Plastic Strategy).

Plastic Debris Pollution In Freshwater Environments Of The World

"Macro and Microplastics: St Louis River Estuary and Lake Superior"

Lorena Rios Mendoza, University of Wisconsin Superior
Cera Johnson, University of Wisconsin Superior
Maryelle Nyeck Nyeck, University of Wisconsin Superior

ABSTRACT

Microplastic particles are a new type of pollution reported in the Great Lakes with unknown impacts in the ecosystem and human health. Little information is currently available on the composition, distribution, or fate of microplastic debris in special in the western end of Lake Superior and St. Louis River Estuary. The aims of this research were to identify possible sources, abundance, and the potential of microplastics to be ingested by fish. Identification and quantification of organochlorine pesticides, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons adsorbed on the surface of plastic particles were determined. In this study, there were 58 samples collected (creeks, rivers, lake water, effluents water from four wastewater treatment plants, and beaches around Lake Superior) during the summers of 2016-17. A manta trawl was used to collect the samples with a duration of one hour. The identification of the type of synthetic polymer was determined using a Fourier transform infrared (FTIR) Micro Spectrophotometer. The microplastics were classified by color, size, pellets, fibers, and fragments. Preliminary results from effluent water from four wastewater treatment plants showed a range of 0.1 to 17.5 plastic particles per liter. The main plastic particles were fibers (cotton, synthetic plastic and mixed cotton-plastic).

Plastic Debris Pollution In Freshwater Environments Of The World

"Microplastic and anthropogenic litter in rivers: Sources, retention, export, and biological interactions"

Timothy Hoellein, Loyola University Chicago
Rachel McNeish, Loyola University Chicago
Samuel Dunn, Loyola University Chicago
Lisa Kim, Loyola University Chicago
Amanda McCormick, University of Wisconsin Madison
Sherri Mason, State University of New York at Fredonia
John Kelly, Loyola University Chicago

ABSTRACT

While rivers are considered a conduit of microplastic (particles < 5mm) and anthropogenic litter (AL) to oceans, less is known about its abundance, transport, and biological interactions within freshwater ecosystems. We conducted 2 sets of projects to examine the ecological dynamics of microplastic and AL in rivers. First, we measured microplastic in water column, sediment, macroinvertebrates, and fish in the 8 largest tributaries of Lake Michigan, completed seasonally for 1 year. Watersheds spanned a gradient of urban land-use. Microplastic was found at all sites, but those with agricultural and urban land use had greater concentration and export of particles. Sediment concentrations were higher than water column, suggesting deposition as a sink of microplastic in rivers. Almost all fish and macroinvertebrates collected had microplastic ingestion, with differences by taxon and feeding group. Our second set of projects examined the abundance, distribution, and biofilm colonization of AL in urban rivers. AL abundance and composition was different between benthic and riparian habitats. Within stream reaches, most AL accumulated in debris dams, where it interacts with microbes and macroinvertebrates critical for leaf breakdown. Finally, experimental incubations of different types of plastic revealed the influence of polymer type on microbial primary succession. Results will directly inform policy and engineering advances to prevent or mitigate the effects of microplastic and AL in rivers. Synthesizing research across freshwater and marine disciplines is critical to quantify the physical and biological factors driving the 'life cycle' of plastic at a global scale.

"Microplastic Ingestion By Several Species of Fish from the Great Lakes"

Keenan Munno, University of Toronto
Paul Helm, Ontario Ministry of the Environment and Climate Change
Donald Jackson, University of Toronto
Chelsea Rochman, University of Toronto
Dave Poirier, Ontario Ministry of the Environment and Climate Change
Satyendra Bhavsar, Ontario Ministry of the Environment and Climate Change
Richard Chong-Kit, Ontario Ministry of the Environment and Climate Change
Steve Petro, Ontario Ministry of the Environment and Climate Change

ABSTRACT

Microplastics, plastics less than five millimetres in size, come from several sources including industry, consumer products and the breakdown of larger plastic debris, with greater abundances of plastics found near major urban centres. We collected fish in 2015 from nearshore waters of Lake Ontario adjacent to the cities of Toronto and Hamilton, Ontario, to investigate the prevalence of microplastics in fish subjected to inputs from the most populated Canadian region of the Great Lakes. The fish included several species varying in size, feeding strategy (benthic and pelagic) and trophic level. Some of the species are also sportfish which are caught and consumed locally. Abundance and type of microplastics (>125 µm) contained in fish digestive tracts were determined. Preliminary results show that bottom-feeding fish species, with counts ranging up to 223 particles, have a greater abundance of microplastics in their digestive tracts than fish feeding near the surface of the water. Fibers are found to be the most prevalent particle type. Particle abundances and character will be compared to those in water samples collected from the same locations to determine whether certain shapes are more prevalent in fish digestive tracts relative to the surrounding environment, and which sources may contribute most to abundances in fish. This study provides an indication of the role of lake sediments in the exposure of fish to microplastics, and provides information regarding the most abundant types of microplastics and their potential sources. These results, which are the first from highly impacted areas of the Great Lakes, will inform management decisions and policy development to address microplastics.

"Microplastics from waste-water treatment plants in Portugal. Preliminary data"

Joana Antunes, FCT UNL

ABSTRACT

Two WWTP were analysed, regarding microplastics: a mixed domestic and industrial wastewater (WWTPA) and a mostly domestic wastewater (WWTP B). Samples were collected at the entrance of the plant and from the treated effluent flowing to the environment. A NaCl saturated solution were added to samples and posteriorly filtered through GFC/C filters in a laminar flow chamber. Particles were sorted by type (fragments, beads, fibres, color and shape), counted, measured and analysed with FTIR (work in progress). A total of 4887 microplastics were observed in 18 samples. 99% of the microplastics analysed were fragments, mostly from treated effluent (average 404 items.100ml-1). Fibres presented a higher percentage in the affluent (85%). Comparing WWTP, the highest accumulation of fragments was registered in the WWTPB affluent. Fibres accumulation were similar in the both WWTP. Significant differences were observed in the treated effluent. WWTP A registered a higher number of fragments (average 783±1069items.100ml-1) in this effluent. This result was not expected and probably occurred due to fragmentation from bigger microplastics into reduced dimensions or probably due to a punctual contamination from the internal WWTP structures. Microplastics analysed had sizes between 89 μm and 3000 μm. Smaller microplastics were observed on the top fraction of samples and the bigger microplastics appeared on the bottom layer in the sludge. This is a work is in progress as part of a master thesis at FCT-NOVA, provides a perception into the impact of WWTP discharges on the environment and recommend a long-term monitoring in future studies.

"Microplastics in riverine sediments and the factors affecting their accumulation"

Patricia Corcoran, University of Western Ontario
Sara Belontz, University of Western Ontario
Kelly Ryan, University of Western Ontario
Paul Helm, Ministry of the Environment and Climate Change

ABSTRACT

Reports of microplastic debris in marine and fresh surface waters provide a glimpse into the extent of plastics pollution on a global scale. Microplastics buried in benthic sediment, however, are relatively poorly document because of the challenges faced in separation procedures. The Thames River in Ontario, Canada flows approximately 400 km through agricultural and urban regions before emptying into Lake St. Clair in the Laurentian Great Lakes system. Thirty-five samples and duplicates were collected from river bottom sediment using a petite ponar grab in November and December of 2016. Microplastics were separated from sediment and organic debris by splitting, wet sieving, sodium polytungstate density separation, and microscopy. The 63 μm to 2 mm grain size grade was retained for examination. Every sample contained microplastic particles. Counts ranged from 16 to >10,000 particles/kg dry sediment with an overall fragment-fiber-microbead ratio of 27:67:6. The most abundant fragments were blue and red, whereas fibers were mainly blue and black, and beads were mainly black and gray. A weak correlation was noted between river flow and microplastics abundance, with moderate flow regions averaging greater counts than low and high. Preliminary grain size analysis shows that original samples composed of a considerable mud, clay, and organic matter contained the greatest number of microplastics. Greater particle counts were noted in samples from urban versus rural areas. The results indicate that microplastics abundance in riverine systems is influenced by a variety of factors, including, but not limited to sources, land-use, population density, grain size, and flow rate.

Plastic Debris Pollution In Freshwater Environments Of The World

"Plastic pirates sample macroplastic litter along rivers from Germany – riverside litter and sources estimated by schoolchildren"

Tim Kiessling, Universidad Catolica del Norte
Katrin Knickmeier, Kieler Forschungswerkstatt
Katrin Kruse, Kieler Forschungswerkstatt
Dennis Brennecke, Kieler Forschungswerkstatt
Alice Nauendorf, Kieler Forschungswerkstatt
Martin Thiel, Universidad Catolica del Norte

ABSTRACT

Rivers receive important loads of litter by visitors and terrestrial runoff, but the particular sources of riverine litter have not been identified. Here we used a citizen science approach where schoolchildren examined riverside litter and identified possible sources at over 200 sites along large and small rivers of Germany, covering all large river systems. Abundances of shoreline litter ranged from 0 to 6.08 items m-2 with an average of 0.64 items m-2. Litter comprised plastics (31%), cigarette butts (22%), glass (14%), paper (13%), metal (12%), and other items (such as food leftovers, 8%), indicating mostly contributions from visitors. Along many rivers there were also accumulations of litter that were deposited in the vicinity of the riverside, underlining the fact that visitors leave or directly dump litter along the river. Among the items found was also a high proportion of items potentially dangerous to people, including broken glass, sharp metal objects, used hygiene articles and items containing chemicals (such as batteries and aerosol cans). In the search for litter sources, the schoolchildren likewise identified mainly people who use the rivers as leisure areas (in contrast to people who live in the vicinity or the river itself bringing litter from upstream sources). These results indicate that a large proportion of riverside litter is directly left behind by visitors, highlighting the urgent need for better education in order to protect river environments and reduce input of riverine litter to the marine environment.
Financial support: Kiel Science Factory, Federal Ministry of Education and Research, Lighthouse Foundation

Plastic Debris Pollution In Freshwater Environments Of The World

"Predicting microplastic behavior in rivers on a US national scale"

Albert Koelmans, Wageningen University
Christopher Holmes, Waterborne Environmental
Scott Dyer, The Procter & Gamble Company

ABSTRACT

Whereas the small scale aquatic behaviour of microplastic particles is rather well understood and large scale models exist for traditional chemicals, no existing models unify these areas of knowledge. Here we provide the first deterministic model that combines the key features of microplastic settling, with a large scale US national model implementation of river network hydrology. We derived depth dependent in-stream first order removal rate constants for microplastics from the Besseling et al. (2017) NanoDUFLOW model and used these as input for the iSTREEM® model (Kapo et al., 2016). NanoDUFLOW provides removal rates while accounting for heteroaggregation, thus gaining realism especially for nanoplastic behavior. Subsequently, the iSTREEM model was used to simulate the emission, transport and water column concentrations of microplastics in rivers on a US national scale. Simulations were based on monitored microplastic data from wastewater treatment plants (WWTPs) and used these to estimate loading rates into WWTPs and receiving rivers in iSTREEM®. River flow rates and estimated depths for over 200,000 individual river sections provided realism with respect to the variability in hydrodynamics within the whole US river network. Our results illustrate that the nested modeling approach provides a powerful tool for prospective scenario analyses. River dynamics appear to lead to a high spatial variability in microplastic concentrations among sections in a river, dependent on their flow, retention time and depth, and on inputs from WWTPs and tributary rivers. Generally, microplastic concentrations decrease with increasing river order. However this is less pronounced for nanoplastics, which are carried much further in the network. Microplastic size thus drives retention with important implications for transport to the oceans.

"Removing microplastic particles from samples with high organic matter content: a countrywide investigation of sewage sludge produced across Norway"

Amy Lusher, Norwegian Institute for Water Research (NIVA)
Rachel Hurley, Norwegian Institute for Water Research (NIVA)
Christian Vogelsang, Norwegian Institute for Water Research (NIVA)
Marianne Olsen, Norwegian Institute for Water Research (NIVA)

ABSTRACT

Developing methods to investigate the presence of microplastics in the aquatic environment began slightly later than those for the marine environment; however, we are closer to standardized methods having learnt from the challenges encountered in the marine realm. Most methods to extract microplastics from complex matrices rich in organic matter, such as sludge samples encounter difficulties and may not efficiently remove the high volumes of organic material. Furthermore, the lack of standardized methods for sampling and analysis complicates the comparison between the relatively few sludge studies available worldwide. NIVA were given the task to develop appropriate methods to qualitatively and quantitatively characterize microplastic particles in sludge and sediment from Norway. The main objectives were to characterize microplastics in sewage sludge collected from various wastewater treatment plants (WWTPs) in Norway applying different wastewater and sludge treatment technologies and compare the results. As the general sludge characteristics are very dependent on the applied technologies, both for wastewater and sludge treatment, it was first necessary to identify the most appropriate methods for analyzing collected samples. Additionally, these methods should be time- and cost-effective to facilitate future monitoring efforts. Results will be discussed under the framework of method development and inter-site comparisons. We will establish the effect of biosolid processing on microplastic concentrations, in addition to the influence of WWTP characteristics (secondary/tertiary treatment, population equivalent etc.). We also propose a standardized method for ongoing monitoring of WWTP sludge microplastic contamination.

"Spatiotemporal Distribution and Characteristic of > 20 μm Microplastics and Annual Load on Nakdong River in South Korea"

Soeun Eo, Korea Institute of Ocean Science and Technology
Young Kyoung Song, Korea Institute of Ocean Science and Technology
Gi Myung Han, Korea Institute of Ocean Science and Technology
Sang Hee Hong, Korea Institute of Ocean Science and Technology
Won Joon Shim, Korea Institute of Ocean Science and Technology

ABSTRACT

River is an important pathway for transporting plastics to the oceans. Nevertheless, abundance, composition and load of riverine microplastics, especially less than 300 μm in size, is limited. The Nakdong River, the second largest river, in Korea was investigated spatially and seasonally. Surface water sampling was done in upstream (US), midstream (MS) and downstream (DS) in February (dry season), May (intermediate) and August (wet). Bottom water (DB) was also sampled in downstream. Each 100 L of river water was analyzed in triplicate and >20 μm microplastics was identified using micro-FTIR. Mean abundance of microplastic on Nakdong River was in range of 293 (US, February)-4,760 (DS, August) n/m3. Abundance of microplastic on surface increased downstream in February and August, and DS > US > MS in May. Microplastic abundance was 1.8-3.7 times higher in surface than bottom water in all seasons. Microplastic less than 300 μm accounted for 66%, 81%, 72% of the total abundance in February, May and August, respectively. Dominant polymer type was polyester in February (32%), polypropylene in May (66%) and in August (38%). Fragment was most abundant shape (62-80%), and it was followed by fiber (20-38%). The annual microplastic load in Nakdong River was estimated as 1.2×10^{13} n/y. Top 20 cm surface water transported 9.9×10^{11} n/y, 1.1×10^{13} n/y was discharged by subsurface water.

"Bans don't stop cups: citizen science indicates that the ban of styrofoam cups resulted in the use of other types of cups"

Chieh-Shen Hu, The Society of Wilderness

ABSTRACT

Taiwan is one of the countries with the highest recycling rate in the world, but the production and use of single-used food packaging is also very high. Takeout drinks are an increasingly popular item in Taiwan because Taiwan has a total of 27,000 tea shops, coffee shops and convenience stores, which sell about 1.5 billion disposable cups each year. There are six different types of disposable cups sold in Taiwan, each using different materials and forms to cater to the needs of the consumer. Each type is separately regulated by a national recycling fund system. In addition, one of the six types (the styrofoam cup) has been banned by one regional government because of local environmental initiatives. In order to examine the effectiveness of the policies regulating these cups, two NGOs conducted a preliminary citizen science survey focused on the abundance and composition of beached disposable cups in different cities in 2016. The results showed that the regional ban has reduced the local styrofoam cup on the beach in the short term, but has simultaneously increased the use of several other cup types, and it also stimulated the industry to produce a new type of composite material cup which may be more difficult to recycle. This result suggests that a ban on a single type of cup (in this case styrofoam) does not necessarily reduce the overall amount of single-use packaging within the industry. From a long-term or national policy perspective, it could be more effective to change the consumption patterns, redesign recycling incentives, and enhance the extended producer responsibility.

Research In Action: Leveraging Marine Debris Data To Inform Reduction Efforts And Policies

"Characterizing microplastics in the San Francisco Bay and adjacent National Marine Sanctuaries to inform regional policy recommendations"

Carolynn Box, 5 Gyres
Meg Sedlak, San Francisco Estuary Institute (SFEI)
Sutton Rebecca, San Francisco Estuary Institute (SFEI)
Marcus Eriksen, 5 Gyres
Diana Lin, San Francisco Estuary Institute (SFEI)
Anna Cummins, 5 Gyres
Alice (Xia) Zhu, University of Toronto
Chelsea Rochman, University of Toronto

ABSTRACT

One of the goals of the San Francisco Bay Microplastic Project is to characterize microplastics in a variety of media to determine sources, pathways, loadings, and processes leading to microplastic pollution in the San Francisco Bay and adjacent Cordell Bank, Greater Farallones and monterey Bay National Marine Sanctuaries; this information will be used to develop scientifically robust policies and build off of past scientific efforts that influenced statewide and national legislation banning plastic microbeads in personal care products. A limited field staff collected stormwater runoff, wastewater effluent, receiving waters, fish and sediment, all of which were analyzed for microplastic. Sample sites were selected based on population density, known hotspots and ambient conditions, and were geographically distributed. The results of this study will be incorporated into a regional ocean model to determine spatial distributions. Guided by the research results, the project will bring together key policy experts in the field to develop recommendations on data-driven source reduction and communicate these recommendations to stakeholders, policy makers and the general public.

"How land-use and hydrology characteristics affect microplastic contamination and distribution in subwatersheds of Lake Ontario"

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Paul Helm, Ontario Ministry of the Environment and Climate Change
Chelsea Rochman, University of Toronto

ABSTRACT

Canada has been making progress with microplastics regulation, enforcing a ban on the manufacturing of microbeads for personal care products. To continue informing policy, scientists in the province of Ontario are actively investigating urbanized regions within the Lake Ontario Watershed for microplastics. In this study, we collected grab water samples of wastewater treatment plant effluent, storm water, agriculture, and lake surface water onto 10um polycarbonate filters to identify microplastics across varying sources and at smaller size classes than regularly investigated. The type and abundance of microplastics will be determined using microscopy and Raman micro-spectroscopy, and their relationship to watershed attributes will be assessed using regression models. We expect that watersheds with higher percent urban land cover and population density, and a greater number of end-of-life vehicle yards, landfills, wastewater treatment plants and plastic industry will have a higher abundance of microplastics. Discerning the types of microplastics found in relation to the watershed features, hydrology, and activities will enable policy makers to target the sources of microplastics in urban watersheds that lead into lakes and oceans, mitigating potential harm to both freshwater and marine waters and wildlife.

"Leveraging Marine Debris Data to Inform Marine Debris Mitigation Efforts on Maui."

Lauren Blickley, Swell Consulting

ABSTRACT

In recent years, Hawaii has been at the forefront of marine debris policies and reduction efforts. Both Maui and Oahu have bills that prohibit smoking on county beaches. In 2016, Hawaii also became the first state with a ban on single-use plastic bags when similar measures were passed at the county level on each island. Most recently, Maui and Hawaii counties have laws restricting the use of polystyrene foam to-go containers.

Though the successful passage of these policies is the result of many factors, local marine debris data has played an in increasingly important role in influencing marine debris legislation in Maui County. Scientific information about debris sources, loads, composition, and environmental impacts has helped to both frame the context of legislation and lend credible evidence for the passage of these bills. Comparing pre-/post-legislation data on specific debris items like plastic bags furthermore provides evidence of the role that legislation plays in reducing debris loads. This evidence is then used to inform marine debris legislation nationwide.

In addition to providing scientific support for legislation, debris data helps inform the efforts of NGO's and government agencies. By identifying primary debris items and understanding drivers of debris deposition, Maui-based efforts to mitigate and remove debris have been increasingly targeted and, ultimately, more effective.

The successful collaborations between marine debris researchers and nonprofit organizations to advance marine debris policies and mitigation efforts on Maui demonstrates the importance of leveraging marine debris data to inform mitigation strategies.

Research In Action: Leveraging Marine Debris Data To Inform Reduction Efforts And Policies

"Paradise Trashed? Understanding the types and sources of marine debris in French Polynesia as a means of assessing local mitigation strategies"

Krista Verlis, Macquarie University
Scott Wilson, Macquarie University

ABSTRACT

Marine debris is a significant issue across the globe, but no formal data existed on levels in French Polynesia. This multi-island nation is known for its picturesque beauty and diversity of marine life, including over 600 species of coral. Like many other South Pacific nations, tourism is an important economic resource with marine debris having the capacity to negatively impact on this critical industry. Thus, increased knowledge of the sources, types and extent of recovered marine debris can lead to more informed management of this ecologically sensitive area. Our study assessed baseline levels of macro- and micro-sized marine debris loads on beaches and ingestion of marine debris by sea cucumbers on the more populous islands of Moorea and Tahiti. Many sites on both islands were classed as 'extremely dirty' or 'dirty' based on the Clean Coast Index (>1 item/m2). Land-based sources of marine debris were the most common, with stormwater/local source being the greatest contributor (37%), followed by land-based tourism (18%) and recreational boat/yachts (17%). Unsurprisingly, plastics dominated recovered marine debris (72%), with glass (10%) and metal (8%) the most common non-plastic items. Beverage containers and associated items, such as caps were commonly recovered. Limited abatement measures to reduce marine debris loads have been implemented locally. Based on the collected debris data the efficacy of the existing programs will be discussed and recommendations for improvements suggested.

Research In Action: Leveraging Marine Debris Data To Inform Reduction Efforts And Policies

"Solid waste in coastal cities: an initial assessment on the transboundary role of tourists"

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Andrea Lima de Oliveira, University of São Paulo, Oceanographic Institute
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ABSTRACT

Generation of solid waste is one of the major impacts of tourism economy in coastal areas. Thus, understanding the production and discharge of solid waste by tourists can help coastal management strategies related to marine debris. In this study, 30 tourists (second home owners and users) and residents of Maranduba Beach (Ubatuba-SP, Brazil) were interviewed regarding: the amount of solid waste they produce (in average per week); the destination they give to it; and the drivers for these habits. Tourists were also questioned about their habits at their local cities. Based on results, tourists produce more debris (recyclable or not) than local community. Also, most of the tourists (67%) dot not separate recyclable items when on vacation, contrasting with their habits at home, where 80% separate recyclable waste. According to them, this behaviour is driven be either the absence of an efficient system for selective waste collection, the lack of communication about public services, and/or the lack of personal engagement. However, local people also mentioned lack of information about public waste management services. As an alternative, 46.67% of tourists count on waste pickers to better dispose wastes such as cans and PET bottles. Nevertheless, for most of the visitors, "reduce consumption" and "reuse materials" were not considered individual actions towards good practices of waste management when on vacation. Differently, most of local people recognize the importance of reusing materials and decreasing consumption. Results suggest that tourism activity increases waste generation in coastal destinations and that deficiencies in public services and/or lack of engagement of tourists hinder the efficiency of waste management. Together these factors raise the risks related to the generation marine debris in coastal areas.

"Automated Identification and Quantification of Microplastics by FTIR Imaging and Image Analysis"

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ABSTRACT

In the last decades the pollution of the oceans with plastic particles smaller than 5 mm, called microplastics has moved into the focus of science and governments. The analysis of particles especially <500 µm in size is a challenging field. These particles cannot be handled well manually and are therefore often concentrated on filters or meshes. By common FTIR microscopy the filter will be inspected visually and particles of interest marked for the following analysis. The manual selection process is prone to human bias, which can be overcome by FTIR imaging. Here, the complete filter area is mapped by FTIR using focal-plane-array (FPA) detectors, which collect several hundred spectra within one measurement for a large area. Each particle on the filter is therefore examined by FTIR spectroscopy. The results of this imaging can be either analyzed manually by the application of integrals for certain regions of the spectrum or automated. While the manual process is time consuming and prone to human bias we present an automated approach, which is totally impartial. With this process it is possible to analyze measurement files containing up to 1.8 million single spectra by library searches against an optimized database of different synthetic and natural polymers. The high quality data generated allowed image analysis, giving information for the particle size distribution for each polymer type as well as their distribution on the filter. All data was collected with relative ease even for complex sample matrices like (deep sea) sediments, waste water treatment plants, plankton samples and arctic ice cores. This approach has significantly decreased the expenditure of time for the interpretation of FTIR-imaging data and increased the quality of the generated data. The approach allows the standardization of microplastic analysis.

"Dynamics of chemical transfer on microplastic in gut"

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Wanling Huang, Wageningen University & Research
Albert A. Koelmans, Wageningen University & Research

ABSTRACT

Microplastics acting as a vector for bioaccumulation of hydrophobic organic chemicals (HOCs) is a long standing hypothesis within the research on plastic debris. Previous studies have demonstrated that microplastics contributed to 1-2 times increase or decrease in bioaccumulation of HOCs. These studies were mostly in-vivo with exposure scenarios favouring uptake of chemicals from microplastic, whereas in the environment, chemical uptake by plastic might also occur. Furthermore, the exact transfer kinetics of the HOCs between the ingested microplastics and organisms in the gut cannot be quantified in such tests. Simulating gastrointestinal conditions with artificial gut fluids is an experimental technique to assess bioavailability of chemicals in an organism and can better test the sorption mechanisms. The uptake of chemicals by microplastics from contaminated food has not been studied before. Here, we demonstrate different exposure scenarios of microplastics in artificial gut fluids and transfer of a range of HOCs to/from these microplastics. The data was modelled with a non-equilibrium dynamic model, accounting for reversible transfer of HOCs between microplastics, water, gut fluid and natural food components under different relevant uptake scenarios. Chemical transfer half-lives range between hours and days, and we show how organisms with different gut residence times will be affected differently by the ingestion of microplastic. In nature, the levels of chemical mixtures in the biota and microplastics may not be at equilibrium and direction of transfer depends on the fugacity in different compartments.

"Microplastic occurrence in La Paz Bay (Mexico) and phthalate esters concentration in two resident filter-feeder species"

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Maria Cristina Fossi, University of Siena

ABSTRACT

Release of hazardous chemicals from floating plastic debris may cause toxicological effects on marine species. Phthalate esters (PAEs) are suggested to act as endocrine disruptors even at low concentrations. Large filter-feeding species, characterized by a long life span and a continue feeding activity, are potentially chronically exposed to these contaminants both leaching from ingested plastics and from their degradation and through the food chain. In this study, we evaluate the abundance and the polymer characterizations by FTIR spectroscopy of microplastics collected through surface-trawling plankton nets in the Bay of La Paz, Mexico. The increasing human pressure in this area is giving rise to chemical pollution from urban wastewaters, agriculture and maritime activities. Presence of six PAEs as plastic tracers has been assessed in neustonic samples and in skin biopsy samples of fin whales (Balaenoptera physalus) and whale sharks (Rhyncodon typus) by GC-qMS. Sixty six per cent of the net tows contained plastics with a maximum of 0.22 items/m3. Neustonic samples showed different fingerprint of PAEs, indicating heterogeneous levels and spatial patterns in the investigated area. Diethylhexyl phthalate presented the highest values in all samples analyzed, with a concentrations ranged from <BDL to 29.97 ug/g d.w.. Overall, data obtained suggest that filter-feeder organisms are exposed to the accumulation of compounds released by plastics. The low concentrations of floating microplastics found contrasts with the levels of PAEs measured in biological samples, which are in the same order of those measured in filter feeder species from other polluted basins, such as Mediterranean Sea. This could be related both to the high ingestion rate of plastic particles and to the ingestion of plastic debris, such as macroplastics.

"Nano-fragmentation of expanded polystyrene exposed to sunlight"

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ABSTRACT

Fragmentation of micro- and nano-sized particles was qualitatively and quantitatively determined from the expanded polystyrene (EPS) exposed to sunlight for 9 months. The exposed EPS cubes (3x3 cm surface area) were sampled in duplicate at 2 (2M), 5 (5M) and 9 month (9M). The surface colour was changed from white to dark yellow during exposure. The fragmented particles at the top surface of the each cube directly exposed to sunlight were collected in 2 ml solution consisting of HPLC grade pure water with 0.1% tween 80 by sonication for 1 min. The collected particles in solution were sequentially filtered with 10 µm and 0.8 µm pore filter-paper. The mass of >10 µm EPS particles produced per EPS cube surface area (g/m2) significantly ($p<0.05$) increased according to exposure time; 0.1±0.1 g/m2 for control, 2.6±0.3 g/m2 for 2M, 3.9±0.4 g/m2 for 5M and 7.2±0.2 g/m2 for 9M. The mean and median size of >10 µm EPS particles measured by laser diffraction was 26-29 µm and 18-20 µm, respectively. The hydrodynamic diameter of the EPS particles in the filtrates of <0.8 µm pore filter-paper was 532 nm for 2M, 530 nm for 5M and 752 nm for 9M by dynamic laser scattering. Their particle abundances measured by nanoparticle tracking analysis were 1.8x109 particles/ml for 2M and 3.2x109 particles/ml for 2M and 9M. Two months of outdoor exposure of EPS were enough to produce a large number of micro- as well as nano-sized plastics.

The Chemistry Of Plastic Marine Debris

"Occurrence of wide-range of additives in marine plastics and their exposure to marine organisms"

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ABSTRACT

Additives are essential components of plastic products. Some of them are hazardous to marine organisms and human. They can be also utilized as indicators of plastic-mediated chemical exposure to marine organisms. The present study measured wide range of additives including plasticizers (phthalates), UV absorbers (benzotriazoles and benzophenones), flame retardants (PBDEs, DBDPE, HBCDs, and tetrabromo bisphenol A) in large plastic fragments and microplastic fragments and pellets on sandy beaches, and buoyant microplastics in coastal and open ocean, plastic fragments from fulmar from the Netherland, and preen gland oil from seabirds globally collected. UV absorbers, especially benzotriazoles, are widely detected in large plastic fragments on the beaches and plastic fragments in seabirds' stomach. They are also detected in preen gland oil from some species of seabirds such as black footed albatross from Tern Island, Hawaii. Brominated flame retardants such as BDE-209 and DBDPE were also detected in the plastic fragments from the stomach of fulmar. They are also detected in preen gland oil from several species of seabirds from some locations in the world such as Hawaii, Western Australia, and Marion Island. These suggest transfer of plastic additives from ingested plastics to the tissue of seabirds. Among beached microplastics, plastic fragments contained more BDE-209 than pellets. In buoyant microplastics even from open ocean, BDE-209 was significantly detected. This means that hydrophobic additives, i.e., BDE-209, is retained in microplastics even after fragmentation and suspension in seawater. These hydrophobic additives could be source of chemical exposure to small marine organisms in remote ecosystem.

"Persistent organic pollutants on plastic debris from the Great Pacific Garbage Patch: concentrations and prospective risk assessment"

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ABSTRACT

Plastics are widely distributed in the world's oceans, however, the variability in concentrations of plastic-bound Persistent Organic Pollutants (POPs) is poorly understood. Here we report concentrations of polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and hexabromocyclododecane (HBCD) on oceanic plastics from the surface layer of the Great Pacific Garbage Patch.

Marine plastic samples composed of nets and ropes showed relatively higher PAHs and PCBs concentrations, while hard plastic and pellet samples had higher PBDEs concentrations. HBCD concentrations were relatively constant among different types. Most samples showed a pyrogenic PAH signature. PCBs were predominated by penta- to hepta-chlorinated congeners and 42% of our samples had PCB congener patterns similar to those of a common additive. No trends between PAHs, PCBs and PBDEs concentrations and plastic debris size were found; except for HBCD, which showed higher concentrations in smaller particles (the so-called microplastics).

Concentrations of POPs were equal to or higher than literature values for marine sediment, but significantly lower after normalization on sediment organic matter content. We used sediment Environmental Quality Standard (EQS) values as a proxy to assess toxicity profiles for oceanic plastics contaminated with POPs. 84% of the plastic samples had at least one chemical exceeding sediment threshold effect levels.

Furthermore, our surface trawls collected far more plastic than biomass, indicating that GPGP organisms feeding opportunistically upon floating particles may have plastics as a major component of their diet. If gradients for POPs mass transfer from plastic to predators exist, GPGP plastics may play a role in transferring POPs to certain marine organisms.

The Chemistry Of Plastic Marine Debris

"Plastic debris can be both a source and sink for flame retardants in ring-billed gulls (Larus delawarensis)"

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Jonathan Verreault, Université du Québec à montréal
Miriam Diamond, University of Toronto
Chelsea Rochman, University of Toronto

ABSTRACT

Plastic debris has been recognized as a contaminant of concern for wildlife because it can act as a vector for hazardous chemicals. The theory that ingested plastic can act as a source of chemicals to wildlife has been tested by several researchers via laboratory experiments, mathematical models, and observational studies in nature. Several laboratory experiments have demonstrated chemical transfer via ingested plastic, while mathematical models find that the transfer depends on the initial concentration in the plastic, in the animal, and gut retention time. These models suggest that plastics with low chemical concentrations could act as a sink for chemical pollutants in organisms. As such, results from the field can be mixed. Here, we test the hypothesis of chemical transfer via ingested plastic in a colony of freshwater ring-billed gulls from the St. Lawrence River in Québec, Canada. Unlike previous studies, we examine a colony that resides in a heavily urbanised and industrialized habitat that was shown to be a hotspot for flame retardant (FR) chemicals. We measured plastic ingestion and the concentration of a series of FRs on both ingested plastic and plasma. We found that 29 of 44 of the gulls examined contained ingested plastic, and FRs were detected on all ingested plastic samples. We examined the body burden of 25 of these individuals and detected FRs in all plasma samples. There were weak, but significant relationships between the amount of plastic ingested and some FRs in plasma. Relationships between the amount and identities of FRs in plastic and plasma suggest that ingested plastic in this colony can act as both a source and sink for these chemicals. These results suggest that there are many sources of FRs to these gulls and that the role of ingested plastics can be complex.

"Production of hydrocarbon gases from plastic at ambient temperatures"

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ABSTRACT

Over the past 50 years, polymer manufacturing has been increasing at a very fast pace, from 15 million tons in 1964 to 381 million tons in 2015 and is expected to double again over the next 20 years. Although plastic has widespread applications because of its favorable mechanical properties, thermal properties, stability and durability, it is still vulnerable to weathering and degradation processes. During these processes, plastic reacts with its environment and releases additives and polymer degradation products throughout its lifetime. Here we demonstrate that most commonly used plastics emit methane and ethylene when exposed to solar radiation at ambient temperatures. Polyethylene, which is globally the most produced and discarded synthetic polymer, is the most prolific emitter for both gases. Through an extensive time series of 212 days, we also show that emissions of methane, ethylene, ethane and polypropylene from virgin pellets of low-density polyethylene increase with time. Moreover, environmentally aged low-density polyethylene debris collected in the North Pacific Subtropical Gyre also emitted hydrocarbon gases when exposed to ambient solar radiation. Due to the longevity of plastics and the large amounts of plastic that persist in the environment, gas production may occur throughout the degradation lifetime of plastic and may represent a source of climate-relevant trace gases for an extended period of time.

"Quantitative determination of sorbed and additive chemicals in microplastics from the Korean coastal waters"

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Gi Myung Han, Korea Institute of Ocean Science and Technology
Lian Hong, Korea Institute of Ocean Science and Technology
Mi Jang, Korea Institute of Ocean Science and Technology
You Na Cho, Korea Institute of Ocean Science and Technology
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ABSTRACT

Plastic debris and microplastics are complex mixtures of chemicals, including additives originally included in plastic products, and environmental contaminants sorbed from surrounding environments, which may impact the environments with which they come into contact. To evaluate the environmental risks of microplastics, the level of exposure and effects of not only the particles themselves but also their associated chemicals in the environment should be analyzed. However, limited field data is available on chemicals associated with microplastics, especially additive chemicals. This study investigated the levels and profiles of chemicals (both sorbed and additive chemicals) in various types of plastic particles (in size and shape) collected from the Korean coastal waters. Polychlorinated biphenyls (PCBs), organochlorine pesticides (DDTs, HCHs, and HCB), polycyclic aromatic hydrocarbons (PAHs), brominated flame retardants (PBDE and HBCD), phthalates, UV stabilizers, antioxidants were widely detected in microplastic samples. Except for expanded polystyrene (EPS) samples, phthalates showed the highest concentrations in most of size classes (< 1mm, 1 to 5 mm, and > 5 cm) and shapes (fragments, fibers, and pellets), followed by HBCDs, UV stabilizers, antioxidants, PAHs, PBDEs, PCBs and DDTs. EPS samples contained relatively high concentration of HBCDs and PAHs compared to fragments, pellets, and fibers. There was no significant difference in concentrations of the chemicals among size classes (< 1mm, 1 to 5 mm, and > 5 cm), which might be due to the diversity in their original plastic products, environmental exposure time, ect. This is the first detection of additive chemicals in microplastics smaller than 1 mm.

"Study of the leaching of additive from microplastics using an in vitro enzymatic digestion model"

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ABSTRACT

Plastics debris, including microplastics, are nowadays recovered in every marine compartments. Many studies have been conducted on desorption of pollutants from microplastics but few were focused on plastic additives. If leaching of some plastic additives has been recently demonstrated in water, no work has yet explored leaching of plastic additives after ingestion of microplastics by marine organisms and exposed to digestion. However such mechanism could have potential adverse effects on the host. In this work, the development of an in vitro enzymatic model has been performed to study the leaching of a common plastic additive found in polyethylene (PE). Lab made Irgafos 168 ® loaded PE fragments (PE-Ir) (20 – 100 µm) were used in the study. The in vitro enzymatic model mimics the main enzymes from the stomach and pancreas of vertebrates: pepsin and trypsin respectively. Moreover, a pancreatic extract of enzymes (including amylase, lipase and trypsin) acting in the intestinal lumen was also used. PE-Ir particles (5 MPs/mL) were exposed to the three digestive conditions for 8h at two different temperatures, 20°C and 37°C, representing fish and human models, respectively. The leaching of Irgafos 168 ® and enzyme specific activities were recorded over time using GC-MS/MS and spectrometric assays, respectively.

This work could provide some relevant insights on the transfer of common plastic additives to marine organisms.

"To what Extent Microplastics from the Open Ocean are Weathered?"

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mingotaud anne francoise, CNRS
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ABSTRACT

Plastic pollution has been recognized by the scientific community as a major environmental problem. Since the 1950, mankind has produced over 8300 million metric tons of plastic1. Today 5040 million metric tons is already accumulated in landfills or in the natural environment 1.

Microplastic (1-5 mm) occurrence has been document in a fair number of places on earth, but there is a fundamental scientific knowledge gap towards understanding the mechanisms involved in plastic weathering and fragmentation in the environment.

Although degradation of polymers has been studied for a long time under laboratory condition, the weathering conditions occurring in a complex environment such as oceans lead to masses of questions. What is the extent of the plastic debris weathering2? What are the degradation processes? What is the influence of the biofilm3 and possible additives or adsorbed pollutants4, 5? In order to answer to some of these questions, we characterized plastic debris collected in the North Atlantic sub-tropical gyre during the campaign Expedition 7th Continent. The microplastics (1-5 mm) have been analyzed by electronic microscopy, infrared spectroscopy, size exclusion chromatography, calorymetry, pyrolysis-gaz chromatography-mass spectrometry (Py-GC-MS). Polyethylene was the predominant polymer found among microplastic. The debris showed a strong modification of their rate of crystallinity and their molar mass; indicating an advance state of degradation. The characterization of small microplastics (25-1000 µm) revealed the presence of great variety of polymers, going further than the expected polyethylene and polypropylene, the Py-GC-MS chemical fingerprint showed differences with the reference polymers, indicating a strong chemical modification of the polymer backbone.

"Validation of ATR FT-IR to identify polymers of ingested plastic marine debris"

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Viviana Rodriguez C., Material Science and Engineering Division
Kathryn Beers, Material Science and Engineering Division
George Balazs, Pacific Islands Fisheries Science Center
Thierry Work, U.S. Geological Survey
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Sarah-Jeanne Royer, Daniel K. Inouye Center for Microbial Oceanography: Research and Education
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ABSTRACT

Polymer identification has become an integral part of plastic debris monitoring to help determine debris sources, fate and impact. Attenuated total reflectance Fourier transform infrared spectroscopy (ATR FT-IR) is commonly used for polymer identification. We optimized and validated this fast, simple and accessible method to identify plastic found in the guts of pelagic Pacific sea turtles (≥5 mm on largest side) or on Hawaiian beaches (≥1 cm). An in-house spectral library was created using consumer goods of resin codes #1-6 and several #7 polymers. These spectra were similar to purer plastics, including National Institute of Standards and Technology Standard Reference Materials (SRMs), scientifically-sourced and raw manufactured polymers. A blind test of 11 consumer goods, float tests in various densities of diluted ethanol, and an inter-laboratory comparison with high temperature size exclusion chromatography with multiple detectors confirmed that ATR FT-IR could differentiate #1-6 and several #7 polymers. Distinguishing high-density (HDPE) and low-density polyethylene (LDPE) was challenging, but we present a clear step-by-step guide that allowed identification of 78% of ingested PE samples. When coupled with an ethanol float test, 92% of beach PE samples could be distinguished. Optimal cleaning methods for ingested plastics were wiping with water or cutting. These preferred methods eliminated the use of hazardous chemical treatment and preserved the pieces for future chemical analysis. The ATR FT-IR method was highly successful, resulting in the ability to identify 97% of ingested plastics from sea turtles and 99% of Hawaiian beach debris. Results and implications of those studies are presented elsewhere at this meeting. This study presents these standardized methods and will discuss future production of SRMs.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

"Anticyclonic eddies increase accumulation of microplastic in the North Atlantic subtropical gyre"

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emile perez,
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ABSTRACT

There are fundamental gaps in our understanding of the fates of microplastics in the ocean, which must be overcome if the severity of this pollution is to be fully assessed. The predominant pattern is high accumulation of microplastic in subtropical gyres but there are some high spatial heterogeneities regarding sea surface microplastic concentrations that were not rationalized. During the sea campaign 7th Continent in the North Atlantic subtropical gyre we sampled to mesoscale eddies (one cyclonic and the other anticyclonic). Using in situ measurements were compared with data from satellite observations and models. We show how microplastic concentrations were up to 9.4 times higher in the anticyclonic eddy explored, compared to the cyclonic eddy. Satellite-observed chlorophyll-a was also more abundant inside the anticyclonic eddy (on average 30%). Although our sample size is small, this is the first suggestive evidence that mesoscale eddies might trap, concentrate and potentially transport microplastics. As eddies are known to congregate nutrients and organisms, this phenomenon should be considered with regards to the potential impact of plastic pollution on the ecosystem in the open ocean.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

"Gyres North & South. A Partnership on both sides of the Equator to Mitigate Marine Debris."

Raquelle de Vine, Algalita Marine Research and Education

ABSTRACT

Less than ten years ago it was unknown whether the Southern Ocean subtropical gyre's accumulated marine debris or not. That the South Pacific subtropical gyre accumulates marine debris was confirmed in January 2017 during Algalita Marine Research and Education's 6month South Pacific Research voyage. 3 weeks of which we spent documenting the extent and concentration of marine debris in the gyre.

During this time I obtained surface samples and observed high concentrations of plastics in the surface zone. The alarming results highlighted a need to address the high input and sources of the debris and the importance of communicating this to the South Pacific Nations in a time critical manner. In order to contribute to the mitigation of the increasing problem of accumulating marine debris in the South Pacific subtropical gyre I have obtained the support of Algalita Marine Research and Education to inaugurate a sister organization in my home country of Aotearoa New Zealand.

