AMOUNTS, TYPES, SOURCES AND DISTRIBUTION OF MARINE DEBRIS DERIVED FROM A STATISTICAL ANALYSIS OF US DATA

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6th International Marine Debris Conference - March 5, 2018

Ocean Conservancy

11 Million	190 Million	360,000
volunteers	pounds of trash	miles
2016: 504,583	18,399,900	14,997

30	153	215 Million
YEARS	COUNTRIES	ITEMS COLLECTED

TOP 10 ITEMS COLLECTED

Ocean Conservancy®

1. CIGARETTE BUTTS
1,863,838

2. PLASTIC BEVERAGE BOTTLES
1,578,834

3. PLASTIC BOTTLE CAPS
822,227

4. FOOD WRAPPERS
762,353

5. PLASTIC GROCERY BAGS
520,900

6. PLASTIC LIDS
419,380

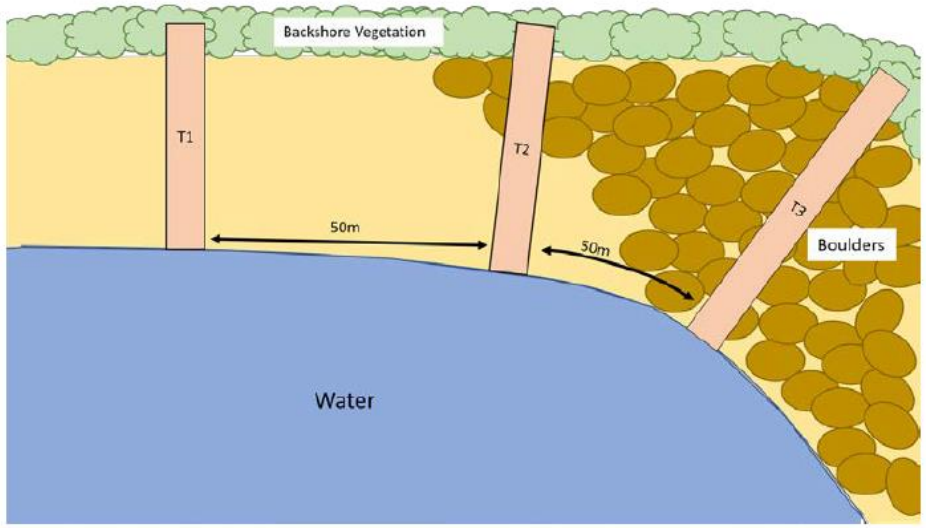
7. STRAWS, STIRRERS
409,087

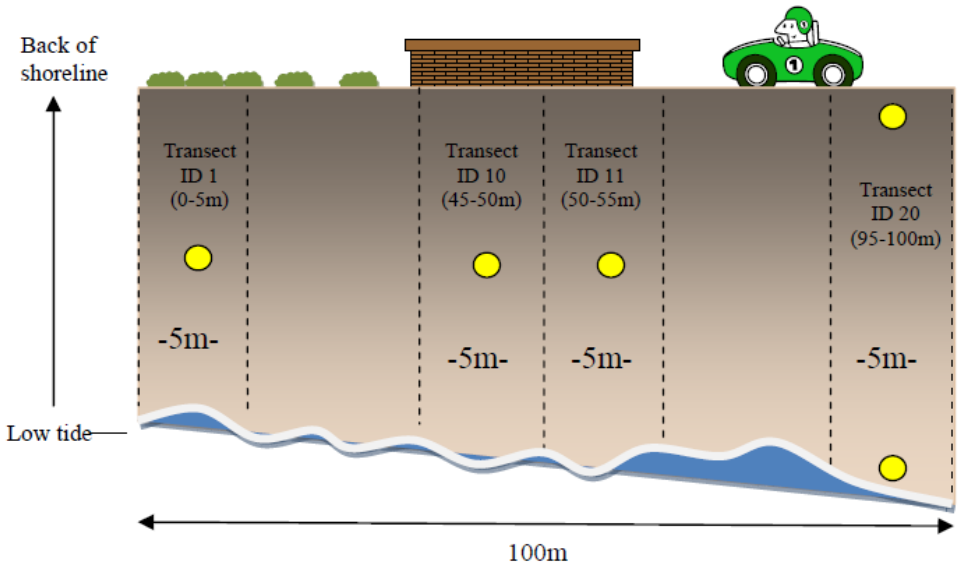
8. GLASS BEVERAGE BOTTLES
390,468

9. OTHER PLASTIC BAGS
368,655

10. FOAM TAKE-AWAY CONTAINERS
365,584

Sampling Methods





Goals and Objectives

- Goal: Develop a baseline estimate of the amounts, types and distribution of coastal marine debris along US beaches and waterways.
- Key Questions:
  - Where are the “hot spots” or regions where marine debris is most prevalent?
  - Are there specific littered items that are most abundant? Do these change locally or regionally?
  - What policies are most effective at preventing marine debris?
  - Overall, how much marine debris is on U.S. shores?