In my presentation I will highlight the need for a sister organization of Algalita in the South Pacific and what our roll will be, now and in the future with specific focus looking at possible collaborations with other South Pacific nations . I will discuss how we plan to address mitigation of the problem of accumulation in the subtropical gyre with emphasis on Aotearoa New Zealand's contribution and look into some of the challenges facing the implementation of effective mitigation measures.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

“Impacts of plastic pollution in oceanic islands off the North Atlantic subtropical gyre”

Christopher Pham, IMAR-Institute of Marine Research and MARE—Marine and Environmental Sciences Centre, University of the Azores, Horta, Portugal
Yasmina Rodríguez, IMAR-Institute of Marine Research and MARE—Marine and Environmental Sciences Centre, University of the Azores, Horta, Portugal
Ressureição Adriana, IMAR-Institute of Marine Research and MARE—Marine and Environmental Sciences Centre, University of the Azores, Horta, Portugal
Rios Noelia, IMAR-Institute of Marine Research and MARE—Marine and Environmental Sciences Centre, University of the Azores, Horta, Portugal
Frias João, IMAR-Institute of Marine Research and MARE—Marine and Environmental Sciences Centre, University of the Azores, Horta, Portugal
Carriço Rita,

ABSTRACT

Subtropical gyres are recognized to be important zones for the accumulation of marine debris in the oceans. As a result, global risk assessments predict that marine organisms found in oceanic gyres experience an increased likelihood of debris ingestion. The Azores archipelago is a remote group of nine volcanic islands located off the North Atlantic Subtropical Gyre. Plastic pollution is ubiquitous in the archipelago but its impacts for the marine environment and local communities are poorly known. In this presentation, we provide an overview of recent research efforts dedicated to studying the issue in this remote region of the North Atlantic. Surveys aimed at quantifying plastic debris on the seafloor, along the island’s coastlines and in the water column demonstrate a high abundance of debris in the region. Furthermore, results on monitoring plastic ingestion by different components of the food-web confirm a high exposure of marine fauna to these pollutants. Finally, preliminary results on the socio-economic impacts associated with marine debris also reveal significant costs for local populations. Overall, the information obtained during the past years highlight the vulnerability of oceanic archipelagos to the increased amount of debris accumulating in oceanic gyres.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

"Midway Atoll (Northwestern Hawaiian Islands) Marine Debris Accumulation Project"

Kevin O'Brien, NOAA Pacific Island Fisheries Science Center

ABSTRACT

Since 2011, NOAA's Pacific Island Fisheries Science Center (PIFSC) Marine Debris Project has conducted shoreline plastics removal operations at Midway Atoll in the Northwestern Hawaiian Islands (NWHI) within the Papahānaumokuākea Marine National monument (PMNM). Due to the extremely remote nature of the NWHI and the expense of conducting work there, PIFSC's focus had previously remained on the removal derelict fishing gear (DFG) in order to mitigate the entanglement hazard for the critically endangered Hawaiian monk seal and threatened green sea turtle. However, for the last six years, PIFSC has been able to also dedicate resources to shoreline plastic survey and removal at Midway Atoll due to its accessibility and resources to handle and process collected debris.

In an effort to determine the level of accumulation, PIFSC designed a shoreline study on Eastern and Spit Islands on the southern side of Midway Atoll. Those islands have been sampled, surveyed, and cleaned annually since 2013, providing a four-year data set. Additionally, a project to expand this study to five of the other NWHI was piloted this summer in partnership with NOAA PIFSC Protected Species Division. This presentation will review the experimental design and discuss preliminary analysis of debris accumulation.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

"Mini-Gyres showing up across the State of Hawaii"

Kahi Pacarro, Sustainable Coastlines Hawaii

ABSTRACT

Mini-gyres are showing up across the state of Hawaii whereas their prevalence prior was one of rarity. This increased occurrence is the result of society's overuse of plastic and an unsustained cleanup effort. It is our hope with this presentation to bring light to this new common phenomenon, share what we've learned thus far, and to encourage new ideas to predict, clean, and use them to inspire consumer behavior change.

When faced with these mini-gyres, the physical immenseness is daunting. Appearing like cauldrons of colored confetti, these mini-gyres focus in bowls formed by coastline topography, winds, waves, and currents. From what we've been able to observe, these mini-gyres have a certain predictability that could lead to a better understanding of the larger gyres as a whole.

Cleaning these mini-gyres up range from simple to extremely difficult but very few of these cleanups have ever been attempted. The video of this one being cleaned up on a remote island in the Hawaiian chain shows the challenges and opportunities surrounding mini-gyre cleanup operations (video here: https://vimeo.com/234888931).

It is our hope that our inclusion into this session can provide a springboard for others to help in the understanding of these mini-gyres which lead to a reduction in their occurrences and the simplification of their cleanups. In addition we aim to share what we've learned thus far and how we've been able to turn this microplastic into a commodity.

The Importance Of Oceanic Subtropical Gyres As Debris Accumulation Zones And How They Affect Ocean Life

"Subjective Impressions from a denizen of the Gyres"

Charles Moore, Algalita Marine Research and Education

ABSTRACT

Captain Charles Moore Founder and Research Director Algalita Marine Research and Education

Over the last 20 years, on a dozen research voyages, I have spent several months in the North and South Pacific Subtropical Gyres, searching for heavy accumulations of marine debris. In my presentation, I will summarize the subjective impressions of a researcher who has dedicated his time and resources to understanding and mitigating the ocean's plastic load. These include:

1) The shock of discovering for the first time the quantity of plastics in surface trawls in 1999 vs the vague feeling of something amiss in sightings in the same area in 1997.

2) The appearance and patchiness of visual sightings of marine debris

3) The associated marine life in the garbage patches

4) Diving day and night in the heavy debris zones

5) Collection methods for sampling living creatures and marine debris

6) Changes in the extent of high debris concentrations in the North Pacific Accumulation Zone

"An estimate of the abundance of Japanese tsunami marine debris washed ashore on the west coasts of the North America, based on a combination of webcam monitoring and a particle tracking model experiment"

Shinsuke Iwasaki, Kyushu Univ.
Atsuhiko Isobe, Kyushu Univ.
Shin'ichiro Kako,
Tomoya Kataoka,
Kei Yufu,
Charlie Plybon,
Thomas Murphy,
Hideaki Maki,

ABSTRACT

Particle tracking models (PTMs) are capable of computing debris motion in the ocean circulation. However, it is difficult to determine by the PTMs alone if modeled particles in the ocean are washed ashore onto the land, because the stranding must be dependent on nearshore processes that might not be resolved in modeled ocean currents (hence, PTMs) sufficiently. Also, re-drifting processes of stranded particles into the ocean should be incorporated into the PTM; otherwise the estimate of debris quantity on beaches remains unreliable. The webcam monitoring on a beach in Newport, OR provides us with a simple scenario of stranding/re-drifting processes: the debris on the beach increased during the downwelling-favoring winds, and rapidly decreased under the onshore-winds at spring tides by re-drifting. The PTM in the present study consists of two models: one is a PTM to reproduce the tsunami-debris motion in the North Pacific using an ocean reanalysis product (ocean circulation) and satellite-derived winds (leeway drift), and the other is a "sub-model" to give the criterion whether the modeled particles are washed ashore on the neighboring land grid cell, and whether they return to the oceanic domain from the land. The satellite-derived winds on the grid cells neighboring the land boundary were used for the criterion in the sub-model. An attempt in the present study is to evaluate the abundance of the modeled particles (which can be approximately converted to tsunami-debris weight) washed ashore on the land during the past five years.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

"Diving into debris: the biology and ecology of biota transported on Japanese tsunami marine debris"

Jessica Miller, Oregon State University
James Carlton, Williams College
Reva Gillman, Oregon State University
Cathryn Clarke Murray, PICES
Gregory Ruiz, Smithsonian Environmental Research Center
Michio Otani, Osaka Museum of Natural History
Jocelyn Nelson, PICES
Jonathan Geller, Moss Landing Marine Laboratories
John Chapman, Oregon State University

ABSTRACT

Nearly 300 coastal marine species collected on >650 debris items from the 2011 Great East Japan earthquake and tsunami have landed alive along the Pacific coast of North America and the Hawaiian Archipelago. We synthesized life history, environmental, and distributional information for 103 of these species and quantitatively compared traits of species with (n = 31) and without (n = 62) prior invasion histories. Tsunami-transported species with invasion histories occurred more frequently on artificial and hardpan substrates, included more boring and fouling organisms, were more common in subtropical and tropical waters, and exhibited greater salinity tolerance than those species with no invasion history. We also identified species with no prior invasion history that overlapped in multidimensional space with known invasive species but are not currently present in the Northeast Pacific or the Central Indo-Pacific to identify candidate species for monitoring. Additionally, we examined the size, reproduction, and growth of an invasive mussel Mytilus galloprovincialis, which was present on >50% of the debris items, to better understand long-distance rafting of a coastal species. The majority of mussels (79%) had developing or mature gametes, and growth rates averaged 0.075 mm/day. Structural and elemental analysis of mussel shells generated estimates of growth in coastal waters, which provides an indication of residence times in waters along North America and the Hawaiian Islands prior to landing. Detailed studies of species can contribute to our understanding of debris as a transport vector and aid efforts to evaluate potential risks associated with marine debris.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

“Finding a needle in a debris haystack: surveillance of debris from the Great Japan Tsunami”

Cathryn Murray, Fisheries and Oceans Canada
Kirsten Moy, Department of Land and Natural Resources
Miguel Castrence, Resource Mapping Hawaii
Brian Neilsen, Department of Land and Natural Resources
Tomoya Kataoka, Tokyo University of Science
Atsuhiko Isobe, Kyushu University

ABSTRACT

The devastating Great East Japan earthquake and resulting tsunami in 2011 dispersed an estimated 5 million tons of marine debris into the ocean. An estimated 70% of that debris sank (Ministry on the Environment of Japan, 2011), but the remaining 1.2 million tons were dispersed across the Pacific Ocean and began to appear in North America and Hawai’i in 2012. As a part of the Assessing the Debris-Related Impact of Tsunami (ADRIFT) project, aerial surveys were conducted along the coast of British Columbia, Canada and the eight main Hawaiian Islands, USA to identify potential tsunami items and estimate macro-debris abundances. The resulting imagery was analyzed to identify and quantify visible marine debris on these coastlines. These projects provided a baseline of marine macro-debris densities at a moment in time, and collaborated with the state and provincial authorities to prioritize areas of highest marine debris accumulation, or “hotspots”, in order to provide guidance to citizen cleanup groups, regulatory agencies, and local and federal partners.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

"How the 2011 Japanese Earthquake and Tsunami Prompted a Marine Debris Monitoring Program in Central California, USA"

Kate Bimrose, Greater Farallones Association
Kirsten Lindquist, Greater Farallones Association
Jan Roletto, Greater Farallones National Marine Sanctuary

ABSTRACT

The March 11, 2011 Japanese earthquake and tsunami amplified the existing global marine debris problem with the input of an estimated 1.5 million tons of debris, some of which landed on U.S. shorelines along the Northeast Pacific Ocean for several years following the disaster. This devastating event and subsequent impacts have become the focus of research and coordination among various levels of government to answer important questions surrounding when, where, and with what impacts does debris hit our shores. In July, 2012 Greater Farallones National Marine Sanctuary (GFNMS) and Greater Farallones Association, joined the NOAA Marine Debris monitoring and Assessment Project (MD-MAP). Participation in the project includes execution of monthly beach surveys at several locations along the California coast. NOAA protocol are utilized to monitor each location and record the presence of debris along with detailed instructions for recording and reporting potential tsunami debris sightings. For the past five years GFNMS, in partnership with citizen science volunteers, has recorded 25,000+ debris items over the course of 300 beach surveys, establishing an important first ever baseline of information on monthly marine debris presence along California shores. This presentation will discuss how the Japanese earthquake and tsunami helped California, and the U.S. west coast, better understand the marine debris problem both locally and regionally. Additionally, the presentation will discuss how findings from data analysis can have national and international implications for the prevention and mitigation of marine debris.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

"Megarafting: The Role of Marine Debris in the Coastal and Transoceanic Transport of Marine Life"

James Carlton, Williams College
John Chapman, Department of Fisheries and Wildlife
Jonathan Geller, Moss Landing Marine Laboratories
Jessica Miller, Department of Fisheries and Wildlife
Deborah Carlton, Williams College
Megan McCuller, Williams College
Nancy Treneman, Oregon Institute of Marine Biology
Brian Steves, Department of Environmental Science and Management
Gregory Ruiz, Smithsonian Environmental Research Center

ABSTRACT

The amount of anthropogenic non-biodegradable material, especially composed of plastic, on coastal land has increased dramatically over the past half-century. Not surprisingly, the amount of plastic waste flowing into, dumped, or ejected into the world's oceans from nearly 200 countries has now reached many millions of tons per year. In turn, climate change models predict that cyclonic systems, such as hurricanes and typhoons, capable of effectively sending coastal infrastructure into the sea, will increase in size and frequency. This juxtaposition of situating vast amounts of non-biodegradable materials in great density along coastlines now available to be swept into the ocean at potentially increasing rates appears to have no historical precedent. Studies on the marine debris field generated by the Great East Japan Earthquake and Tsunami of 2011 reveal that the debris fraction still existing after more than 6 years at sea consists solely of plastic material, with wood having disappeared from the debris field in the early years after 2011. On tsunami marine debris we found nearly 300 living Japanese species landing in North America or the Hawaiian Islands. Our work demonstrated that many of these coastal species can survive for years drifting on the high seas, and eventually landing on distant continental shores, due to these ocean rafts being no longer biodegradable. Plastic marine debris is a potentially increasing novel vector for successfully transporting marine invasive species along coastlines and between oceans.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

"Pathways, impacts and fate of marine debris generated by the 2011 tsunami in Japan derived from a synthesis of numerical models and observational reports"

Nikolai Maximenko, University of Hawaii
Jan Hafner, University of Hawaii
Masafumi Kamachi, Japan Agency for Marine-Earth Science and Technology
Amy MacFadyen, National Oceanic and Atmospheric Administration

ABSTRACT

March 11, 2011 tsunami devastated the east coast of Japan and produced millions of tons of marine debris that drifted across the North Pacific. The extraordinary amount and unusual composition of tsunami debris allowed to trace its drift across the ocean and arrivals on remote shores and helped to better understand the pathways of floating marine debris. Synthesized with a suite of ocean models, these observations helped to produce most complete picture of the debris dynamics, pathways, and fate. While observations allowed to optimize such model parameters as windage and source distribution, the models filled large gaps in sparse observations and produced estimates of the total budgets. For example, the study suggests that the original number of boats lost to the tsunami was about 1,000 and more than 100 of these boats may be still floating in the ocean.

Tsunami debris increased risks to navigation and had impacts on shoreline activities in some areas. In addition, floating debris transported Japanese species from Japan to North America and Hawaii and posed on local ecosystems risk of invasion. Here we will present new methods developed to characterize these impacts.

The Risks Of Marine Debris Mega-Pulse Events: Lessons From The 2011 Great Japan Tsunami

"The invasion risk of invertebrate species associated with Japanese Tsunami Marine Debris in North America and Hawaii"

Thomas Therriault, Fisheries and Oceans Canada
Jocelyn Nelson,
James Carlton,
Michio Otani,
Danielle Scriven,
Gregory Ruiz,
Cathryn Murray,

ABSTRACT

Marine debris from the 2011 Great Japan Tsunami represents a novel transport vector for Japanese species to reach Pacific North America and Hawaii. Over 650 debris items attributed to the tsunami have been intercepted and over 380 species of algae, invertebrates and fish have been identified associated with this Japanese Tsunami Marine Debris (JTMD). Most of the species encountered are native to Japan, not currently present in North America or Hawaii, and their invasion risk is unknown. Thus, it is important to characterize the risk their introduction may pose to North American and Hawaiian ecosystems. Here we characterize the risk of individual invertebrate species associated with JTMD using an established screening-level risk assessment tool – the Canadian Marine Invasive Screening Tool (CMIST). This tool scores both the probability and consequences (impacts) of an invasion for receiving ecosystems to generate an overall risk score that encompasses assessor uncertainty. Although there were some ecoregional differences, well-known global invaders, such as the mussel Mytilus galloprovincialis and the ascidian Didemnum vexillum were higher risk for most ecoregions, while those that have yet to invade many (or any) of the assessed ecoregions like the sea star Asterias amurensis and the shore crab Hemigrapsus sanguineus were also higher risk. However, most of the invertebrate species assessed were considered relatively low to moderate risk, due perhaps in part to a lack of reported invasion history and impacts elsewhere.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

“A journey into the Great Pacific Garbage Patch”

Laurent Lebreton, The Ocean Cleanup
Julia Reisser, The Ocean Cleanup
Boyan Slat, The Ocean Cleanup

ABSTRACT

In 2015, the Ocean Cleanup Foundation conducted a multi-vessel expedition in the subtropical oceanic waters between the Hawaiian Archipelago and the Californian coast, sampling for buoyant ocean plastics in the Great Pacific Garbage Patch (GPGP). The expedition was followed a year later by an aerial survey to collect imagery of the same area. We assessed the validity of several sampling methods regarding debris sizes to quantify ocean plastic pollution at the sea surface. We report numerical and mass concentration for microplastics (0.05 – 0.5 cm) and mesoplastics (0.5 – 5 cm) using Manta trawls (0.5 mm mesh, 90 cm x 15 cm, n = 501 net tows), macroplastics (5 – 50 cm) using Mega trawls (1.5 cm mesh, 6 m x 1.5 m mouth, n = 151 net tows) and finally, megaplastics (> 50 cm) using aerial RGB imagery (~ 360 m x 240 m frame size, 0.1 m resolution, n = 7,298 frames). Our observations were used to calibrate a multi-forcing and multi-source global Lagrangian dispersal model able to predict the spatio-temporal distribution of ocean plastic concentrations within the GPGP area. Here, we present mass and count load estimates of ocean plastic in the GPGP with confidence intervals that account for uncertainties related to both monitoring and modelling. Using our calibrated model, we discuss seasonal and inter-annual variability of the GPGP position. Finally, we assess whether previous samplings reported in the literature were conducted inside or outside the GPGP, allowing us to draw a decadal trend of plastic pollution in the area from early monitoring in the 1970s to present.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"An estimate of future spread of pelagic microplastics based on a transoceanic survey and numerical modeling over the Pacific Ocean"

Atsuhiko Isobe, Research Institute for Applied Mechanics
Shinsuke Iwasaki, Research Institute for Applied Mechanics
Keiich Uchida, Tokyo University of Maritime Science and Technology
Tadashi Tokai, Tokyo University of Maritime Science and Technology

ABSTRACT

As a part of microplastic research project granted by the Ministry of Environment, Japan, a transoceanic survey of pelagic microplastics (0.3< size <5 mm) was conducted from the Southern Ocean to Tokyo from January to March in 2016 (see figure for stations). The concentrations of microplastics (pieces/m3) were vertically integrated (pieces/km2) to reduce influences of oceanic turbulence owing to winds/waves during the surveys. It is found that the concentrations in the Northern Hemisphere (~100,000 pieces/km2) are one order of magnitude larger (smaller) than those in the Southern Hemisphere (East Asian seas). A numerical particle tracking model (PTM) was established using the HYCOM (ocean currents) and a wave model (Stokes drift) to hindcast/forecast the concentration of pelagic microplastics over the Pacific from 1950s to 2060s. The microplastic concentrations observed in the transoceanic surveys were used for model validation. Our PTM includes simplified source & sink terms to express the generation and disappearance of pelagic microplastics in the upper ocean. The source term is based on the recent estimate of mismanaged plastic wastes over the world, and on the time series of gross domestic product in regions. The sink term was required to reproduce the observed concentrations of pelagic microplastics; otherwise the numerical model overestimated microplastic concentrations in the actual ocean.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

“Beneath the waves: a deep dive into the transport and fate of microplastics in pelagic ecosystems”

Anela Choy, monterey Bay Aquarium Research Institute
Bruce Robison, monterey Bay Aquarium Research Institute
Kyle Van Houtan, monterey Bay Aquarium

ABSTRACT

While plastic waste has been documented in all aquatic ecosystems (terrestrial, freshwater, and marine), little is known about the transport and fate of microplastics within Earth’s largest habitat, the deep sea. Using targeted sampling and instrumentation on remotely operated vehicles, we present a comprehensive dataset on the counts and types of microplastics found throughout the upper kilometer of the oceanic water column of monterey Bay. Large volumes comprising approximately a thousand liters of seawater were sampled from discrete depths, filtered for potential plastics, and identified using microscopy and Raman spectroscopy. Microplastics (primarily microfibers) were identified across all depth horizons, comprising a diversity of plastic types (e.g., polycarbonate, polyamide, polyethylene) of varying degraded states. Further, we examine the ecological fate of microplastics in the monterey Bay food web by identifying them in the bodies of representative ecological vectors that ingest and transport microplastics through marine ecosystems. Pelagic red crabs (Pleuroncodes planipes) are key prey of numerous predators (tuna, sea birds, marine mammals), and as particle-feeding detritivores would effectively deliver microplastics into pelagic food webs following ingestion. Giant larvaceans (Bathochordaeus spp.) are filter-feeders that contribute to the vertical flux of microplastics through the rapid sinking of fecal pellets and discarded mucus feeding filters. We present a comprehensive deep water survey of microplastics, providing empirical data on key biological vectors linking surface waters with the seafloor. Our findings point to the need for an urgent consideration of plastic pollution and its attendant chemical burdens within pelagic food webs, as these ecosystems are intimately tied to global human societies.

"Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current modelling"

Elizabeth C. Atwood, RSS Remote Sensing Solutions GmbH
Francesco M. Falcieri, CNR – ISMAR
Sarah Piehl, University Bayreuth, Dept. Animal Ecology I
Mathias Bochow, University Bayreuth, Dept. Animal Ecology I
Michael Matthies, University of Osnabrück, Institute of Environmental Systems Research
Jonas Franke, RSS Remote Sensing Solutions GmbH
Sandro Carniel, CNR – ISMAR
Mauro Sclavo, CNR – ISMAR
Christian Laforsch, University Bayreuth, Dept. Animal Ecology I
Florian Siegert, RSS Remote Sensing Solutions GmbH

ABSTRACT

Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, coral reefs, the fishing industry and shipping transport safety. Microplastics (particles < 5 mm) can be ingested by planktonic animals, thus potentially introducing accumulated persistent organic pollutants (POPs) or carcinogenic plastic additives into the base of the food chain. Research has mainly concentrated on marine systems, while river plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas have to date received less attention. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from Landsat-8 and Sentinel-2A. Model accumulation maps were validated against in situ sampling at 9 beaches (sampled particle size range: 1-5 mm). Hydrodynamic modelling suggests that the amount of discharged particles is only semi-coupled to beaching rates. Object tracking revealed that beaching of emitted particles was strongly mouth dependent and relatively low (less than 25%), primarily occurring within the first five days. The southernmost Po River mouth posed an exception, where more released particles (94%) were found to beach over an extended period of time and along a longer stretch of coastline. Comparison with remote sensing based accumulation maps and validation against in situ beach samples are discussed. The presented methodology lays groundwork for developing an operational monitoring system to assess microplastic pollution being emitted by a major river and its distribution along adjacent coastlines.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"From the sea surface to the deep seafloor: microplastics prevail at all ocean depths of the HAUSGARTEN observatory (Arctic)"

Mine B. Tekman, HGF-MPG Group for Deep-Sea Ecology and Technology, Alfred-Wegener-Institut Helmholtz-Zentrum fü r Polar- und Meeresforschung
Gunnar Gerdts, Department of Microbial Ecology, Biologische Anstalt Helgoland, Alfred-Wegener-Institut Helmholtz-Zentrum fü r Polar- und Meeresforschung
Claudia Lorenz, Department of Microbial Ecology, Biologische Anstalt Helgoland, Alfred-Wegener-Institut Helmholtz-Zentrum fü r Polar- und Meeresforschung
Sebastian Primpke, Department of Microbial Ecology, Biologische Anstalt Helgoland, Alfred-Wegener-Institut Helmholtz-Zentrum fü r Polar- und Meeresforschung
Melanie Bergmann, HGF-MPG Group for Deep-Sea Ecology and Technology, Alfred-Wegener-Institut Helmholtz-Zentrum fü r Polar- und Meeresforschung

ABSTRACT

Although recent research indicates that microplastic (MP) has spread to all marine ecosystem compartments from the sea surface to the deep sea, our understanding of transport pathways is still limited. Currently, our knowledge of MP concentrations throughout the water column is largely based on model runs. To fill this gap, we deployed in-situ pumps at four different depths (sea surface, ~300m, ~1000m, near seafloor) at five stations of the HAUSGARTEN observatory (west of Svalbard). These pumps filtered 218–560 litres of seawater (> 10µm). Our analyses using µFTIR spectroscopy resulted in 16–8,750 MP m-3, comprising 16 different polymer types. The highest concentration was detected at the sea surface near the coast of Svalbard. Rubber was the dominant polymer in this sample. Of the four deep stations (2500m depth), the northernmost station, which is located in the marginal ice zone, harboured the highest concentration (1,927 MP m-3) throughout the water column, and polyamide accounted for the largest proportion (28%). The surface waters had the highest MP concentrations at all stations with a decrease throughout the water column. Our results will be compared with trends in the vertical distribution of organic particles and discussed in the context of prevailing water masses and sea ice coverage. Still, our preliminary results highlight that noticeable amounts of MP are present throughout the water column, Earth's largest biome, which has been largely neglected in previous estimates of plastic in the world's oceans.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"Generation of secondary microplastics in the sea swash zone"

Irina Chubarenko, P.P.Shirshov Institute of Oceanology of Russian Academy of Sciences
Irina Efimova, P.P.Shirshov Institute of Oceanology of Russian Academy of Sciences
Margarita Bagaeva, P.P.Shirshov Institute of Oceanology of Russian Academy of Sciences

ABSTRACT

Mechanical fragmentation of plastics in the sea swash zone is one of the major mechanisms of generation of marine microplastics (MPs). Reproducing the process of repeated wave breaking, the series of experiments in a rotating laboratory mixer with an inclined axis of rotation were carried out, with the goal to disclose (i) qualitative features of the process of fragmentation and of the particles generated, (ii) increase in mass of MPs with time, (iii) variation of size distribution of MPs with time, and (iv) distribution of mass of MPs versus their size. Samples made of the world's most common plastics were used: Low Density Polyethylene (LDPE, garbage bags), polystyrene (PS, disposable dishes), polypropylene (PP, disposable cups), and foamed polystyrene (PSfoam, sheets for building heat protection). The results indicate that the mass of MPs generated from macro-samples increases exponentially for LDPE, PS, and PP samples, while foamed PS first shows linear mass increase due to its initial break-down to individual spherules (also regarded as MPs) and only then – breaking of the very spherules to smaller MPs. Time of complete disintegration of the PP / LDPE / PS macro-samples into MPs, recalculated from the number of rotating circles using typical surface wave period for the Baltic Sea of about 5 s, is estimated to be about 1 month (for PP samples) / 2 weeks (LDPE) / 1 week (PS) for the swash zone with coarse bottom sediments (cobbles) under rather moderate wind-wave conditions. Log-log presentation of the number of generated MPs particles versus their size shows a clear linear trend, allowing for suggestion that the right wing of the oceanic size-distribution of floating MPs (Cózar et al., 2017) resembles mechanical fragmentation of larger debris on the oceanic coasts.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"Is there a garbage patch in the Indian Ocean?"

Mirjam van der Mheen, School of Civil, Environmental and Mining Engineering and the UWA Oceans Institute, The University of Western Australia
Charitha Pattiaratchi, School of Civil, Environmental and Mining Engineering and the UWA Oceans Institute, The University of Western Australia

ABSTRACT

Buoyant marine plastic debris accumulates in garbage patches in the centre of subtropical gyres. The accumulation mechanism was previously explained in the Pacific Ocean by considering surface ocean currents. However, other surface forcing mechanisms such as direct wind forcing and Stokes drift also influence the transport of buoyant objects. To determine the influence of different forcing mechanisms on the evolution of the garbage patches, we use the trajectories of two types of global drifters: drogued and undrogued. Drogued drifters follow the currents at 15m depth, whereas undrogued drifters are influenced by surface dynamics. We use the observed trajectories of the two types of drifters to create two statistical drifter models (SDM): SDM-D from drogued drifters and SDM-U from undrogued drifters. We simulate global particle transport using both SDMs. Our results show that the SDM-D and SDM-U accumulation patterns are very different in the Indian Ocean compared to other ocean basins. This may be attributed to the different ocean dynamics of the Indian Ocean. In other ocean basins there is a significant, well-defined accumulation region for both SDM-D and SDM-U simulation results. In contrast, in the Indian Ocean SDM-D results show an accumulation band spanning almost the entire width of the basin. SDM-U results show a far less pronounced accumulation region on the western side of the Indian Ocean. Based on these results, we suggest that there may not be a "real" garbage patch in the Indian Ocean, in the sense that there is no consistent and well-defined accumulation region.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"Making virtual particles behave like plastic: developing the OceanParcels Lagrangian Ocean Analysis framework"

Erik van Sebille, Utrecht University
Michael Lange, Imperial College London
Philippe Delandmeter, Utrecht University

ABSTRACT

Most of our understanding about plastic debris movement in the ocean comes from observations of drifting buoys or numerical simulations of passive virtual particles in ocean general circulation models. However, neither of those represent the fragmentation, sinking, beaching and other processes that affect the movement of real plastic items in the ocean.

In order to facilitate the simulation of virtual particles that 'behave' like plastic, we're developing the new Parcels framework. Parcels is primarily written in Python, utilising the wide range of tools available in the scientific Python ecosystem, while generating low-level C-code and using Just-In-Time compilation for performance-critical computation.

Here, we will demonstrate the ease of use of this code in simulating particles as plastic. This will aid studies into the global distribution and fate of plastic particulates; not only at the ocean surface but also in the abyss, on beaches and in marine animals. We will discuss the code's current limitations and future development plan. We will also highlight some of the other applications of the OceanParcels framework, including the simulation of plankton and fish.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

“predicting accumulation zones of marine debris at management relevant scales”

Kay Critchell, James Cook University

ABSTRACT

Models that predict the movement of marine debris are generally conducted at broad scales with relatively coarse resolution. To be useful to environmental managers, predictive models of marine debris dispersal need to be conducted at a finer spatial scales and resolution. In this study, I compare field data to predictive models of marine debris dispersal in a small (approximately 10,000 km2) management jurisdiction within the Great Barrier Reef, Queensland, Australia. I compared the model outputs to the field data in two ways. First, I assessed whether the field site was correctly categorised by the model as an accumulation “hot spot” or as an area of low accumulation (“cold spot”). Secondly, I assessed the magnitude of accumulation predicted by the modelling. I found that the predictability of a site varied based on the physical characteristics of the site. Understanding the characteristics of a correctly categorised site could explain what makes a site a “hot spot”. An accurate understanding of where debris accumulates is needed to inform many levels of marine spatial management, from risk assessments to debris removal efforts. My study shows the utility of fine spatial scale predictive models of marine debris dispersal.

"Source to Sea Transport of Microplastics: Modeling Fate and Transport in San Francisco Bay and the Coastal Ocean"

Rusty Holleman, San Francisco Estuary Institute
Emma Nuss, San Francisco Estuary Institute
Lawrence Sim, San Francisco Estuary Institute
Meg Sedlak, San Francisco Estuary Institute
Diana Lin, San Francisco Estuary Institute
Carolynn Box, 5 Gyres
Rebecca Sutton, San Francisco Estuary Institute

ABSTRACT

Microplastics enter the environment from a variety of sources, with varying morphologies, size and composition. These characteristics affect the transport and fate of such particles, with an impact on whether plastics enter the aquatic food web, wash ashore, deposit on the bed, or even become entrained in one of the five global gyres.

We present a process-based modeling study intended to predict the trajectories of microplastics from potential sources, through San Francisco Bay, and to the coastal ocean and beyond. The Bay portion of the domain requires a robust treatment of tidal transport and mixing, complex geometry and wetting and drying. Modeled transport in the coastal ocean, including three National Marine Sanctuaries, draws on HF radar data as well as regional ROMS models. We investigate the sensitivity of the predictions to particle characteristics and source location. The modeling study complements a field-based study of the Bay and coastal ocean, with the ultimate goal of assessing the feasibility and model skill for predicting microplastic transport and fate.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"Understanding wind-driven vertical mixing of microplastics"

Jessica Donohue, Sea Education Association
Kara Lavender Law, Sea Education Association
Ethan Edson, Northeastern University
Kathryn Tremblay, University of Massachusetts Dartmouth, School for Marine Science and Technology

ABSTRACT

How initially buoyant microplastics move vertically in the water column remains poorly understood. The amount of floating microplastics measured at the sea surface varies depending on the wind speed (Kukulka et al. 2012). The energy from the wind mixes buoyant microplastics down to depths out of reach of the nets used to measure them. Using measured wind speed and sea surface plastic concentrations, numerical models can predict the amount of plastic that has been mixed to depth. A key parameter in these models is the particle rise velocity – the speed at which a submerged particle would rise back to the surface if released at depth.

Utilizing a custom built rise velocity chamber, we carried out laboratory experiments measuring the rise velocity of individual microplastics collected at variable depths by Sea Education Association. We measured more than 200 particles of various forms, shapes and sizes, and evaluated the relationship between these particle characteristics and rise velocity. We also measured the mass of each particle, numerous 2-D size parameters using high-resolution scanned images, and polymer type using Raman spectroscopy. These results can advance our understanding of the depth distribution of microplastics in the upper ocean, improve existing numerical models, and lead to better predictions of surface microplastic concentrations in variable wind conditions.

Transport And Fate Of Marine Debris In The Ocean And Shelf-Seas: Theory, Modeling And Observations

"Use of NOAA's Trajectory Analysis Planner (TAP) for Marine Debris Transport Studies"

Dylan Righi, Genwest Systems, Inc.
Sherry Lippiatt, NOAA Marine Debris Program
Peter Murphy, Genwest Systems, Inc
Glen Watabayashi, NOAA Office of Response and Restoration, Emergency Response Division

ABSTRACT

NOAA's Office of Response and Restoration has developed the Trajectory Analysis Planner (TAP) tool to prepare contingency plans for oil spill response. TAP graphically presents the results of thousands of simulated oil spills to help understand and anticipate many possible spill outcomes and potential habitat damage.

We have applied this tool to marine debris release scenario modelling in the Southern California Bight region. Using water velocity and wind forcing data from a 10 year Regional Ocean Model (ROMS) study, we predict marine debris trajectories from numerous sources in the area. At each source location a large number of trajectories are computed, each with random start times over the 10 year forcing record. Combining these trajectories gives a statistical view of debris fate. We are also able to vary marine debris characteristics, such as windage, to study how different debris types are distributed. We will present results from this study and discuss its applicability as a marine debris planning tool.

What, Why and How: Using Research to Change Littering and Recycling Behaviors

"Behavior Change Strategies to End Littering and Improve Recycling"

Wes Schultz, Cal State - San Marcos

ABSTRACT

In an effort to go beyond the typical self-report measures used to study littering behavior, our research includes observations of individuals in a diverse sample of public locations. With regard to general littering, our statistical analyses revealed several important predictors. In addition to our systematic observations of disposal behaviors, we randomly selected locations where we conducted intercept interviews with the observed disposers. The goal was to obtain a small, representative sample of individuals and to link the responses from our intercept interview to the observed disposal behaviors. At each of the selected intercept locations, individuals who had been observed disposing (either properly or improperly) were approached to take part in a face-to-face survey. During this session, researchers and in-field practitioners will share current research to address the behaviors and strategies and methods to encourage proper disposal and reduce waste.

What, Why and How: Using Research to Change Littering and Recycling Behaviors

"Prevent Marine Debris Through Empowering New Generations' Actions at Educational Institutions"

Christine Flowers, CSU Sacramento
Sammi Dorfan, San Diego Jewish Academy

ABSTRACT

This session will provide examples of how to use tools and resources developed by Keep America Beautiful (KAB) and examples from California State University's Sac State Sustainability program to focus on protecting local watersheds. Sac State Sustainability became the first KAB University Affiliate as the program expands to accommodate colleges and universities.

KAB has developed a Youth Advisory Council (YAC) to provide a national framework for youth engagement. To support implementation the Youth Initiatives Program Guide includes three modules that address litter, solid waste and beautification. These modules are user friendly for all grade levels, address the National Stem Initiative and provide opportunities for Service Learning. Currently there are ten local YACs and two State level YACs. A pilot was completed at three schools. There is a potential for outreach to 9,000 schools annually through the KAB Affiliate system.

The Litter Free Places Initiatives piloted by the YAC is showing a sustained 38% reduction in litter. A member of the National Youth Advisory Council who has started a YAC located in a coastal community will provide her insight into how this program has changed her perspective and given her the confidence to establish a program at her school and seek ways to expand efforts in the broader San Diego Community.

SacState Sustainability will showcase efforts to improve local storm water quality through prevention, volunteer efforts and education. In 2015, SacState Sustainability found a way to focus on keeping the neighboring American River clean through construction of 25 stormwater capture and treatment devices, making the campus a model for LID. Sacramento State has adopted multiple areas along the American River Parkway and 2-3 times a year coordinate river clean-ups.

"Regional Litter Prevention Campaign: Building a Campaign That Works"

Hannah Seligmann, Alice Ferguson Foundation

ABSTRACT

The Anacostia River Total Maximum Daily Load (TMDL) for trash requires jurisdictions to capture, prevent from entering, or remove baseline trash loads. In order to meet these trash load expectations, the Anacostia River watershed has developed new infrastructure, watershed framed policy, social marketing campaigns, and regional collaboration. Despite this mandate to clean-up the river, stormwater outflows continue to carry food packaging, beverage bottles, and take out containers from the streets into the streams. The Regional Litter Prevention Campaign aims to change individuals littering behaviors through community based social marketing.

This workshop will contribute littering behavior observation research, motivating factors that foster proper waste management habits on a personal and communal level, and a case study of a community based social marketing campaign.

The Alice Ferguson Foundation partnered with a social research firm to conduct focus groups and interviews with residents of the Potomac River watershed. Further research was conducted to target millennial and Spanish speaking audiences. The findings resulted in images and words that can promote behavior change in people who litter. Statements like, "Your litter hits close to home" and images of parks, green space, and community pillars have ranked highly in focus groups with admitted litterers.

Over 9 years, the campaign has been piloted in single neighborhoods, expanded to larger communities, and most recently has encompassed the entire District of Columbia.

The campaign has successfully reduced littering behavior by 30% in DC neighborhoods pre/post campaign signage. We'll discuss lessons learned, success stories, and what's next.

"Who Gives a Hoot Intercept Surveys"

Renee Bator, SUNY Plattsburgh

ABSTRACT

Across 14 different outdoor settings in 8 states, the authors interviewed 102 disposers to examine how littering behavior is affected by environmental factors, social norms, demographic characteristics, and self-reported motivations. Observations revealed that 25% of all disposals were littered, and the most commonly littered item was cigarette butts. Participants were less likely to litter in locations with more receptacles available and with receptacles positioned so they could be easily reached. Younger participants, who reported weaker personal norms against littering, were more likely to litter. Implications of this work suggested the necessity of adequate receptacle availability and accessibility, especially cigarette-butt receptacles.

In addition, antilittering campaigns were advised to direct their appeals to those most at risk for littering—targets under the age of 30.

"Micro-Plastic Particle Analysis of Hudson River Surface Water Using Novel Flow-Through Imaging Raman Spectroscopy"

Scott Gallager, Woods Hole Oceanographic Institution
Wade McGillis, Columbia University
John Lipscomb, Riverkeeper, Inc.

ABSTRACT

It is estimated that an average of 5-13 million MT of single-use plastic products enter the world's ocean each year, degrade through photochemical and mechanical abrasion, and become what is known as microplastics (MP)- particulate plastics between 1 µm and 5 mm. The fate of MPs is only starting to be revealed, but is fundamentally an oceanographic problem since their distribution is a function of both large and small scale mixing, microbial degradation, ingestion by a variety of suspension feeders, and nucleation of marine snow particulates, which export MPs to the deep sea. This study provides an overview of the development of a flow-through particle sensor based on both particle microscopic imaging and time-domain Raman spectroscopy with results of a cruise along the entire Hudson River sampling surface water continuously. Surface waters of the Hudson River contained 0 to 4.4 round, fiber, sliver, and bead particles/m3 of type PS, PE, PET, and PP, apparently higher in areas of maximum population density. Flow-through particle analysis using optics and Raman spectroscopy is possible, but the Raman signal to noise ratio must be maximized and fluorescence minimized using time-domain spectroscopy.

"Microplastic screening and plastic surface weathering characterization with optical microscopy and SEM/EDS"

Zhong-Min Wang, Environmental Health Laboratory
Jeff Wanger, Environemtal Health Laboratory
Sutapa Ghosal, Environmental Health Laboratory
Stephen Wall, Environmental Health Laboratory

ABSTRACT

This study aimed to 1) develop and optimize a rapid procedure for microplastic screening with optical microscopy and scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM/EDS) suitable for fish guts and water samples, and 2) characterize plastic surface weathering using SEM/EDS. Microplastic particles from Atlantic and Pacific Ocean trawls, lab-fed fish guts, and ocean fish guts were characterized using both optical microscopy and SEM/EDS in terms of size, morphology, and chemistry. The analysis procedure is summarized as a flowchart as a practical reference for future studies. Optical microscopy yielded morphological classifications and size ranges of particles or fibers present in the sample, and also helped identify candidate plastic particles. SEM/EDS analysis was used to rule out non-plastic particles and further screen samples for potential microplastic, based on their elemental signatures and surface characteristics. Likely chlorinated plastics such as polyvinyl chloride (PVC) were identified with SEM/EDS due to their unique, elemental chlorine signatures, as were mineral species, often falsely identified as plastics by optical microscopy. Particle morphology determined by optical microscopy and SEM suggests the ocean fish ingested particles contained both degradation fragments from larger plastic pieces and also manufactured microplastics. SEM/EDS revealed unique insights into plastic degradation, likely weathering mechanisms, and environmental fate via high resolution imaging of characteristic cracks on the plastic surface. The ocean fish and trawl SEM results were consistent with their known environmental exposures, and revealed pigment particles consistent with manufactured materials.

"Plastics in Antarctica – preliminary findings from the Antarctic Circumnavigation Expedition (ACE)"

Peter Ryan, FitzPatrick Institute of African Ornithology
Giuseppe Suaria, CNR-ISMAR
Vonica Perold, FitzPatrick Institute of African Ornithology
Jasmine Lee, Centre for Biodiversity Conservation Science
Stefano Aliani, CNR-ISMAR (Institute of Marine Sciences – Italian Research Council)

ABSTRACT

The Antarctic Circumnavigation Expedition (ACE) sampled micro, meso and macroplastic litter around Antarctica from December 2016 to March 2017. Only small numbers of microfibres were found in beach sediments from sub-Antarctic and Antarctic sites, and surface tows with a 200 micron neuston nets captured no mesoplastic items. Only 22 macrolitter items were observed south of the Subtropical Front in almost 15,000 km of transect counts, confirming that the Southern Ocean is the ocean least polluted by plastics globally. However, macro debris was found in two of the small number of seabed trawls, and apparently synthetic microfibres were detected in virtually all bulk water samples collected around Antarctica. Surprisingly, there was no marked gradient in these fibres as we approached continental source areas. Confirmation of the identity of these fibres is still pending, but if they prove to be plastic, they suggest that all the world's surface waters apparently carry low concentrations of microfibre pollutants, at a density of ~0.1-1 fibres per litre.

Where Is All The Plastic? New Tools To Determine The Plastic Marine Debris Budget

"The Arctic deep sea - a sink for microplastic ?"

Melanie Bergmann, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
Vanessa Wirzberger,
Mine B. Tekman,
Thomas Krumpen,
Claudia Lorenz,
Sebastian Primpke,
Gunnar Gerdts,

ABSTRACT

Some 99 % of plastic debris projected to enter our oceans has not been captured by current global litter estimates based on empirical data. It has been speculated that a large fraction of plastic debris evades our detection through fragmentation into small particle sizes, uptake by biota and accumulation in remote environments such as the deep ocean floor, which covers 60 % of the Earth.

Here, we analysed nine sediment samples taken at the HAUSGARTEN observatory in the Arctic at 2,340 – 5,570 m depths by Attenuated Total Reflection FTIR and µFTIR spectroscopy. Our results indicate the widespread occurrence of high numbers of microplastics (MP) in Arctic deep-sea sediments (44 – 3,463 MP L-1). The northernmost two stations harboured the highest MP quantities, indicating the importance of sea ice. A positive correlation between MP and chlorophyll a suggests vertical export via incorporation in sinking (ice-) algal aggregates. Overall, 18 different polymer types were detected dominated by chlorinated polyethylene (38 %), polyamide (22 %) and polypropylene (16 %). Almost 80 % of the MPs were ≤ 25µm. Many previous studies did not capture this size, which may partly explain why the MP concentrations are amongst the highest recorded from benthic sediments so far. MP quantities on the seafloor are 2 - 3 magnitudes higher than at the sea surface (Tekman et al.) indicating that the deep Arctic seafloor is a major sink for MP. This highlights the need to incorporate data from the deep sea into global litter estimates if we want to tackle the question 'Where is all the plastic?'.

“The Role of the "Plastisphere" Microbiome in Plastic Resin Density Changes Over Time”

Linda Amaral-Zettler, NIOZ Royal Netherlands Institute for Sea Research and Utrecht University
Erik Zettler, NIOZ Royal Netherlands Institute for Sea Research and Utrecht University
Cathleen Schlundt, Marine Biological Laboratory
Drishti Kaul, J. Craig Venter Institute
Chris Dupont, J. Craig Venter Institute ,
Jessica Mark Welch, Marine Biological Laboratory
Tracy Mincer, Woods Hole Oceanographic Institution

ABSTRACT

While macroplastic is the most conspicuous and iconic debris in the marine environment, micro (< 5 mm) and nano-sized (<50 µm) plastic particles are now recognized as a growing concern. The disconnect between a large and recurring source and a relatively small standing pool of Plastic Marine Debris points to large and unknown sinks that must account for the fate of the "missing plastic". Plastic is colonized within hours of contact with water by a thin film of microorganisms, what we refer to as the "Plastisphere" microbiome. Important questions include how does the density of plastic in the ocean change over time as a result of biofilm formation, and how this determines whether the plastic sinks. As part of our ongoing research on microbial interactions with plastic marine debris, we conducted a long-term incubation experiment in temperate marine waters off Woods Hole, MA employing polyethylene (PE), polypropylene (PP), and expanded polystyrene resins to look at how biofilms begin, grow and change by collecting samples weekly for a month, then monthly for a year. In addition to monitoring changes in density of colonized resins, we employ a multiphasic approach including next-generation amplicon and metagenomics sequencing, culturing, Scanning Electron Microscopy, and most recently Combinatorial Labelling and Spectral Imaging – Fluorescence In Situ Hybridization (CLASI-FISH). Time series investigations such as these, provide a time-stamp on the succession and community assembly in Plastisphere communities that is difficult if not impossible to achieve in naturally collected samples and allow us to interrogate the importance of the spatial structure of the Plastisphere.

Where Is All The Plastic? New Tools To Determine The Plastic Marine Debris Budget

"The terminal rising velocity of ocean plastic"

Francesco Federico Ferrari, The Ocean Cleanup
Laurent Lebreton, The Ocean Cleanup
Anna Schwarz, The Ocean Cleanup
Hannah Maral, The Ocean Cleanup
Julia Reisser, The Ocean Cleanup

ABSTRACT

Buoyant plastics are now ubiquitous in the world's ocean. They are comonly sampled with surface neuston nets that only sample the first centimeters of the water column. As wind-induced vertical mixing can lead to the distribution of buoyant plastics throughout the water column, a substantial fraction of ocean plastics can be missed by sea surface samplers, potentially leading to underestimations of plastic pollution levels. A linear model formulation has been proposed to correct sampled concentration for this effect, which is a function of sea state and ocean plastics' terminal rising velocity (Wb). The latter refers to a constant speed driven by the buoyancy of the particle and friction forces in an undisturbed water column. In this study, we measured the Wb for 764 plastic pieces collected in the North Pacific Ocean. The plastics length ranged from 0.5mm up to 2.5m, and they were classified into four different types: hard plastic, ropes/nets/lines, pellets and foam. Using containers filled with seawater, we measured the Wb of each ocean plastic particle 3 times. Our results show that ocean plastics' Wb varies within three orders of magnitude, with hard plastics Wb varying between 1.31 and 9.10 cm s^{-1}; ropes/nets/lines between 0.47 and 7.43 cm s^{-1}, pellets between 3.96 and 6.58 cm s^{-1}; and foam between 0.97 and 23.95 cm s^{-1}. Wb was also influenced by the size of the plastic debris, with this speed increasing proportionally to the ocean plastics' length. Our measurements were used to develop a series of conversion matrices that determine 'depth-integrated' concentrations from in-situ surface samples as a function of observed sea state (Beaufort scale) and plastics' type and sizes.

"Bags, bottles, and beads: the way forward on product and corporate campaigns"

ABSTRACT

NGOS, policymakers, and advocates have worked together over the last few decades on product-specific source reduction through both regulatory and corporate facing campaigns to address particularly problematic items – plastic bags, microbeads, and polystyrene to name a few. Several of these product campaigns have resulted in legislative outcomes – the California and Hawaii statewide bans on plastic bag, the Federal ban on microbeads, as well as numerous municipal policies directed at sources reduction around the country. But non-legislative campaigns have also lead to successful initiatives – such as Ikea's and McDonald's phasing out of polystyrene, and restaurants around the country switching to paper straws and recyclable/compostable packaging. What can we learn about these success, failures, challenges, and outcomes going forward to better inform plastic waste reduction campaigns? This panel will feature experts from both the legislative/policy perspective, and the corporate engagement sector, to share case studies, best practices, strategy, and engage the audience in a discussion around collaborative future approaches.Panelists- Dune Ives (USA)Anna Cummins (USA)Nicky Davies (Australia)Monica Wilson (USA)Kate Melges (USA)

"International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review"

Dirk Xanthos, Ecology Action Centre
Tony Walker, Dalhousie University

ABSTRACT

Marine plastic pollution has been a growing concern for decades. Single-use plastics (plastic bags and microbeads) are a significant source of this pollution. Although research outlining environmental, social, and economic impacts of marine plastic pollution is growing, few studies have examined policy and legislative tools to reduce plastic pollution, particularly single-use plastics (plastic bags and microbeads). This paper reviews current international market-based strategies and policies to reduce plastic bags and microbeads. While policies to reduce microbeads began in 2014, interventions for plastic bags began much earlier in 1991. However, few studies have documented or measured the effectiveness of these reduction strategies. Recommendations to further reduce single-use plastic marine pollution include: (i) research to evaluate effectiveness of bans and levies to ensure policies are having positive impacts on marine environments; and (ii) education and outreach to reduce consumption of plastic bags and microbeads at source.

"Plastic Bag Ban Legislation in Caribbean Region"

Martina De Marcos, Fundacion Isha educando para la paz

ABSTRACT

Plastics, including plastic bags, are a significant source of litter, causing harm to animals by ingestion or entanglement. Plastic bags also clog up water drains, causing floods, threatening humans. Problems related to plastic bags have led to regulations in many countries around the globe, including, in recent years Small Island Developing States (SIDS). The need to stop indiscriminate consumption of single-use plastic bags is particularly relevant for Countries of the Wider Caribbean Region (WCR) as the most significant downstream impact of litter on the environment is marine pollution. This region has an abundance of natural assets, with the majority of the population living within 10 kilometres of the ocean and with vital economic sectors dependent on vulnerable coastal ecosystems. Also, SIDS has poor waste management infrastructure which exacerbates the need for single-use plastic reduction. Places, where a single-use plastic bag ban has been introduced, include Aruba, Antigua and Barbuda, Haiti, Puerto Rico, and Rincón, a municipality in Puerto Rico.

This session will present SIDS' case studies by analysing approaches for the successful enforcement of the ban. Methods analysed include incentives, enforcement, education, capacity building and funding from international agencies. The analysis shows the importance of (i) using a combination of different approaches for successful enforcement, (ii) education and capacity building being pivotal in the realization of the plastic bag ban -successful education programs led to very little opposition to the ban and big compliance rates; and (iii) in some cases, the aid from international agencies.

"Single-use debris on the Israeli coast"

Galia Pasternak, University of Haifa
Dov Zviely, School of Marine Sciences, Ruppin Academic Center,
Asaf Ariel, Ecoocean
Ehud Spanier, Department of Maritime Civilizations, The Leon H. Charney School for Marine Sciences, University of Haifa
Christine Ribic, Department of Forest and Wildlife Ecology, University of Wisconsin

ABSTRACT

In a study conducted on the beaches of Israel between 2012-2015, 19 surveys were conducted on eight undeclared beaches, with the aim of characterizing the marine debris, its distribution and sources, to find solutions to this problem. Ninety percent of the debris was made of plastic. Thirty-two percent of the debris found on the beaches were single-use items (e.g., food-related items such as cutlery and food packaging), followed by plastic bags (23%), cigarette butts (12%), bottle caps (11%), and plastic bottles (5%). The high percentage of plastic bags vs. the low number of drinking bottles (most probably due to the effectiveness of the Israeli bottle recycling law) found on the Israeli coast, was used as part of the argument for new legislation in the Israeli parliament to charge for plastic grocery bags. To check the effect of the new levy on plastic grocery bags, which entered into force in January 2017, an additional survey was conducted in June 2017 on five beaches. The relative amount of plastic bags detected in the new survey decreased by 50%. Using these findings, we are offering action plans to reduce the most abundant items on the beach. Our work indicates that changing people's behavior to reduce the use of disposable items (i.e., reduction in origin), most of which are made of plastic, will likely significantly reduce the amount of marine debris on Israeli beaches.

"Taiwan's PET Bottle Recycling System and Application"

Yiong-Shing Sheu, Recycling Fund Management Board
Hsin-Chen Sung, Recycling Fund Management Board
Shou-Chien Lee, Recycling Fund Management Board

ABSTRACT

PET bottle has been widely recognized as a major pollutant to the marine and costal environment. Taiwan has been recycling PET bottles since 1988. In 2016, Taiwan recycled 97%, or 102,337 metric tons, of waste PET bottles. From 1988 to 1997, the industry associations, were required by the Amendment of Waste Disposal Act (WDA) of 1988 to be responsible for the collection and recycling. The 1997 Amendment required the manufacturers and importers (responsible enterprises hereafter) to pay recycling fees, instead of doing the recycling by themselves, to the recycling funds managed by the Recycling Fund Management Board under Taiwan EPA. At least 70% of the fund revenue was distributed to trust fund for subsidizing collection and recycling businesses. The rest of the fund revenue went to the special income fund for the audit of responsible enterprises, certification of collection and recycling volumes, support local collection and recycling programs, education, communication, and administration. Sellers, such as convenient stores, supermarkets, hypermarkets, were also required by the law to accept used bottles returned by consumers. The waste pickers collected valuable recyclables, including PET bottles, for living. The municipalities, which receive grants from the recycling funds, are responsible for collection recyclables free of charge from the residents. The collected PET bottles were sorted, baled and shipped to 16 recycling plants for label-removing, washing, advanced sorting and purification. The scraps of PET bottles were turned to post-consumer resins, which can be used for bottles, fibers, sheets or other applications. Some brand names, such as Coca Cola and Adidas, used Taiwan's recycled PET in their products. The recycling of PET in Taiwan has proved to be a success in solving plastics pollution problems.

"Local, State and Federal Ocean Litter Laws from around the Nation"

Angela Howe, Surfrider Foundation
Brad Verter, Mass Green Network
Charlie Plybon, Surfrider Foundation (Oregon)
Corali Lopez-Castro (INVITED), Kozyak Tropin & Throckmorton

ABSTRACT

In the United States, ocean litter has been addressed at the local, state and national level through law-making efforts. Marine debris laws can take the form of local ordinances, statewide laws or even federal legislation. For instance, one of the most recent local laws aiming at the regulation of marine plastic pollution is the ban on foam food containers passed by the Hawaii County Council on September 22, 2017. Statewide, the California bag ban was passed in 2014 and affirmed by a voter referendum in 2016 with 7.2 million votes in favor. Finally, in December 2015, President Barack Obama signed bipartisan federal legislation to enact a phase-out of plastic microbeads found in personal care products.

Sometimes these laws correspond and complement each other; however, at other times there is a battle of jurisdiction for the right to govern. In the latter instance, there have been several statewide preemption efforts to take away local home rule over plastic pollution reduction ordinances, now affecting 10 U.S. states. For instance, in Florida currently there is a court battle over whether the town of Coral Gables expanded polystyrene foam ordinance was preempted by statewide legislation concerning product packaging and/or legislation regarding the distribution of "auxiliary containers". On the other hand, a good local idea can take hold and spread to multiple localities before being taken up at the statewide level. For instance, the California statewide bag ban was not passed until over 150 local municipalities (and approximately 1/3 of the state's population) were covered by a single-use bag ban. The successes and challenges in passing effective marine debris legislation can be instructive for future law-making efforts in localities, states, regions and countries worldwide.

"Coral Gables Prohibition on Expanded Polystyrene and Single Use Plastic Bags"

Matthew Anderson, City of Coral Gables

ABSTRACT

Marine debris is a serious problem that can affect not only the health of humans and wildlife but it can also have a negative impact on the infrastructure and aesthetics of local communities. The City of Coral Gables is focused on preserving the environment. Coral Gables has over 42 miles of coastline and waterways. The potential impacts that marine debris can have on our city is enormous. As a result, over the last two years the City has passed legislation prohibiting the use of expanded polystyrene and single use plastic bags. Coral Gables became the first city in the State of Florida to prohibit the use of single use plastic bags. The State of Florida has an existing state statue Section 403.7033 that preempts cities from enacting legislation regulating plastic bags. Coral Gables was able to pass legislation due to a court decision finding that Sections 403.708(9) and 403.7033, F.S. relating to plastic bags and packaging unconstitutional. More information on the ordinances is included below. Throughout the process of developing both ordinances, the City made it a priority to work closely with the business community including our local chamber of commerce and business improvement district. The City of Coral Gables Florida would like to request the opportunity to present at the sixth international Marine Debris Conference and talk about our experiences and lessons learned.

"Preemption of Local Plastic Pollution Ordinances at the State Level Threatens Effective Marine Debris Regulation"

Jennie Romer, plasticbaglaws.org
Angela Howe, Surfrider Foundation
Christopher Chin, COARE: The Center for Oceanic Awareness, Research, and Education

ABSTRACT

Moderator & Panelist:

Jennie Romer, Esq., Policy Consultant & Founder of plasticbaglaws.org - Jennie will moderate the discussion as well as outline state-of-the-art plastic bag and EPS law structures and present a case study on preemption of local plastic bag laws in New York City.

Panelists:

Christopher Chin, Executive Director at The Center for Oceanic Awareness, Research, and Education (COARE) - Christopher will discuss strategies for ocean advocates to combat preemption, including having a voice at the statewide level. Ocean advocates must also keep a strong on-the-ground presence to make sure that strongest possible local laws continue to be adopted and diligently tracked the efficacy of these laws to demonstrate how these policies effectively change consumer behavior and reduce the amount of single-use plastic pollution in local parks, streets, beaches, and waterways.

Angela Howe, Legal Director at Surfrider Foundation - Angela will provide an overview of local plastic pollution preemption laws in the U.S., discussing the emergence and evolution of these laws as well as the role that American Legislative Exchange Council (ALEC) has played. State legislators in nine states have already preempted regulation of plastic bags, and often all manner of containers, and much of the preemption legislation is identical. Angela will also provide broader context of the usurpation of "Home Rule," including attempts to preempt local action on building efficiency rules, fracking, pesticide regulation, medicine take back programs and environment conservation efforts. Angela will then present a case study on preemption on local single-use plastic laws in Florida.

Save the Albatross!

"Plastic and Marine Debris: What Can Be Done about bottle caps?"

Richard Anthony, Diirector

ABSTRACT

When will the weight of all fish in the ocean equal the weight of plastic discards in the ocean? These plastic discards in the water impacts birds and sea life around the world. Just as the canary in the coal mine forewarns of danger, the Laysan or Pacific Albatross provides a way to measure the impact of plastics in the ocean. Known as the sailor's companion, this once ubiquitous bird is threatened to extinction because of the unintended consequences of our discards that look like food but are not.

The cultural change needed to reverse this trend is to focus the public's attention to the unintended consequences of single use non-recyclable plastic packages, containers, and products. The plight of the Albatross due to the large amount of plastic debris washing up on Midway Atoll and the Northwest Hawaiian Islands is somewhat like an oil spill. The flow must be stopped and the residual must be removed.

The Save the Albatross (albatrosscoalition.org) Campaign objective is to motivate identified producers to pay for plastic cleanup on Midway and other US Pacific Islands which are nesting areas for the Laysan and Black-footed Albatross. Bottle caps are one of the most frequent plastic items found in coastal clean ups. There is need to bring the producers these products and packages to the World table to draft Zero Waste responsibility plans for proper management of discarded plastic via redesign for recyclability, buy back purchasing opportunities (closed circle), and recovery campaigns for vagrant plastics on land and sea.

The paper discusses the science and the campaign which includes legislative action to force the redesign to leash the lid, a law suit to fund the cleanup and a public education campaign that includes returning the caps foun

"Anatomy of a Plastic Bag Ban Campaign"

Sarah Sikich, Heal the Bay
Jennie Romer, Plastic Bag Laws
Patrick Holland (INVITED), Los Angeles County, Department of Public Works
Jacy Bolden (INVITED), The JBC Groups
Betsy Rivera (INVITED), Environmental Charter High School
Alison Huyett (INVITED), Patagonia

ABSTRACT

Using California as a case study, experts from a variety of disciplines will discuss how California went from a state with a few local bag ordinances to the first state in the nation with a comprehensive single-use bag policy. Panelists will discuss opportunities, challenges, policy evolution, and pivot points that led to eventual passage of Proposition 67 in 2016 – the referendum that upheld California's plastic bag ban and paper bag surcharge. Panelists will provide critical commentary and insights on the roles that various stakeholders – educational, business, government, legal, and environmental non-profit -- play in environmental campaigns, using Proposition 67 as a case study. The dialogue will engage with its audience to discuss strategy and work through opportunities and challenges that areas outside of California may face in advancing source reduction strategies for marine debris.

POSTER ABSTRACTS

"Determining Effectiveness of Dungeness Crab Escapement in Derelict Traps Commonly used in the Washington Waters of the Salish Sea"

Antonelis Natural Resources Consultants, Inc., Joan
Drinkwin Natural Resources Consultants, Inc., Jason
Morgan Northwest Straits Marine Conservation Foundation, Paul
Rudell Natural Resources Consultants, Inc.,

ABSTRACT

The prevalence and impacts of derelict Dungeness crab traps in the Washington waters of the Salish Sea (WASS) have been well documented. Several efforts have been made to reduce trap loss, extract accumulated traps, and reduce the impacts of traps that become derelict. To minimize crab mortality in lost traps, fisheries co-managers require that traps have escape hatches secured with biodegradable escape cord. When properly equipped with escape cord, a derelict trap becomes "disabled" upon escape cord degradation, allowing an egress route for entrapped crab to escape. However, among the multiple trap designs commonly used in the region, the effectiveness of escapement varies. Data collected during derelict crab trap retrievals in the WASS has documented continued crab mortality in some traps even after disintegration of escape cord. A laboratory experiment simulating derelict traps was conducted to analyze the escapement effectiveness of 13 trap designs, some equipped with simple modifications. The least successful trap designs in allowing crab escapement were those with escape routes that require crab to push open a door situated on the topside of the trap, offset from the edge. The traps most successful at allowing crab escapement were those that provided an unobstructed escape panel either on the wall of the trap or along the edge of the topside of the trap. Traps that are not initially designed with this feature can be easily modified by detaching one escape ring, and re-attaching it with escape cord. The opening in the trap following escape cord degradation from the ring falling to the seafloor allows crab to freely escape. Results have informed crab fisheries management discussions, and an outreach program aimed at encouraging the manufacturing and use of more effective designs is currently being implemented.

"Beyond a Plastic Sea"

Lozano-Knowlton MERITO Foundation, Jill
Santos MERITO Foundation,

ABSTRACT

'Beyond a Plastic Sea' is a pilot project of the MERITO Foundation weaved into our existing environmental education and citizen science programs that addresses explicitly the amount of plastics currently used, disposed and entering the ocean and harming marine food webs in the Santa Barbara Channel Region. This project's empowers students ages 10 to 18 to advocate and change the behaviors of other students, school's personnel, businesses and public at large through education, advocacy, citizen science and environmental entrepreneurship.

'Beyond a Plastic Sea' focuses on plastics of any size including micro-plastics by working with teachers and partner organizations from academia, resource protection, and businesses in Ventura and Santa Barbara Counties and involves 3 phases: Increasing students ocean literacy and awareness of marine debris impacts; Students participation in marine debris monitoring activities using NOAA Marine Debris Toolkit and shoreline survey protocols; and then students author project proposals for their school campuses to reduce the plastic waste, advocate for sustainable policies at local level, or educate a communities about the issue.

'Beyond a Plastic Sea' directly increase the scientific knowledge and awareness of plastics pollution in the ocean of 1000-1200 students per year, and is catalysis for plastic pollution preventive practices at school campuses, policies at municipalities and/or businesses, and public awareness. We contemplate this project to share lessons learned to teachers and students across the Pacific Ocean in an Easter Asian country in following years through partnerships with NGOs and Resource Protection agencies.

"BLUE responsibility: Creating change through communication"

Iversen Salt Lofoten AS, Hilde Rodas
Johnsen Salt Lofoten AS, Siri Beate
Arntzen Salt Lofoten AS, Gry Anette
Stromnes West Lofoten High School, Marthe Larsen
Haarr Salt Lofoten AS,

ABSTRACT

A considerable amount of waste is generated through activities at sea. Raising awareness about the sources and environmental consequences of marine debris amongst blue professionals therefore constitutes a central element in reducing the problem.

At the brim of Northern Norway, large commercial fisheries and other maritime industries utilize the vast ocean areas for wealth creation. The archipelago of Lofoten is situated on the narrow continental shelf expanding into some of the richest fishing grounds in the world. As fisheries and other maritime activities are fundamental components of the communities in Lofoten, one of the local high schools has a special focus on educating the next generation of workers in the blue industries.

In cooperation with the local high school of West Lofoten, the knowledge-based company SALT has developed the outreach program BLUE responsibility, targeting the next generation of fishermen and seafarers. The goal of BLUE responsibility is to create behavioural change in blue industries through communicating knowledge about the ocean, marine ecosystems and marine debris – and highlight the role and responsibility that lies in the hands of the people living of the sea.

A modified version of the educational program, targeting already active fishermen and seafarers, is being developed for the mandatory safety courses both in Norway and Russia.

BLUE responsibility is a valuable tool in including the blue professionals into the solution space to reduce the problem of marine debris. Communicating the role and responsibility of fishermen and seafarers in both the cause and solution of marine debris, creates change in attitudes and behaviour. This will in turn reduce the impact of their seabound professional lives in the future.

"Clean Beaches Start at Home"

Flores Clean Beaches Start at Home,

ABSTRACT

Sustainable Coastlines Hawaii (SCH) inspires local communities to care for their coastlines through fun, hands-on beach cleanups; however, not everyone can make it to a beach cleanup. SCH has found a way around this challenge by bringing the beach to them. In 2016, SCH launched a new K-14 "Plastic Pollution" Program aimed at educating youth statewide through engaging presentations and activities. The most unique aspect of our program is the Education Station, an upcycled shipping container that has been converted into a mobile outdoor classroom. SCH has increased student and teacher participation 10-fold by offering schools the option to host the Education Station at their campuses and through classroom presentations.

SCH also engages the public through outreach events, drawing people in by using simple, interactive activities. Our key message is clean beaches start at home, because most of what we find on our beaches originates from home or as a result of what we eat at home. If we can make better choices about our consumption habits; we can rely less on plastic and switch to better alternatives. Through our education and outreach program, SCH reached over 8,000 individuals statewide in 2016 and over 8,500 as of October, 2017. We have fostered environmental stewardship by empowering people to think about the ocean and make better choices. Our goal is to increase the effectiveness of this program through innovation, collaborations, student and teacher surveys, and increased participation in our beach-cleanups.

Most importantly we want to share the lessons we've learned along the way from scaling our educational outreach efforts up to the Education Station and where we're going with our newest incarnation, the Education Station II. A mobile van aimed at providing easier access and further reach to an even broader dem

“CoastSavers an Alliance for Change”

Stephens Olympic National Park,

ABSTRACT

CoastSavers an Alliance for Change

The alliance that makes up CoastSavers began with a few dedicated advocates for Washington coastal beaches,our group was formed from this grassroots effort that has grown to an impressive, empowered, diverse group of community leaders that love to talk trash and then get out and clean it up! Some of the most generous members have since passed away but their personal commitments to clean the ocean and beaches continues to fuel the mission of protection, preservation and education.

Over the last ten years, CoastSavers has brought together all of these diverse coastal stakeholders and secured a commitment twice a year to go clean Washington beaches. Our collective group has also taught in class rooms,employed interns, made movies,given presentations,partnered with tribal communities, raised funds, and championed fresh ideas that connect the public to reduce,recycle, and reuse principals. As an organization we have collected approximately 500,000 tons of trash.

CoastSavers has thoughtfully worked towards a collective goal of solving our beach trash problem through service learning and volunteerism. We will continue to advocate for positive change in our local coastal communities by looking to develop environmentally sound options that keep our coast protected from the damage of trash. Our collective energy has inspired incredible stewardship of the most amazing places on the earth and we want to share our success story with you.

Come join our discussion and learn how to create a volunteer force that will make a difference for your local and global beloved coastal beaches. Come share your successes so we can generate new ways to look at this huge challenge. This is an opportunity to take the next step and create your own alliance for change!

"Conservation Art And Education With Marine Debris"

McCarthy Sustainable Coastlines Hawaii,

ABSTRACT

Conservation art is grounded in the act of "doing". Not only is the art inherently sustainable, but it subsequently has the power to spark dialogue and solution oriented ways of thinking then acting upon the subject presented. Using ocean plastic pollution as the prominent medium in a work of art, one can give viewers a glimpse of the current state of the middle of the ocean, without having to travel there. It can provide those who have never put their feet in coastal sands what our reefs, beaches, and marine life, are experiencing and becoming devastated by. The art is the translator between the ocean, the science, and humans.

The medium is the message. I will be discussing two facets within "Conservation Art and Education With Marine Debris". The first will be about my experiences as an artist using marine debris as my dominant medium for the past five years. About the impacts I have seen resonating throughout communities and individuals as plastic pollution awareness continues to increase. This also applies to sustainable business practices. The second will be about my experiences as an art teacher, leading students on beach cleanups, and their process from learning about the ocean environment, how to protect this environment, to creating large marine debris art pieces that demonstrate and communicate the need for solution oriented thinking.

“Creating K-12 Projects To Combat Plastic Pollution with Global Empathy”

Ellwein Harrisburg South Middle School,

ABSTRACT

In this session, view the integrated approach to plastic pollution. Science is the core curriculum in these projects, but it goes beyond the study of ocean currents. Marine life, study of chemistry elements and researching plastic debris is just the tip of learning for middle school learners in South Dakota. It is a learning plan that includes a school in Bergen, Norway, along with nonprofit and university experts from California. By providing research and information to learners, they are allowed to use student voice and choice to produce projects with an entrepreneurial focus.

With the use of our Makerspace and maker materials, including STEM materials, learners had the task of inventing solutions to the plastic pollution problems in our world today. In three iterations prototypes were created with a local and world focus. Some local projects included Plastics Craft Day, working to minimize plastic bag use in grocery stores and working on creating local legislation. Other learners created inventions with a oceanic purpose.

Continuing to build on these projects, the focus now includes our work with Norway and other schools around the world. We are engaging in a longitudinal project that has our learners working with local scientists to collect data on plastic pollution. Scientists from Bergen University in Norway and South Dakota State University in South Dakota are working with our students. This global empathy project will include other schools around the world as the year continues.

"Don't Break the Lake: A Social Marketing Campaign for Plastic Marine Debris in Cleveland, Ohio"

Lehn City of Cleveland Mayor's Office of Sustainability,

ABSTRACT

Don't Break the Lake is a social marketing campaign launched for the greater Cleveland area in Ohio, USA by the City of Cleveland's Office of Sustainability in collaboration with Cleveland Water.

Community-based social marketing combines psychology and social marketing in order to identify barriers to a desired behavior, e.g. using a reusable bag versus a plastic grocery bag. The campaign was motivated by the Great Lakes Land-based Marine Debris Action Plan (2014) and concern over the impact of plastic marine debris in Lake Erie waters. Lake Eris is one of our greatest assets in the region, and an invaluable natural resource.

This campaign specifically focuses on the reduction of plastic grocery bags and plastic disposable water bottles. Through surveys conducted by Ohio Sea Grant, the barriers to desired behaviors were identified and a campaign was developed to address these barriers. The long-term goal for this project was to target specific behaviors that will result in the reduction of plastic grocery bags and plastic disposable water bottles use in our region, and the ultimate reduction of the amount of plastic marine debris entering our waters.

Strategies used, results, and lessons learned from the campaign will be shared in this presentation. Funding for the campaign was secured through the NOAA Marine Debris program.

"Empowering youth as leaders in the community to prevent and remove marine debris in the Gulf of Maine"

Pelletier Gulf of Maine Lobster Foundation,

ABSTRACT

The Gulf of Maine Lobster Foundation (GOMLF) has taken a comprehensive approach to addressing marine debris in the Gulf of Maine. By teaching students the complete cycle of marine debris types, sources, movement, impact, and solutions, our youth develop a greater sense of ecosystem-based understanding, responsibility, and stewardship. With funding support from the NOAA Marine Debris Program, we have led a project which connects people across watersheds, disciplines, ages, and institutions by engaging participants, especially students, in a complete cycle of experiential, place-based activities designed to teach them about the types and sources of marine debris, how the debris moves through the watershed and into the estuary and ocean, how it is transported by ocean currents, the impact on human and ecosystem habitats and resources, and the solutions to reducing debris in the marine environment. We will present here our work and share best practices for engaging youth, and how they have committed to implementing local action plans to reduce and prevent marine debris in their communities.

"Enhancing social awareness and triggering co-responsibility about marine litter in Europe"

Veiga Deltares,

ABSTRACT

To address marine litter, understanding people's perceptions of the issue, changing motivations and behaviour is a vital part of any solution. The project MARLISCO sought to raise societal awareness, trigger co-responsibility and facilitate dialogue towards solutions for marine litter, partnering various organisations, including Research, Authorities, NGOs and Industry.

MARLISCO implemented activities across 15 European countries to develop and test mechanisms to engage society, instil a sense of ownership and desire for collective actions, based on sound scientific evidence and showcasing feasible measures. Engagement activities included: a traveling exhibition displayed in over 80 locations; a video competition involving 2100 students; 12 national participatory events designed to pave way towards concerted solutions, which brought together 1500 stakeholders and revealed support for cross-cutting, preventive measures. Evaluation of these activities showed their effectiveness in improving individuals' awareness about the problem but also commitment in being part of the solution.

MARLISCO also produced educational, multi-lingual and decision-supporting tools: a teaching resource with learning activities, accompanied by an e-course undertaken by over 400 educators; an online 'serious game'; a short animation and a web-documentary; a data-base of best practices; brochures on how to communicate with stakeholders and highlighting practices that can be implemented by different sectors.

The poster summarises the approach of MARLISCO and presents the legacy of tools that have been developed and translated in several languages, currently being used widely around European Seas to raise awareness about marine litter and promote effective societal responses

"Harnessing the Power of Community to Fight Marine Debris"

Liebengood 808 Cleanups, Barbara
Wiedner Surfrider Foundation Kauai Chapter, Scott
McCubbins Surfrider Foundation Kauai Chapter, Cynthia
Welti Surfrider Foundation Kauai Chapter, Robert
Zelkovsky Surfrider Foundation Kauai Chapter,

ABSTRACT

To a single person, marine debris can seem like an expansive and overwhelming issue. Our communities have power to affect tremendous change, but many become overwhelmed trying to figure out where to start. What if you could send out a call for help to clean up a massive derelict fishing net, and within 24 hours, you get extra hands to assist in getting the job done? For 808 Cleanups and Surfrider Foundation Kauai, this scenario is a reality for our volunteer 'ohana.

Our organizations empower communities through daily cleanup posts on social media and inspirational grassroots cleanup efforts. We bring together community members from every age, background, and income. Surfrider has a hot-line to call and both organizations use social media for volunteers to report newly arrived debris. Through 808 Cleanups' Adopt a Site program, volunteers clean up an average of 3 times per day and removed over 29,000 lb. of marine debris, lead weights, and derelict fishing gear in the past two years. Surfrider Foundation Kauai Chapter has removed >163,000 lb. so far in 2016-2017 through our monthly Beach Cleanups and weekly Net Patrols.

This hands on approach not only provides a sense of community for volunteers who felt alone in the endless fight against marine debris, but also gives us daily opportunities to connect and educate about alternatives to plastic, foam, and other single-use materials. We reassure those who are weary, provide extra support where needed, and build community leaders while significantly reducing marine debris along our coastlines.

"How a Beach Cleanup evolved into a National Public Education Campaign"

Stanley Jamaica Environment Trust, Diana
McCaulay Jamaica Environment Trust, Tamoy
Singh Clarke Jamaica Environment Trust,

ABSTRACT

The Jamaica Environment Trust (JET) has been coordinating beach clean-ups since 1994 and became national coordinators of International Coastal Cleanup Day (ICC) in Jamaica in 2008. JET has witnessed the growth of ICC activities in Jamaica from 32 cleanups in 2008 to 138 in 2016 and a significant increase in the amount of garbage being removed from Jamaica's coastlines during ICC; from about 9,000 pounds in 2008 to over 109,000 in 2016. JET's experience coordinating ICC inspired a national public education program on marine debris called the Clean Coasts Project, launched in 2014. Clean Coasts also pioneered the Nuh Dutty Up Jamaica campaign, which sought to change Jamaican attitudes and behaviour regarding littering and garbage disposal. Nuh Dutty Up Jamaica aims to increase awareness of the impact of poor solid waste management on public health and the marine environment while encouraging personal responsibility for trash. Guided by ongoing research into knowledge, attitudes and practices and feedback from the target audience, the campaign spreads its message using the Jamaican language via social and traditional media, animation, event branding, local celebrity ambassadors and targeted community based environmental education. JET is about to embark on its fifth year of delivering the Nuh Dutty Up Jamaica campaign using lessons learnt since its launch to broaden its reach and refine its messaging. This presentation will share strategies, methodology and lessons learned from JET's experience delivering Nuh Dutty Up Jamaica.

"How Candy Wrappers Motivated a School to Stand Up Against Marine Debris"

Nachbar NOAA, Teri
Briggs Goleta Family School,

ABSTRACT

The NOAA Ocean Guardian School program works with K-12 schools to implement stewardship projects focused on watersheds, the ocean and special areas like national marine sanctuaries. The school makes a commitment to ocean conservation and protection and then develops and implements a project that inspires changes in environmental stewardship behavior in their school community and beyond. The program was developed in 2009 and to date has worked with over 100 schools and 5,000 students. This investment has led to large impacts that "guard" our ocean and protect resources, including: 123,189 pounds of trash removed; 108,857 plastic bottles kept out of the landfill; and 7,870 reusable bags distributed to students to replace single-use plastic bags.

One of the NOAA Ocean Guardian Schools, Goleta Family School, was recently recognized as our first 5-year Ocean Guardian School and was acknowledged for the work they do to reduce litter on their local beach, In the process of weekly beach clean ups, the students noticed an increase in the amount of plastic waste on the beach and decided to target the source. They were able to work with a local restaurant to make small changes to their behavior and their patrons behavior and therefore reduce the amount of debris found on the beach., It's an excellent example of how working at the local level can result in large impacts on our ocean environment.

"Leading by example to inspire the next generation of forward-thinkers"

Smith University of Georgia, Aria
Colangelo College of Coastal Georgia,

ABSTRACT

The University of Georgia Marine Extension and Georgia Sea Grant steer ongoing efforts to address marine debris along the Georgia coast. In a project funded by NOAA's Marine Debris Program, extension specialists and partners educated coastal youth to foster community pride, leadership and participation in marine debris prevention. Using NOAA and Ocean Conservancy's new marine debris curriculum, "Talking Trash and Taking Action," we delivered positive messages consistent with those of other leaders tackling the marine debris issue across the nation. Collaborating with teachers on the coast, we presented four classroom lessons to seventh-grade Life Science students in a series of interrelated themes: 1) Introduction/Entanglement, 2) Impacts/Ingestion, 3) Design/Innovation, and 4) Solutions/Leadership. To enhance each lesson, we incorporated a hands-on activity, a partner to share their experiences, and a short video to reinforce the ideas presented. We highlighted challenges and current findings and introduced students to the circular economy to inspire a new generation of forward-thinkers. Cleanup opportunities provided an outdoor learning component to the project. Students in the science club participated in monthly cleanups, tracking debris removed from the marsh around the school using NOAA's Marine Debris Tracker. Successes were highlighted during morning news announcements, boosting pride among the group and school community. In taking ownership of the project, club members developed an outreach message to the community, "Less Plastic is Fantastic," and used artistic expression and group reflection to design t-shirts and stickers to share their message and inspire others in the community. With a focus on solutions and leadership, our goal was to leave a positive impact that would ripple into the next generation.

"Loggerhead Marinelife Center's Debris Sorting Team: A Method for Data Collection and Raising Awareness"

Cutt Loggerhead Marinelife Center, Demi
Fox Loggerhead Marinelife Center,

ABSTRACT

At Loggerhead Marinelife Center (LMC), a nonprofit sea turtle research, rehabilitation, education, and conservation organization, we conduct many varied marine debris removal activities. All collected trash is turned in to our Center for analysis. A Sorting Team, comprised of staff, interns, and volunteers, separates the debris into 20 simple categories and logs findings in our debris database. We have found that a consistent Sorting Team, regularly scheduled for sorting sessions, standardizes protocols and provides an accurate account of the trash removed from the environment. Greatly improved from estimations provided by individual participants at large cleanup events, our data now allows us to publish precise monthly 'Sort Reports' designed to highlight trash statistics in accessible language to share with our partners and the public. Based on our results thus far, we have educated thousands of guests with debris displays, implemented targeted preventative initiatives, and installed trash and recycling receptacles in coastal areas. We have begun to display our sorting method for Center guests and followers via sorting sessions on campus, at annual events, and on social media channels. We are constructing a permanent sorting station in which categories of collected debris will be on exhibit as we work to tally each item. Continuously quantifying the pollution and providing a first-hand look at the trash present in our own back yard creates a more tangible perspective on the marine debris our ocean faces and can inspire responsible action.

"Marine litter reduction strategies for major cultural events in the Caribbean- A pilot study on Carnival in Trinidad and Tobago"

Poon Kong IAMovement, Emma
Doyle Gulf and Caribbean Fisheries Institute,

ABSTRACT

Carnival in Trinidad and Tobago attracts thousands of people to the country annually, and significant amounts of plastic and glass waste from food and beverage consumption is generated as a result. Due to poor waste management, these single-use items are disposed at dump sites but a lot of this ends up in the ocean. This pilot study aims to reduce marine litter through the use of effective communication strategies and economic incentives for stakeholders involved in the Carnival business. In order to achieve this, a needs assessment was conducted by gathering existing information on waste management and identifying key stakeholders. Further to this, the study focused on identifying a marine litter celebrity champion to assist with the implementation of the communication strategy, targeted to specific stakeholders to build awareness of marine litter. The findings of this pilot study can be used as a source of information for event organisers, for a reduction of plastic and glass use, recommend best practices on creating a communications strategy for on-land waste reduction, and monitoring and evaluation pre and post-event. The adoption of these best practices to reduce marine litter can also be shared through a targeted outreach program. This pilot study can be replicated in the Caribbean region as there are similar events held every year, such as Carnivals on other islands, music, and sporting events, that already show interest in achieving greater environmental sustainability. This project was supported by the Caribbean Node of the Global Partnership on Marine Litter.

"Ocean Discovery Institute: A model for empowering future innovators and decision-makers"

Goodwin Ocean Discovery Institute, Shara
Fisler Ocean Discovery Institute, Joel
Barkan Ocean Discovery Institute, Carla
Pisbe Camacho Ocean Discovery Institute,

ABSTRACT

The future of humankind and our ocean depends on finding innovative solutions to global environmental challenges. The US has fallen short in preparing its young people to address these challenges, particularly those in underserved urban communities, who find themselves trapped in a persistent cycle of poverty and unaware of opportunities in science. This has resulted in untapped possibilities for young people and for our environmental challenges. Ocean Discovery Institute is a San Diego-based organization, which was founded to directly address this need. We operate on a single premise: by receiving ocean science education, kids in poverty develop a passion for conservation, belief that science is something they can do, stay in school, go to college, and gain entry to fields where they make a difference. Our unique educational model provides continuous, tuition-free science education paired with mentoring and tools for success across one school-shed (are area where all of the young people flow from elementary schools into one high school) from pre-K to career. We rely on critical partnerships, including NOAA and the San Diego Unified School District to support these activities. Programs have resulted in (1) our in-school participants increase their science knowledge by 30%; (2) 75% of our after-school participants earn a college degree within six years; (3) 15,000 individuals have been mobilized to act for the benefit of our coastal environment. This unique approach and exceptional outcomes earned national recognition in 2010 when it was awarded The White House's Presidential Award for Science, Mathematics, and Engineering Mentoring. Our plan for growth will result in local scaling at our current site in San Diego growing from 6,000 to 10,000 students annually and national replication, beginning with Norfolk, Virginia.

"Ocean Gratitude: nourishing and restoring our relationship to the ocean as a solution to marine plastic pollution."

Emerson Wildbluesea,

ABSTRACT

Plastic pollution is to the present day what air pollution was to the 1960s: invisible, pervasive and largely misunderstood. Seeing earth's atmosphere as limitless and able to absorb whatever toxins were introduced led to substantial ecological disruption and damage. We are repeating the tragedy by seeing the ocean in the same way and allowing a consumer driven lifestyle influenced by planned obsolescence to thoughtlessly discard millions of tons of plastic, putting the entire marine ecosystem at risk. Research, policy and education address the problem, yet it continues to escalate. We investigated what might lead to a societal shift in behavior that would lessen the volume of plastic entering the North Atlantic. We suggest that when the problem is considered by understanding coasts and watersheds are a contiguous community, the dynamics of the issue are more evident. We proposed that by bringing people together at sites around the Atlantic Ocean through regular common activitiy designed to observe, care for and enjoy the coast with others and by sharing support in an online community that provides space to interact and collaborate, we might cultivate awareness leading to collective individual positive action. We developed and piloted an original program held quarterly around the North Atlantic led by trained site hosts combining a beach-cleanup, data collection on unique cards designed to record subjective impressions of the coast, pre/post cleanup survey and quantify common single-use items and a community building activity such as yoga, art, music, meditation or journaling. Preliminary results indicate this science-based Blue Mind approach of altruistic action, program continuity and restoring one's emotional connection the ocean and each other is more effective in changing behavior than traditional cleanup events.

"Participation of Student and Academic communities in Coastal clean up and Beach Sweeping programs along Arabian Sea in India ."

Chaudhari Kishinchand Chellaram College,

ABSTRACT

This presentation is based on the experiences in beaches sweeping and coastal clean up programs through student communities from Schools, colleges and University in Mumbai, Maharaashtra State in India.The city of Mumbai is termed as metropolitan city, as it is having population more than 18 million. The city of Mumbai is surrounded by the Arabian sea and number of rivers and estuaries along the coast of Arabian sea . The population of the Mumbai city poses serious threat to the coast and beaches as lot of waste is generated in city and some of the waste is dumped along coastal region .The sewage disposal in to the Arabian sea also increases the marine litter and formation debris. The schools, colleges and university students and academic communities are playing an important role in coastal and beaches clean up programs from time to time.The coastal clean up and Beach sweeping programs by students not only conserve the local environment but it also increase the tourism activities Along these coast and beaches .This presentation is based on my own experiences on coastal clean up and beach sweeping in Mumbai city from last 5 years.The presentation discusses the causes of marine litter and marine waste accumulation along the coast and beaches of Mumbai city, its effects on environment and local community. The presentation focuses on some successful examples of involving the students, school organizations and educational institutions in coastal clean up and beach sweeping program as well as it introduces the necessity for marine environmental awareness education from childhood. The presentation signifies need of providing tool box , source materials and equipping them for effective and efficient beach sweeping programs periodically .

"Role of active journalism in preventing marine debris generation in the Indian Ocean"

Gulati IANS news agency,

ABSTRACT

Role of active journalism in preventing marine debris generation in the Indian Ocean. With the widespread utilization of plastic, oceans have literally become a dumping ground for human waste -- a global problem. Plastic consistently represents the major category of marine debris in the Indian Ocean too, causing sever environmental problems that is impacting the marine-based economies also. Harmful effects of marine debris on aquatic wildlife can often be seen when mammals ingest and become tangled in debris, potentially leading to their mortality. While coastal areas, with their closeness to human population centers, have suffered disproportionately, marine sanctuaries that serve as breeding grounds or nurseries of several endangered species, including critically endangered sharks, have been witnessing alarming sea changes.

Marine debris is a threat to human health too. According to United Nations Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), 60 to 80 per cent of the global litter found in the coastal and marine ecosystems has originated from land and the rest from sea-based activities. Kenya-based marine litter expert with the UN environment programme Habib El-Habr has rightly remarked: "If we continue like this, by 2050, we will have more plastic in the ocean than fish."

Last month, Kenya enacted the world's toughest law aimed at reducing plastic pollution and made the sale or use of plastic bags subject to imprisonment of up to four years or fines of $40,000 (£31,000). In India, to really clean up the Indian Ocean, there is needed to focus to make the people aware to minimise and even stop producing debris. Ultimately, the problem with sea debris is not taking responsibility by the stakeholders.

"Secondary Student Designed Experiments on Marine Debris"

Applegate Palmer High Tech High,

ABSTRACT

Marine debris surveys have been used to strengthen high school students' connections to the environment, fostering a sense of ownership through immersion in nature and empowerment through student driven questions and task completion of research. In Kalle Applegate Palmer's classroom at High Tech High, marine debris surveys have been the focus of student led research projects two years in a row. Launched with a model survey, students conducted a small scale study that used the National Oceanic and Atmospheric Administration's accumulation survey protocol at a site along the San Diego Bay. Students were guided to document observations and reflect on the model including data collection and analysis procedures. Students then brainstormed questions that they could answer with the research protocol including: How effective are beach clean-ups? How can the arroyo habitat be surveyed for debris? How does the type and quantity of debris vary in upstream and downstream environments? Groups publicly proposed research to a panel of their peers, community stakeholders and local scientists before embarking on data collection. Student researchers analyzed their data, evaluated their methods and defended their findings. Findings were reported to project clients including the Tijuana River Estuarine Research Reserve. For the second year of this activity during the Fall of 2017, peer-led team learning was utilized with a returning student launching the model survey serving to further strengthen student ownership. This project allowed participants to bridge the gap between rhetoric and the reality of how environmental education may be applied, actively engaging students in the scientific process. Furthermore, research on this activity will be presented by K. Applegate Palmer and Rose of Sharon Wilson, the 12th grade student leader.

“Spring Break marine debris activities cover multiple generations”

Uibel National Marine Sanctuary Foundation at Florida Keys National Marine Sanctuary, Gena
Parsons National Marine Sanctuary Foundation in support of Florida Keys National Marine Sanctuary,

ABSTRACT

A multi-layered, multi-generational Alternative Spring Break program turned marine debris collection into a long-lasting learning experience to be shared with visitors to the Florida Keys. Led by staff from the Florida Keys National Marine Sanctuary, University of Florida students received classroom instruction on environmental issues before collecting and properly disposing of more than 2,500 pounds of marine debris, as well as finding and documenting a vessel for the Migrants and Refugees Escaping by Sea central repository. Sorted trash was then transformed into the Catch of the Day collaborative project for elementary school children during the Splash Trash Tour, a traveling arts-based, hands-on program focused on illustrating the anti-litter message. The result – a fishnet filled with plastics and other items harmful to sea creatures - hangs in the Sanctuary’s Eco-Discovery Center in Key West as a reminder to visitors of all ages about the need to be good environmental stewards.

"Students Talking Trash!"

Kinkade Falmouth Lawrence School, Kalea
Holdren Boulder Middle School, Ursula
Junker Falmouth Academy, Petra
Brienza Falmouth Academy, Sadie
Levegue Falmouth Academy,

ABSTRACT

Kids can make a powerful impact when they deliver important messages to adults and peers. We are a group of middle school students who decided to do something about plastics in our community of Falmouth, Massachusetts. So, we started a campaign to educate people about the damage plastic straws and other disposable plastics can do to our oceans and our earth, and encourage them to change their behavior to use less plastic. We think Falmouth, a coastal town with lots of scientific institutions, should be a leader in making our world a better place and an easy place to start is by reducing our use of straws and other single-use plastics.

We are working with schools to reduce their use of straws in the cafeterias, but also to get marine debris education into the classroom so other students know more about how their daily choices affect ocean health. We host local beach cleanups, and work with community organizations like Girl Scouts, Boy Scouts, and our local town government to help spread the word and encourage change. We've also started talking to restaurants about changing their policies on using straws and other single-use-plastics. We've even teamed up with the Sea Education Association (SEA) to collaborate with them on a tool box that helps their college students teach marine debris in their home towns.

We feel adults listen to kids who have strong messages to tell. Our poster will explain our activities in more detail.

"The Trash Free Waters Program: Integration and the Holistic Picture of the Trash Pollution Issue"

Maschal Oak Ride Associated Universities (ORAU),

ABSTRACT

How should one approach a puzzle? Study the picture on the box first, so the end goal is in mind? Group the pieces by characteristics so they are easier to apply when it's time? Build the framework edge or focus on the central image? The US EPA's Trash Free Waters Program (TFW) asks the same questions when tackling the problems related to marine litter and they use every technique to connect the pieces.

TFW started on the puzzle by building partnerships – at every level, on all sides, bottom-up and top-down, across-the-pond and in the backyard. From the Clean Water Act to the Resource Conservation and Recovery Act, there are many different federal laws that intersect through TFW projects. As a program, TFW is uniquely positioned to support projects like the Trash Free Trinity Adopt-A-Spot program that aligns aquatic trash prevention and stormwater management with community engagement, in an area upstream from a National Estuary Program location – Galveston Bay. This presentation will highlight how TFW stakeholders in the private sector, academia, other government agencies, and international communities as well as internal EPA programs have worked on various projects to prevent trash from entering waterways.

The Trash Free Waters Program uses a holistic approach for aquatic trash prevention and reduction. Each puzzle piece on the table has a place, but finding the right fit for a project takes attention which is why the Trash Free Waters Program supports research, education, and innovative strategies.

"Using Environmental Education as a Catalyst for Youth Activism around Plastic Pollution: A Case Study of the Plastic Pollution Education and Ocean Conservation Summer Camp"

Ambrose Bahamas Plastic Movement,

ABSTRACT

Understanding the detrimental role plastic plays in our marine and terrestrial ecosystems is extremely important to the alleviation of the problem. By conducting scientific research, we can quantify the extent of the issue universally. However, there are still major disconnects between science, education and communication as it relates to evoking unified change for plastic reduction at the global level. By building a community of inquiry-based education and environmental stewardship, Bahamas Plastic Movement provides accessible science opportunities for the next generation of environmental leaders. A fundamental program ran by the organization is the Plastic Pollution Education and Ocean Conservation Summer Camp. This intensive summer program takes students on a holistic journey from the problem with plastic to solutions to this environmental crisis. This camp, which is the first of its kind for The Bahamas, empowers students to become environmental leaders and tackle the issue of plastic pollution using a dynamic, creative and hands on approach. Our unique method of encompassing science, technology, engineering, art, math (STEAM) and community engagement translates a very real-world problem into tangible, realistic outcomes that youth can connect to and execute effectively. Grounded in plastic pollution threats facing our environment, this program is rooted deeper in the hopefulness that comes from engaging young people in environmental work. For the past 4 years, the Plastic Pollution Education and Ocean Conservation Camp has truly shifted the education paradigm and provided youth with the tools necessary to innovate realistic solutions to plastic pollution based on their culture and environment.

"Using Marine Debris and Microplastics Surveys to Engage and Educate the Public about an Important Global Challenge"

Sanders University of Georgia, Jay
Brandes Skidaway Institute of Oceanography,

ABSTRACT

Our research explores the distribution and accumulation rates of marine debris along barrier islands in Georgia and microplastics in coastal seawater, sediments and organisms. Articles about ocean trash have generated public interest in mitigating these impacts, but we need to bring that interest and passion home – thousands of kilograms of plastic blemish the coast and clean-up efforts remove only a fraction. Citizens poorly understand the importance of coastal systems, and the interconnections of water with land and living resources, yet this is where debris ends up. Accordingly, we have developed experiences to engage and educate the public about marine debris in the coastal zone. Participants move from awareness to understanding the human activities that affect marine debris and potential negative impacts in oceanic systems, to taking positive actions. Our programs are multifaceted. Surveys are conducted along shorelines and in salt marshes; participants collect marine debris within the survey site, sort, tally, weigh and record the items. Microplastics in coastal water are examined by using a simple isolation method, followed by visual identification and enumeration of microfibers and particles. Microplastics in sediments are surveyed by comparing sediments collected from an undeveloped and a developed island, using a density suspension separation method we developed. Our outreach efforts have educated thousands on the topic of marine debris and microplastics, engaged them in stewardship experiences, and removed debris and collected data on plastics at several survey sites. There is a critical synergy between scientific research and informal education and our citizen science-based programs incorporate useful and successful strategies that "equip the outreach toolbox" and connect citizens to the natural world.

"Youth Arts+Media for Plastic Free Waters - giving voice to urban youth of color with citizen science, civic action, arts and media"

Cohen Cafeteria Culture, Executive Director and Founder, Atsuko
Quirk Cafeteria Culture, Media and Program Director,

ABSTRACT

The YOUTH ARTS+MEDIA for PLASTIC FREE WATERS (YAM 4 PFW) program is a STEaM based school-community partnership and pilot program in low-income New York City communities of color. Students take the lead in their school neighborhoods to reduce single-use plastic litter at the source.

Since 2012, Cafeteria Culture, a non-profit environmental education organization, has been piloting plastic marine litter education in elementary and middle schools. Partner schools function as the project hub, where students serve as community leaders to engage neighbors, businesses, and government; conduct litter characterization studies and cleanups on local streets and beaches, contributing to urgently needed citywide data; survey microplastics; pilot and promote reward systems; and design creative messaging, including giant puppets, short videos, community presentations, performances, and social media campaigns.

By decoding the complexities of marine plastic and microplastics issues, these youth are contributing a powerful voice to the plastic-free movement, designing accessible narratives that are reaching new audiences and helping to inform plastic free policy from the ground up, including NYC's plastic bag fee and polystyrene ban bills.

The project videos are promoted locally and globally via CafCu's YouTube channel, CafCu Media, inspiring other low-income, public housing, and immigrant communities to replicate similar initiatives. Cafeteria Culture is currently compiling Plastic Free Waters lesson plans to share for free as part of our already existing SORT2save.org toolkit, which has previously focused on student leadership to achieve zero waste schools.

"A Case Study on the Viability of Moving the US Plastic Packaging Industry to Marine Degradable Polymers"

Kingsbury TKingsbury Consulting LLC,

ABSTRACT

Using the United States as a case study, the viability of moving the plastic packaging industry away from traditional polymers like polyethylene, polystyrene, PET and polypropylene to marine degradable plastics will be explored. included in the analysis will be the amounts of plastics used, top articles made, and the viability of switching to marine degradable alternatives like PHA. in addition the timeline for such a switch will be presented to understand the time and scale needed to bring alternatives to the market. Lastly, a cost comparison will be presented to show the economic viability of switching various percentages of the market.

"Application of Scoring Techniques to Determine Beach Debris Sources on Remote Open Ocean Areas"

Pieper University of the Azores, Linda
Amaral-Zettler Marine Biological Laboratory, Kara
Lavender Law Sea Education Association, Ana
Martins University of the Azores,
, Hawaii Wildlife Fund

ABSTRACT

About three-quarters off all Marine Debris (MD) consists of Plastic – a reflection of its worldwide use, production and waste mismanagement. The reduction of MD pollution in the Ocean and its elimination has been a widely discussed topic although, the lack of consistent scientific data precludes that effective measures to reduce plastic pollution can be implemented. The occurrence of MD in shorelines can have multiple sources; meaning that defining which source is the primary polluter can be quite complex. In this study we followed the recommendations proposed by the MSFD Technical Group on Marine Litter, and applied the Matrix Scoring Technique as an approach to consider the likelihoods of single debris items originating from a series of potential sources. Several factors were considered: identity and function of debris, the beaches location, influential activities, "mix" of debris found, presence of indicator-items, and quantity of MD. This method was applied on data collected from 2012 to 2017. The standing-stock (abundance and composition) of MD was investigated in two sandy beaches (Conceição - 38°32'35''N, 28°37'08''W; and Porto Pim - 38°31'29''N, 28°37'32''W) of the Azores Archipelago (NE Atlantic). The results of this study show promise towards the implementation of a new scoring technique to determine beach debris sources on remote open Ocean areas.

"Coordinating Efforts: Marine Debris Projects and Programs within the Florida Fish and Wildlife Conservation Commission"

McGee Florida Fish and Wildlife Conservation Commission-Division of Habitat and Species Conservation, Kent Smith Florida Fish and Wildlife Conservation Commission-Division of Habitat and Species Conservation, Tom Matthews Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute, Erin McDevitt Florida Fish and Wildlife Conservation Commission-Division of Habitat and Species Conservation, Gabrielle
Renchen Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute, Kyle Miller Florida Fish and Wildlife Conservation Commission-Division of Marine Fisheries Management, Pamela Gruver Florida Fish and Wildlife Conservation Commission-Division of Marine Fisheries Management, Elizabeth
Winchester Florida Fish and Wildlife Conservation Commission-Division of Marine Fisheries Management, Phil Horning Florida Fish and Wildlife Conservation Commission-Division of Law Enforcement, Gary Klein Florida Fish and Wildlife Conservation Commission-Division of Law Enforcement,

ABSTRACT

The Florida Fish and Wildlife Conservation Commission (FWC), the State's lead agency for managing fish and wildlife resources, is in the process of formalizing their marine debris management efforts beginning with the creation of a Marine Debris Team. This Team coordinates intra-agency efforts and marine debris projects with partner agencies, organizations, and stakeholders. A primary activity of the Team is facilitating implementation of the strategies identified in the Florida Marine Debris Reduction Guidance Plan (FMDRGP). Subject matter experts from multiple divisions within FWC served as co-leads for 4 of the 5 work groups. The development process for the FMDRGP made it clear that marine debris is a cross Divisional issue that requires extensive intra-agency coordination of efforts and resources. Florida is nationally recognized for its coastal and marine resources, resources increasingly harmed or degraded by marine debris. It has the 2nd largest coastline in the United States and much of the State's economy centers around the coastline and marine resources. FWC has constitutional authority to regulate and manage 133 federally listed species, many of which are impacted, or potentially impacted, by marine debris. In addition to these species, FWC serves to protect and manage more than 575 species of wildlife. Four (of 6) Divisions within FWC manage marine debris related projects and programs. This presentation will give an overview of these FWC led marine debris efforts such as those within the Florida Sea Turtle Stranding and Salvage Network and the Derelict Vessel, Trap Retrieval, Florida Manatee, and monofilament Recovery and Recycling Programs. These highlight the impacts to wildlife and habitats that FWC manages and emphasizes the importance of collaborative partnerships both within and outside the agency.

"Fishing for Litter - Norway"

Johnsen Salt Lofoten AS, Peter
Sundt Mepex Consulting AS, Rebecca
Bridies Mepex Consulting AS, Erlend
Standal Salt Lofoten AS,

ABSTRACT

On behalf of the Norwegian Environment Agency (NEA), SALT has developed and administered a two-year pilot scheme of "Fishing For Litter" in Norway. The pilot scheme is part of the Norwegian OSPAR cooperation, and the result of the scheme is reported to OSPAR. In 2016, more than 48 metric tons of marine debris was collected by voluntary fishing vessels and brought to shore in three participating harbours. The governmental funding of the pilot project was increased in 2017, resulting in an upscaling of the project. By the end of 2017, Fishing for Litter – Norway will include eight harbours and more than 40 participating vessels.

A permanent system of free delivery of marine debris for Norwegian fishing vessels are now under consideration by Norwegian authorities. SALT is in charge of providing knowledge of fisheries, waste management, harbours and infrastructure for this process, and for giving advice regarding the design of such a system. The work is carried out in cooperation with Mepex Consulting AS (Mepex). SALT also cooperate with Mepex on the development of a possible system of extended producer responsibility (EPR) for fishing gear and aquaculture equipment.

"From source to sea - a framework for marine litter management between government and NGOs in Taiwan"

Yen Greenpeace East Asia,
, Chemical Sciences Division, National Institute of Standards and Technology

ABSTRACT

The top items of marine litter pollution in Taiwan are PET bottles, straws, fishing gears, plastic cups and tableware, and plastic bags. The distribution of marine litter depends on geography, season, and current direction. The islands which locate off west Taiwan usually receive much more fishing gear and PET bottles from China, while other beach around Taiwan has more local items including styrofoam debris than foreign ones.

In order to effectively solve marine litter problem, key NGOs has formed an alliance in 2017 July and has started regular meeting with Environment Protection Agency to create an overall management framework for longterm governance of marine litter pollution. This is the first time that a platform established between government and NGOs to deal with environmental problem in Taiwan. We identify several goals such as reduction from source, monitor and research, effective cleaning, starting regional dialogue with other countries and education.

For reduction from source, we aim to reduce consumption of single use plastic items gradually by encouraging restaurants, cafeteria and night market to use reusable tableware, levy on single use tableware for take-away consumers, initiating and encouraging alternative for plastic bags and straws, setting water fountain as public service in urban cities, initiating buyback incentive for old fishing gears, etc. Some local corporations have already taken measures like not offering plastic bag (shopping bags) in supermarkets, reducing small package and replacing plastic bag with biodegradable or paper bags. We look forward to share the ongoing strategies for sustainable development.

"Governance solutions to the 'tragedy' of marine plastics"

Vince University of Tasmania, Britta Denise
Hardesty CSIRO, Peter
Stoett The University of Ontario Institute of Technology,

ABSTRACT

Marine plastic pollution has become the new millennium's tragedy of the ocean commons, a complex collective action problem with dire ecological and social consequences. There is long-standing acknowledgement of the difficulty in managing the commons, with regulation, economic and market based instruments, and community-based solutions all having a role to play. Environmental justice is also a key normative dimension to plastic governance since the exposure to accompanying risks is so often inversely related to production and consumption. We review the opportunities and disadvantages to current approaches to plastic governance at multiple scales. We discuss the role of infrastructure, entrepreneurship, legislation, public perception, environmental justice-oriented policies, and social license to operate (SLO) in managing and mitigating marine litter, arguing that while plastic pollution is a tragedy, it is not impossible to overcome. There are numerous opportunities for reducing plastic usage. We share stories of success from countries around the world and discuss the possibility of a global convention aimed at reducing the collective action problem dynamics inherent in this dilemma.

"Harnessing EPA's Statutes and Programs to Effectively Help Communities Address Aquatic Plastic Pollution in the U.S. and Beyond"

Martin US EPA R4,

ABSTRACT

EPA created the Trash Free Waters partnership based program to bring together the knowledge and experience of multiple environmental statutes and regulatory and non-regulatory tools needed to wield impactful regional level, national and international efforts towards addressing this complex issue arising from the connection of land to sea

What legal and policy tools exist to bring to an end the roughly eighty percent of marine debris results that results from trash flowing from 1) land to 2) rivers to 3) sea? The U.S. currently has statutes applicable to all of these three stages that can be used to prevent trash from becoming marine debris/litter. EPA has responsibility to implement programs under the following statutes to prevent and mitigate plastic pollution: Pollution Prevention Act, Clean Water Act, and Marine Protected Restoration and Sanctuaries Act. This talk will explore projects and programs under each Statute including examples across various regions of the U.S. and international examples. Topics may include (as time allows more in depth) a) 303 (d) trash listings, stormwater regulation and trash traps, b) the role of sustainable materials management and source reduction in preventing economic impacts marine debris, and c) current ocean dumping testing requirements and microplastics.

"Portuguese Partnership on Marine Litter – achievements and call for action"

Sobral APLM, Joao
Frias APLM, Patricia
Louro APLM,
, Social Science Research Institute of the University of Hawai'i at Mānoa

ABSTRACT

The 2012 Manila Declaration recognized marine litter as a global threat to coastal habitats and marine species, and gave the United Nations Environment Programme a strong mandate to continue working on this issue. The relevance of marine litter was also emphasized at the Fifth International Marine Debris Conference, as expressed in the Honolulu Commitment and the Honolulu Strategy.

Following the Manila Declaration recommendations, the Global Partnership on Marine Litter (GPML) was launched in June 2012, at Rio+20, Brazil. The main goal of the GPML is to protect human and environmental health by reducing and managing marine litter worldwide.

Since GPML was launched, it has strived to create regional, national and local partnerships that will pursue the same global goals. The Portuguese Marine Litter Association (APLM), created in November 2013, has been working to create the Portuguese Partnership on Marine Litter, and to create the basis to establish the Portuguese Speaking Countries Partnership on Marine Litter.

Public information sessions, presentations, awareness raising campaigns, volunteer cleanup actions, exhibitions and media communication are some of the many actions undertaken by APLM, to expand the issue of marine litter to civil society, governmental and private sector entities.

Over the last two years, APLM has been attending international stakeholder meeting with the Portuguese Speaking Country Community (CPLP), in order to bring marine litter as an environmental concern. So far, several workshops and events in Portugal, East Timor and São Tomé and Príncipe have been made to push forward the formal establishment and creation of these partnerships, focused on the UN Sustainable Development Goals.

"Sustainability of the solid waste management plan of the coastal municipality of Mata de São João, state of Bahia, Brazil"

Pereira Universidade Federal da Bahia, Carla
Elliff Universidade Federal da Bahia, Gerson
Fernandino Universidade Federal da Bahia,

ABSTRACT

Municipal solid waste has increased in volume all over the world. In developing countries in particular this may cause severe impacts to the environment and to public health. In Brazil, many municipalities present difficulties to sustainably manage their solid waste. The objective of the present study was to evaluate the quality of solid waste management in Mata de São João, Brazil. A sustainability indicator matrix for urban solid waste management was used, which was based on the five sustainability dimensions defined by the Brazilian National Policy on Solid Waste (NPSW). Results indicated that Mata de São João presents low municipal solid waste management sustainability due to: a lack of a Municipal Integrated Solid Waste Plan; absence of selective waste collection; economic insufficiency of the public cleaning service; environmental education restricted to tourist areas; absence of means for social control over public policies related to solid waste; and lack of a social inclusion program for the municipality's recyclable material collectors. Comparisons with reports of Brazilian federal agencies and research institutes indicated that the problems faced by Mata de São João regarding its adequacy to the NPSW are similar to those of other small municipalities in Brazil. The methodology used in the present study can be easily conducted by municipal technicians and managers who have access to information concerning this issue, and can also be used in other Brazilian municipalities.

“All Hands on Deck! Monitoring stranded plastic marine debris on Bermuda's beaches”

Hyde Keep Bermuda Beautiful, Struan R.
Smith Bermuda Aquarium Museum and Zoo, J.P.
Skinner Bermuda Institute of Ocean Sciences, Kaitlin
Baird Bermuda Institute of Ocean Sciences, Kyla
Smith Bermuda Institute of Ocean Sciences, Vanese S.
Flood Ministry of Works & Engineering, Bermuda Government, Amy
Harvey Bermuda College, Judith
Landsberg Greenrock Bermuda, Jennifer
Gray Bermuda National Trust, Dorte
Horsfield Bermuda National Trust,

ABSTRACT

Bermuda lies on the western boundary of the Sargasso Sea and is inundated with marine debris from the North Atlantic Gyre. A visit by the 5 Gyres team in 2010 stimulated the formation of the Bermuda Marine Debris Task Force which initiated a monitoring program on six exposed beaches. An awareness campaign was developed to encourage students and citizens to participate in the beach surveys. A total of 82 surveys were conducted on the six beaches from 2010-2015. A total of 931 participants in 5 citizen science teams and 77 school and college groups conducted the surveys. The surveys were done with three 1 x 25m transects randomly laid along the most recent high tide line on each sampling date. Visible plastic marine debris greater than 1x1 mm in size was collected. The quantity of plastic debris stranding on the beaches was variable over time but 36% of the samples had mean weights of plastic debris between 0.1 and 1g m-2, 45% of the surveys found from 1.1 to 10g m-2 and 15 percent of the samples exceeded 10.1g per m-2. Analyses of plastic debris from Elbow Beach determined that about 10% of the debris, by mass, was between 1 mm2 and 22.5 mm2 (4.75 x 4.75 mm, Tyler Mesh #4) in size, ~65% of the debris was in the 22.5 mm2 to 400 cm2 (20 x 20 cm) size class and ~15% were in the >400 cm2 size class. But numerically ~52% of the particles were between 1 mm2 – 22.5 mm2 in size, ~47% were in the 22.5 mm2 to 400 cm2 size class and <1% were larger than the 400 cm2 size class.

"American River Basin Debris Can But Shouldn't Migrate 100 Miles to the Sea - Salmon Should"

Flowers Valley Foothill Watersheds Collaborative, Tim
Vendlinski Urban Creek Advocate, Alta
Tura Sacramento Area Creeks Council, Aaron
Haiman Sacramento-San Joaquin Delta Conservancy,

ABSTRACT

This session will provide examples of how to use Citizen Science and connect inland communities to the concept that they are a source of marine debris. NGOs, educators, and local government representatives will learn about how citizen monitoring projects implemented in

the inland communities of the American River Basin, through cleanup events using Kobo Toolbox, Adopt-a-Creek Programs and the Arcade Creek Project in the IB program at Mira Loma High School, can be used to assist with outreach for compliance with trash TMDL regulations the are part of the 2015 California Ocean Plan.

Since the early 1990's community members with support from local government waste management and storm water programs as well as water agencies have completed restoration projects for better water quality, salmon spawning habitat and riparian habitat that have a trash and debris removal component. Recently the non-profit sector has obtained grants to promote and develop Citizen Science activities for water monitoring including trash data collection.

Partners with the Valley Foothill Watersheds Collaborative are providing unified messaging for creek watershed health and collecting litter and trash data to support future storm water resource management plan development. Examples are: 1) Community participation in the 27th Annual Sacramento Area Creek Council's CREEK WEEK where over 1,700 people at 80+ sites collect litter and debris in the creeks of Sacramento County 2) Train volunteers to use a web based platform, Kobo Toolbox, for ongoing litter/marine debris data collection at selected sites 3) Formalize the training and recruitment of volunteers for the local Adopt-A-Creek programs 4) Encourage student leadership to protect the environment one creek at a time and share their information in new and innovative ways.

"Assessment and Monitoring of Plastics and Microplastics in the Ocean: Supporting a Harmonised Approach"

Galgani IFREMER,

ABSTRACT

Concern about the quantity of plastic debris in the ocean has grown rapidly in recent years, in terms of governance and policy, the private sector, environmental NGOs, special interest groups, the media and amongst the scientific community. In response, GESAMP WG40 undertook an initial assessment of 'Sources, fate and effects of microplastics in the marine environment – a global assessment', published in 2015. A second phase assessment was initiated with an updated set of results published in in 2016, contributing to a wider study of marine marine litter, presented at the Second UN Environment Assembly (UNEA-2, April 2016). During the 43rd Session of GESAMP (Nairobi, 2016) it was agreed that the working group should conduct a third phase, re-focussing on three revised Terms of Reference : 1 sampling methodologies, 2 the impacts of nanoplastics, and 3 plastics as a vector for organisms, with first priority given to ToR 1. The objectives for ToR 1 are to develop guidelines for the assessment and monitoring of plastics and microplastics in the oceans, in order to better support a harmonised approach, a step towards global monitoring of the world ocean. Considering marine litter as a global issue, it will review the existing initiatives and actions plans, provide advice and practical guidance on setting up a monitoring and assessment programme for marine plastics and microplastics, including: i) the basic principles of monitoring and assessment; ii) monitoring methods, including recommended sampling protocols; iii) methodologies for physical and chemical identification of items and analysis of polymers; iv) requirements for monitoring and assessment, including strategies, harmonisation, data quality and management; and, v) propose future developments and recommendations. More generally, the work will support to the develo

“Balloon Litter Monitoring on Virginia’s Remote Beaches: Surprising Results and Next Steps”

Trapani Clean Virginia Waterways, Kathy
O'Hara Clean Virginia Waterways, Katie
Register Clean Virginia Waterways,

ABSTRACT

In 2011, staff from Clean Virginia Waterways and the Virginia Aquarium created a website for citizen scientists to report balloon-related litter in Virginia. In 2013, as data from this effort began to accumulate, researchers O’Hara and Trapani embarked on a project to collect detailed documentation of balloon-related litter on Virginia’s more remote beaches, virtually inaccessible to the general public. Five survey locations were chosen for their proximity to each other (a somewhat even sampling of the state’s coastline) and accessibility. Protocols were developed to provide detailed information on numerous parameters including type of balloon (foil, latex, only ribbon, or weather balloon), condition (burst, deflated, nub or piece), color, shape, size, occasion and promotional markings, ribbons and other attachments, beach location (high, mid or low) and other unique findings. GPS coordinates and images were taken prior to removal and all balloon litter was collected and archived.

Data compiled from 43 surveys conducted from 2013-2017 showed more than 5,400 pieces of balloon-related litter collected. Preliminary analysis shows latex balloons comprise the majority of balloon findings overall (47%) followed by foil (36%) and ribbons only (17%). Most latex balloons were in the burst condition (49%) whereas foil balloons were mostly deflated (72%). More than 450 balloons were imprinted with messages indicative of special occasions and company logos. As analyses continues it will be interesting to see whether there are obvious differences among these parameters between sites.

These are the type of results that will be used as one indicator of the success of a Community-Based Social Marketing project targeting balloon releases currently taking place in Virginia as well as for educating the public.

"Bridging community work and academia"

Royer Daniel K. Inouye Center for Microbial Oceanography: Research and Education, University of Hawaii at Manoa,, Mugdha
Flores Sustainable Coastlines, Hawaii, Katie
Ziemann Sustainable Coastlines Hawaii, Kahi
Pacarro Sustainable Coastlines Hawaii,

ABSTRACT

Although the Hawaiian Islands are small and remote, their location in the Pacific results in high amounts of marine debris found on beaches and in surrounding waters. Marine debris travels significant distance from the edges of the Pacific Rim before reaching the coastlines of Hawaii. Thankfully, numerous organizations to bring people together to clean beaches and reefs; however, their mission can only succeed if combined with prevention based on educational outreach, laws, and best business practices. Ultimately, fundamental research on the dynamics and impacts of marine debris is necessary to ensure that measures are adequate and efficient. Sustainable Coastlines Hawaii (SCH) has been very successful in organizing and utilizing beach cleanups, educational programs, social media to inspire better consumer behaviors and continued coastal stewardship. SCH gathered an impressive data collection since 2011 that can be used by the scientific community to assess the impact of marine debris in Hawaii. SCH executed 87 beach cleanups on 6 Hawaiian Islands and the Papahanaumokuakea Marine National monument accounting for the removal of 308,638 lbs of marine debris. Since 2017, SCH developed a partnership with International Volunteer Head Quarter , where volunteers visit Hawaii to learn about plastic pollution, its implications and participate in data collection. Volunteers are part of a survey where they track the abundance of nurdles on Kahuku and Kailua beaches to assess weekly changes across locations and seasons. The results show the presence of nurdles at both locations, across time, indicating a constant input from non-local sources. Through beach-cleanups and nurdle surveys, SCH has engaged local and international volunteers to gather scientific data on marine debris, to ultimately change policy and consumer behaviors.

“Community Driven Micro Clean Ups: Small Scale but Big Impact”

Silverwood Take 3, Scott
Wilson Macquarie University,

ABSTRACT

Every day, tens of thousands of people across the world pick up litter and marine debris from the environment through so-called ‘micro clean ups’. What if ‘citizen science’ captured data from such actions could enable communities and stakeholders to increase our understanding of litter/ debris, support policy/ decision-making and provide evidence of impact & change? The individuals/groups that undertake small-scale ‘micro clean-ups’ and casual clean-up actions do so under their own volition. Rarely, if at all, is data on the material collected or the amount of effort (hours spent doing these actions), captured.

In 2017, ‘Take 3 for the Sea’ initiated a social media campaign called ‘Pick it up, Snap it, Share it’ (https://www.facebook.com/groups/take3forthesea/) to encourage people doing these micro-clean-ups to take photographs and submit them for more detailed analysis. The campaign leveraged off Take 3’s large and committed audience of 50k+ social media followers and proven success in engaging communities in ‘micro clean up’ activities. Over 1600 images from the larger pool of submissions were viewed and put through a quality assurance/quality control analysis. Of those only 500 images could be definitively assessed and from this over 10,000 litter items and a variety of types, locations and collection efforts were identified. This approach and the associated analysis of the photographs demonstrated a novel and standardised way of collecting and reporting on these informal ‘micro clean-ups’. A description of the approach and implications for enabling future citizen science outcomes will be discussed.

"Engaging citizen scientists to assess large scale microplastic distributions"

Sparks Mississippi State University Coastal Research and Extension Center, Amanda
Sartain Mississippi State University Coastal Research and Extension Center, Caitlin
Wessel Dauphin Island Sea Lab,

ABSTRACT

Marine debris is a global issue that significantly impacts aquatic environments. The most prevalent type of marine debris is microplastics, which is ubiquitous in marine, estuarine, and freshwater systems. Microplastics have become an emerging research topic and contaminant of concern due to their prevalence and potential impacts on aquatic and marine life. However, few education, outreach, and research projects address marine debris, specifically microplastics, and public perception of debris issues has remained relatively unchanged. To better understand microplastic distributions and increase awareness of this issue, we are conducting a citizen science based microplastic sampling project across the US Gulf of Mexico coast. We have created a microplastic sampling guidebook and instructional videos for collecting and processing microplastics. These educational products were used for in-person trainings of thirteen organizations, ranging from Corpus Christi, TX to Key Largo, FL, that are collaborating on this project. Each partner organization has trained local citizen scientists to collect and process beach and water samples for microplastics in their respective area. Information collected by each citizen scientist includes: sample location, number of microplastics per volume or area, and type of microplastics (fibers, fragments, film, or beads). All partners and associated citizen scientists will collect microplastic samples in September and October 2018 and 2019. Once annual data has been processed, US Gulf-wide microplastic distribution maps will be created and made open access. This project will inevitably increase awareness of microplastic issues by connecting with and involving the public in a citizen science based monitoring project and developing educational materials.

"EPA's Standard Trash Assessment Method – unleashed!"

McCauley U.S. Environmental Protection Agency, Sydney
Barnes-Grant University of Washington, Seattle, Sydney
Harris ,

ABSTRACT

How do I know whether my community has more litter than yours? How do we understand how trash gets carried from inland waters to the ocean? Where are the sources of particularly high risk trash, for both humans and aquatic life?

EPA representatives from across the U.S. have been working on a standardized assessment protocol to monitor trash larger than 5 millimeters (not microplastics). The protocol can be used in any environment from city streets to riverbanks to outer coasts. It is informed by numerous site specific protocols, such as the Urban Rapid Trash Assessment, the NOAA shoreline monitoring program, and other citizen science programs. The talk will describe how our new protocol is both risk-based and set up to produce data that will align well with municipal solid waste characterizations, which can be used for upstream pollution prevention.

EPA has been testing the protocol with citizen science groups and is pleased to be ready to release it for wider use at the 6th IMDC. The goal for the protocol will be that data generated is replicable, consistent, and able to be used to inform water quality listings and local-level pollution prevention plans in partnership with businesses and other community organizations.

“Fishing4Plastic Tournaments to Quantify Floating Marine Macro Litter”

Monteleone The Plastic Ocean Project, Inc., Tammy
Bleier University of North Carolina Wilmington, Erin
Cummings University of North Carolina Wilmington, Lisa
Rider Onslow County Solid Waste Department,

ABSTRACT

Floating Marine Macro Litter is one of the more challenging to recover and often times becomes substrate habitat for marine life. For this reason, charter fishers look for natural debris e.g. Sargassum, an essential fish habitat, or manmade debris e.g. floating plastics, to find fish. June 3, 2107, Plastic Ocean Project organized the first ever Fishing4Plastic Tournament off the coast of Beaufort, NC, (a region known for accumulating windrows of Sargassum) as a public outreach and citizen science activity recruiting charter fishers along with community members to collectively reduce marine debris (not fish) from the ocean in a tournament spirited setting. This mutual participation increases awareness and prevention of marine debris by educating participants that (1) the debris collected can be linked to both the general population (e.g., plastic bottles, balloons, and wrappers) as well as the charter, commercial, and recreational fishing communities (e.g., bait containers, nets, and fishing line) (2) hand-netting debris from the ocean is much more difficult than picking it up on land, emphasizing the importance of reducing use and properly disposing of trash (3) the data can be quantified using the NOAA Marine Debris Tracker as well as with NOAA Marine Debris Shoreline Survey Field Guide data sheets and provide publishable citizen science data, and (4) the tournament style cleanups can be replicated around the globe and be incorporated into fishing tournaments as another prize competition. Winning teams are awarded quality prizes. This activity engages the community and the fishing industry to work together, building relationships and trust – and providing the participating fishers with an additional source of revenue.

"Florida Microplastic Awareness Project: using citizen science to inspire behavior change"

McGuire University of Florida/FL Sea Grant,

ABSTRACT

The Florida Microplastic Awareness Project (FMAP) was created in 2015 with support from a NOAA Marine Debris Program Outreach and Education grant. Floridians were aware of the Great Pacific Garbage Patch, but did not necessarily see a connection between it and their activities. FMAP trains citizen scientists to sample and analyze local waters for the presence of microplastics. Since September 2015, the volunteer effort has allowed the collection and analysis of over 1,200 samples from more than 420 locations around the state. Data from the project are used in a larger outreach effort which encourages people to take a pledge containing 8 actions they can do to reduce their plastic waste production. More than 1,500 people have completed the FMAP pledge. On average, people pledged to make about 3.5 behavior changes (they report already taking an average of 4 of the suggested actions). In follow-up surveys received from over 135 pledge-takers, people reported on average having made more than three behavior changes. 85% reported having shared information about microplastics with others. FMAP has grown since its inception, both within Florida and throughout the Gulf of Mexico.

"From Land to Sea - Model for the documentation of land-sourced plastic litter"

Cieplik BKV GmbH,
, Bermuda National Trust

ABSTRACT

A quantitative model for the estimation of total amounts of land-sourced plastics litter entering the sea has been developed. It is the first methodical approach to systematically document, structure and quantitatively evaluate the main discharge pathways and sources. The total amounts of plastics litter are split into the pathways/sources contributing (rivers, river navigation, coastlines, ports, landfills) and into particle size (micro vs. macro plastics).

The model is fed by available data and best estimates in case of insufficient data bases. It can continuously be complemented by newer or more reliable data. To model the loss of load during the transport, factors are introduced which consider transport losses for the mentioned pathways, socio-economic aspects etc. The used factors and the basic assumptions are continuously verified and further developed.

Due to the fact that the quality and quantity of the available data vary considerably between the studied areas of micro- and macroplastics, the data situation is assessed. The determined absolute discharge quantities should be regarded as an estimate based on the current knowledge and expert talks. Due to the dynamic character of the model and the many different variables, a sensitivity analysis has been carried out in order to investigate the influence of changes in input parameters on the final result. It shows that the difference between the minimum and maximum discharge are in a reasonable range.

The model can be applied to any sea or region worldwide. The prototype model has been developed for the plastics litter inputs of Germany into the North Sea. In 2018, an overall picture of the inputs of Germany into the North Sea, the Baltic Sea and the Black Sea will be available. Free of charge: Report and handbook (German/English) at http://www.bkv-gmbh.de.

"Global plastic waste input to the ocean from inland, coastal and marine sources"

Kefela University of California, Santa Barbara, William
Burke University of California, Santa Barbara, Jessica
Couture University of California, Santa Barbara, Violaine
Desgens-Martin University of California, Santa Barbara, Patrick
Hunnicutt University of California, Santa Barbara, Niklas
Griessbaum University of California, Santa Barbara, Julia
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Lépessier University of California, Santa Barbara, Laura
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Geyer University of California, Santa Barbara,

ABSTRACT

A critically important part of addressing the problems caused by plastic marine debris is to have a robust understanding of all types of sources and their magnitudes. Despite receiving widespread attention in academic and policy communities, the total annual flow of plastic debris to the ocean remains uncertain. There is a recent peer-reviewed study (Jambeck et al. 2015) that estimated the mass of land-based plastic waste entering the ocean , and a consultancy report providing an estimate of the total inputs. However, a robust, peer-reviewed assessment of global flows from terrestrial and marine sources is still absent from the literature. We attempt to address this lacunae, using source-specific methods to include unstudied sources and improve upon unverifiable estimates found in the "grey" literature. One of the unexplored sources of global plastic flows are tsunamis. Our preliminary finding is that their average annual contribution is around 2.4 million metric tons. We also develop new -- and refine existing -- estimation strategies and leverage new and robust data. One important example are land-based textile microfiber inputs. Our preliminary finding for this source is an estimated annual input of 0.4 million metric tons. Detailed and robust assessments of all global plastic flows into the ocean are critical to better understand environmental impacts of marine plastic debris and develop effective mechanisms for the regulation and management of plastic waste and plastic marine debris.

Citation:

Jambeck et al. (2015) Plastic waste inputs from land into the ocean. Science, 6223:768-771.

"Governess initiated by general public in minimising land based marine debris from thirteen islands of Cochin Backwater, Arabian Sea"

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ABSTRACT

Cochin Backwater, a part of the Vembanad Lake, the largest coastal lake along west coast of India is under stress from hectic activities of urbanization. Shakti ,a science based women NGO in association with the Department of Economics , St Tresas College, conducted a survey during 2016-'2017 on waste disposal methods in selected wards of " Kadamakkudy Grama Panchayat" consisting of 14 islands. The villagers of the islands are practicing traditional fishery and Pokkali paddy cum prawn cultivation. The feedback we received indicated that waste is not a problem since they could dump everything in the surrounding waters. It is observed that Plastic contributed 80- 90 % of the non- biodegradable waste namely tyres, plastic sacs ,thermocol, footwear, toys , and ghost nets which accumulated in the open ground and the canals. Seventy seven percentage of homesteads burn the plastics and the innumerable plastic carry bags are dispersed everywhere and finally seen in the edges of water bodies. During monsoons everything is flushed out into Cochin Backwater and the coastal waters of Arabian Sea . Kripa et al,2016; and Saha, 2017 reported the loss of biodiversity and the reduction in fishery in the Arabian Sea. As an NGO addressing issues in coastal environment we explained that Plastic has formed a thick bed in the bottom causing ecological degradation affecting benthic resource. Prawns and the and the fish, pearl spot, the delicacy of Kerala and the marine biodiversity are at loss. The public is aware of the decreasing trend in number and quantity of fishes caught by them. We learned that the fishermen are elusive to government rules. Through our intervention they realized the gravity of the problem. They were advised to keep the damaged nets and plastic materials at their residence and hand over to agency doing recycling. A re-visit after one year showed that the inside canals and the boat jetties are mostly devoid of plastics.

"Importance of local source versus long-range transport of marine litter in Arctic Greenland"

Strand Aarhus University, Marine
Cusa Aarhus University, Robin
Lenz Aarhus University, Lis
Bach Aarhus University,

ABSTRACT

Marine litter pollution in the ocean has today also found its way in the Arctic marine environment. Adding on to the potential long-range transport of especially plastic debris into the Arctic region, the local sources can also be significant. Survey data from 2016-2017 suggests that the occurrence of relatively high amounts as well as the composition of beach litter in West Greenland relate more to local sources than in East Greenland, where the litter dominantly originates from sea-based activities and potential long-range transport. Studies on ingestion of plastic particles by the northern fulmar (Fulmarus glacialis) from West Greenland collected in year 2000 and 2016 find that the plastic particles are dominated by polymers (identified with FT-IR) with densities < 1 g cm-3 supporting that the main contribution originates from floating plastics. 35 % of the birds from 2016 contained more than 0.1 g plastic in their stomachs indicating that seabirds in West Greenland are more impacted by plastic debris than other studied fulmar populations in the Arctic. The data established here for beach litter and fulmars can potentially be used as input for defining baseline levels used for future spatial and temporal trend assessments in the region.

"Innovating Marine Debris Research for Citizen Scientists: Considering the End User During the Development of New Technology"

Ball Arizona State University,

ABSTRACT

This abstract is intended to address the needs of marine debris research. Current methods limit our ability to research coastal zones and engage stakeholders, such as citizen scientists, in the issue. Innovative methodology and new technology will increase our research capabilities. Methods for creating effective technology for citizen scientists are discussed in this abstract. The author presents a case study of m-PARR. m-PARR is a new instrument still in the prototype stage which has been designed for sampling micro-plastics in coastal zones and engaging citizen scientists.

"Interactions between marine debris and brown boobies (Sula leucogaster) and masked boobies (Sula dactylatra) on Clipperton Atoll"

Sorce Harvard University, Sean
Rothwell New England Aquarium,
, University of California, Santa Barbara

ABSTRACT

Clipperton Atoll, is a small, isolated atoll in the Pacific Ocean, 768 nautical miles south of Cabos San Lucas, Mexico. Clipperton is home to the one of the largest colonies of Masked boobies in the world, with a population recently estimated at 110,000 birds. In May, 2017, I traveled to this atoll to conduct the first quantitative marine debris survey to be done on Clipperton.

In addition to this marine debris survey, the interaction between plastics and the large Booby population was also a topic of interest. There have been many observations of birds using human trash as nesting material, as well as possible mate attractants. After observing and documenting dozens of nests on Clipperton, plastics were found in many of the nest structures, not only as practical construction materials, but also in what appear to be aesthetic decisions. Several nests documented, included monochromatic color schemes, most commonly incorporated plastics were shades of bright blue.

To get a sense of whether or not plastic has made its way into the Clipperton birds' diets, I opened up the stomachs of 33 deceased birds, found on different parts of the island. Of the stomach and throat cavities examined, only one bird contained visible plastic.

Due to the high volume of plastic debris on Clipperton Atoll, and other studies done on birds living in similar conditions, it was somewhat shocking that more of the deceased birds examined did not contain visible plastic. One possible explanation could have to do with the healthy fish populations found around Clipperton Atoll. This, combined with the Boobies' highly developed eyesight and plunge-dive feeding technique, could result in a decreased likelihood of mistaking plastic as a food source, and explain why only one bird sampled had plastic in its stomach.

"Is crumb rubber used on artificial turf pitches a source for marine plastic litter? How to get children involved in crowd science"

Herzke Norwegian Institute for Air Research, Claudia
Halsband Akvaplan Niva, Booth
Andy SINTEF,

ABSTRACT

In Norwegian coastal communities, rubber microplastic granules (≤ 5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the composition, degradation and environmental impacts of these rubber granules from locations in northern Norway and Svalbard. Plastic litter is an important environmental problem, posing a risk for the health of marine ecosystems and human populations relying on marine resources. At present, many tons of rubber particles reach the marine environment via runoff from land to the sea, and may be further transport northwards with ocean currents. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wild life through direct ingestion, especially at the base of the marine food chain (Cole et al., 2013; Booth et al. 2016), but may also provide an exposure route for toxic additive chemicals present in tires to marine organisms (Herzke et al., 2015).

Pupils of all ages participated in a 4 week research campaign, designed and facilitated by the authors together with the Norwegian Research Council and Miljolærer. Pupils were tasked to identify and report artificial turf pitches, record the amount of rubber granule collected on clothing during a game as well as recording the type of rubber granules used at the pitches. So far more than 6500 children and youth have participated (September 2017) in more than 300 games on 264 pitches. Results will be presented under the conference.

"JRC LITTERCAM for Monitoring of riverine floating macro litter"

Hanke European Commission Joint Research Centre, Fausto
Bonavitacola , Daniel
Gonzalez European Commission Joint Research Centre,

ABSTRACT

The quantification of macro litter floating at sea and in rivers is challenging, due to the need for long term observations in order to cope with temporal variability and environmental conditions. Visual monitoring by human observers can only be done for limited time periods and a physical collection of riverine litter in most cases is not possible. There is need for methodologies that provide unbiased documentation and results comparability in order to derive litter flux data from rivers to the seas. Within the JRC exploratory project RIMMEL (RIverine and Marine floating macro litter monitoring and Modelling of Environmental Loading) an autonomous system for the monitoring of floating macro litter in rivers has been developed. The system consists of an industrial high resolution (25 Megapixel) CMOS camera with a computer system for management and data storage, linked to an environmental sensor array. Image recognition software with a specifically developed ruleset provides for multistep identification of floating objects. Image acquisition speed is typical ca. 1 image/second, so that weeklong deployments are possible. The presentation provides the system set-up and its test application on different bridges.

"LITTERBASE: An Online Portal for the Distribution of Marine Litter and Microplastics and Their Implications for Marine Life"

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ABSTRACT

Contamination of the oceans with anthropogenic litter is a global environmental problem which currently receives increasing attention by scientists, policy makers, public authorities, media and the general public. Although research efforts have been intensified, they often do not provide stakeholders with easily understandable information about the dimensions and the extent of the problem. We have developed an online portal to provide easily digestible and continuously updated information on marine litter and microplastics to stakeholders based on scientific literature on a global scale. LITTERBASE gives insight about the distribution of marine litter and its effects on marine biota. Data from 1,420 scientific studies (status 09/10/2017) have been compiled into global maps and real-time graphs to make scientific knowledge accessible to the public. Bibliometric data of all publications were entered, as were metadata pertaining to litter type, litter size, litter quantity unit, aquatic system, biome and total litter quantity. Litter quantities were standardised to the most frequently used units to achieve comparability. Data on biological interactions with litter were also extracted: location of field records, number of species affected, percentage of individuals affected, type of interaction, effects on biota, litter type, litter size, aquatic system and biome. Currently, 1,441 species (status 09/10/2017) have been found to interact with marine litter resulting in mortality in almost 20% of the cases. Web statistics reveal that the information displayed in the LITTERBASE online portal is continuously being retrieved by users from all over the world.

"Macro and microdebris in marine mammals from Ireland: promoting standarization of protocols and research on top predators"

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Hernandez-Milian University College Cork, Simon
Berrow Galway-Mayo Institute of Technology, Emer
Rogan University College Cork, Ian
O'Connor Galway- Mayo Institute of Technology,

ABSTRACT

Mammals have been suggested as suitable monitoring species for pollution research and harmful effects from marine debris have been detected; microplastics have emerged as an additional threat. It is therefore necessary to develop protocols which are suitable for research groups with lower economic resources.

Digestive tracts of cetaceans and seals stranded and bycaught in Irish territory were investigated for marine debris from 1990 to 2016 (n=435). A particular focus was paid to microplastics between 2009 and 2015 (n=44). Each stomach chamber was individually dissected and intestines divided into 20 equal pieces, compartments were subsequently rinsed with prefiltered water and digested using a solution of 10% KOH, and filtered.

Nineteen species of marine mammal stranded within the study period (n = 2,936), and 241 presented signs of possible entanglement or interaction with fisheries. In addition, 325 marine mammals were recovered from fisheries activities. 528 digestive tracts were analysed, 12% contained marine debris. Macrodebris was detected in 23 marine mammals while 44 presented microplastics. Several different types of macrodebris were identified, with a 40% of them related to fisheries activities. Microplastics were detected in all animals studied. No significant relationship was found between incidence of marine litter and presence of food or ecological habitat, although higher incidence of macrodebris was detected in deep diving species. Most microplastic were blue/black/grey fibers (85%; mean length 28 mm). Further research of debris implications is required to understand the effects of these pollutants in marine food webs.

"Marine Debris in New Zealand"

van Gool University of Waikato,

ABSTRACT

All of the ocean's surface waters, coastlines and seabeds contain anthropogenic litter, including high levels of litter found in the ice of poles, and on remote islands. The world's five main gyres and coastal zones are known collection points for litter. Global patterns of currents and prevailing winds can deposit marine debris far from where it entered the ocean. However, the problem of marine debris has received very little scientific attention in New Zealand, an OECD island nation in the Southern Hemisphere. The Ministry for the Environment (MfE) and Statistics New Zealand have identified that the lack of national data hampers the development and implementation of policy, measures, and tools to mitigate this issue. Furthermore, MfE and the Department of Conservation (DoC) recently published their science research priorities for the coming five years (2017-2021), calling for, amongst others, monitoring tools for the marine environment.

The aim of this research is to set a sound scientific baseline for a national marine debris survey. This will facilitate detection of potential regional differences, national comparisons, and an effective baseline against which to measure or evaluate (future) management or policy changes. This research will also enable follow-on research in fields such as microplastic research, invasive species, environmental planning, environmental, ocean and coastal policy development.

The research questions address the effects of population density and local waste management strategies. In addition this research will examine the effects of hardened coast lines on local marine debris distribution.

"Marine Debris Sensing with RapidScat and GPM"

Burgin NASA Jet Propulsion Laboratory, Razi
Ahmed NASA Jet Propulsion Laboratory, Jan-Willem
De Bleser NASA Jet Propulsion Laboratory,

ABSTRACT

Marine debris is defined as manufactured or processed solid material that finds its way into the marine environment or the Great Lakes. Winds and ocean currents carry floatable marine debris over long distances and rotating ocean currents called "gyres" trap it in accumulation zones. These gyres collect debris near their center, but because gyres are dynamic systems, a gyre's exact size is difficult to measure. It is estimated that the North Pacific Subtropical Gyre is 7 to 9 million square miles in size. It is hence crucial to monitor and identify these dynamic and seasonally changing accumulation zones to allow timely marine debris removal.

In this study, we analyze data from RapidScat and the Global Precipitation Measurement (GPM) mission to assess if and what kind of marine debris can be observed with Ku-/Ka-band radars from space. RapidScat is a Ku-band radar providing dual-swath radar data from October 3, 2014 to August 19, 2016 at a spatial resolution of 7 km x 25 km. GPM was launched on February 27, 2014, and carries a Ku-/Ka-band radar with a spatial resolution of 5 km. A detailed analysis of the sensitivity of Ku-/Ka-band radar data to marine debris will be discussed at the talk.

The research described in this paper is supported by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

"Marine litter trends of beaches with different human-induced pressures on the European Atlantic coast (Portugal)"

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Vaz ECOGESTUS Lda, Waste Management Consulting, Figueira da Foz, Portugal., Paula
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Marques 1 MARE – Marine and Environmental Sciences Centre, Faculdade de Ciências e Tecnologia, Universidade de Coimbra, 3004-517 Coimbra, Portugal,

ABSTRACT

Marine litter on sandy beaches is an issue of major current concern due to its ecological and economic impacts. Yet our understanding of the distribution and composition of beach litter and the drivers of these variation are still limited and constitute an important way to inform the local authorities to develop policy strategies to address the problem of marine litter on coastal areas. In this study, the abundance, weight and composition of marine debris were determined in four beaches with different human-induced pressures in the European Atlantic coast (Portugal). Sampling followed the OPAR recommendations and was performed in 4 beaches with different anthropogenic uses (industrial, urban, peri-urban and rural beaches) during winter 2016 and summer of 2017. So far, a total of 6408 items were characterized, with significant differences according to beach type and season. The "urban beach" registered the highest number of marine litter items (90% plastics), followed by the "industrial beach", the peri-urban beach and the beach with less number of marine debris was the remote, non-habited beach.

This baseline results suggest that seasonal variations as well as urbanization of the coastline and beach users behaviour are the major factors influencing the levels of marine litter.

These results enhance the idea that urban areas are the main drivers for the occurrence of marine litter in this coastal stretch and that the presence of such litter could be effectively reduced by improving litter and waste collection systems and by raising awareness, increasing de facto behavioural changes to reduce marine litter in sandy beaches.

"Microplastics in benthic fauna and sediments in Arctic waters and local inputs"

Bach Institut for Bioscience, Maria
Granberg IVL Swedish Environmental Research Institute, Geir
Gabrielsen Norwegian Polar Institute, Kerstin
Magnusson IVL Swedish Environmental Research Institute, Jakob
Strand Aarhus University,

ABSTRACT

Plastic pollution in the ocean has today also found its way in the Arctic marine environment. Adding on to the potential long-range transport of especially plastic debris into the Arctic region, the local sources can also be significant. Local input was investigated in an arctic town, Sisimiut, Greenland, where wastewater is lead untreated into the sea and waste handling is less adequate. When plastic particles are released into the marine environment, they may settle and accumulate in marine sediments. It is therefore key to investigate uptake and bioaccumulation processes in benthic food chains when aiming to understand the fate and effects of microplastics in the marine environment. Sediment samples were collected in gradients from an area impacted by harbor activities, sewage outlets and from the dump site along with benthic biota and the amounts and composition of microplastic particles were determined. Similar samples were collected at reference sites in an undisturbed fjord for assessing background levels. Microplastic characterization in samples was supported by FT-IR analyses. The results showed a clear gradient of microplastic particles from local urban sources and in sediments it was dominated by polymer materials with densities > 1 g cm-3. The amounts and composition in benthic biota will be discussed in relation to the sediment findings and set in relation to an understanding of the sources and fate of microplastics in the marine environment.

"Microplastics in Tampa Bay, Florida: Abundance, Spatial and Temporal Variability in Natural Waters and Waste Water Treatment Plants"

Hastings Eckerd College, Kinsley
McEachern University of South Florida St Petersburg, Cypress
Hansen Eckerd College, Amelia
Kalagher Eckerd College,

ABSTRACT

We have been sampling microplastics for the past 5 years in Tampa Bay, FL using various collection methods: discrete water samples, plankton net towed for 3 minutes, surface sediments, and at wastewater treatment plants. Water samples were filtered at 0.45mm; tow samples were split 5x and digested with Proteinase K; sediment samples were processed with an elutriation column and separated with a NaI solution. Microplastics were identified under a dissecting microscope with confirmation by a hot metal needle that deforms plastic fragments.

Discrete water samples yielded a microplastics concentration, averaged over the year and throughout Tampa Bay, of 0.9 (0.2) particles/L, 20-65% higher in the rainy summer. Plankton net samples resulted in substantially lower abundance, averaging 0.005 particles/L. The highest tow value of 0.046 particles/L was at the mouth of the Alafia River, a primary freshwater source. Microplastics in sediment samples ranged from 3-152 particles/100g, averaging 45/100g. The highest values were close to the mouth of the Alafia River (57/100g) and in the heavily industrialized Ybor Channel (152/100g).

Effluent from wastewater treatment plants was sampled over a day, a week, and several months. Microplastics concentration was typically an order of magnitude greater than estuarine values, suggesting that most microplastics and microfibers from laundry are removed. Temporal trends showed a peak on weekends, when clothing is typically washed: 3x higher on Saturday and double on Sunday, compared to the weekday average.

Since many natural biotic particles appear similar to microplastics, confirmation with a hot needle is essential. Airborne contamination is common and can lead to substantial errors. We continue to monitor microplastics in Tampa Bay to constrain temporal variation.

"Monitoring macro and micro plastic in Pelagos Sanctuary: a citizenscience successful approach."

Merlino CNR-ISMAR (Institute of Marine Sciences – Italian Research Council), Marinella
Abbate ENEA, Marina
Locritani INGV, Stefano
Aliani CNR-ISMAR (Institute of Marine Sciences – Italian Research Council), Marco
Bianucci CNR-ISMAR,

ABSTRACT

SEACleanerII is the present follow up of the SEACleaner citizenscience project (2014-2016) implemented by CNR-ISMAR in collaboration with other Research and Organization Centers (DLTM, INGV), 5 Regional/National Parks in South Liguria and North Tuscany, and many associations School Institutions. The project's aim is to collect data on the type, distribution and principal pollution sources of macro and micro "Anthropogenic Marine Debries" (AMDs) on several beaches in a vast area belonging to the Pelagos Mammals Santuary. SEACleaner takes advantage of the ministerial program Alternanza Scuola-Lavoro to involve hundreds of secondary school students. Strong collaborations and synergies have been activated with other citizenscience projects focused on biological surveys, through Reef Check Protocol MAC-e, in the same selected areas. Results were made public by means of scientific publications (also for generic public), a master thesis and trough the documentary "MARINE RUBBISH. A challenge to share" distributed by CNR-WEB TV, realized for the 10th of Researchers Night in Bruxell in 2015, and presented in various national and international Environmental Film Festival. In 2016 the network has been extended to ENEA-UTMAR of La Spezia. SEACleanerII focuses on microplastics which represent a major problem for marine mammals in the considered area. It provides data collected during repeated campaigns at the same georeferenced stations, with seasonal time lapse. Compared to the previous project, the survey is restricted to marine high protected areas and to some neighboring urban beaches, in order to compare situations that differ for anthropization, tourist exploitation, cleaning beach actions etc. Here we present some preliminary results of the last year of microplastic collection and a brief review of past SEACleaner results.

"Our coasts are trashed, now what? Seeking effective trash solutions from urban creek Monitoring data"

Venuti California Sea Grant, Theresa
Sinicrope Talley California Sea Grant,

ABSTRACT

A number of trash monitoring efforts in California watersheds have revealed the types and distributions of trash in urban coastal environments; needed now is a translation of this information into strategies that will reduce (or eliminate) trash pollution. A trash removal tracking effort this past year in mid-city San Diego revealed that 87 cu meters (8.3 mt) of trash accumulated along an only 1 km-long reach of urban creek. Longer-term monitoring in this and nearby creeks revealed that most trash enters the watershed through illegal dumping, homeless encampments and storm drain flows. Most of the meso-trash (2-25 cm length) was dominated by plastics (53±9% of total volume), in particular food-related wrappers and packaging (67±7% of total plastic volume). Tiny plastics (0.5-20 mm) line these seasonal creek beds (100% of sites, up to 45,787±31,380 pieces m-2 in the top 5 cm of soil) likely due to the deterioration of larger plastic items (65-100% non-pellet plastics). Plastic bags were more susceptible to entanglement than plastic bottles or polystyrene cups, which washed quickly downstream, during a 150-day study in two study creek beds. Downstream, 12-25% of wetland and bay fishes consumed plastics, posing potential health risks to the fishes and their consumers. Community cleanups are an important trash control strategy in many areas, but the constant inputs and inaccessibility of much trash make them Sisyphean efforts that may not sufficiently address the problem. With humans at the source and receiving end of the marine debris issue, collaborations with industry, local government, sociologists, economists and the public are desperately needed to develop long-term solutions.

"Pelagic litter and its potential effects on whales in the Gulf of Maine"

Kennedy Blue Ocean Society for Marine Conservation, Rebeca
Murillo Blue Ocean Society for Marine Conservation, Dianna
Schulte Blue Ocean Society for Marine Conservation, Michael
Toepfer University of New Hampshire Cooperative Extension,

ABSTRACT

Marine debris is pervasive in the ocean and on the coastline. We know that it can harm wildlife and humans. Yet, the impacts of marine debris on cetaceans are not fully understood. Data collected on litter at sea, along with whale sightings, can provide a glimpse into what debris items are most prevalent the debris whales encounter during the summer. From 2011-2016, Blue Ocean Society for Marine Conservation staff, interns and volunteers recorded 15,725 pieces of litter aboard 1,906 whale watch trips in the Jeffreys Ledge and Stellwagen Bank regions of the Gulf of Maine. Sightings of humpback (Megaptera novaeangliae), fin (Balaenoptera physalus) and minke whales (Balaenoptera acutorostrata) were also recorded, along with notes on whale behavior and the presence or absence of marine debris. Of the litter recorded, an average of 12% was seen near whales, some of which were engaged in behaviors such as surface feeding lead to contact with the debris. This presentation will discuss project methodology, limitations, results, and the applications of this data for education and resource management.

“Predictive model of coastal debris accumulation”

Larsen Haarr Salt Lofoten AS, Levi
Westerveld GRID-Arendal, Kjersti Eline
Busch Salt Lofoten AS, Joan
Fabres Grid-Arendal, Kriss Rokkan
Iversen Salt Lofoten AS,

ABSTRACT

The Marine Debris Removal Planner is an interactive mapping tool developed to (1) optimise the use of public funds spent on marine debris pollution remediation and mitigation, and (2) enable coastal cleanup crews to succeed in delivering a steady supply of recovered materials into a circular economy value chain. Our tool is based on a scientifically derived predictive model of coastal litter accumulation sites based on coastline characteristics. The predictive model will identify the stretches of coastline likely to have a high concentration of litter within a stakeholder´s area of interest. The outcome of the use of this modeling tool is the efficient channeling of public funds earmarked for coastal cleanup, and the ability of material’s recovery actions targeting marine litter in a circular economy framework to succeed by identifying the optimal collection plan.

The predictive capacity of The Marine Debris Removal Planner is illustrated through the field data used to generate the model prototype. At the locations with the eight highest scores, the average litter density was 75 items per 100 m2. In comparison, the average litter density following repeated random selections of eight locations was only 13 items per 100 m2, and as low as 5 items per 100 m2 for sand beaches traditionally selected for coastal cleanup actions. When fully developed the Marine Debris Removal Planner will become a valuable tool in optimizing clean-up actions nationally and internationally. The elegant structure of the model, using mainly freely available coastline data and not depending on the use of models requiring a large data-processing-capacity, makes it highly scalable.

"Preventing marine plastic pollution through citizen science while promoting public stewardship of aquatic environments"

Galgani University of Siena, Steven A.
Loiselle University of Siena,

ABSTRACT

Plastics waste is a global emerging threat for aquatic ecosystems, ubiquitous in rivers, lakes and marine areas, where about 8 million metric tons of plastic debris end up every year.

It is estimated that 80% of marine debris has land based origins, transported to the sea by rivers and sewage. By comparison, the amount of plastics released into freshwater and terrestrial environments is likely to be much higher as these provide the main transport pathways to the marine environment. As an example, in the Mediterranean Sea, terrestrial debris represent 94%, of which 95% consists of macro and micro plastic litter.

However, relatively little is known about the abundance and sources of this anthropogenic litter. This information is fundamental to determine its impact and to identify successful mitigation strategies prior to its arrival in our waters. Importantly, while the scientific community (including ourselves) is dedicating much effort on the impacts of plastic on marine and in general, aquatic ecosystems, the problem of plastic pollution needs to be tackled on land.

We present here a citizen-science project aimed at promoting public stewardship of local aquatic resources, quantifying the type and quantity of plastic entering our rivers with the aim of reducing the amount of plastic reaching our seas. Efforts to solve the plastic problem require a partnered approach between research institutions, municipalities, educational institutions and citizens, achievable through citizen science. Focusing on the connectivity of all aquatic ecosystems in the emerging challenge of plastic debris in the hydrosphere, we present recent research activity and the efforts of the community of citizen scientists monitoring local water bodies for anthropogenic litter presence and composition.

"Results from 12 years of weekly community litter collection on 11 Gold Coast beaches, Australia"

Lee Griffith University, James
Gullison Griffith Centre for Coastal Management, Laura
Richards City of Gold Coast,

ABSTRACT

The Griffith Centre for Coastal Management, in collaboration with the City of Gold Coast, has established the Coastal Community Engagement Program in 2002. The program has a focus in creating a platform for the local community to become actively involved with dune regeneration, environmental education, citizen science and beach clean ups. The program runs 3 sister programs: BeachCare, DuneWatch and CoastEd.

BeachCare has been managing 11 dune sites on the Gold Coast, stretching over 52 km of coastline. Community members meet every Saturday at one of these sites and assist in the regeneration and management of those dunes. Volunteer attendance has grown exponentially from 40 volunteers in 2005 to 1028 in 2016. During the regeneration events, clean ups are conducted in and around the dune site.

CoastEd has been focusing on the educational component concerning marine debris. The program reaches over 6000 students per year and works with 193 schools and community groups throughout the region.

The Coastal Community engagement program is unique where a collaboration between a city council, a university and members of the community has been achieved to successfully work together towards common goals for 15 years. The presentation will showcase results from 15 years of coastal education, 12 years of marine litter collection and audits and 3 years of citizen science with a focus on the Gold Coast, Queensland, Australia.

"Seabirds in politics - the Northern Fulmar in EU marine litter policies."

van Franeker Wageningen Marine Research, Susanne
Kühn Wageningen Marine Research, Elisa
Bravo Rebolledo Wageningen Marine Research,

ABSTRACT

By its irrational habit to ingest marine plastic litter, the Northern Fulmar has established itself as a guide for EU policy makers and general public. Seabirds thus can contribute to positive change. Results of long-term monitoring of plastic ingestion by fulmars in the Netherlands will be presented in detail and discussed in the light of data from other geographical areas.

"Temporal and Spatial Analysis of Microplastic Concentrations in Tampa Bay Surface Waters"

McEachern USF- St. Petersburg, David
Hastings Eckerd College, Amelia
Kalagher Eckerd College, Cypress
Hansen , Henry
Alegria USF-St. Petersburg,

ABSTRACT

We sampled microplastics in the Tampa Bay estuarine surface waters from June 2016 to July 2017 in order to identify temporal and spatial differences in concentrations. The study will provide an understanding of how seasonal differences , circulation patterns, freshwater sources, and waste water treatment plant locations affect microplastic concentrations. Microplastics were collected by taking discrete water samples as well as plankton tows in the four different regions of Tampa Bay as well as surrounding rivers. Microplastics were identified through visual inspection under a dissecting microscope and a hot needle test was utilized to determine if the particles were plastic.

Discrete water samples yielded an average. concentration of 1.0 particles/ L in Old Tampa Bay, 0.7 particles/ L in Hillsborough Bay, 1.1 particles/ L in Middle Tampa Bay, and 0.9 particles/ L in Lower Tampa Bay. Samples taken with a 330 µm plankton net yielded an average concentration in Old Tampa Bay of 3.6 particles/ m3, 4.6 particles/m3 in Hillsborough Bay, 4.4 particles/ m3 for the Middle Tampa Bay region, and 5.8 particles/ m3 in Lower Tampa Bay.

For discrete samples the highest average concentration of microplastics throughout the study was in the Middle Tampa Bay region which is closely located to the effluent of the Little Manatee River. For plankton tow samples the highest average concentration over the course of the study was in Hillsborough Bay which is next to the largest freshwater source, the Hillsborough River, as well as in Lower Tampa Bay which is close to the freshwater source of the mouth of the Manatee River. The highest concentrations of microplastics for both discrete and plankton net samples were taken in the summer months when rainfall and runoff was highest.

"The influence of meteorological and oceanographic events on the small-scale temporal variation of solid waste deposition on gradient estuarine shorelines"

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Krelling IFPR, Alexander
Turra University of São Paulo (USP), Department of Biological Oceanography, Oceanographic Institute (IOUSP),

ABSTRACT

The present study aims at establishing relationships between debris deposition and small-scale meteorological and oceanographic events (precipitation, wind, tide, and river flow). The samples were collected during 60 consecutive days in two Brazilian beaches in Pontal do Paraná. The first site (Assenodi) is at the outermost area of an estuary, which is exposed to the action of waves and to southern, southeastern, and easterly winds. The second site (Canto das Pedras) is sheltered from direct wave action and is located at an estuarine outlet. Assenodi accounted for 29% of the total debris collected, while Canto das Pedras accounted for 71%. The higher influence of domestic

plastic debris was observed in both sites, suggesting the influence of waste coming from the estuary's inner municipalities for the whole region. The lower depositional rates of items are preceded by higher precipitation events for both sites. The strand of debris also varied among beaches according to wind conditions. Stranding of debris increased after events of intense winds (wind speeds of 2 to 4 m/s), varying spatially: after a 2-day action period in Assenodi and a 3-day period in Canto das Pedras. Tides also influenced deposition in both sites and the explanatory model indicated a linear relation in Assenodi and a unimodal behavior in Canto das Pedras. The river flow influenced positively debris accumulation in Canto das Pedras. Thus, the daily dynamics of meteorological and oceanographic events express variations in the arrival of marine litter in temporal and spatial scales.

"The Riverine Input Project: a citizen-science project to monitor litter inputs from rivers to the marine environment"

Bruge Surfrider Foundation Europe,

ABSTRACT

Marine debris are known to affect marine wildlife and represents extra pressure on already threaten species. Many studies have investigated ocean plastic pollution, accumulation in gyres, degradation and impacts. Rivers are recognized as a major pathway for litter entering the ocean, especially plastic debris. Yet, further research is needed to improve knowledge on rivers contribution, increase data availability, precise litter origins and develop relevant solutions.

This presentation aims to present the first results of The Riverine Input Project, a long-term citizen-science litter monitoring project on river banks. Surfrider Foundation Europe has been applying this method since 2014 on the Adour river, southwest of France. Sampling consists in collecting all litter stranded on the river banks or stuck in the riparian vegetation in a pre-defined area. To this aim, several sampling sites were identified from cartographic and hydromorphological analysis, and with the support of local stakeholder. Litter samples are then sorted and counted according to a grid adapted to riverine litter containing 130 items categories.

Since the project launch, 278 litter samplings were carried out and 120,632 litter items were collected, sorted and counted. 41% of litter could not be identified due to high degradation. Food and beverages packaging, smoking-related items, sewage related debris, fisheries and mariculture tackles and common household items represents 70% of identifiable items.

Overall, the present study contributes to our knowledge of litter sources and pathways, with the target of reducing the amounts entering oceans. The long-term application of this monitoring is a way forward to measure societal changes as well as assess current and future measures effectiveness.

"Tracking Debris Hotspots in Southwest Florida USA with the Help of Student Scientists"

Bassos-Hull Mote Marine Laboratory, Katie
McHugh Chicago Zoological Society's Sarasota Dolphin Research Program, Kasey
Gaylord-Opalewski Mote Marine Laboratory, Ronda
Ryan Sarasota Bay Watch,

ABSTRACT

Southwest Florida coastal waters and shorelines (which includes bridges, jetties and piers) are heavily used by both residents and tourists and are popular areas to fish. As a result, marine debris (both consumer debris and derelict fishing gear) is prevalent in the region. A recent publication (Adimey et al. 2014) identified this region as a hot spot for entanglement of dolphins, manatees, and sea turtles. To address this issue on a fine scale, Mote Marine Laboratory high school and college interns were trained to collect data on human activity, wildlife frequency, and marine debris frequency on area bridges, piers and jetties on a monthly basis. During these surveys, students used the Marine Debris Tracker App to record all marine debris and collected derelict fishing gear for measurement. Additionally, interns conducted or participated in several coastal cleanup events where trash was logged and derelict fishing gear was further measured. To date (since 2015), with the help of over 50 interns , over 10,000 pieces of trash have been logged and over 2 kilometers of fishing line have been removed and measured from area bridges, piers, jetties and beach and mangrove shorelines. Student interns communicated these results through a variety of modes such as public or scientific posters, educational games and activities at outreach festivals, peer mentoring of elementary-school children on relevant conservation topics, and presenting their activities and findings to a worldwide audience via videoconference technologies. Allowing students direct involvement in research and conservation education opportunities during teenage years builds important capacity in this next generation of potential future ocean scientists and creates conservation-minded members of the public.

"Volunteers Support Scientific Research and Increase People Awareness: The case of Legambiente's beach litter survey"

Di Vito Legambiente Onlus, Serena
Carpentieri Legambiente Onlus, Giorgio
Zampetti Legambiente Onlus, Luca
Pucci Legambiente Onlus,

ABSTRACT

Citizen Science experiences can be a powerful tool to build effective cooperation between science and society, to recruit new talents for science and to pair scientific knowledge with social awareness and responsibility. The interaction with citizen assisting in data collection is growing as a cost-effective way to deploy continuous large scale environmental monitoring.

Legambiente is the most widespread environmental NGO operating in Italy since 1980. One of the most important topics for the organization is the marine environment. In fact, in the last years, Legambiente promotes national campaigns all around Italian seas and coasts, monitoring land based pollution like wastewater, coast degradation and littering. Legambiente has increased its activity linked to the presence of marine litter and microplastics in seas and freshwaters. A beach litter survey was started in 2014 within "Clean-up the Med", an international beach cleaning campaign that involves every year, in May, thousands of volunteers from Italy and the whole Mediterranean sea. In this work, the "Clean-up the Med" initiative is presented, analyzing results of beach litter monitoring of more than 200 beaches monitored from 2014 to 2017 (75% Italian and the rest from other Mediterranean countries involved in the initiative). The survey used a standard protocol according to the Technical Subgroup on Marine Litter (TSG ML) Mediterraneo. Our activity and campaigns are well recognized at the European level, from Unep, Environmental European Agency and by the US Department State, among others. In the meantime, actions, policies and good practices input are suggested starting also from data analysis, as the plastic carrier bags ban in all the Mediterranean countries.

"Where should we collect samples on the beach for mesoplastic analysis?"

Lee OSEAN, Jongmyoung
Lee OSEAN, Sunwook
Hong OSEAN, Sang Hee
Hong , Won Joon
Shim , Soeun
Eo ,

ABSTRACT

We surveyed the abundance and deposition patterns of mesoplastic marine debris (5–25 mm) by lines) and plastic types within the beach on 20 beaches in Korea. We selected 100 m transect, divided it into four transects and four sampling lines (backshore, middle line, high strandline, and water edge). The mean abundance from four lines was 222.05 ± 421.98 items/m2 and mean weight was 11.84±18.99 g/m2. Of all mesoplastics Styrofoam was overwhelmingly dominant and the proportion of it was 73.3% on a basis of number. The abundances of mesoplastics differed from sampling lines within the beach, of which backshore had the most mesoplastics, followed by high strandline. Distribution of mesoplastics were different by plastic types. Relatively light plastics such as Styrofoam and film seemed to accumulate in the backshore, whereas hard plastic and fiber was likely to accumulate in high strandline more. The present study suggested that sampling strategies including selecting sampling spots on the beach, plastic types and defining size of plastics should be modified by the objective of research.

"Wrightsville Beach Smoking Ban Preliminary Results"

Melick University of North Carolina Wilmington, Bonnie
monteleone University of North Carolina Wilmington, Brooks
Avery University of North Carolina Wilmington,

ABSTRACT

Cigarette filters are consistently the number one manmade debris discarded in the environment and have negative consequences, especially on beaches. There are documented cases of small children hospitalized from ingesting cigarette filters and cigarette filters found in dissected birds and fish. Furthermore, these filters are composed of cellulose acetate, a form of plastic, and can persist in the environment indefinitely.

A study conducted by The University of North Carolina Wilmington undergraduate students looked at the amounts of manmade debris found on Wrightsville Beach, NC, a smoke-free beach. Over the course of 4 years, 45 undergraduate students gained field research experience collecting over 500 samples. Focusing on the data collected from discarded cigarette filters showed the smoking ban was effective in reducing the amount. The data also revealed that the piers are hot spot areas. Cigarette filters continue to be the number one item found on Wrightsville Beach, which led to recommendations for better marine debris management.

"A global community dedicated to bringing a permanent end to pinniped entanglements: The Pinniped Entanglement Group (PEG)"

Raum-Suryan NMFS Alaska Region, Protected Resources Division, Lauri
Jemison Alaska Department of Fish and Game, Kate
Savage NMFS Alaska Region, Protected Resources Division, Sue
Goodglick Alaska Dept. of Fish and Game, Mike
Williams NMFS Alaska Region, Protected Resources Division,

ABSTRACT

Marine debris is a global concern affecting at least 200 marine species in the world's oceans. The entanglement of marine mammals in all forms of marine debris is increasingly recognized as a serious source of human-caused mortality for marine mammal populations including pinnipeds. Marine debris most commonly associated with pinniped entanglements include plastic packing bands, fishing nets, monofilament line, rope, crab traps, and wide rubber bands. Entangling debris may cause death, injury, or increased energy expenditure. Responding to pinniped entanglement is limited to a small group of trained people. We must all work together to prevent pinniped entanglement in marine debris. To provide increased global collaboration and communication among scientists, non-government organizations, non-profits, and others, the Pinniped Entanglement Group (PEG) was created in 2009. The PEG collaborates to reduce pinniped entanglements in marine debris and fishing gear through education, outreach, and rescue. The PEG interacts through quarterly phone calls, newsletters, a google group, and in workshops. Outreach materials have included brochures, harbor signs, messages in tide books, posters, public service announcements on TV and radio, bumper stickers, and video. Our aim is to continue to grow PEG globally and we welcome new members dedicated to the safety and welfare of pinnipeds.

"Cast Away at Sea: Key Elements and Best Practices for Designing Model Legislation Aimed at Reducing Marine Debris"

Lee-Andersen McCarthy Tetrault LLP,

ABSTRACT

Advances in plastics technology have provided untold benefits to consumers over the years and opened up an array of consumer goods to people around the world. However the availability of cheap plastic, coupled with a throw-away mentality, is leading to unintended consequences for our oceans and their supporting ecosystems, i.e. ubiquitous plastics of considerable persistence in the marine environment. Given that a significant amount of plastics that end up in the oceans enter through riverways, the issue needs to be tackled upstream through better life cycle management of plastic packaging and waste. As a result, many local initiatives have proliferated which are designed to achieve product-specific source reductions through both regulatory and educational means. From bans on plastic bags and microbeads, to the voluntary phase-out of polystyrene and the push towards compostable packaging, communities are building expertise on source reduction strategies for marine debris. This session will consider the key elements of an effective regulatory system for managing plastic waste, in particular single-use plastic products. By drawing on success stories and best practices from around the world, there is an opportunity to develop model legislation for reducing marine debris that will incentivize the transition from a throw-away society to a more sustainable one, while providing consistent regulatory standards. What would such model legislation look like? This session will also explore practical strategies for industry to support efforts to reduce the consumption of non-durable plastic products, as well the potential scope of a voluntary code guided by industry best practices.

"Extended Producer Responsibility as a Tool to Reduce Plastic Marine Debris - A British Columbia Case Study"

Harris Memorial University of Newfoundland,

ABSTRACT

As a regulatory instrument, extended producer responsibility policy (EPR) has the ability to address plastic marine debris through preventing waste from being formed in the first place (i.e. source reduction), and by reducing leakage into the environment through funding, creating or expanding infrastructure for postconsumer recycling. EPR is a waste management policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle, which provides incentives to producers to incorporate environmental considerations in the design of their products and reduces the amount of waste generated and going to landfill. However, there has been minimal research on EPR's effectiveness to drive source reduction of packaging waste and reduce packaging leakage into the marine environment. A thorough analysis of shoreline pollution levels in a coastal jurisdiction that has introduced EPR legislation for packaging waste is needed to determine if EPR is a viable solution for plastic marine debris reduction. This research focuses on British Columbia (BC) as a case study, given that it is the first and only coastal jurisdiction in North America to implement a 100% industry-funded EPR program for packaging in 2014. This research will use existing citizen science shoreline cleanup data as the primary data sets for analysis. The objective of this research is to determine how the introduction of packaging EPR policy in BC has affected plastic packaging waste levels on shorelines.

"Field measurements to quantify microplastics from effluent and urban runoff in the San Francisco Bay"

Lin San Francisco Estuary Institute, Meg
Sedlak San Francisco Estuary Institute, Rebecca
Sutton San Francisco Estuary Institute, Alicia
Gilbreaeth San Francisco Estuary Institute, Carolynn
Box 5 Gyres Institute, Xia
Zhu University of Toronto, Chelsea
Rochman University of Toronto, Yee
Donald San Francisco Estuary Institute,

ABSTRACT

Treated wastewater effluent and stormwater runoff are suspected to be two of the most important pathways for microplastics and microfibers to enter the San Francisco Bay. The Bay is an important ecosystem surrounded by a dense urban population and industrial land uses, and therefore vulnerable to contamination from land-based sources. This study presents field measurements that quantify and characterize microplastics from effluent and urban surface runoff in the region. Microplastic particles were collected from the effluent of eight wastewater treatment plants, employing varying treatment technologies to calculate first order estimates of microplastic loads from effluent discharges into the Bay. At least two 24-hour composite samples were collected from each facility. Stormwater samples from 15 sites representing both urban and undeveloped spaces in the San Francisco Bay region were collected during rain events in 2016 and 2017. Using a newly developed field technique, samples were composited from multiple sips collected over the course of the storm. Microplastics were identified and quantified using optimized analytical methods. Discussion of sample results and increased understanding of the predominant types of microplastics and microfibers discharged into the Bay will support identification of microplastic sources and inform development and prioritization of source control solutions for this emerging contaminant.

"Killing them with Kindness | Finding New Ways to Educate and Engage Cigarette Smokers"

Schoenwald VolunteerCleanup.org, Dave
Doebler VolunteerCleanup.org,

ABSTRACT

This is a case study in new and effective approaches for engaging cigarette smokers and educating them about the harmful effects of cigarette butt litter on the marine environment.

Most of us probably know that cigarettes are the number one most littered item in the world. And we probably also know that they are made of plastic and are not biodegradable. But the smokers we need to reach may not know that, and they don't know what happens when they litter their butts.

In order to effectively reach and engage our target audiences, we need to new ways to get the message out. Some strategies to reach smokers have focused on telling them what not to do (don't litter) or shaming them, which causes them to disengage. Instead, we used the iterative design thinking process, and social theories of reciprocity to come up with an alternative, more empathetic approach. By proactively providing smokers with a reusable pocket ashtray "gift" that is also educational, they are more receptive to the message and more likely to feel obligated to use it in order to return the favor, compared to other approaches. Additional tactics like humor will also be discussed.

As part of the case study, we will review the social theoretical frameworks relevant to this approach, present an overview of the design thinking process, and discuss the benefit of using it for this kind of problem-solving.

"Microplastic extraction from biolids: method comparison and validation"

Berry RMIT Univeristy, Phoebe
Lewis RMIT University, Brad
Clarke RMIT University,

ABSTRACT

Microplastics are a contaminant of emerging interest and international concern. Wastewater discharge is considered an important source of microplastics into the aquatic environment with estimates of 1 - 610 microplastics L-1 entering wastewater treatment facilities each day. Throughout wastewater treatment stages (primary, secondary, tertiary), microplastics can sink out of the water column via sedimentation and flocculation processes, becoming a component of sewage sludge. An estimated 99% of microplastics in wastewater can be removed during various stages of the wastewater treatment process. Dry, mature sewage sludge is referred to as biosolids, which may be used in land applications and carbon sequestration. However, the potential environmental impacts of microplastic contaminated biosolids remains poorly understood. The extraction of microplastics from complex biological media, such as biosolids, has resulted in a lack of standardized methods for extraction. Extraction techniques are inconsistent in the literature and many methodologies lack adequate validation procedures such as the calculation of recovery rates for a suite of polymer and microfiber types. In this presentation, I will compare the three most commonly used methods for microplastic extraction from biosolids: density separation, digestion followed by filtration, and digestion followed by density separation and filtration. The most efficient extraction method of microplastics from biosolids, in terms of recovery rates, cost and time, will be discussed.

"On-going participation of bathing beach users in marine litter prevention – preliminary results"

Pasternak Department of Maritime Civilizations, The Leon H. Charney School for Marine Sciences, University of Haifa, Michelle
Portman Faculty of Architecture and Town Planning, Technion - Israel Institute of Technology, Yasmin
Yotam Department of industrial design, Hansen, Bezalel Academy of Art and Design, Ron
Nuassbaum Environmental Studies, The Porter School of Environmental Studies, Tel Aviv University,

ABSTRACT

Marine litter damages marine habitats, flora and fauna, impacts negatively on human health and the economy and destroys the aesthetic quality of the coast. More than half of the litter on the Israeli beaches is deposed of by holidaymakers and bathers. Therefore, it is important to find ways to encourage non-littering norms and behaviors that address the marine litter problem at its source, rather than depending exclusively on 'end-of-pipe' interventions such as beach cleaning by employed cleaners or volunteer groups. Descriptive norm is what is typically done in a given setting, whereas injunctive norm is what a particular culture approves or disapproves of. Research has shown that activation of a descriptive norm only reduces littering in a clean environment, and actually increases littering in a littered environment. Activating an injunctive norm has the potential to motivate anti-littering behavior in a littered environment, assuming the relevant anti-littering norm exists. Related to these understandings are physical design messages and particularly the assumption that trash can design can influence on-going participation of bathing beach users in litter prevention. At the same time, trash cans designs must also consider physical challenges characteristic of the bathing beach milieu: e.g., transportation, weather, maintenance, and budget related constraints.

The main objective of the research described here is to identify the elements of beach trash receptacle developed through persuasive product design principles. We have developed two prototype trash cans based on literature from three fields: waste management, environmental behavior and product design, and based on interviews with Israeli bathing beach managers and professionals (at the municipal-level) about possible designs and beach litter waste removal.

"Preventing MD with New Apps and Maps: Better Data Defines High Priority Areas and Actions"

Reynolds University of South Florida, Frank
Muller-Karger University of South Florida, Hannah
Torres University of Central Florida, Pat
Deplasco Keep Pinellas Beautiful,

ABSTRACT

To prevent aquatic or marine debris, it is essential that communities and local governments understand the primary sources/causes of litter and the pathways by which "trash travels" and enters specific watersheds. Municipalities are adding new GIS based aps and stormwater maps to their marine debris prevention tool box to collect data on upland litter and define actions. This session will review two new free tools, processes and municipal effort to prevent marine debris. In 2015, Keep Pinellas Beautiful and the USF College of Marine Science worked with the City of St. Petersburg Stormwater and Engineering Departments to develop a process for KPB and local governments to diagnose conditions, define probable sources and root causes of litter for specific "high priority" locations, and develop targeted community engagement programs. The pilot was a part of the Clean Community Clean Coast project supported by a NOAA Marine Debris Prevention grant. To support KPB's practices, USF created an open-source tool, based on criteria and metrics in the Keep America Beautiful Litter Index and the Florida DEP's "Walk the Waterbody" program. The team reviewed storm drain and street maps to define watershed flow and selected 15 sites. The teams assessed the sites and entered data into smart phones: defining type of litter, drain conditions, nearby buildings, bins and transit stations. The program was repeated in 2016 and in 2017, KPB expanded to five cities. In Philadelphia, the Mayor issued an executive order to develop a data-driven, coordinated action plan to reduce litter in the streets and landfills. The Philly team also developed a GIS tool based on KAB metrics and a website. These easy-to-use GIS apps, maps and better data enables cities and partners to determine specific actions and prevention–oriented engagement strategies

“Targeting a Source of Marine Litter: A Social Marketing Approach to Reducing the Mass Release of Balloons”

Witmer Virginia Coastal Zone Management Program, Kathleen
Register Clean Virginia Waterways of Longwood University, Laura
McKay Virginia Coastal Zone Mangement Program,

ABSTRACT

The Virginia Marine Debris Reduction Plan included an action to design and implement a social marketing campaign targeting behaviors that will reduce a harmful type of marine litter: balloons. Partners in Virginia conducted extensive research to better understand who plans balloon release events – and, most importantly, why. Research included media reports of balloon releases, analysis of wedding blogs and social media, a public survey, interviews and focus groups. Research informed design of a social marketing campaign to reduce balloon releases at weddings. The campaign-Joyful Send-off-“sells” a positive behavior-joyful, picture-perfect, and litter-free send-off alternatives to balloon releases. The goal is that couples will learn that all released balloons become litter, and will not organize or participate in a balloon release in the years to come. Researchers spoke with brides about what a send-off ceremony means to them, and then conducted message testing to refine a strategy that would be effective at reaching couples. The strategy includes behavioral prompts at the time and place couples are making a decision about what type of send-off their ceremony will include, a request for a commitment to select an alternative to balloon releases, and vivid, captivating multi-media with other couples sharing their own experiences. The campaign message is conveyed by wedding experts, a credible source for engaged couples. Pre-campaign research was comprehensive so that it not only informed Joyful Send-off, but laid a foundation for other strategies to reduce balloon releases during celebratory and memorial events--engaging other non-traditional audiences including funeral homes, car dealerships, sports teams and schools. Partners also considered the transferability of the campaign research and strategy to other states.

"Upper River Outreach Strategy to Decrease Plastic Marine Debris"

Otsuka ISLANDS4KIDS, Teruo
Otsuka ISLANDS4KIDS,

ABSTRACT

The fight against marine debris seems to have just started when we think about the biodegradation timeline. This timeline will only continue to extend unless significant efforts are made worldwide to decrease the vast amounts of land-based plastics flowing into river systems after every storm or flooding. BAOTecS (Broad Area Outreach Technology Study) is a web-based educational program developed in the efforts to decrease the volume of plastics flowing into river systems around the world. This "Upper River Outreach Strategy to Decrease Plastic Marine Debris" is operated by our 501(c)(3) non-profit organization, "ISLANDS4KIDS". Our outreach program is dedicated to educating children and young adults worldwide, especially those living by upper streams, riverside towns, and cities that are hundreds, even thousands of miles inland from the ocean.

At upper stream areas, trash is generally visible, reachable, collectible and disposable at lower costs. For our outreach efforts to connect to millions of young people across the globe, we are implementing a cross generational communication method to increase the input of information to children. Disposal of plastics into local rivers is happening at every country, developed and developing. However, attempting to physically communicate an outreach program by sending people to every corner of the world will take a tremendous amount of time and manpower to achieve positive results.

To overcome this obstacle, we are developing BAOTecS to create customized online study courses and curriculums to be utilized by classrooms and individuals. Currently, we have two programs: K to 6, 7 to 12; each with a course curriculum, activities, and resources. Lessons begin with an encompassing curriculum of marine debris and then delve into the source of debris. Through offering activities and discussion questions, BAOTecS is intended on building critical thinking skills for children to develop their own thoughts and be encouraged to pour their creativity in discovering innovative solutions to establish proactive measures of preventing debris from entering into rivers and streams. ISLANDS4KIDS is dedicated as a hub of the BAOTecS program.

"Application of a Technique for Detecting and Estimating the Quantity of Macro-Litter on Beaches Using Unmanned Aircraft System"

Tran Department of Physical & Environmental Sciences, Jeremy
Conkle Department of Physical & Environmental Sciences, Michael
Starek Department of Computing Sciences, James
Gibeaut Harte Research Institute for Gulf of Mexico Studies,

ABSTRACT

Marine debris is a global issue with adverse impacts on the marine environment, wildlife, economy, and human health. Contamination of marine debris on beaches may vary due to beach topography, hydrological conditions, proximity to litter sources, and the extent of beach use. monitoring beach litter is essential for understanding spatial and temporal patterns, however, these surveys are labor intensive and time-consuming. To maximize the effectiveness of marine debris monitoring, the aim of this study was to develop a comprehensive method for detecting and quantifying the marine debris using images taken by a small unmanned aircraft system (UAS). RGB images were captured by a rotary UAS at various altitudes and dates over a 100 m section of beach on Mustang Island located along the Gulf Coast of Texas. The images were processed through structure-from-motion photogrammetry to derive orthomosaics for each flight. The derived orthomosaics are then passed into an image processing and classification workflow developed for segmentation and delineation of imaged debris. Results were compared across different survey dates to assess the impact of flight design and ground sample distance (GSD) on detection and quantification of marine debris. The proposed UAS method has potential to increase the efficiency and temporal repeatability of marine debris monitoring relative to standardized field counting approaches.

"Concept for a hyperspectral remote sensing algorithm for floating marine macro plastics. The first measurements."

Goddijn-Murphy University of the Highlands and Islands, Steef
Peters Water Insight BV, Erik
van Sebille Institute for Marine and Atmospheric Research, Neil
James Environmental Research Institute, North Highland College, Stuart
Gibb Environmental Research Institute, North Highland College,

ABSTRACT

Remote sensing has the potential to provide long-term, global monitoring but for marine plastics it is still in its early stages. We developed a theoretical reflectance model of sunlight interacting with a sea surface littered with macro plastics, based on geometrical optics and the spectral signatures of plastic and seawater in the visible (VIS) to short wave infrared (SWIR) spectrum. Our model describes a mathematical relation between sea surface fractions of marine plastic and light reflectance measurements in air. In our presentation we will show and discuss the first results of our experiments designed to test the model with measurements at sea using a field spectrometer (the ASD FieldSpec Pro). A few kinds of plastic debris of different chemical composition, shape and transparency, will be analysed. This could be a step forward to the development of a hyperspectral remote sensing algorithm in the VIS-SWIR spectrum, applicable to airborne and satellite observations.

"Crowd NIR scanning of (micro) plastics."

van Bavel Norwegian Institute for Water Research,

ABSTRACT

One of the most exiting innovations in the field of NIR spectrometry is the development of pocket size (smaller than a cigarette package) spectrometer as an affordable (220 $) gadget for mobile telephones (www.consumerphysics.com, 4 x 6.8 x 1.5 cm). This development makes this technology available at a larger scale and for the testing of the concept with for example NGOs. Here we are working closely together with Hold Norge Rent as a partner to dissimilate the technology. In the first phase of the project we are validating the concept to store data of litter in a 'knowledge' cloud.

The collected data includes a picture(s) of the sample, GPS coordinates, date and time and the NIR spectra of the plastic. To be able to add meta scientific information to the observation of litter is crucial and will add value scientific value of data collected by volonters at for exempel beach cleaning or surface (manta) trawlings. This way polymers can be identified and traced back to user patterns, products or other sources and be usel for model purposes. The NIR scanner is projected to be developed further directly into a mobile phone by a telephone producer (http://mobile.

NIR spectrophotometer available to the general public worldwide is an opportunity not to be missed within marine litter research. Figure 1. Screenshot of test series of different polymers by the NIR gadget. Identification of

polyamide.

"Economic Costs of Paraffin Pollution"

Metcalfe KIMO International,

ABSTRACT

Pollution from paraffin on beaches and coastlines is an ongoing issue for coastal communities. It continues to be found washed up on beaches in various countries bordering the North Sea and the Baltic Sea and has serious consequences for the environment, wildlife and for coastal communities.

Pollution from paraffin presents a major risk to marine life as paraffin fragments are mistaken for food by marine animals and swallowed. The risk to humans is less clear but most forms will irritate the skin, eyes and respiratory tract and some are considered to be carcinogenic.

Pollution from paraffin is detrimental to the recreation and tourism industries of coastal communities. The impact on local economies can be considerable and income will be lost to local communities when beaches are closed following the incidence of paraffin pollution. Since identification of the source of the pollution is extremely difficult the costs of the consequential beach and shore clean-up and processing of waste are currently borne by coastal communities and national governments.

Between 2012 and 2016, at least 91 incidents occurred in 5 OSPAR countries affecting 300 km of coastline, involving at least 37 Local Authorities and costing well over €1.4M. As a consequence of poor/inconsistent reporting of data, the number of incidents recorded and the associated costs are likely to be very low estimates. Robust protocols that facilitate more consistent, accurate reporting are necessary to recognise the full extent of this problem.

"Estimating Costs to Fisheries of Lost Dungeness Crab Traps"

Drinkwin Natural Resources Consultants, Inc., Kyle
Antonelis Natural Resources Consultants, Inc.,

ABSTRACT

Crab trap loss in Dungeness crab fisheries on the West Coast of the United States and Canada is widespread and ubiquitous. In the U.S. portion of the Salish Sea, over 12,000 traps are estimated lost each year. Densities of 390 lost crab traps/km2 have been found in Boundary Bay, British Columbia. In the British Columbia Area A crab fishery, fishers reported losing between 6% and 10% of traps deployed annually. Lost crab traps not only continue to trap and kill target species, they threaten navigational safety and may play a role in the increasing numbers of reported large whale entanglements along the west coast.

Lost traps also have economic impacts to the fisheries themselves. Estimating the economic costs of trap loss can employ a variety of methods. Natural Resources Consultants presents two methods to estimate economic costs in West Coast Dungeness crab fisheries. One method relies on limited data available while the second takes advantage of a more robust dataset, including results of controlled research.

In the Area A Dungeness crab fishery, commercial trap loss was reported by each fisher on the annual Crab Trap Questionnaire required by the Canada Department of Fisheries and Oceans. Using these data combined with readily available information on the cost of trap replacement and landed values, we can estimate that the value of lost traps represents approximately 4.68% of the average annual landed value of Dungeness crab from Area A from 2010 – 2015.

In the U.S. portion of the Salish Sea, lost crab traps were simulated and the number of crab trapped and killed in the traps were documented. These data were combined with loss estimates, catch effort, crab value, and additional harvest variable cost rates to estimate the annual value of harvest lost due to lost traps at $744,296, or 4.5% of exvessel value.

"Increasing the value of plastic through container deposit legislation reduces mismanaged waste"

Schuyler CSIRO, Britta Denise
Hardesty CSIRO, TJ
Lawson CSIRO, Kimberley
Opie CSIRO, Chris
Wilcox CSIRO,

ABSTRACT

Mismanaged waste and marine debris have significant detrimental effects on wildlife, public health, and the economy. Container deposit legislation (CDL) is one of the many legislative actions proposed by lawmakers to curb the amount of mismanaged waste entering the ocean. Beverage containers may comprise up to 40-70% of coastal litter in some parts of the world, so effective legislation could prove a significant lever to reduce debris inputs to the marine environment. Understanding what factors influence the effectiveness of CDL is essential to designing appropriate legislation. We evaluated CDL in two countries, the United States and Australia, by comparing results of debris surveys in states with and without cash incentives for returned beverage containers. We also examined the influence of factors such as population density, socio-economic status, and time since implementation of the legislation. Overall, states with CDL had a lower proportion of containers compared to those without CDL. Additionally, CDL states had a higher ratio of lids to bottles. The influence of socio-economic factors differs between states with and without CDL, indicating that the marginal value of bottle deposits in poorer areas is significantly higher than in more affluent areas. These results provide strong evidence that fewer beverage containers end up as mismanaged waste in states that provide an incentive (cash refund) for returned beverage containers, and highlight the need to understand not only the results from debris surveys, but also the context in which they are collected.

“Marine debris removal technology bringing together sailing community and marine trade with a focus on prevent”

McLaughlin Clean Ocean Access, Eva
Touhey University of Rhode Island,

ABSTRACT

Aquidneck Island, Rhode Island has 69 miles of beautiful shoreline facing the Atlantic Ocean, and is home for Newport known as the sailing capital of the world. Millions of people venture to Newport each year to enjoy the cliff walk, mansions and enjoy sailing on Narragansett Bay. Marine debris is a problem locally, and the sailing community brings back stories of horrific issues in the ocean. Clean Ocean Access is working to address this problem and recently developed a partnership with the sailing community, marine trade industry, local government, and state agencies to address the marine debris problem with technology innovative approach to remove floating surface debris and to use marina trash skimmers installations to educate, inspire and empower the community to prevent litter from becoming marine debris. Marina trash skimmers are highly effective at collecting floating surface debris and provide an equally beneficial service of oxygenating the surrounding waters, that in turn breakdowns hydrocarbons that emulsify oil sheen and allows the fuels and oils to be collected in the skimmer. With four units installed on Aquidneck Island and nearly 40 units installed on the west coast of United States, this technology and partnership model serves as scalable and transferable innovative solution to advance marine debris removal and prevention.

"Organizational Model and Plan of Action for Funding Efforts to Mitigate the Impacts of Marine Debris"

Antonelis Na Kama Kai, James
Coe , Kirsten
Moy Hawaii Coral Reef Initiative,

ABSTRACT

The worlds' oceans cover more than 70% of our planet and the health of these waters is vital to all lifeforms. On-going human disregard for marine ecosystems at all scales is resulting in the accelerated death and disappearance of many species. Among the many factors responsible for compromising the health of our oceans, the negative impacts of marine debris are indisputable. In 1973 the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) was adopted and the entry into force of its fifth Annex on garbage in 1988 was a significant step in controlling ship-source marine debris. To date, however national and international efforts to further the elimination of marine debris from all sources have been woefully inadequate. This is largely due to the complexity of the problem (jurisdictions, technologies, economics…) and the ease with which it can be ignored. To begin to remedy this failure, we propose the formation of a non-profit organization to oversee the development and funding of comprehensive strategies to mitigate marine debris. To initiate this effort, the US Congress should work with relevant agencies to develop a charter for the organization with the appropriate level of oversight. Once established, the chartered organization would use federal funding to leverage matching funds and cooperation from corporations, foundations, international organizations, NGOs and other governments to conduct a comprehensive grant program guided by a panel(s) of multidisciplinary and multinational experts.

"Raman analysis: using spectroscopy to identify microplastics in complex matrices"

Zhu University of Toronto, Chelsea
Rochman University of Toronto,

ABSTRACT

Zhu, X.1 and Rochman, C.M.1

1 Department of Ecology and Evolutionary Biology, University of Toronto, St George, Toronto, Canada

Without the use of polymer identification methods, it is often the case that natural polymers are identified as synthetic plastics (false positives) and true polymers are excluded (false negatives) by visual inspection, leading to inaccurate quantification of the amount of microplastic pollution in a given sample. This issue becomes more evident with smaller and smaller microplastics (especially < 100 µm) in complex matrices. To overcome this issue, investigators confirm material type using chemical analysis. Raman spectroscopy is an ideal method for this application because it uses backscattering of laser light from a material to produce characteristic spectra for specific materials, including natural and synthetic polymers, minerals, and dyes, thereby increasing the confidence with which scientists identify plastics in complex samples. We are optimizing methods for single particle identification using library software and creating our own Raman libraries. We are also optimizing methods for multi-particle mapping, scanning and analysis using ParticleFinder software from HORIBA Scientific, New Jersey. Finally, we tested the effects of chemicals commonly used for degradation of organic matter in samples, namely H2O2 and KOH, on the quality of Raman spectra for many polymer types to assure that Raman spectra can still be obtained for common thermoplastics and fibres. Based on our preliminary studies, we are optimistic we can develop a fast and accurate analysis of microplastics in the environment.

"A Gallon in Every Foot: Innovative Strategies for Removing Creosote-Treated Wood and Large Debris from the Salish Sea."

Tollefson WA-DNR,

ABSTRACT

For the Salish Sea and Washington State's inner-coastal waterway, pollution from wood preservatives and Styrofoam are a seasonal expectation, with every winter storm creating an opportunity for large, often derelict structures to break free from their original locations, and to migrate over-water to an unsuspecting, defenseless shoreline. Hundreds of toxic objects break free every year, including recreational, commercial, and industrial docks, submarine-net floats, aquaculture-related infrastructure and detritus, creosote-treated pilings, dolphins, piers, and bulkheads, wave-attenuators, and the occasional, untraceable, grounded vessel. Each of these objects presents its own set of unique challenges to the marine debris removal professional, and special consideration is necessary for each clean-up project.

Washington Dept. of Natural Resources began tracking and removing large debris in 2004, and has continued to expand its operation ever since. Our project has developed some new and interesting ways to both remove and safely dispose of large marine debris items, and will discuss these methods in detail in our 6IMDC Poster Presentation. Since our project's beginning, we have removed nearly 8 million pounds of diffuse, large debris from Washington shoreline, utilizing almost every conceivable tool available during the process. Our intention in presenting is to bring awareness to the issues these unconventional, and always cumbersome, forms of marine debris cause, and to inform others on practical solutions for safely removing them.

"Challenges of addressing marine debris removal in protected areas"

Delaney NOAA Florida Keys National Marine Sanctuary,

ABSTRACT

Marine debris is a persistent problem in nearshore, coastal systems that can result in significant impacts to sensitive species and habitats. But a one-size-fits-all removal approach may not address the intricacies of debris retrieval in marine protected areas, where multiple laws and protections must be considered. In the Florida Keys National Marine Sanctuary (FKNMS), derelict vessels and vessel debris litter remote, sandy beaches that serve as foraging and resting habitat for protected bird species and support nesting by threatened sea turtle species. Seagrass patches are found growing over defunct cables and concrete stabilizing mats in an underwater corridor connecting mainland utilities to a resort island. And stony corals of various species have colonized sunken debris in shallow, nearshore waters such as failed seawalls and docks, tires, pipes, wooden boards, and other materials. Given the extent of development along the Florida Keys shoreline, abandoned materials compromise aesthetics and contribute to habitat degradation in the sanctuary. NOAA FKNMS staff are working to develop consistent practices for marine debris removal within a region that supports complex species protections and regulatory frameworks.

"New Skimming Vessel"

Dieters Trash Skimming Boat,

ABSTRACT

I have created a new type of skimming vessel. I have a Utility Patent on my boats methods and skimming device. My new way of skimming gets both large items and micro debris. My system is a one man operation. I can custom build each boat to fit the needs of each customer or water way that the boat is skimming in.

I am currently in the final stages and working out the details of my pilot project/ skimming contract with the Port of San Diego. I have been selected by the Port to demonstrate and test my vessel in San Diego Bay. I will be collecting data on how much trash my vessel can gather and the volume of debris that is in the water etc. I will have current metrics of my collections for the debris convention in March.

"A simplified method for extracting microplastics in laboratory-cultured coral and water samples"

Duffy Student Services Contractor, US EPA, Cheryl
Hankins US EPA, Kate
Drisco ,

ABSTRACT

The deleterious effects of microplastic ingestion by marine organisms and the impacts across trophic levels are widely unknown. Due to the extensive ecological and socioeconomic benefits provided by coral reefs, investigating the impacts of microplastics on reef ecosystems is of growing importance. Current methods for extracting microplastics from tissue samples require the use of harsh chemicals that may degrade the surface of plastics, which could hinder accurate polymer identification. The method presented here was developed to extract microplastics from coral and water samples using a sonic cell disruptor. This technique was tested for efficacy in an effort to eliminate the need for chemicals and ensure chemical properties of microplastic surfaces are not altered for polymer identification. This method was performed using laboratory-cultured coral species montastrea cavernosa and Orbicella faveolata as well as culture water samples exposed to cured, fluorescent microplastics (Cospheric® 850-1000µm, 425-500µm, 90-106µm). Both coral and water samples were exposed to a sonic cell disruptor to emulsify fine organic matter. Samples were then vacuum filtered to separate out microplastics, whereby dry weights of microplastics were determined and compared to initial dose weights. The sonic cell disruptor method could not effectively emulsify large quantities of organic debris or mineral debris. Furthermore, it can fragment the microplastics into smaller pieces and is thus recommended for applications using measured doses of plastics. Overall, the use of sonic cell disruption in place of chemicals for organic digestion is an effective method for use with coral samples and water with little organic debris, and is recommended for specific laboratory-based applications.

"An assessment of potential microplastic impacts on the health of the Centropristis striata fishery"

Brander Oregon State University, Samantha
Athey University of North Carolina, Wilmington, Anthony
Andrady North Carolina State University, Pamela
Seaton University of North Carolina, Wilmington, Wade
Watanabe , Bonnie
monteleone , Alison
Taylor ,

ABSTRACT

An appreciable fraction marine debris in coastal habitats occurs as microplastics. These particles are ingested by marine organisms and can be transport vectors for aquatic pollutants. The extent of trophic transfer throughout marine food webs is unknown. However, plastics have been found in many food fish species, suggesting a risk of human exposure to plastic particles and their associated contaminants. As part of the NOAA Marine Debris Program, we have initiated an investigation into microplastic ingestion, contaminant bioavailability, and trophic transfer in the Atlantic coast fishery species Centropristis striata (black sea bass). Responses in cultured C. striata will be evaluated alongside those in wild caught specimens. Combined findings on biochemical (e.g. circulating cortisol) and organism level endpoints (e.g. condition index) in wild and lab-reared specimens will be used to produce an impact and risk assessment of marine micro-plastics on the physiology and development of this commercial fish species. A weighted evidence strategy will be used to assign scores to selected assessment and measurement endpoints that will allow for comparisons between field and laboratory data. We are testing three primary hypotheses: 1) In accordance with other microplastic studies in fishes, we predict an overall negative effect of plastic ingestion on lab-reared and wild C. striata. 2) That trophic transfer of plastics to C. striata is more significant than direct ingestion. 3) Commonly used plastic additives associated with ingested microplastics are bioavailable and absorbed into C. striata tissue. We expect that this project will greatly enhance our understanding of marine debris effects on C. striata and other demersal species, as well as informing risks to human health from the ingestion of plastic-contaminated seafood.

"An integrative approach for assessing the potential risks of microplastics to sea scallop on the Eastern Seaboard"

Mincer Woods Hole Oceanographic Inst, Linda
Amaral-Zettler NIOZ Royal Netherlands Institute for Sea Research, Erik
Zettler NIOZ Royal Netherlands Institute for Sea Research, Scott
Gallager Woods Hole Oceanographic Inst,

ABSTRACT

Plastic has become the most common form of marine debris in the last 60 years. It is estimated that an average of 8 million metric tons of plastic products escape the waste stream and enter the world's oceans each year, posing a significant, yet poorly characterized, risk to many marine organisms. Our ongoing study is undertaking an ecological risk assessment of microplastic ingestion to populations of the sea scallop, Placopecten megellanicus, in the Mid-Atlantic Bight and Georges Bank regions, which represents one of the most highly valued commercial fisheries in the continental United States. Scallop gut contents collected since 2013 as part of the NOAA Northeast Fisheries Science Center's annual sea scallop survey have confirmed microplastics, identified using Raman Spectroscopy, implying an impinging threat. Through a combination of fieldwork and laboratory experiments, essential data to calculate the risk to scallop stock populations associated with microplastic ingestion are being gathered and results will be discussed. Additionally, this study is investigating the hypothesized role that intense seasonal diatom blooms play in influencing the downward transport of microplastic (size 5 millimeter to 333 micron) and nanoplastic (size less than 333 micron) particles, making the debris bioavailable to sea scallop. This project will also assess risks associated with sea scallop larvae microplastic ingestion, using lipid content as a metric for health. Through focusing on one specific species in a well-characterized fishery, our integrative study aims to provide prioritized data for resource managers and policy makers to predict risk, preserve resources, and take corrective actions.

"An optimised extraction method of fluoranthene from micro-plastics using accelerated solvent extraction (ASE)"

Kandziora Indonesian Waste Platform, Thomas
Schiedek Technische Universität Darmstadt, Kaori
Sakaguchi-Söder Technische Universität Darmstadt,

ABSTRACT

Microplastics (MPs) are a group of anthropogenic contaminants with a high persistence in the environment. In order to determine the ecotoxicological impact of microplastic (MP), it is necessary to understand the nature and extent of chemicals that travel a long distance with MPs in the sea. However, currently no harmonized analytical methods are available to extract MPs from the environmental matrix as well as to extract pollutants from MPs. Therefore, this paper proposes a reliable method to determine the mass of contaminants adsorbed onto MP using an accelerated solvent extractor (ASE). A series of batch experiments were carried out in the laboratory to charge fluoranthene, a 4-ring polycyclic aromatic hydrocarbons, onto plastic pellets made of three different polymers: polyethylene (PE), polystyrene (PS) and polypropylene (PP). Fluoranthene adsorbed on the pellets was extracted using an ASE 300 (Dionex, Idstein). First results showed that best ASE extraction conditions for PE were at 100° C (at 100 bar) for 5 minutes in two static cycles using isopropanol, leading to an extraction efficiency of approx. 70 -80%. A similar extraction efficiency was determined for PS at 70°C at 100 bar for 5 minutes in two static cycles using isopropanol. The highest recovery rate of 110 -115% was obtained for PP under the ASE condition at 100°C at 100 bar in 1 static cycle using isopropanol. Further research is needed to extend the analysed toxic pollutants adsorbed onto MPs and to develop a standardised and globally applied methodological approach.

"Analyzing source and quantifying microplastic abundance in near-shore marine environments of Atlantic Canada"

Smith Bluenose Coastal Action Foundation, Brooke
Nodding Bluenose Coastal Action Foundation, Shanna
Fredericks Bluenose Coastal Action Foundation,

ABSTRACT

The Atlantic Canada Microplastic Research Project, led by Bluenose Coastal Action Foundation, is a partnership project aimed at addressing the environmental problem of marine plastic pollution, specifically microplastic (<5 mm in diameter). The project is an ecosystem-based research initiative that will quantify microplastic distribution and concentration across three locations in Atlantic Canada; the Bay of Fundy, the Bay of Islands (i.e., Gulf of St. Lawrence), and the LaHave River Estuary (i.e., Atlantic Coast). As research shows, plastic particles allow chemicals to adhere to their surface as they travel throughout the marine environment, contributing to reduced water quality over time. Although research has been conducted on these impacts, further understanding of water quality impacts from microplastic pollution, and its subsequent impact on habitat and biodiversity, is needed across Atlantic Canada's ecosystems. The proposed project involves one year (2017-2018) of project development and training and two years (2018-2020) of microplastic sampling and analyses within the three study areas. Sampling methodologies will replicate those used by researchers in the Great Lakes and the St. Lawrence River (Eriksen et al., 2013, Casteñeda et al., 2014, and Corcoran et al., 2015), to compare the results of those studies to data collected in Atlantic Canada. Samples will be collected from surface water trawls and benthic sediment grabs to quantify microplastic particles and determine concentrations. The culmination of the proposed project will be an international workshop event to share and discuss results of microplastic data with researchers, scientists, non-government organizations and students.

“Anthropogenic microlitter in the Baltic Sea with the emphasis on microfibers”

Bagaev Shirshov Institute of Oceanology, Russian Academy of Sciences, Liliya Khatmullina Shirshov Institute of Oceanology, Russian Academy of Sciences, Irina Chubarenko Shirshov Institute of Oceanology, Russian Academy of Sciences,

ABSTRACT

Amounts of anthropogenic microlitter (0.5-5 mm) in the water column (depth range from 0 to 217.5 m) of the main Baltic Proper basins were analyzed. Water samples were acquired during 6 cruises in the Bornholm, Gdansk, and Gotland basins in 2015-2016, filtered using 174 mkm filters, and subsequently analyzed by microscope. The bulk mean concentration of microlitter particles in the analysed 95 water samples was 0.40±0.58 items per litre, with fibers being the most abundant type of particles (77%), compared to 19 % of paint flakes and 4 % of fragments. No microbeads or pellets were recognized. The highest concentration of microliter was found in the near-bottom samples from the coastal zone (2.2. - 2.7 items per litre max) and in the near-surface waters (0.5 m) of the Bornholm basin (1.6 - 2.5 items per litre). Preliminary results indicate ubiquitous distribution of the microfibres in the water column of the Baltic Sea with surface and bottom layers revealing higher abundances of microfibres in comparison with intermediate layers, and open-sea waters being less contaminated than the coastal ones. The enhancement of sampling and processing technics is suggested, especially for microfibers analysis. Apart from that, we consider that it is crucial to understand the dynamics of different types of microlitter in the marine environment (e.g., settling, entrainment by currents, resuspension) to explain obtained distribution of particles. It is hypothesized that in the presence of convective mixing, turbulence and various currents, some particles like thin films and fibers would not practically rise of settle but would follow the water movement, which can serve as an explanation for their prevalence in the samples. The research is supported by the Russian Science Foundation grant number 15-17-10020.

"Applicability of chemical index in age determination of weathered plastics"

Song Korea Institute of Ocean Science and Technology, Soeun
Eo Korea Institute of Ocean Science and Technology, Sang Hee
Hong Korea Institute of Ocean Science and Technology, Won Joon
Shim Korea Institute of Ocean Science and Technology,

ABSTRACT

Three synthetic polymers [low-density polyethylene (LDPE), polypropylene (PP) and expanded polystyrene (EPS)] were exposed to outdoor sun light and UV in a laboratory chamber for 12 months. The exposed polymers were sub sampled in every month, and their carbonyl index (CI) and vinyl index (VI) were measured by FTIR-ATR to characterize the degree of photo-oxidation of polymer. When CI and VI were compared between outdoor and laboratory exposure, amount of outdoor sunshine is approximately 24% of UV chamber. CI of PE (2.79), PP (2.66) and EPS (20.0) and VI of PP (0.16) and EPS (2.67) expose to UV in chamber for 4 month was similar to those (3.43, 2.34 and 12.7 for CI, and 0.13 and 2.33 for VI, respectively) in outdoor for 12 months. The CI and VI of PE and PP showed a linear increase with UV exposure duration for 1 year in laboratory exposure (corresponding to 4 years in outdoor), but nonlinear increase for EPS. The CI and VI showed a good correlation by UV exposure time in outdoor exposure. When comparing the VI between outdoor and the field collected samples, the VI of 14 out of 32 PE and 12 out of 16 PP pellets were higher than in those of outdoor samples exposed for 1 year. On the other hand, the CI showed no variation among the field samples, and CI of all the PE and PP pellets were lower than the outdoor exposure samples.

"Are British Columbia Blue Mussels Accumulating Microplastics?"

Dimitrijevic Simon Fraser University, Marie
Nöel Ocean Wise Conservation Association, Leah
Bendell Simon Fraser University, Peter
Ross Ocean Wise Conservation Association,

ABSTRACT

Microplastics (plastic polymers <5mm) are an ever-growing international concern for marine biota. Studies have shown microplastic consumption in taxa ranging from marine mammals, turtles and sea birds to zooplankton, echinoderms and bivalves. Reporting for the first time in British Columbia, microplastic abundances will be described for blue mussels (M. edulis). Between January and March 2017, mussels of the same genetic stock were deployed in cages at 11 locations of varying anthropogenic disturbance within the Strait of Georgia. Mussels and water quality data were sampled at each site on day 0, 30 and 60. Using Corolase 7090 enzyme, individual mussels were digested over a period of 18 hours at 60°C. Digests were then filtered through a 20µm polycarbonate filter and microplastics were quantified and characterized using light microscopy. Fourier-Transform Infrared Spectroscopy is being used to determine polymer type. Microplastic abundances and polymer composition are being compared temporally and spatially to determine if and what kind of microplastics accumulate in these filter feeding invertebrates. Preliminary results suggest low microplastic contamination in mussels over the 60 day study period. These findings may result from the combination of low microplastic environmental contamination at the 11 study sites, selection against microplastics during filter feeding and/or the ability of blue mussels to eliminate microplastics once ingested. Further results will help shed light on the initial notion that blue mussels may have the capacity to reject or eliminate microplastics and are not as vulnerable to contamination as other shellfish such as clams and oysters.

"Assessment of the risks associated with microplastic marine pollution in the food chain"

Gómez Marine Ecophysiology Group (EOMAR), Alicia
Herrera Marine Ecophysiology Group (EOMAR), Ico
Martínez Marine Ecophysiology Group (EOMAR), María Ascención
Viera-Rodríguez Marine Ecophysiology Group (EOMAR), Theodore T.
Pacikard Marine Ecophysiology Group (EOMAR),

ABSTRACT

Marine ecosystems are being invaded by wastes of anthropogenic origin, mostly plastics. In the recent decades a new threat from plastic, microplastics, has been detected. These microplastics, can be ingested by fish, zooplankton, and other organisms and transferred through the food chain. In addition to the physical hazards associated with ingestion, there are also biochemical hazards because microplastics adsorb persistent chemical contaminants (POPs) that bioaccumulate and biomagnify in the food chain. Our studies have revealed that a large amount of microplastics from the ocean accumulate on the Canary Island coast. The Canary Current flows through the Canary Islands in a south-southwest direction, transporting surface wastes that are deposited mainly on the beaches most exposed to the prevailing winds and surface currents. In the areas of maximum concentration, more than 300 grams/m2 of microplastics have been detected from the tide line. In addition, these samples were contaminated by organic chemicals, among them polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides and derivatives of UV filters. Many of these compounds have carcinogenic effects and act as endocrine disruptors (compounds that alter the normal biological function by substituting for hormones). These effects have been scientifically documented.

These organic compounds have already been detected associated with microplastics in waters of the Canary Islands, but it is still unknown how they impact marine organisms and the food chain. Particularly, their impact on the local fishery and human consumption and health is not known, but potentially important. Therefore, we consider it a priority to study the effect that the ingestion of microplastics and their associated contaminants, has on marine life.

"Candidate in-situ Sensing Applications for Plastic Particle Pollution in the Water column"

Robberson US EPA, Harry
Allen EPA, Anna-Marie
Cook USEPA,

ABSTRACT

Microplastic particles (characterized as < 1 mm in size) have been reported in marine ecosystems worldwide and yet, the extent of this pollutant remains poorly characterized. Standardized water column collection, identification and quantification methodologies are urgently needed but also sensing instrumentation must be developed and deployed to guide field studies of this pollutant.

This poster will present groundbreaking research on plastic particle detection in the lab and will evaluate candidate technologies for remote and in-situ plastic particle observation. The session will present the latest in development of deployable sensors and platforms which could be applied to microplastic particle sensing and will include examples of remote sensing and proxy imaging applications for observing and mapping plastic particles. Examples include imaging flow cytometry (Fluid Imaging Technologies, Inc.), fluorescence and Raman spectroscopy and more. Sensing instruments are integral to a systems approach to field study.

"Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients"

Davies Personal Care Products Council,

ABSTRACT

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPCPs) contain a wide array of polymeric ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and have the highest potential to contribute to environmental litter. Environmental exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer's physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer's properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

“Characterizing plastic debris from the North Pacific Subtropical Gyre”

Schwarz The Ocean Cleanup, Aurore
Levivier The Ocean Cleanup, Serena
Cunsolo The Ocean Cleanup, Laurent
Lebreton The Ocean Cleanup, Francesco
Ferrari The Ocean Cleanup, Francesco
Ferrari The Ocean Cleanup,

ABSTRACT

Any plastic debris afloat at sea has a unique story. This includes the original purpose of the plastic, entry point in the ocean, time spent afloat and fate as oceanic debris. In this study, oceanic plastics are characterized and identified. The plastic was collected in the North Pacific Subtropical Gyre during a multi-vessel expedition conducted in 2015. With Fourier transform infrared spectroscopy and a variety of visual methods, including language, age and logo identification and debris characterization, a unique insight on the ocean debris was obtained. Most represented polymer types were polyethylene and polypropylene. For hard plastic fragments, many plastics were unidentified fragments. Some identifiable objects included items with a marine purpose, such as ropes, nets, oyster spacers, containers and eel trap cones. More than 50% of the plastic debris mass was likely originating from fishing and aquaculture industries. Other commonly observed items were bottles, lids and melted plastics. Furthermore, 9 languages were identified for 386 objects, in which Japanese, Chinese and Korean were most represented. 12 countries of production were assigned for 41 objects. 50 particles contained evidence of age, ranging from 1977 up to 2010. Thick, hard plastic debris with a low windage were mostly observed in the North Pacific Subtropical gyre. These unique properties showed that only a fraction of plastic debris reach and persist in open oceanic environments. Other plastic debris, such as films and foams, were only observed in small amounts. With this study, knowledge on debris contributions from land and oceanic sources was improved. Also, characteristics of plastics that persist in the ocean were determined and geographic origins identified. Hence, mitigation strategies can be designed more effectively.

"Data counts! The importance of showcasing locally collected data during the legislative process: Maui County's Polystyrene Foam Bill 127"

King Turtle Island Restoration Network,

ABSTRACT

After a ~6 year legislative process, a bill for an ordinance establishing a new chapter 20.26, Maui County Code, restricting the use and sale of polystyrene foam food service containers passed unanimously on May 18, 2017. Maui County council members evaluated countless documents gathered by a special task force and considered thousands of opinions via petitions plus written and oral testimonies. Furthermore, the council requested an 8-person "expert panel" to deeply examine the latest facts and to get their questions clarified. As one of these presenters, I focused on describing the data collected from 40 monthly marine debris cleanups at Ka'ehu, Maui, Hawai'i. The majority of the 17,825 items were plastic (78.2%) followed by polystyrene foam (8.9%), fabric (4.8%), metal (3.6%), rubber (3.1%), glass (0.9%), and processed wood products (0.6%). Beyond the 8.9% impact, bringing in samples of what had washed ashore right down the road truly resonated with council members. It's a complicated topic, but there was no denying that if polystyrene foam items became litter, they had a significantly more negative effect on our ocean ecosystem than paper-based products that would be suggested to replace them. Similar to banning the bag, this was simply the right thing to do for our islands and future. Mayor Alan Arakawa signed Bill 127 on June 5, 2017, but the effective date isn't until December 31, 2018 so vendors have time to make the switch. A similar Hawai'i Island bill passed on September 20, effective July 1, 2019. Continuing to collect cleanup data consistently before and after these dates will essentially show the effectiveness of these bills. It's a large time commitment, but we highly encourage other projects to incorporate regular data collection into cleanup activities worldwide.

"Distribution and biological implications of plastic pollution on the fringing reef of Mo'orea, French Polynesia"

Connors University of California, Berkeley,

ABSTRACT

Coral reef ecosystems of the South Pacific are extremely vulnerable to plastic pollution from oceanic gyres and land-based sources. To describe the extent and impact of plastic pollution, the distribution of both macro- (>5mm) and microplastic (plastic <5mm) of the fringing reef of an isolated South Pacific island, Mo'orea, French Polynesia was quantified. Macroplastic was found on every beach on the island that was surveyed. The distribution of this plastic was categorized by site type and by the presence of Turbinaria ornata, a common macroalgae on Mo'orea. Microplastics were discovered in the water column of the fringing reef of the island, at a concentration of 0.74 pieces m-2. Additionally, this study reports for the first time the ingestion of microplastic by the corallimorpha Discosoma nummiforme. Microplastics were made available to corallimorph polyps in a laboratory setting over the course of 108 hours. Positively and negatively buoyant microplastics were ingested, and a microplastic particle that was not experimentally introduced was also discovered in the stomach cavity of one organism. This study indicates that plastic pollution has the potential to negatively impact coral reef ecosystems of the South Pacific, and warrants further study to explore the broader potential impacts of plastic pollution on coral reef ecosystems.

"Do microplastics affect marine ecosystem productivity?"

Troost Deltares, Terence
Desclaux Ecole Centrale de Nantes, Heather
Leslie Vrije Universiteit (VU), Myra
Van der Meulen Deltares, Dick
Vethaak Deltares,

ABSTRACT

Marine and coastal ecosystems are among the largest contributors to the Earth's productivity. Experimental results indicate negative impacts of microplastics (< 5mm) on individual algae or zooplankton organisms. Consequently, pelagic marine primary and secondary productivity may be negatively affected by the presence of plastic particles in the water column. In this study we made an attempt to estimate the impacts on productivity at ecosystem level by means of a modelling approach, using our biogeochemical model for the North Sea (Delft3D-GEM). Impacts of microplastics on relevant process parameters of algae and zooplankton were calibrated based on the data from experiments and literature. Although model results suggested that microplastic exposure does not affect the total pelagic primary or secondary production of the North Sea as a whole, relative changes in secondary production locally ranged up to ±10%. In addition, the modeling approach reveals large knowledge gaps which may guide future research. This work was supported by the European Union Seventh Framework Programme (FP7/2007–2013) under grant agreement No. 308370.

"Ecological impacts of microplastic debris in Southern California sandy beach ecosystem"

Steele California State University Channel Islands, Dorothy
Horn California State University Channel Islands, Michaela
Miller California State University Channel Islands,

ABSTRACT

Millions of tons of plastic debris are added to marine and coastal ecosystems annually and microplastic pollution is an emerging concern in these systems. Of particular concern is the durability of plastics, their propensity to attract other pollutants, and tendency to degrade into ingestible microplastics (particles or fibers <5mm). Sandy beaches accumulate marine debris, exposing their detritivorous and planktivorous invertebrate fauna to risk of ingestion. Subsequently there is a risk of tissue-transfer of pollutants and bioaccumulation and bioconcentration of pollutants through the food web. We assessed the distribution of microplastics in beach sediments and examined the rate of ingestion by filter-feeding beach infauna along 900 km of the California coast. Microplastics were ubiquitous in beach sediments and commonly found in the gut of <i>Emerita analoga</i>(Pacific mole crab). We experimentally tested for sublethal effects of microplastics presence on the predator-avoidance behavior and reproductive output of <i>E. analoga</i>. Initial results show no strong effect of ingested microplastics on behavior or metrics of reproductive output, however, particulate feeders like these crabs provide a clear exposure pathway for plastic and adsorbed pollutants to enter marine and coastal food webs. Additional experimental testing is needed to evaluate the extent of the ecological impact of microplastics in these coastal systems.

"Effects of Nanoplastics on the Marine Plankton Communities"

Ripken Okinawa Institute of Science and Technology,

ABSTRACT

Over the last century the anthropogenic effects on the marine ecosystem from ocean acidification and temperature rise to increased organic and inorganic pollution have increased and diversified.

Marine nanoplastic litter is one of the emerging pollutants from synthetic litter, and the impacts of its presence on plankton communities have not been fully understood. As there is no way to return to an ocean without micro- and nanoplastics in it, it is crucial to investigate and understand how their presence changes the chemical and physical interactions in the ocean. Recent studies on algae have highlighted that nanoplastics cause reduction of CO_2 uptake, enhanced production of reactive oxygen species, and a reduction of the chlorophyll a pigment levels as well as the overall growth rate.

Creating a complete picture of chemical and physical effects for planktonic species will require growth inhibition tests (checking chlorophyll a, cell viability, growth rates) and single-cell PCR to establish which genes are responsible for the reported reduction in chlorophyll a content and reduced growth rates.

While it is known that nanoplastic particles are transferred in the planktonic food web, it has not been investigated whether the process starts with planktonic primary producers (autotrophic) or only in the higher trophic levels (mixo- and heterotrophic). We complete the picture by examining the effects of nanoplastics on phytoplankton and by continuing with higher trophic levels including mixotrophic and heterotrophic organisms. We will compare the effects of direct ingestion of nanoplastics by heterotrophic dinoflagellates and large ciliates with indirect ingestion via prey. Answers to these questions will elucidate the overall effects nanoplastics have in the marine environment.

"Examining incorporation of microplastics into marine snow: A comparison of shape and plastic type"

Mladinich Microplastics of different shapes and sizes are produced as a primary product or as a by-product from the breakdown of larger plastic debris. Polypropylene (PP) and polyester (PE) are common microplastics in marine debris and are used in the production of, Abigail
Plungis University of Connecticut- Avery Point, Jennifer
Wozniak University of Connecticut- Avery Point, J. Evan
Ward University of Connecticut- Avery Point,

ABSTRACT

Microplastics of different shapes and sizes are produced as a primary product or as a by-product from the breakdown of larger plastic debris. Polypropylene (PP) and polyester (PE) are common microplastics in marine debris and are used in the production of marine equipment and clothing. Larger plastics debris are fouled in surface waters, causing the typically buoyant debris to sink. Similarly, the sinking rate of buoyant microplastics would increase when these particles are incorporated into marine snow (heteroaggregations). Marine snow offers a medium for microplastic delivery to organisms such as bivalves, leading to high levels of exposure following increased microplastic flux to the benthos. We know little, however, about the rate and efficiency at which plastic particles are incorporated into heteroaggregations. This study examined how PP and PE were incorporated into marine snow. Plastic particles were suspended in natural intertidal seawater filtered through a 210 µm sieve to remove large material, but retain natural particulates and transparent exopolymer particles; important for natural aggregation. Plastic suspensions were transferred to 1-L bottles and placed on a roller table. Incorporation rate was determined over a 5-day period by sampling aggregates from some bottles after days 1, 3 and 5. Aggregation rate was then compared between the two types (PP fibers and PE fibers) and the two distinct shapes (PP fibers and PP granules) of microplastics. Results of these experiments provided insight into how physiochemical properties of microplastics mediate their incorporation into marine snow.

"Floating an international problem to local officials: the story of the booms, the blocks, and the bags"

Carson Washington Dept. of Fish and Wildlife,
, National Institute of Standards and Technology

ABSTRACT

Hawai'i Island has become famous for Kamilo, or "Junk Beach", where a staggering amount of plastic debris accumulates from around the North Pacific. On field trips to the beach, students found objects of apparently local origin among the debris and wondered the extent to which their community contributed to this global issue. We investigated this using debris-retention booms in the urban watersheds of Hilo, which we used to quantify the amount and types of debris generated. We then released wood block drifters below the booms to simulate where the captured debris would have gone. Although some drifters did wash up near Kamilo, a more surprising result was the number (up to 24% of one release) that were recovered on other Hawaiian Islands. Students presented their data to the local council while they considered, and eventually passed, a ban on plastic bags.

“Floating macro and microplastics in the Mediterranean Sea: is there a spatial overlap?”

Suaria CNR-ISMAR, Paolo
Celentano CNR-ISMAR, Stefano
Aliani CNR-ISMAR,

ABSTRACT

The Mediterranean Sea is one of the most impacted regions of the world by marine litter, however detailed knowledge on the existing relationship between the distribution of different plastic size classes in off-shore environments is still limited. We present the results of a large-scale synoptic survey of floating macro (> 2 cm) and micro (< 5 mm) plastics performed in the central and western Mediterranean basin with the main goal of improving our understanding of the size distribution of plastic items at sea. During two consecutive cruises, the abundance of floating macro-litter (FML) was estimated through visual survey techniques (line transect/distance sampling), while microplastics were sampled at the same time and locations using a 200 m Neuston net. The concentrations of both size fractions were computed and expressed as number of items/km^2, then the spatial correlation between size classes was explored and graphically represented at different grid resolutions throughout the study area. A very high level of spatial heterogeneity in both macro and microplastic abundance was found, however no significant basin-scale correlation emerged between the two variables. FML abundance in Mediterranean surface waters is not always correlated to the abundance of microplastics and vice-versa, accumulation areas of synthetic microparticles do not always correspond to high concentrations of FML. No significant correlation with environmental variables such as salinity and sea surface temperature was found, suggesting that macro and micro-debris do not always originate from the same sources and they probably respond to different drivers at different spatio-temporal scales.

"Gulf of Microplastics- microplastic abundance and transport along the continental shelf in the northern Gulf of Mexico"

Wessel Dauphin Island Sea Lab, Just
Cebrian Dauphin Island Sea Lab,

ABSTRACT

Recent calculations have shown that 10% of all plastic produced around the world ultimately ends up in the ocean. Eventually that plastic will break down into smaller and smaller pieces, smaller than 5 mm, called microplastics that can harm sea life and end up in our food. Studies and research cruises have sampled microplastic concentrations across the Pacific, Atlantic, Southern, and Indian Oceans, in the Mediterranean, Adriatic, and Black Seas, and in the Persian Gulf and many of these numbers have been used to estimate microplastic concentrations world-wide using modeling. In collaboration with NOAA Fisheries SEAMAP sampling in the Gulf of Mexico during September of 2016 and 2017 we collected the first Gulf-wide estimates of sea surface and water column abundances of microplastics ranging from offshore of Brownsville, TX in the west to the Florida Keys in the east. Using a combination of whole water sampling, and neuston and bongo tows we were able to capture microplastics ranging in size from 1 µm to 5mm and document various types of plankton that had consumed microplastics. So far 36 separate stations have been sampled across the continental shelf of the northern Gulf of Mexico. Microplastics were found in every tow and out of 244 whole water samples collected 99% contained microplastics with an average of 7 microplastics per liter. This is much higher than estimates of less than 1 microplastic per meter squared that models produced in 2015 using data from the Atlantic Ocean predicted for the Gulf of Mexico. In addition, we also found an opposing trend when there were high concentrations of microplastics at the surface there were lower concentrations in the water column and vice versa.

"Hanging by a fibre: The danger of sample contamination by airborne plastic fibres"

Kühn Wageningen Marine Research, Anastasia
O'Donoghue University of Utrecht, Jan Andries
van Franeker Wageningen Marine Research,

ABSTRACT

Fibres originating from clothing are ubiquitous in the environment. Studies focusing on microplastic ingestion by fish and invertebrates have reported fibres as composing 100% of the ingested plastics. However, recent studies show that in common lab facilities it is impossible to exclude contamination of samples through airborne fibres. Scientists must be aware of this so as to not overestimate the extent of plastic ingestion by (marine) organisms. In order to provide a more realistic overview of the kinds of (micro)plastic ingested by (marine) organisms, we recommend reporting fibres and other plastic types separately. Ideally, this would be accompanied by a description of what was done to avoid or minimise airborne contamination.

"Identifying microplastics in North Sea waters – A matter of extraction and detection"

Lorenz Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research, Biologische Anstalt Helgoland, Lisa
Roscher Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research, Biologische Anstalt Helgoland, Melanie
Meyer , Sebastian
Primpke , Gunnar
Gerdts Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research, Biologische Anstalt Helgoland,

ABSTRACT

In times of a rising plastic production the occurrence of microplastics (< 5 mm in size) in the marine environment has been identified as an emerging topic of global concern. Microplastics are omnipresent in our environment, hardly degradable and are easily ingested by a wide range of organisms throughout all trophic levels.

However, the extent of this microplastic pollution as well as the resulting impacts on the marine environment remains largely unknown. Therefore, standardized and reliable methods to securely detect microplastics are urgently needed. The conclusive identification requires a successful extraction from different, complex environmental matrices.

Thus we developed a highly promising procedure to successfully analyze also small microplastics (11-500 µm) isolated from surface water samples. This procedure includes the usage of an enzymatic-oxidative purification in newly developed semi-enclosed filtration units (microplastic reactors). This is followed by a state-of-the-art analysis via micro Fourier transform infrared (µFTIR) spectroscopy.

The aim of this work is to contribute to the field of microplastic research by applying innovative analysis techniques as well as generating solid and comparable data. These provide information on quantities, polymer and size composition as well as spatial distribution of microplastics in North Sea surface waters.

First results show that microplastics are present in the North Sea exhibiting a variety of polymer types, dominated by rubbers and polyethylene. Concerning the size, the vast majority of the detected microplastic particles is less than 75 µm in length.

"Impacts of Microplastic on Reproductive Development in Pacific mole crabs on the Oregon coast."

Horn Portland State University, Elise
Granek Portland State University,

ABSTRACT

Microplastic are an emerging pollutant in marine and coastal ecosystems. Millions of tons of plastics are added into these systems annually and are of particular concern due to their, persistence, propensity to attract other pollutants, their toxicity and tendency to degrade into microplastics (particles or fibers <5mm) making them easily ingestible. Sandy beaches are consistently exposed to plastic accumulation from wave action and near shore currents exposing the infauna to persistent plastic pollution. Pacific mole crabs (Emerita analoga) are filter feeders that have been shown to ingest microplastic. To assess the impact of polyethylene fibers on the reproductive development of Pacific mole crabs, adult females were exposed to environmentally relevant concentrations of polyethylene fibers (<1mm) for 2 months during a reproductive cycle. Effects were investigated on offspring development. Our study shows that the exposure and ingestion of polyethylene microplastic debris at environmentally relevant concentrations may alter the reproductive systems in adult Pacific mole crabs and warrants further research.

"Impacts of Temperature and Selected Chemical Digestion Methods on Microplastic Particles"

Munno University of Toronto, Paul
Helm Ontario Ministry of the Environment and Climate Change, Donald
Jackson University of Toronto, Chelsea
Rochman University of Toronto, Alina
Sims Ontario Ministry of the Environment and Climate Change,

ABSTRACT

Microplastics, particles of plastic less than five millimetres in size, come from several sources including industry, consumer products and the breakdown of larger plastics. Chemical digestion methods are often used to isolate microplastics from organic matrices for the purpose of quantification and identification of polymer types. We used several types of microplastic particles to assess alkaline and wet peroxide oxidation (WPO) chemical digestion techniques for recoveries of a known quantity of the microplastics and for possible impacts on the ability to identify polymer types. The tested microplastics were representative of those often found in environmental samples, including microbeads isolated from personal care products, polystyrene foam, polyethylene shavings, and nylon carpet fibers. We found that methods using WPO generated enough heat to result in the complete loss of some types microbeads from personal care products, and boiling tests confirmed that temperatures >70 °C were responsible for the losses. Analysis of recovered particles by Fourier transform infrared spectroscopy confirmed minimal alteration of the recovered polymers by the applied methods. Our results suggest that temperatures of less than 60 °C need to be maintained during chemical digestions to ensure that microplastics, particularly microbeads from personal care products, are not lost from the process.

"Implementation of a sensitive GCMS-Pyr based technology to estimate fluxes of microplastics in sewage treatment plants"

Gomiero International Resarch Intitute of Stavanger, Geir
Skogerbø IVAR IKS, Kjell Birger
Øyestad International Resarch Institute of Stavanger, Mari
Mæland International Research Institute of Stavanger, Anne
Vatland Krøvel International Research Institute of Stavanger,

ABSTRACT

Substantial amounts of microplastic particles are likely to be collected in the sewage system, mainly deriving from cleaning of synthetic clothing, and waste water disposal facilities have been identified as point sources of microplastic in the aquatic environment. Today's waste water treatment plants (STP) are not designed to manage microplastics. The main objective of this study was to develop a standardized method to collect, quantify and characterize microplastic particles. This study aims at contributing to the knowledge about the possible significance of waste water treatment facilities as point sources of micro-plastic particles into food chains both in water and land. Special attention is addressed to the sewage sludge, a valuable by-product of the sewage treatment process being adopted in agriculture production. According to Scandinavian practice stabilized waste water sludge shall preferably be utilized on agricultural soil. However, more research is needed to understand the incidence, potential accumulation and biological adverse effects of micro-plastic in aquatic and terrestrial ecosystems. We have implemented a pyrolysis-gaschromatography-mass spectrometry (Pyr-GC-MS) methodology to waste water filtrates, sludge and plant material. Applied to waste water deriving from the Stavanger area, a typical Scandinavian urban settlement of about 250.000 inhabitants, the data obtained so far suggest a microplastic content (100-500 um) in the influx water of approximately 0.5 % of the water dry matter content, divided fairly evenly between the five plastic types tested. Application of the methodology to a wider range of WWTPs will bear out whether similar figures generally holds in a Scandinavian context.

"Influence of sampling techniques and density separation methods on the quantification of benthic microplastics"

Pagter MFRC, João
Frias MFRC, Ian
O'Connor GMIT, Róisín
Nash GMIT,

ABSTRACT

The rapid development of the microplastic research field in recent years has led to an increase in publications from around the world. To date there has been no preferred benthic sampling tool or separation technique for microplastics in sediment, which makes comparison of data between studies and areas very difficult. This research is part of the JPI-Oceans BASEMAN project, and aims to contribute to these knowledge gaps in sampling through comparing benthic tools (van Veen grab; Reineck box corer, gravity core) and laboratory density separation techniques (elutriation column, sodium chloride solution, sodium tungstate dihydrate solution).

Subtidal sediment samples (27), classified as sand, were collected from Galway Bay, Ireland. Microplastic fibers were recorded from all samples and represented 94% of all findings with the remaining 6% being fragments. While the van Veen grab recorded a higher average abundance of microplastics per kg dry weight (102) when compared to the Reineck box corer (94) and/or the gravity core (80) there was no statistically significant differences between these sampling tools. The sodium tungstate solution proved to be a feasible option for density separation with 210 microplastics per kg dry weight recorded which was statistically significant when compared to the other techniques such as sodium chloride (90) and the elutriation column (50). Design issues with the column used didn't allow for a realistic comparison and were disregarded from further comparisons.

When cost, which includes the time to deploy benthic grabs, is added as a criterion along with efficiency to produce reliable results, then this study suggests that the Reineck box corer and sodium chloride be recommended as best practice for future benthic sampling and density separation techniques for microplastic monitoring.

"Influence of Varying Environmental Conditions on the Leaching of Flame Retardant Additives from Polyurethane Foam Microplastics"

Evans Virginia Institute for Marine Science, Drew
Luellen Virginia Institute for Marine, Mark
LaGuardia Virginia Institute for Marine Science, Kelley
Uhlig Virginia Institute for Marine Science, Robert
Hale Virginia Institute for Marine Science,

ABSTRACT

Polyurethane foam (PUF) is widely used in cushioning and insulation. While PUF is typically a minor constituent of marine debris, it often contains a substantial additive load and fragments into microplastics faster than most polymers. In an aquatic system, additives such as brominated and organophosphate ester flame retardants (BFRs and PFRs) may be released. To investigate this, we exposed PUF microparticles to varying water temperature, salinity, humic acid and proxy digestive fluids. Experiments were conducted by passing 1 L of the desired fluid through a sand column containing ~400 mg of microparticles over 24 hours. BFRs and PFRs were measured in leachate using ultra-high performance liquid chromatography/mass spectrometry. Releases of flame retardants varied from ~10 to 10,000 ng/L, as a function of additive type and test condition. Increasing salinity (0-35) generally decreased BFR leaching. Increasing temperature (4-40C) increased BFR and PFR leaching. Increasing humic acid and digestive fluid concentrations increased BFR, but had minimal effect on PFR leaching, likely due to PFRs' already substantial water solubilities. PUF microparticle surface areas and structure were examined using the Brunauer, Emmett and Teller (BET) approach and Scanning Electron Microscopy (SEM). FR leaching was modestly affected by surface area, presumably due to the narrow size range tested. This study has implications for water quality and aquatic health, whereby low salinity, high temperature, high dissolved organics concentration or ingestion may increase flame retardant leaching. Leaching is also a concern in natural disaster scenarios (such as Hurricanes Harvey, Irma and Maria) whereby indoor PUF is inundated by flood waters and removed to the street or landfill, potentially contaminating flood water and runoff.

"Investigating the population-level impacts of a range of microplastics to Fathead Minnows"

Bucci University of Toronto, Dave
Poirier Ministry of the Environment and Climate Change, Paul
Helm Ministry of the Environment and Climate Change, Chelsea
Rochman University of Toronto,

ABSTRACT

Plastic pollution is accumulating in aquatic ecosystems at an unprecedented rate. In marine environments around the world, the presence of microplastic pollution (plastic debris <5mm) has been well-documented. In freshwater environments, however, observations of microplastics have been much more rare. In fact, relatively little is known about the biological or ecological impacts of microplastics in freshwater communities. Furthermore, there is a significant lack of ecologically relevant studies, employing relevant microplastic shapes, sizes, and concentrations, and studying relevant life-stages. The objective of my project is to understand the potential population-level impacts of microplastics in fish using the Fathead Minnow, a representative Great Lakes fish species. By exposing Fathead Minnow eggs to environmentally-relevant microplastics and their leachates, I will test egg hatchability and survival in fish embryos. I plan to test a range of microplastics, which may include polyethylene and polypropylene fragments, polyurethane foam, polystyrene, tire dust, and bioplastics. I will use standard measures to observe the hatchability of eggs, and survival and growth in larvae to determine whether there are significant differences among treatments and compared to the control. Results to date will be presented at this conference.

"Leachate toxicity of microplastics from artificial sports pitches"

Halsband Akvaplan-niva, Dorte
Herzke Norwegian Institute for Air Research, Andy
Booth SINTEF Ocean,

ABSTRACT

Rubber particles from car tires have been identified as a major source of microplastics in the coastal waters of Norway. Crumb rubber samples collected from a sports field in northern Norway (Tromsø) have been incubated in filtered seawater for two weeks to produce a leachate solution. The major contaminants recorded in the leachate were heavy metals and PAHs. The supernatant of this mixture was added to culture media for marine planktonic copepods in concentrations varying from 5 to 100%. Two species of copepods were exposed to these media and mortality rates were recorded. The results show significantly higher mortalities in exposures than in controls at all concentrations. The dose-responses of the two copepods were, however, different, where the smaller species (Acartia longiremis) was more sensitive than the larger one (Calanus finmarchicus). The ecological consequences for individual marine species as well as ecosystems are discussed.

"Levels of Hexabromocyclododecane (HBCD) in expanded polystyrene (EPS) marine debris and microplastics from South Korea and the Asia-Pacific coastal region"

Jang Korea Institute of Ocean Science & Technology (KIOST), Won Joon
Shim Korea Institute of Ocean Science & Technology (KIOST), Gi Myung
Han Korea Institute of Ocean Science & Technology (KIOST), Rani
Manviri Korea Institute of Ocean Science & Technology (KIOST), Young Kyoung
Song Korea Institute of Ocean Science & Technology (KIOST), Sang Hee
Hong Korea Institute of Ocean Science & Technology (KIOST),

ABSTRACT

The role of marine plastic debris and microplastics as a carrier of hazardous chemicals in the marine environment is an emerging issue. This study investigated expanded polystyrene (EPS, commonly known as styrofoam) debris, which is a common marine debris item worldwide, and its additive chemical, hexabromocyclododecane (HBCD). To obtain a better understanding of chemical dispersion via EPS pollution in the marine environment, intensive monitoring of HBCD levels in EPS debris and microplastics was conducted in South Korea, where EPS is the predominant marine debris originate mainly from fishing and aquaculture buoys. At the same time, EPS debris were collected from 12 other countries in the Asia-Pacific region, and HBCD concentrations were measured. HBCD was detected extensively in EPS buoy debris and EPS microplastics stranded along the Korean coasts, which might be related to the detection of a quantity of HBCD in non-flame-retardant EPS bead (raw material). HBCD was also abundantly detected in EPS debris collected from the Asia-Pacific coastal region, indicating that HBCD contamination via EPS debris is a common environmental issue worldwide. Suspected tsunami debris from Alaskan beaches indicated that EPS debris has the potential for long-range transport in the ocean, accompanying the movement of hazardous chemicals. The results of this study indicate that EPS debris can be a source of HBCD in marine environments and marine food web.

“Macroplastic counts at sea in eastern Sicily, Mediterranean Sea”

Frey OceanCare,

ABSTRACT

It is evident today that plastic debris is a major threat to marine life. The Mediterranean Sea has been identified as one of the worldwide “hotspots” for land- and sea-based sources of plastic and microplastics. However, information on the quantitative extent of marine plastic pollution and the temporal evolution of the abundance of floating plastics are still lacking. In the context of a long-term cetacean monitoring project in eastern Sicily (incl. Strait of Messina), Mediterranean Sea, we started to examine the extent of the plastic pollution in the surface waters based on visual debris counts.

Floating debris on the water surface has been counted continuously during line transect surveys and recorded on a standardised protocol in 20-minute intervals. Counts were assigned to 12 categories (e.g. fragments, nets, bags, and non-plastics). Density maps (plastic items/km2) have been established.

Floating debris has been counted during 298nm and 690nm in 2016 and 2017, respectively. Our results confirm that floating debris is ubiquitous as almost no count interval resulted in 0 observed floating items. More than 50% of observed debris consisted of plastic fragments. Highest numbers of floating plastic items have been found in the more northern part of the study area near the Strait of Messina.

Our first study results allow to identify local “hotspots” of floating plastic debris in the study area and thus add information about the habitat quality. Our sampling efforts will be continued in the future and complemented by microplastic surface sampling, as well as the analysis of the chemical composition of both floating plastic and microplastic. Moreover, our data may serve as a basis for future modelling approaches to better understand the spatial and temporal distribution of floating plastic debris in the are

"Marine Debris Removal as restoration under Oil Pollution Act"

Ammann National Marine Fisheries,

ABSTRACT

Under the Oil Pollution Act (OPA) 1990 restoration following an oil spill must be scaled to the damaged incurred by the natural resources and services lost due to the spill. Work has been conducted on human use losses and gains due to Marine Debris on public beaches but not in the area of natural resource restoration. To conduct natural resource scaling it is necessary to quantify the effects of marine debris removal in a way that can be scaled to the damages incurred. Two methods commonly used in scaling for OPA cases are Habitat Equivalency Analysis (HEA) and Resource Equivalency Analysis (REA) . This poster walks through logic models for quantifying marine debris removal as restoration for REA and HEA scaling, identifies data gaps for these logic models, proposes experimental designs for filling these data gaps, and discusses current work on this in Alaska.

"Marine debris research to identify solutions"

Frazer Beach Environmental Awareness Campaign Hawaii, Dean
Otsuki Beach Environmental Awareness Campaign Hawaii,

ABSTRACT

A non-profit organization in Hawai`i is researching and sorting marine debris from the Great Pacific Garbage Patch in order to find long term solutions to the problem. Items collected from beaches on the islands of O`ahu, Hawai`i and Lana`i from 2008 to 2012 have been sorted, counted and where possible, the manufacturer, country of origin and industry is identified. Signficant findings from this project including total number of items collected, the types of items, origins and recommendations for solutions will be shared. Solutions will be proposed at the local, state, national and international level. (As this research project is currently underway in 2017, the data will not be available until the conference in March 2018).

“Methods for the detection of microplastics ingested by fish”

Digka Hellenic Center for Marine Research (HCMR), Catherine
Tsangaris Hellenic Center for Marine Research (HCMR), Giuseppe Andrea
de Lucia Institute for Coastal Marine Environment-National Research Council (IAMC-CNR), Luca
Palazzo Institute for Coastal Marine Environment-National Research Council (IAMC-CNR), Ana
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Raga Science Park, Marine Zoology Unit, Cavanilles Institute of Biodiversity and Evolutionary Biology University of Valencia Paterna, Claude
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ABSTRACT

The MEDSEALITTER project aims to detect microplastic ingestion by fish inside and outside Mediterranean Marine Protected Areas. Starting from a literature review, we applied and tested methods proposed for the detection of ingested microplastic in order to adopt a common methodology among partners. The efficiency of three tissue digestion methods was tested (H2O2 15%, H2O2 30%, KOH 10%) on gastrointestinal tracts of 25 anchovies (Engraulis encrasicolus). Fish tissue (aprox. 0.60g) was enriched with specific number of microplastics ranging from 300-1000 um (10 particles/ sample). Five types of plastic were tested: PE, PP, PVC, PS and PET. After digestion and filtration, samples were observed under stereoscope and microplastics were counted. Ultrasonic separation method was also tested. Two mussels (Mytilus galloprovincialis) were exposed to 0.060g of PE particles (300- 1000 um) individually in 1L tanks for one day. Digestive gland and gills were extracted. Among the three digestion methods, H2O2 15% seems to be the most efficient in terms of both digestion efficiency and time consumed. According to our results, H2O2 15% indicated the highest percentage of recovery (94%), following this of KOH (92%) and that of H2O2 30% (86%). In terms of time needed for each digestion method both H2O2 15% and 30% were the fastest with no significant difference between them. KOH 10% needed more than 7 days to sufficiently digest organic matter, but was the most efficient method in terms of tissue digestion although pieces of tissues were visible in the sample after digestion. Ultrasonic treatment resulted in partial separation of microplastics from tissue, since few particles remained in the tissues after treatment, however further investigation is needed.

"Microbial Communities on Plastic Marine Debris Accumulation in the Nearshore Karachi Coastal Waters"

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ZIA NATIONAL INSTITUTE OF OCEANOGRAPHY, ABDUL
HASEEB NATIONAL INSTITUTE OF OCEANOGRAPHY, REHAN
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ABSTRACT

Karachi city with population of about 18 million is the biggest trade & economic center/industrial hub of the country generating approximately 8,700 tons of litter (domestic solid wastes) per day of which plastic is the major components of it. However, the arrangements for garbage collection, composting and recycling are not adequate to handle the entire waste generated by the city. High proportions of the solid waste is at the mercy of winds to find its final destination to the beautiful and fragile environs of most visited Karachi coast together with over 400 million gallons untreated effluents. The domestic waste together with plastic debris spread along the coast and deposited in the low lying areas. However, no study has yet been made on peculiar and more serious issue relate to plastic debris and bacteria assemblages on it in the coastal marine environment of Pakistan.

Present study is attempting to focus on monitoring plastic debris that has potential to host variety of micro-organism, that are threat to coastal community along Karachi coast. The initial results of the study revealed that higher number of bacterial colonies including hydrocarbons degrading bacteria embedded in cracks and pits on plastic surfaces as compared to surrounding waters. The identified species were Escherichia coli, Staphylococcus aureus, faecal Streptococci, Pseudomonas stutzeri, Bacillus subtilis, and Micrococcus luteus. Faecal coliforms and Escherichia coli were dominant among all bacterial species on the surface of the polyethylene bags collected fro

"Microplastic contamination in wild and commercial bivalves from South Korea"

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Jang Korea Institute of Ocean Science & Technology, Gi Myung
Han Korea Institute of Ocean Science & Technology, Won Joon
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ABSTRACT

As plastic debris breaks down to small plastic particles in the environment, it becomes available for ingestion by a wide range of small marine organisms. Among them, bivalves are important monitoring species because they are filter feeders that that filter large amounts of seawater and therefore likely to expose to microplastics present in the water column. Additionally, bivalves are one of the popular seafood for human consumption. This study investigated microplastic contamination in wild and commercial bivalves (oysters and mussels) from the Korean coats and fishery markets, respectively. Wild bivalves were collected from ten locations along the Korean coasts and commercial bivalves are bought from fishery markets in three major cities. Microplastic pollution was widespread in both wild and commercial bivalves from Korea with detection frequency of 95%. The mean concentration of microplastics was 0.67 ± 0.6 particles / g (3.45 ± 4.49 particles / individual) in wild bivalves and 0.10±.0.09 particles / g (0.73 ± 0.70 particles / individual) in commercial bivalves. The relatively low levels of microplastics in commercial bivalves might be due to the depuration of ingested particles during transportation and storage. In both samples, fragment (> 80%) was the dominant type of microplastic, and the most common size class is 100 – 200 µm (> 40%). The dominant polymer type was polyethylene (PE), followed by polypropylene (PP) > polyester > polystyrene (PS) in wild bivalves, while in commercial bivalves PS was the dominant type followed by PP > PE > polyester. The relative abundance of PS in commercial bivalves might be related to their culturing method using expanded polystyrene buoys.

“Microplastic ingested by fish could be a new indicator of debris impact?”

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ABSTRACT

monitoring the ingestion of litter is a complex task, indentifying interactions between marine litter and marine organism depends on the quantity and quality of data collection. Guidance developed according to Marine Strategy Directive, OSPAR, HELCOM and Barcelona Convention, furnish general approaches and strategies for marine litter monitoring giving emphasis to develop indicators to determine impacts of litter on marine life (biota). Given their propensity to ingest debris, their wide distribution and the large range of habitats used during their life, sea turtles, in particular the species Caretta caretta, were proposed as possible indicator for the Mediterranean basin and the sea birds Fulmarus glacialis for the Northern European waters. Fish are considered another target for developing monitoring purposes on ingestion of litter by marine organism. This work analyses the feasibility of “microplastic ingested by fish” as an indicator of debris impact. The choice of a good indicator species depends on the wide distribution, the sensitivities of species, the ingestion rate and impact mechanisms. A search of the available original peer-reviewed literature was performed. Information on sampling procedure, geographical location, species examined, laboratory analyses, plastic frequency of occurrence, size of plastics and type, was extracted from each article. Each paper was critically examined and data collated to allow for a comparative analysis and general overview. Possible source of bias have been analyzed for field sampling, isolation procedure and identification, in addiction procedure to minimize contamination have been considered. New data, have also been used to evaluate the potentiality of this indicator, trough experimental catches and analysis.

"Microplastic Pollution below 500µm in the Highly Urbanized Waterways Surrounding Long Beach, CA"

Wiggin California State University Long Beach, Erika
Holland California State University Long Beach,

ABSTRACT

Plastic production has drastically increased over the last 60 years, and consequently so has marine plastic pollution. New research demonstrates a vast prevalence of smaller plastic particles in the marine environment, known as microplastics (MP;<5mm). MP pollution presents an increasing concern as smaller sizes can be consumed by lower trophic species vital to the bottom of the food chain. Even though recent studies have shown that invertebrate zooplankton can eat plastic particles from 1µm to 30µm, common sampling protocols only samples plastic greater than 333µm, a common plankton net mesh size. To address this data gap, the presence of MP sized 3-500µm was assessed in Long Beach Harbor, the San Gabriel River (SGR), and the Los Angeles River (LAR) (CA;USA), three areas with highly urbanized surroundings. The efficacy of different digestion protocols to breakdown organic material such as algae and organic fibers was evaluated comparing Wet Peroxide Oxidation (WPO), enzymatic digestion (Cellulase), and hydrogen peroxide. Digestion trials demonstrated that 15% hydrogen peroxide was highly efficient at digesting organic material, and the simple protocol minimized contamination and loss of virgin plastic particles compared to other methods. Field samples collected were quantified in 20L surface water grab samples and particles size fractionated through sieves of various pore sizes. Particles present on each sieve were subject to the hydrogen peroxide digestion protocol and quantified and categorized under 40x-200x magnification. Preliminary assessments utilizing digestion revealed 1,650 MP/m3 in SGR and 9,593 MP/m3 in LAR. This project will help establish a standard processing protocol for MP quantification to include sizes below 500µm to help understand the risk that small MP pose to invertebrate zooplankton.

"Microplastic pollution in the Canary Islands"

Herrera , Maite
Asensio , Ico
Martínez , Ted
Packard , María
Gómez ,

ABSTRACT

Marine litter and its effects on the biosphere are a growing concern in the scientific community. Microplastics, one component of marine litter, because of their small size, can be ingested by zooplankton and thus enter the food chain. In this way, chemical contaminants associated to microplastics can bioaccumulate and biomagnify at higher trophic levels. The MICROTROFIC project has carried out an annual study of microplastic contamination in three beaches of the Canary Islands. It has also made the first ingestion study of microplastics in the pelagic coastal fish, Scomber colias. The results obtained confirmed the high levels of pollution present in the beaches of the Canary Islands, with concentrations reaching 300 g/m2. Among the debris found, there were also high levels of tar pollution on two of the beaches. The microplastics ingestion study found that 78.3% of the fish were impacted. The microplastics found were mainly synthetic fibers (74.2%), plastic fragments (11.9%) and boat paint-chips (11.5%). The next phase of the MICROTROFIC project will determine the concentration of associated chemical contaminants (POPs and emerging pollutants) and evaluate the effects on fish physiology using the biomarker technique, CEA (Cellular Energy Allocation).

"Microplastic Pollution in the Snake River: A 'snap shot' view from the Greater Yellowstone Ecosystem to the Pacific Ocean"

Kapp Central Wyoming College, Ellen
Yeatman Central Wyoming College,

ABSTRACT

In 2015, the United Nations recognized microplastics (plastic particles less than 5 mm) as one of the world's most important emerging environmental contaminants. These particles threaten biota not only by physical harm, but they also adsorb potentially harmful toxins such as POP's and metals while leaching out additives like phthalates and bisphenol A, suggesting a plausible risk for bioaccumulation in the food web. While microplastics are considered ubiquitous in the marine environment, less is known about their occurrence in freshwater systems. The Snake River, the largest tributary in the Columbia River Basin (1,078 miles), travels through Wyoming, Idaho, Washington and Oregon. The river is highly prized for its recreation, world class fishing and irrigation. Beginning in one of the least populated and intact ecosystems in the U.S, it flows through increasingly more populated areas and human dominated landscapes. This study is the first to report on the occurrence of microplastic particles in the Snake River and identifies potential hotspots worthy of more thorough investigation. Both grab (average sample volume 1.86L) and 100µm plankton net (average volume 3,328 L) samples were collected every 50 river miles along the Snake River from the Greater Yellowstone ecosystem to its confluence with the Columbia River, and along the Columbia to the Pacific Ocean (n = 28) June-August, 2016. Preliminary results from both sampling methods show that over 80% of samples contained microplastic. Sample concentrations ranged from 0 to 0.012 L-1 (plankton net samples) and from 0 to 7.027 L-1 (grab samples).

"Microplastics identification by Py-GC/MS: method optimization and validation"

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Boricaud Anses, Laboratoire de sécurité des aliments, Charlotte
Himber Anses, Laboratoire de sécurité des aliments, Guillaume
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Dehaut Anses, Laboratoire de sécurité des aliments,

ABSTRACT

Recently, the scientific community has been interested in the plastic pollution. Indeed plastic are found to be the major debris found in marine litter. Moreover, ingestion of microplastics particles (<5 mm) by numerous seafood products has been documented, and 80% of particles would have a size comprised between 50 and 100 µm. Therefore, microplastics can represent an emerging problem regarding seafood consumption. Only a few studies performed the identification of plastic polymers with reliable methods using spectroscopy (FTIR or Raman) and chromatography coupled with mass spectrometry. For a few years, Pyrolysis-GC/MS (Py-GC/MS) has been used to get more information on the composition of plastic polymers with some applications on microplastics. This technique is also relevant to specifically identify polymers and plastic additives. The purpose of this work was to optimize and validate a Py-GC/MS method to accurately identify MPs as small as possible. Optimization on multiple GC parameters was carried out using polyethylene (PE) and polypropylene (PP) particles (size: 100 – 400 µm). Validation was made by calculating LOD for multiple polymers and performing repeatability and reproducibility tests. Finally, the optimized method was applied to different samples, including different plastics from sediments and organisms collected in the marine environment The optimized Py-GC/MS method allows to accurately identify unknown particles down to 50 µm.

"Microplastics in a North Queensland River, quantifying plastic sources in the Great Barrier Reef"

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Hoogenboom James Cook University, Mark
Hamann James Cook University,

ABSTRACT

Microplastics have been recorded in oceans around the world. However, understanding the sources on a local scale remains a large knowledge gap in the scientific community. Recent research has shown that rivers can transport large quantities of plastic pollution to the ocean. This is often attributed to sewage, storm water drains, and pollution effluents entering directly into the river, which later flows into the ocean. Further identifying river systems as a source is important to understanding marine plastic pollution at a finer scale, and can help provide insight on how to mitigate the problem on a local scale. In Australia, microplastics have been recorded in surrounding oceans nation wide, but little is known about the sources contributing to sensitive habitats, such as the Great Barrier Reef (GBR). The following research focuses on microplastic abundance in the surface water and sediments of a north Queensland river, which is influenced by storm water effluents. Samples were collected before and after heavy rain periods to determine plastic runoff within the river outside the storm drains, and into the nearshore reefs of the GBR.

"Microplastics in Arctic surface water and sea ice: Korean Ice Breaker ARAON Expedition"

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ABSTRACT

The Arctic is one of the pristine environments on earth but is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces/m3 in sea ice and 0.34 pieces/m3 in the Atlantic arctic polar water). However, there is still unclear in transport pathway of MPs to arctic environment. We investigated MP in the Pacific ocean-side polar region covering Bering Strait and Chukchi Sea, expedited by Korean research ice breaker R/V ARAON in 2016 (ARA07B; Aug /05-21/2016). The results of this study suggest the contamination level and distribution characteristics of MPs observed in seawater (surface and sub-surface layer) and sea-ice collected in the summer of Arctic 2016. Seawater samples were collected by manta-trawl net (200 mm mesh, n=12), bongo net (330 mm; n=16) and sea ice samples (n=7) were collected using ice-corers. MPs were detected in all samples with average concentrations of 0.41 n/m3, 0.55 n/m3 and 12.90 n/L, respectively. It is generally known that plastics are light and float, therefore they could be enriched on the water surface layer. However, MPs abundance observed in the bongo net (sub-surface) was similar to that of the manta nets (surface), which can be a strong evidence of the possible sinking of MPs into the deep water of the Arctic Ocean. On the other hand, the sea ice's contamination level was observed to be several tens of thousands higher than seawater. This indicates the necessity of further study on the trapping mechanism in the freezing process and the effect on the environmental change.

"Microplastics in commercially exploited fish from Grenada, West Indies"

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Adams Department of Biology, Ecology and Conservation, St. George's University, Emily
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Michelle
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ABSTRACT

Microplastics are small particles produced for industrial purposes or formed by breakdown of anthropogenic debris. Many Caribbean islands have high coastal population densities and plastic products are abundant. Caribbean islands have variable waste management strategies and the region is vulnerable to natural disasters including hurricanes and flooding. Microplastics have been found in an array of marine environments. Occurrence of microplastic in the intestinal tracts of marine fish is a concern to human and ecosystem health as pollutants and pathogens can associate with plastics. Studies have shown that the incidence of microplastics in marine fish varies with species and location, though causes of variation are not yet well understood.

Prevalence of microplastics (≤ 5 mm) in six fish species from Grenadian waters (representing pelagic, semi-pelagic and demersal lifestyles) harvested for human consumption have been investigated via gut analysis. Harvested tissue was digested in 10% KOH and particles retained on a 0.177 mm sieve were examined. Microplastics identified have been classified according to type, colour and size.

Over 97% of fish examined thus far (n=34) contained microplastics. Current and future work includes: examining the invasive Lionfish (Pterois spp.) for microplastics, analysing fish tissue for mercury and other persistent contaminants, investigating marine invertebrate species as well as water and sand for possible microplastic content. Our findings underscore the importance of continuing investigations into microplastics in marine life; this will contribute to understanding the associated health risks. Our findings support action to mitigate the volume of plastics entering the world's oceans.

This research was supported by the Caribbean Node of the Global Partnership on Marine Litter.

"Microplastics in Global Table Salt Products"

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Kim Greenpeace East Asia, Seung-Kyu
Kim Incheon National University,

ABSTRACT

Microplastic pollution is becoming a global issue in marine environment pollution. Some recent studies have identified microplastic contamination that remains in salt. Since salt is an essential consumer food, the presence of microplastics in salt products means that salt intake is a pathway of exposure to human exposure to microplastics. In addition, since sea-salt is produced through the evaporation of seawater, there is a possibility to represent the degree of contamination of microplastic remaining in seawaters. The purposes of this study are 1) to identify the contamination of microplastic in commercial table salt and 2) to determine if salt can reflect the degree of contamination of microplastic in the seawaters. To do this, we purchased and analyzed the salt samples sold in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) in four continents. In total, 37 samples were identified as final samples, including sea-salt as well as lake-salt and rock-salt. Qualitative quantitative analysis of size, color, polymer, and shape of each microplastic was performed through microscopic analysis and Fourier-transform infrared spectroscopy. Thousands of microplastics were detected per 1 kg of the salt samples of this study, and the predominant forms were fragment and fiber, which were frequently detected in the order of PP > PE > PET. After further analysis, it will be announced that human body exposure, characteristics of microplastic distribution by country, and whether sea water pollution is reflected in salt samples.

"Microplastics in Sandy Environments Along the Florida Panhandle and Ingestion by the Sand Dollar, Mellita tenuis"

Plee University of West Florida, Christopher
Pomory University of West Florida,

ABSTRACT

Plastic production has been continually growing worldwide due to its high durability, low cost, and light weight. Microplastics are either intentionally created or derived from larger plastic sources via mechanical, photolytic, or chemical degradation. Microplastics can adsorb contaminants and persist in the ocean, often settling in the sediment. This may pose problems for benthic marine organisms that ingest small particles. Microplastics have been found in some nearshore sandy areas along the Florida panhandle (northwest Florida, USA, Gulf of Mexico).

Sand dollars are microphagous feeders ingesting particles, and occur in high densities in nearshore environments altering the sediment through bioturbation. It is unknown if Mellita tenuis, a common sand dollar in the northern Gulf of Mexico, ingests microplastics. In this study, we examine if Mellita tenuis is ingesting microplastics in the field, and if sediments at the collection sites contain microplastics. Laboratory experiments in progress are examining if Mellita tenuis will ingest microbeads (600 µm), microfragments (355-500 µm), and if they are selecting microplastics over the sediment.

“Modeling plastic debris transport in the freshwater systems”

Hoffman Rochester Institute of Technology, Rebecca
Knauff Rochester Institute of Technology, Eric
Hittinger Rochester Institute of Technology,

ABSTRACT

We will discuss numerical modeling of particles in the world’s largest lakes system (the Laurentian Great Lakes) to understand the fate and transport of plastic debris in this important freshwater system. We have developed two- and three-dimensional transport models for all five of the Laurentian Great Lakes which use velocity fields from operational forecast models to propagate simulated debris. The model allows particles to be propagated forward in time to compare with observed distributions and backward in time to estimate input locations for samples in the literature. Using these methods we will explore how much of the observed variability in current samples appears to be explained simply by physical transport. We can also explore the importance of the input distribution on simulated results. Finally, we will use the three-dimensional model to estimate the distribution and abundance of plastic debris in the bottom of the lakes. We will also highlight differences in modeling these freshwater systems vs. ocean systems and some of the challenges in modeling plastic debris in freshwater systems.

“Modelling of plastic nanoparticles redistribution in the ocean.”

Mouyen Geosciences Rennes, Philippe
Steer Geosciences Rennes, Julien
Gigault Geosciences Rennes, Laurent
Jeanneau Geosciences Rennes,

ABSTRACT

The fate of plastic debris entering the ocean is primarily controlled by their origin and the oceanic currents, which drive them either toward one of the main five oceanic gyres or back on coastal areas. Despite a reasonably good prediction of their accumulation zones, in situ global quantifications largely underestimate the actual mass of plastic debris that must have entered the ocean since its earliest production. A significant assumption behind global plastic transport simulations is that plastic debris are considered as buoyant particles mostly released from coastal and estuarine areas. Although valid for a broad range of particle sizes, this assumption does not hold for nanoparticles, which may rather follow the water stream without buoyancy force. Besides, these nanoparticles technically remain challenging to observe and quantify in situ. Here we use time-variable sea velocity fields in 3D (zonal, meridional and vertical) to simulate their path across the seawater column, for various input depths. Since these nanoparticles can also be created from the decomposition of pre-existing plastic debris, we test sources located across the main oceanic gyres, in addition to usual coastal sources. First results show that their redistribution patterns are not spatially confined to gyres as for buoyant particles and that they can spread over large oceanic areas, back to the coasts. To validate these simulations, we shall use the Moderate Resolution Imaging Spectroradiometer (MODIS) data to identify oceanic reflectance patterns that are spatially consistent with the simulated ones. Our main hypothesis being that the lacking mass of marine plastic debris consists in nanoparticles, which are neither easily observable with present surveying methods nor properly localized by simulating the transport of buoyant particles.

"One size to fit all: Do Australian aquatic species respond differently to microplastics?"

Wilson Macquarie University,

ABSTRACT

Toxicity testing with endemic Australian species has consistently shown that local species have different levels of sensitivity to a range of contaminants compared to species from other regions of the world. As such water quality protection measures have been specifically developed to enable appropriate management of Australian aquatic ecosystems. There is currently limited data on the effects of microplastics to Australian aquatic species thus the question over comparative sensitivities remain and whether a one size fits all approach can be used to managing these impacts. To address this, a series of acute, chronic and behavioural tests are being conducted with microplastics to understand the potential effects to native aquatic fish and invertebrate species.

Preliminary result to date demonstrate reduced feeding behaviour and avoidance of microplastic laden mussels by predatory gastropods at relatively low load levels (20 PE microspherules/g) but no adverse chronic level effects in exposed fish. Further testing is ongoing using both virgin and dosed PE at different trophic and taxonomic levels. This presentation will describe these findings and highlight any differences in effects and concentration responses compared to that reported for other regions. The implications for both Australian and regional level management will be discussed.

“Optimization of large microplastic (1-5mm) sampling methodologies”

Martínez Sánchez Universidad de Las Palmas de Gran Canaria, Alicia
Herrera Ulibarri Universidad de Las Palmas de Gran Canaria, Javier
Lorenzo Navarro Universidad de Las Palmas de Gran Canaria, Modesto
Castrillón Santana Universidad de Las Palmas de Gran Canaria, Theodore T.
Packard Universidad de Las Palmas de Gran Canaria, May
Gómez Cabrera Universidad de Las Palmas de Gran Canaria,

ABSTRACT

Recently there has been a surge in the interest in microplastic pollution. It has become in a major threat for the environment, affecting kilometers of coast around the world. To investigate this pollution, standardization is being forced on biological, chemical, and physical analytical methods. This is necessary to obtain comparable temporal and regional data sets; otherwise, strong inferences and conclusions cannot be made. In relation to beach sampling, the standardized methodology outlined in the manual, Guidance on monitoring of Marine Litter in European Seas, is currently being used to collect microplastics in the Canary Island Archipelago. From that starting point, we have made modifications and improvements in order to minimize the time spent sampling and the use of human resources, both in field and in the laboratory.

Our new methodology consists of:

a. Collecting large microplastics (1-5 mm) beach samples at the tide line with a 1mm mesh bag;

b. Using density separation with ethanol (96%), to separate microplastic from organic matter;

c. Employing image-analysis software to quantify microplastics after capturing the remaining particles with a commercial scanner. In a first step, the developed software performs a segmentation of the image based on the Otsu’s method. After that, an extraction of shape, color and texture features is done to feed a classifier that assigns a label (fragment, pellets, tar, line, …) to each microplastic particle.

d. Calculating statistics with the “R program”.

To a first approximation, these changes have resulted a significant reductions in the time spent on sampling in the field and on sample treatment in the laboratory. Furthermore, they greatly improved the separation of microplastics from organic matter. They advance the development of simple and inexpensive methodol

"Physical factors affecting plastic debris load on beaches"

Biber University of Plymouth, Richard
Thompson University of Plymouth, Andy
Foggo University of Plymouth,

ABSTRACT

Beach surveys present an efficient way to assess the abundance of plastic in the marine environment. However, they are susceptible to variation from local factors other than actual quantities of at-sea debris abundance, such as local littering and litter removal, beach morphodynamics (e.g. slope, wave climate), beach exposure and weather. With progressing deterioration of existing debris, small debris constitutes an increasingly important portion of marine debris. This study aims to identify environmental factors that promote the accumulation of small plastic debris to better understand the dynamics of the debris load on the shoreline. Using a rapid survey method, the contamination by small plastic debris of 52 beaches was measured. These beaches were characterised according to their environmental variables extracted from a weather database, and a survey of beach morphodynamics. Beach curvature and apex towards the open sea were assessed cartographically. The power of these environmental variables in explaining debris load patterns was tested. The findings showed that small plastic debris contamination changed over time and was linked to hydrodynamic parameters more strongly than to wind. Results also showed that two overreaching factors, retention and deposition, influenced small plastic debris contamination in the same way, but that these factors may be conversely linked to physical parameters such as beach exposure or wave action.

"Plastic Debris: Ocean a final destination"

ATHAR COMSATS Institute of Information Technology,, AREEBA
ATHAR Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST) Islamabad Campus,
NUZHAT
KHAN NATIONAL INSTITUTE OF OCEANOGRAPHY,

ABSTRACT

Very first videographic record on the issues relate marine debris in the Pakistan Coastal water.

Coastline of Pakistan is about 990 km long along the Arabian Sea. The coastline of Karachi metropolitan is about 70 km long situated between the Cape monze, a high cliff projecting into the Arabian Sea and Korangi creek, is relatively well developed as compared to the rest of the Pakistan coast. It is generally oriented NW-SE. Western side is bounded by the Hub River and mangrove swamps and Indus Deltaic Creeks on the east.

Karachi city, industrial hub of the country facing serious several environmental threats. Over 8 million resident of the city generated more than 8,000 tons of solid waste every day, most of the waste find its final destination to coastal waters due to underprivileged handling of the solid waste. The plastic debris has become very prominent on the beaches of Karachi.

Very first attempt to have videographic recodes of the marine debris and issues relate to it that include deposition/accumulation sites along the coast, sources/dumped sites, environmental and health impacts by interviews of researcher and community representatives.

"Plastic ingestion by fish in the South pacific: Field study"

Markic University of Auckland, Clarisse
Niemand University of Waikato,

ABSTRACT

Plastic pollution of the marine environment has raised much concern in the current decade. Plastics do not biodegrade and they pose a threat to a range of marine organism which are prone to plastic ingestion. Upon ingestion, plastic debris does not harm the organisms only physically (rupture, blockage), but it also releases toxic chemicals bound to the surface or internal structure of plastic materials, which then accumulate in tissue of marine animals. Plastic pollution questions seafood safety, and consequently human health safety as well, as coastal and island nations greatly depend on marine resources. In this study, 34 species of commercial marine fish from four locations in the South Pacific (Auckland, Samoa, Tahiti and Easter Island) were examined for the presence of plastic debris in their gastrointestinal tracts and in gastrointestinal tracts of some of their prey (fish, squid, crabs). Plastic debris was found in 33 species collected from 4 locations in the South Pacific. The greatest ingestion rates were found in fish from Easter Island, 49.2 % on average, while New Zealand fish exhibited the lowest ingestion rates (15.8 %). Secondary ingestion was examined on prey of 57 individual fish and was confirmed for nine (17.5 %). Benthopelagic fish, which feed on the bottom and throughout the water column, are more prone to plastic ingestion than benthic and pelagic fish. Additionally, offshore species were found to ingest plastic slightly more often than coastal species. The most common size of recovered plastic debris was between 100 and 500 µm. Black (22 %), blue (18 %), white (17 %) and transparent (12 %) were the most common colours of ingested particles. Most prevalent type of retrieved debris were plastic fragments (49.5 %), followed by fibres (33.9 %) and film (16.6 %).

"Plastic on beaches and in seabirds: preliminary results from a comparative study in the Norwegian Arctic and North Sea"

Buhl-Mortensen Institute of Marine Research, Geir
Gabrielsen Norwegian Polar Institute, Tycho
Anker-Nilssen Norwegian Institute for Nature Research, Erlend
Standal SALT AS,

ABSTRACT

Each year 5-13 million tonnes of litter enter the oceans and plastics are by far the most abundant material recorded, even in areas with low human settlements.

Litter has been surveyed annually for the Norwegian Environmental Agency since 2011 at seven beaches, two in the northern North Sea and five in the Arctic regions.

Ingestion of marine plastics by northern fulmars have been surveyed twice in Svalbard twice (1987 and 2013) and North Norway (2011-15), and every winter in South Norway since 2002/03. Based on this, we could compare litter composition and density on beaches with stomach contents of seabirds from the same regions to indicate the transfer of litter to marine food webs.

Preliminary results show that 91% of the beached litter was plastic with a mean of 41100 items/km, which is comparable to most European coasts. Litter was three times more plentiful on North Sea than Arctic beaches, but fishing-related litter was relatively more abundant in the Arctic. In both regions, most fulmars had ingested plastics, but the proportion of birds that exceeded the Ecological Quality Objective (EcoQO) of < 0.1 g of stomach plastic decreased from 55% in the North Sea to 35% in North Norway and 24% in Svalbard.

“Plastics and microplastics as vectors for bacteria and human pathogens”

Laverty Old Dominion University, Fred
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ABSTRACT

Plastics remain in the environment on much longer timescales than most natural substrates and can provide a novel habitat for colonization by bacterial communities (Zettler et al. 2013). The full spectrum of relationships between plastics and bacteria, however, is little understood. The objective of this study was to examine marine plastic pollution as a substrate for bacteria, with particular focus on Vibrio spp. We set up colonization experiments in a tributary of the lower Chesapeake Bay to follow Vibrio spp. colonization and total bacterial community composition over time. We also collected microplastics and paired seawater samples and determined the presence, abundance, and antibiotic-resistance profiles of Vibrio spp. they harbored. We examined Vibrio isolates’ response to six antibiotics and found no differences between the antibiotic susceptibilities of vibrios isolated from plastics compared to those from surrounding seawater. There was, however, a significant difference in antibiotic susceptibility between isolates from colonization experiments and microplastics, with more resistance overall seen in the former. In every instance examined, we found vibrios to be enriched on plastics by at least two orders of magnitude compared to those from paired seawater samples. Bacterial colonization was detected with DNA sequencing as early as day two and plastic communities were consistently distinct and more diverse than surrounding seawater. Colonization rates and community structure varied temporally and among substrate types, suggesting that numerous factors should be considered when characterizing microbial communities on plastic. This study demonstrates that plastic pollution serves as a habitat for Vibrio species and confirms that plastics may serve as a vector for these and other potentially pathogenic bacteria.

"Polymer Identification of Plastic Debris Ingested by Pelagic-phase Sea Turtles in the Central Pacific"

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Work U.S. Geological Survey, National Wildlife Health Center, Sara
Orski Material Science and Engineering Division, National Institute of Science and Technology, Viviana
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Beers Material Science and Engineering Division, National Institute of Science and Technology, Kayla
Brignac School of Ocean, Earth Science, and Technology, University of Hawai'i at Manoa, David
Hyrenbach College of Natural and Computational Sciences, Hawaii Pacific University, Brenda
Jensen College of Natural and Computational Sciences, Hawaii Pacific University, Jennifer
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ABSTRACT

Sea turtles have been known to eat plastic since 1968. We identified the polymer structure of 828 representative pieces of ingested plastics from 37 olive ridley, 9 green and 4 loggerhead sea turtles caught as bycatch in the Hawaiian and American Samoan longline fisheries using Fourier transform infrared spectroscopy. Unidentified samples (n = 27) were analyzed using high temperature size exclusion chromatography with multiple detectors and/or x-ray photoelectron spectroscopy. We examined species differences in ingested polymer composition expecting deeper diving species to ingest more high-density, sinking polymers. Ingested plastics were comprised of 51% low-density polyethylene (LDPE), 26% polypropylene (PP), 10% unknown PE, and 5% high-density PE, all of which float in seawater. Green turtles ate proportionally more unknown PE and PE/PP mixtures than olive ridleys. Of plastics expected to sink, 14 pieces (polyvinyl chloride, polystyrene (PS), polyurethane (PU), nylon) were found in deeper diving olive ridleys, five (PS & PU) in intermediate diving greens and only four (PU) in surface foraging loggerheads. Olive ridleys captured farther south and west ate proportionally more PP than those captured further north and east nearest to the North Pacific Garbage Patch. Green turtles south of the equator ate proportionally more LDPE; those in the north and east ate more PE/PP mixtures. No differences were observed in regards to sex, turtle length, size class, year, or hook depth. Products made from LDPE and PP, the most produced and rarely recycled polymers, are driving the problem of sea turtle marine debris ingestion. These novel data are important details to describe the threat of plastic ingestion in sea turtles and can help inform environmentally-friendly practices for plastic production, use and waste management.

"Polymer Identification of Plastic Marine Debris on Beaches and the Sea Surface in the Hawaiian Archipelago by FT-IR to Determine Sources"

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King Sharkastics, Jens
Currie Pacific Whale Foundation, Megan
Lamson Hawaii Wildlife Fund, Lauren
Blickley Swell Consulting, Kevin
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ABSTRACT

Identifying the polymer type of plastic debris has become a necessity for waste and recycling management and environmental and public health. For the first time, polymers of beach and sea surface plastics throughout the Hawaiian Archipelago were identified using Fourier Transform Infrared Spectroscopy. Ten beaches from Hawaii Island to Midway Atoll were sampled systematically, along with floating debris at three locations near the Main Hawaiian Islands. Approximately 4,459 pieces of primarily macroplastics (> 1 cm) were collected. Sea surface sample analysis is pending, but on beaches approximately 25% of pieces were high density polyethylene (PE) (resin code #2), 34% low density PE (#4), and 31% polypropylene (PP) (#5). The remaining 10% included PE terephthalate (#1), polyvinyl chloride (#3), polystyrene (#6), other (#7), PE/PP mixture, and unknown. Others (#7) included ethylene vinyl acetate, cellulose acetate (i.e. cigarette butts), nylon (i.e. weed whacker string), phthalates, latex, polycarbonate, and acrylonitrile butadiene styrene. Polymer composition, and thus chemical density relative to seawater, significantly varied among beaches, indicating greater proportions of less dense, floating plastics from ocean-based sources on windward beaches vs. denser, sinking items or land-based sources on leeward beaches. Greater debris abundance was found on windward (n=6, 72.7 ± 111.8 g/m2) vs. leeward (n=2, 0.43 ± 0.31 g/m2) beaches with greater abundance correlating to less nearby land development (rs=-0.71, p=0.047). Debris was more weathered (larger carbonyl peaks in spectra) on windward beaches. Polymer identification revealed the predominance of PE and PP from ocean-based sources on Hawaiian beaches, which can aid efforts to mitigate this environmental issue.

"Quantifying Microplastics and Microfibers in St. Thomas Coastal Environments"

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ABSTRACT

As plastic waste is exposed to UV radiation, high temperatures, and mechanical weathering, it breaks down into smaller pieces. Plastic pieces less than 5mm in size are characterized as microplastics. Microplastics can enter the coastal marine environments through waste water discharge and rain water run-off, and often they are mistaken for food and ingested by sea birds, fish, and corals, causing physical harm. Also, chemical pollutants present in the environment tend to adsorb to plastic surfaces, providing the opportunity to bioaccumulate in the food web if ingested. Many studies have quantified microplastics in coastal environments and ocean surfaces around the world. However, very few studies have quantified them in the Caribbean, and only at regional scales. This study aims to quantify microplastics on beaches, surface waters, and reef associated sediments in embayments around St. Thomas (U.S. Virgin Islands), and test whether microplastics are more abundant in bays with greater anthropogenic activity in associated watersheds. Preliminary results show that microplastics and microfibers (between 1mm - 0.3mm) are present in beach sediment and surface waters on St. Thomas USVI, and are more abundant in embayments experiencing high anthropogenic activity in associated watersheds. Although this project is still being conducted, final results will lead to understanding distribution of microplastics around St. Thomas, and their potential to impact reef-building corals and other marine organisms.

"Quantifying the Accumulation of Marine Debris near Coral Reefs Using Aerial Imagery and GIS"

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Castrence Resource Mapping Hawaii, Brian
Neilson Division of Aquatic Resources, Hawaii Department of Land and Natural Resources, Amber
Meadows Social Science Research Institute of the University of Hawai'i at Mānoa, Anne
Chung Social Science Research Institute of the University of Hawai'i at Mānoa, Stephanie
Kung Social Science Research Institute of the University of Hawai'i at Mānoa, Alexi
Meltel Social Science Research Institute of the University of Hawai'i at Mānoa, Andy
Omori Social Science Research Institute of the University of Hawai'i at Mānoa, Stephen
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ABSTRACT

Hawaii's coral reef ecosystem is a valuable natural resource that supports a unique and diverse host of marine life, providing sustenance to Hawaii and its inhabitants. The Great Tsunami of 2011 had devastating effects on Japan, dispersing millions of tons of debris, some of which drifted great distances across the Pacific Ocean via wind and current. This Japanese tsunami marine debris (JTMD), which includes an assortment of plastics, buoys, vessels and large docks, continues to make its way into Hawaiian waters. Debris poses serious risk to Hawaii's fragile reefs, including entanglement of reef dwelling organisms, introduction of aquatic invasive species, and physical breakage, particularly from large debris like vessels. In order to characterize the ecological consequences of JTMD, it is important to understand and quantify where and what debris is accumulating. Given the remoteness of coastlines in the Hawaiian Islands, large scale surveillance efforts are needed to identify these "hotspots" of marine debris. This project collected high-resolution aerial imagery and then, using ArcGIS software, identified and characterized marine debris densities along Hawaiian shores. This innovative technique allows analysts to identify hotspots across the state and their association with coral reefs. The project method could also prove useful in other sites or to quantify different targets, such as sedimentation or coastal wildlife. The study's findings will inform resource management on the part of federal and state government and local nonprofit and community groups.

"Quantifying the risk that marine debris poses to cetaceans in coastal waters of the 4-island region of Maui"

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ABSTRACT

Here we present results from the first study to quantify the risk marine debris poses to 5 cetacean species commonly sighted in the leeward waters of Maui, Hawaii by assessing the overlap of cetacean and marine debris densities. Entanglement and ingestion of marine debris poses considerable threat to biodiversity and has been identified as a stressor for a variety of marine life. The 4-island region of Maui provides important habitat for a variety of marine mammals and is located within the boundaries of the Hawaiian Islands Humpback Whale National Marine Sanctuary. The low recovery probability of marine mammals that have ingested or become entangled in marine debris makes debris interactions difficult to quantify. To assess the risk of entanglement and/or ingestion, line transect surveys were conducted from April 2013 to April 2016 and the location of all floating debris and cetaceans sighted were recorded. Localization of entanglement and ingestion risk was observed by mapping the overlap of debris and cetacean sightings within the survey area. The area of overlap varied between species but was largest for humpback whales, which account for the largest proportion of reported entanglements in the 4-island region of Maui. Identifying areas of high debris-cetacean density overlap can facilitate species management and debris removal efforts.

"Reducing the risk of cross-contamination through defining an SOP for microplastic collection, processing and identification"

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ABSTRACT

Environmental pollution, in the form of marine litter, has been reported since the 1970's; however, microplastic research has only come to the fore within the last 20 years. While marine litter and microplastics are currently recognized as ubiquitous pollutants, the full scale of their potential impact is still unknown. Despite the high number of studies published on the topic, surprisingly, there is still a lack of standard operating procedures for sampling, processing and the subsequent identification of microplastics. No consensus exists on reporting units, which creates difficulties when comparing data among studies and consequently the extent of the impact or mitigation measures required.

To address these knowledge gaps, the JPI-Oceans BASEMAN project is working to establish standardized protocols that can be used for research and development and/or monitoring purposes. This work focuses on identifying potential cross-contamination sources from vessels, clothes and/or airborne particles, largely recorded as fibers and fragments, and the subsequent reduction of this contamination through the QA/QC steps identified here. Best practice for microplastics is outlined through the operation of efficient procedures and techniques, improving and cutting costs in monitoring efforts resulting in more reliable data being produced. This is particularly pertinent for policymakers who rely on accurate data to help influence their decision-making. This work follows guidelines and recommendations from NOAA's Marine Debris Programme and from the Technical Subgroup of descriptor 10 of the Marine Strategy Framework Directive.

"Revisiting a Long-Term Time Series of Floating Plastics in the Western North Atlantic Ocean"

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Hardesty CSIRO, Oceans and Atmosphere Business Unit, Kara
Lavender Law Sea Education Association,

ABSTRACT

Despite a rapid acceleration in global plastics production since 1950 and reports since the 1970s of plastics in the surface ocean, previous research has not detected a temporal trend in floating plastics concentration, raising questions about the residence time and fate of buoyant microplastics. Using a generalized additive model, we examined the longest time series available on floating plastics, collected in the western North Atlantic Ocean by Sea Education Association (SEA) from 1986 through 2015. A previous analysis of the dataset through 2008 (Law et al., 2010) failed to detect a temporal trend in the concentration of plastic debris collected using surface plankton nets. Here, we present a statistical analysis that removes variability associated with sampling error, and with the large-scale spatial distribution associated with accumulation in the convergent subtropical gyre. This spatial distribution is, itself, variable in time, which was accounted for in the best performing model. The best performing model also included a temporal term that indicates an accelerating relationship with cumulative global plastics production, providing evidence that the amount of floating small plastics in the western North Atlantic has increased over the time period examined. Because production is reported as mass and debris is reported as a numerical concentration, the second-order polynomial relationship with cumulative production might be explained by particle fragmentation. We will discuss how previous results describing strong decreasing trends in identifiable resin pellets in a subset of this data set and in northern fulmar stomachs in the North Sea (van Franeker and Law, 2014) are not contradictory, and the implications of using floating microplastics as an indicator of changes in ocean inputs over time.

"River discharge as a source of land-based plastic pollution in the Northwest Pacific Russia"

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ABSTRACT

Eight rivers discharging into the marine area of Northwest Pacific Russia were selected to assess the flux of microplastics into the coastal environment, including the Tumen River and the Suifen/Razdolnaya River. The samples were collected by neuston net (mesh size 0.1 mm) at depth 0-20 cm and by gasoline pump (capacity 15m3/hour) at depth below 20 cm in summer and fall 2016-2017. Four major plastic fragment types were revealed, including fibers, fragments, films, and EPS. The most frequent polymer types include PE, PP, PS, nylon, and polyester. Seasonal concentrations by number and weight were calculated for smaller microplastics (0.1-1 mm), larger microplastics (1-5 mm) and mesoplastics (5-25 mm). Summer concentrations of microplastic particles in the lower reaches of the Tumen River and in the seawater near the estuary compared to concentrations in the coastal water along the study area (Southern part of Northwest Pacific Russia) evidence its high impact as a major land-based source of plastic pollution, raising concern about its local and transboundary effects.

"Seafloors as microplastic sinks – negligible upward transport of sedimented microplastics by bioturbation"

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Setälä Marine Research Centre, Finnish Environment Institute, Maiju
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ABSTRACT

Microplastics (MPs) are distributed widely across different habitats in the marine environment. Considerable amounts of MPs are found from seafloor sediments, which have been proposed to act as sinks for microplastic debris. MPs on the sediment surface can be buried under the constantly settling new material or transported deeper into the sediment with and without animal activities. While bioturbation is an important process in the downward transportation of MPs, it is still unknown whether burrowing animals may also transport MPs upwards, and thus increase their availability to benthic fauna feeding on the sediment surface. To study this, thin layers of frozen sediment containing a realistic concentration of acrylonitrile butadiene styrene (ABS) fragments in two size classes (>500 µm and 100–300 µm) were added to depths of 2 cm and 5 cm in the experimental aquaria filled with sediment. The re-localization of MPs by a community of common benthic invertebrates in the northern Baltic Sea (clam Limecola balthica, polychaetes Marenzelleria spp., gammarid monoporeia affinis) was studied in a 10 week experiment, after which the MPs were extracted from each sediment layer and the animals were examined to study MP ingestion. The results indicate that the transportation of MPs to the sediment surface by bioturbation is negligible; thus, the seafloor may form a permanent sink to once sedimented MPs.

"Single-Use or Reuse? Understanding why people use single-use plastics instead of reusable alternatives."

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ABSTRACT

Given the growing saliency of plastic marine debris, and the impact of plastics on beaches and aquatic environments in the Laurentian Great Lakes, applied research is needed to support municipal and nongovernmental campaigns to prevent debris from reaching the water's edge. This study attempts to accomplish this goal examining the barriers and benefits to positive behavior for three plastic debris items in northeast Ohio's Lake Erie basin: plastic bags, plastic water bottles, and plastic cigar tips. An online survey and focus group were employed to gather data on the use and disposal of these plastic items in the Cleveland area, and to solicit recommendations on how to positively change behavior to reduce improper disposal. The results from this project will be used to inform a social marketing campaign broadcast throughout Cleveland in 2017, as well as to serve as a pilot for related research on plastic marine debris in other Great Lakes states.

"Spatio-temporal distribution of coastal plastics in the Western Mediterranean"

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Deudero Instituto Español de Oceanografía,

ABSTRACT

Coastal ecosystems are continuously affected by anthropogenic threats such as urbanization, maritime activities, recreation and more recently plastic marine litter. Plastics enter the environment through terrestrial and maritime activities and overtime degrade posing a potential threat to marine wildlife. The current study aims to quantify and identify the spatial distribution of marine plastics over time in coastal ecosystems of the Island of Mallorca in the archipelago of the Balearic Islands located in the Western Mediterranean Sea. Sea surface samples were collected during summer months in 2017 (July, August and September) at seven locations across the island within 500 meters of the coastline. Three samples at each location were collected for posterior quantification of floating plastics at the laboratory to assess autocorrelation within sampling locations. Plastic items was observed in all 21 samples of July of varying sizes, ranging from macro- (> 25 mm), meso- (5-25 mm) and micro-plastics (< 5 mm). Plastic litter concentrations were heterogeneous with mean values ranging from 0.02 ± 0.01 to 0.38 ±0.14 items/m3 (mean ±SD). Initial results show plastics were present in the sea surface at all sampling locations surrounding the island, composed principally of fragments, films and filaments. These preliminary results indicate the coastal marine plastic concentrations are similar to those found offshore in the Western Mediterranean Sea.

"Studying availability of plastic ingestion of demersal fish and elasmobranch species in seafloor habitats"

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ABSTRACT

There is scientific evidence of the ingestion of microplastics, mainly filaments and blue coloured in stomach contents of fish species in the Western Mediterranean Sea. Microplastic and plastics have been quantified in the marine environment of the Balearic Islands. Ingestion of microplastics and bioaccumulation in species is expected. The aim of this research is to study a possible correlation between plastic abundance in seafloor habitats and microplastic ingestion of species captured in the same area. For this study, during a scientific survey, the stomach contents of 8 species of commercial and ecological interest were studied: Chelidonichthys cuculus, Galeus melastomus, Merluccius merluccius, Nephrops norvegicus, Nezumia aequalis, Serranus cabrilla, Spicara smaris and Spondyliosoma cantharus. In addition to the species, plastic collected during and in the same sampling bottom trawl hauls was weighted and standardized to surveyed area (km2). A total of 189 individuals from 50 scientific bottom trawl hauls were analyzed for microplastic ingestion. A sum of 122 microplastics were identified in 59 individuals, 31 % of the samples. Highest ingestion values were given in Spondyliosoma cantharus with mean values of 3.43 ± 1.09 microplastic/individual. According to plastics in the seafloor, these were found in 66 % of the hauls and with a mean weight of 1.34 ± 0.41 kg/km2. Preliminary results suggest that there is not necessarily a direct link between the presence of plastic in a certain location with the presence of microplastics in the stomach of fish caught in the same location.

"The Chemical contamination by Plastic Marine Debris"

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Koizumi College of Science and Technology, Nihon University, Keiji
Amamiya College of Industrial Technology, Nihon University, David
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Hiaki College of Industrial Technology, Nihon University, Katsuhiko
Saido College of Industrial Technology, Nihon University,

ABSTRACT

From 1950 to 2014, the sum total of all types of plastics produced worldwide was calculated in the amount of 5.4 billion tons.Many studies have addressed the physical effects of large-sized plastics on sea bird, turtle and fishes, whereas few have focused on chemicals derived from debris plastic. To clarify the chemicals produced by debris polystyrene (PS) decomposition to give rise to pollution surrounding Japan. From the year 2000 to 2013, 1,500 samples were obtained from all coast lines taken in this study to be comprised of ten isolated islands. All samples were detected styrene oligomer (SO: means theses mixture of styrene monomer, dimer and trimer). Mean SO contamination values surround Japan coastlines were 3.0 µg/L in the water and 500.0 µg/kg in sand. SO contamination in sand was 160 times that in coastal water.

The results clearly indicate that, not only does debris PS form micro-size (micro-plastic) potsherd on beaches but also that PS decomposes into SO which subsequently disseminates throughout the ocean. SO causing worldwide ocean pollution has increased by 30,000 times as much in the past 60 years. The basic structural units of plastic pose significantly high risks to marine organism life, ecosystems and certainly, human health as well.

"The effect of a microplastic-associated legacy pollutant on the feeding preferences of microzooplankton and their predators."

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Michael , Anthony
Andrady , Alison
Taylor , Susanne
Brander ,

ABSTRACT

Microplastics are becoming more abundant in estuarine systems. The surface of plastic attracts lipophillic compounds, such as the pollutant DDT, that can leach into the tissues of marine organisms upon plastic ingestion. This study used larval inland silversides, Menidia beryllina, as predators, and tintinnid ciliates, Favella spp., as prey. LDPE microspheres (10-20µm) treated with DDT and virgin microspheres were used to determine whether the presence of plastic-associated pollutants affects the feeding preference of larval fish and their prey. We hypothesized that larval silversides feed differentially on prey exposed to DDT-laden microplastics due to the potential effects of DDT on prey predator-avoidance behavior and that trophic transfer is a more important route for microplastic ingestion. After one two-hour feeding period, trophic transfer treatment groups ingested a significantly higher number of microplastics than direct ingestion treatment groups, suggesting ingestion of contaminated prey could be an important route for microplastic exposure. Larvae also ingested significantly more prey exposed to DDT-laden plastics than prey exposed to virgin plastics. DDT seems to play a role in the prey preference of larval fish, and potentially affects the predator avoidance behavior of Favella. Growth parameters were measured after a 30-day period following a 2-hour microsphere feeding session to determine the effects of microplastic ingestion on larval growth. Microplastic gut retention time of larvae was not significantly different between DDT-laden and untreated treatments. The rate of excretion of microplastics was 0.15 particles hour-1. This was the first study to investigate gut retention time in larval fish. The silversides and Favella are common prey items for estuarine species.

"The Effects of Food and Microplastic Availability on the Uptake of Polystyrene Microbeads in Eastern Oyster Larvae"

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ABSTRACT

The Eastern Oyster (Crassostrea virginica) is an ecologically and economically important species for estuarine ecosystems and a massive effort to restore oyster populations has been ongoing in the Chesapeake Bay. Plastic pollution could pose a problem for oysters and the success of restoration efforts if micrometer sized particles are available and ingested by C. virginica larvae. Little is known about how algae and microplastic abundance influence uptake, or the depuration abilities of larval oysters that have ingested microplastics. To determine the amount of microplastic ingestion under different food concentrations, we fed 1 day post fertilization larvae varying concentrations of the algae Isochrysis galbana (2,000-20,000 cells/ml) and 2 µm or 6µm polystyrene microbeads (0-20,000 beads/ml,) for 24 hours. Larvae were then placed into water without microbeads and allowed to depurate for 24 hours. Preliminary data analysis suggested that microbead concentration was an important factor for larval uptake of 2 µm beads but food concentration was not, especially under environmentally relevant concentrations of microplastics. Initial trends also indicated that larvae expelled more than half of the 2µm polystyrene beads they ingested after 24 hours in clean water. Results will be presented from the 6µm particle experiments, additional runs using 2µm particles, and longer term experiments that were run to compare larval growth when grown with or without microbeads present.

"The Risk of Eating Plastic: Laysan Albatross Population Impacts"

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Finkelstein University of California Santa Cruz, Heidi
Auman Institute for Marine and Antarctic Studies, University of Tasmania, Scott
Edwards Dept. of Organismic and Evolutionary Biology, Harvard University,

ABSTRACT

Plastic pollution may diminish marine species adaptive capacity and resilience in an era of global climate change. North Pacific seabirds, specifically albatross, as long-lived, top marine predators, may be ideal contaminant "sentinels" being both spatially and temporally associated with many anthropogenic contaminants, including increasing amounts of plastic pollution. Plastic ingestion in Laysan albatross (LAAL) and other seabirds have paralleled that increase. For over 40-yrs, LAAL chick mortality has been indirectly and directly linked to plastic. No studies, however, have quantified impacts from plastic ingestion on the population growth rate of any seabird. We show plastic ingestion as a source of mortality for chicks (and adults), with metals (Zn, Pb) bioavailable at toxicologically relevant levels. As well, LAAL chicks in the NW part of their breeding range (60% pop.) have the highest mass of plastic and thus are the most likely affected by any causal additions to chick mortality. Demographic modeling (DM) is used, to determine how age-specific mortality from plastic may impact the future population of LAAL. Field data (previous studies) identified credible chick mortality rates linked to plastic. DM projects 80,000 fewer individuals in 50-yrs with a 1% increase to annual chick mortality rates (or in 10-yrs at %5). To date no comprehensive risk assessments or robust contaminant models exist that evaluate the risk of lifetime plastic exposure to a marine species. The LAAL could fill that void. Information gleaned could extend to other marine apex predators and species of conservation concern enhancing this value. Transboundary movements of albatross create situations ideal for the design of international instruments aimed at biodiversity conservation and contaminant regulation in marine ecosystems.

"Tracking and identifying floating marine debris"

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Kyriakides University of Nicosia, Constantinos
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ABSTRACT

The amount litter and plastic debris that enters the oceans is increasing year by year. Due to the sheer scale of marine debris and its geographic distribution manually identifying and mapping marine debris becomes a herculean task. Herein we propose a novel way of identifying different types of floating marine debris at the free surface. The classification capabilities of Convolutional Neural Networks (CNN) and Bag of Features (BoF) methods were tested in the context of floating debris.

The motivation was to teach a classifier to accomplish the task of ranking different types of floating marine debris categories faster and more accurately than prevailing manual processes. Initially, we classified eight categories of which six comprised marine debris and the other two of marine life. More specifically, the categories included: plastic bags, plastic bottles, plastic buckets, polystyrene, plastic buoys fishing gear, fishing nets, dolphins and marine turtles. Comparing the performance of the abovementioned methods on the eight categories we observe that the CNN methods yields better results in terms of validation accuracy that exceeds a human observer. Notably, the CNN method attained a validation accuracy >98% while the BoF methods resulted in 79%.

Subsequently, the CNN and the BoF techniques were used to identify the types of floating debris. Simultaneous classification and recognition of surface debris are key to determining and monitoring marine litter— the first effort of its kind to be reported.

"Transport of marine debris in North Pacific: the case of Hawaii."

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Maximenko IPRC/SOEST U. of Hawaii, Gisela
Speidel IPRC/SOEST U. of Hawaii, Kin Lik
Wang IPRC/SOEST U. of Hawaii, Chris
Woolaway Hawaii's International Coastal Cleanup, Carl J.
Berg The Kauai Chapter of Surfrider, Barbara
Wiedner The Kauai Chapter of Surfrider, Scott
McCubbins The Kauai Chapter of Surfrider, Cynthia
Welti The Kauai Chapter of Surfrider, Megan
Lamson Hawaii Wildlife Fund,

ABSTRACT

Studies of marine debris transport over large distances are very limited. Long term position tracking is required to collect the necessary data. In general the transport of marine debris is determined by the surface ocean currents and winds. The effect of wind on marine debris motion is called windage; high windage debris is affected by the wind more than low windage type.

The 2011 tsunami in Japan was a very tragic event that generated a large amount of unusual debris. Data of tsunami debris were used as an experiment of the nature and many pieces could be directly traced back to origin (e.g. registration numbers on boats). SCUD (Surface CUrrents from Diagnostic model) model was employed to simulate the drift of tsunami debris from the coast of Japan across the N. Pacific to Hawaii. The modeling results were compared to actual observed tsunami debris in Hawaii. The observational data show the effect of wind (windage) on the transport of debris across N. Pacific to Hawaii. The effect of wind is seen in the timing of tsunami debris arrival. High windage type of debris arrived first, followed by medium and low windage types. Similarly this is reflected in modeling results as well. Both observational and modeling results will be compared and presented.

"Virgin microplastics translocate to liver and muscles of adult fish after dietary exposure, causing no apparent harm during the experimental period"

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Olgaç GÜVEN, Middle East Technical University, Institute of Marine Sciences
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ABSTRACT

Among aquatic organisms, fish are particularly susceptible to ingest microplastic particles due to their attractive coloration, buoyancy, and resemblance to food. However, in previous experimental setups, fish were usually exposed either to unrealistically high concentrations of microplastics or deliberately contaminated with persistent organic chemicals and in many experiments fish were exposed only during the larval stages. The present study investigated the effects of virgin microplastics in adult gilt-head seabream (Sparus aurata) after 45 days of dietary exposure to environmentally relevant concentrations of 6 common types of microplastic. The overall growth, biochemical analyses of the blood, histopathology, and the microplastics potential to accumulate in gastrointestinal organs or to translocate to liver and muscles were monitored and recorded. Results revealed that short-term ingestion of virgin microplastics is not causing apparent harm to adult gilt-head seabream. The retention of virgin microplastics in the gastrointestinal tract was fairly low, indicating effective elimination of microplastics from the fish body and no significant accumulation after successive meals. However, the largest particles remained trapped in the liver, likely permanently, and 5.3 % of all analyzed livers contained at least one microplastic particle. Translocation of a single microplastic particle to caudal muscle in one fish was also detected.

"Using Charismatic Sea Turtles to Influence Policy: Loggerhead Marinelife Center's Balloon Ban Initiative"

Cutt Loggerhead Marinelife Center, Demi
Fox Loggerhead Marinelife Center,

ABSTRACT

Marine pollution is widely acknowledged as a significant threat to all sea turtle species. Ingestion of debris and entanglement are often causes for the animals' admittance to Loggerhead Marinelife Center (LMC), a sea turtle research, rehabilitation, education, and conservation organization in Juno Beach, Florida. When released, accidentally or intentionally, deflated balloons often ultimately litter the beach and ocean making them one of the deadliest types of marine debris for the endangered species. Today, state law prohibits the intentional release of ten or more balloons in a 24-hour period, but does little to prevent incidental pollution. In an effort to promote the protection of marine life, LMC launched a Balloon Ban Initiative focused on the Southeast Coast of Florida in 2016. Using charismatic sea turtles as our platform, we partnered with municipalities to prohibit or discourage the use of balloons in coastal areas. The program provides three levels of participation: distribution of educational materials alone, educational materials and installation of signage, and finally, educational materials, signage, and the adoption of an ordinance or resolution. Upon receiving overwhelmingly positive feedback from local communities, municipalities in other Florida regions began to reach out in the interest of joining the Balloon Ban. Currently, 15 municipalities across five counties participate in the program. We found that communicating directly with leaders in each municipality was a successful strategy to effect change. We are working to expand the reach of the ban across the state by way of individual partnerships that best suit each city or town in the hopes of providing widely-dispersed protection for the state's sizable sea turtle population.

"Wet Wipes Turn Nasty!"

Cunningham Marine Conservation Society, Sue
Kinsey Marine Conservation Society,

ABSTRACT

Wet wipes are one of the great convenience products of the 21st century, with more than 70% of people using some form of single-use wipes. However – instead of ending up in the bin when they're finished with –many end up down the loo, and ultimately in the sea. And worse, even the ones labelled as 'flushable' may contain plastic.

MCS's Great British Beach Clean 2016 report showed that wet wipes had increased by 700% in a decade.Currently wet wipes don't meet water industry standards on flushability. It costs South West Water and their customers in the UK £4.5million each year to clear around 8,500 – about 65% of which are caused by wipes and other sanitary products being flushed down the toilet.

MCS launched the 'Wet Wipes Turn Nasty' campaign in June 2016. Eight water companies backed the campaign. We created an inflatable wet wipe monster, Wallace, for events, trialled new types of campaign communications and took retailers down the sewers to get face to face with the issue.

We engaged 100,000 people on social media, 13.9 million media reach and a 23% public awareness of the campaign. We worked with the main UK retailers, with 12 now reviewing the flushability and labelling of their own brand wipes, and most saying they'll make them plastic free. This is critical, as over 30% of people surveyed do not read disposal information, and 20% have flushed wet wipes, even if they weren't labelled as flushable.

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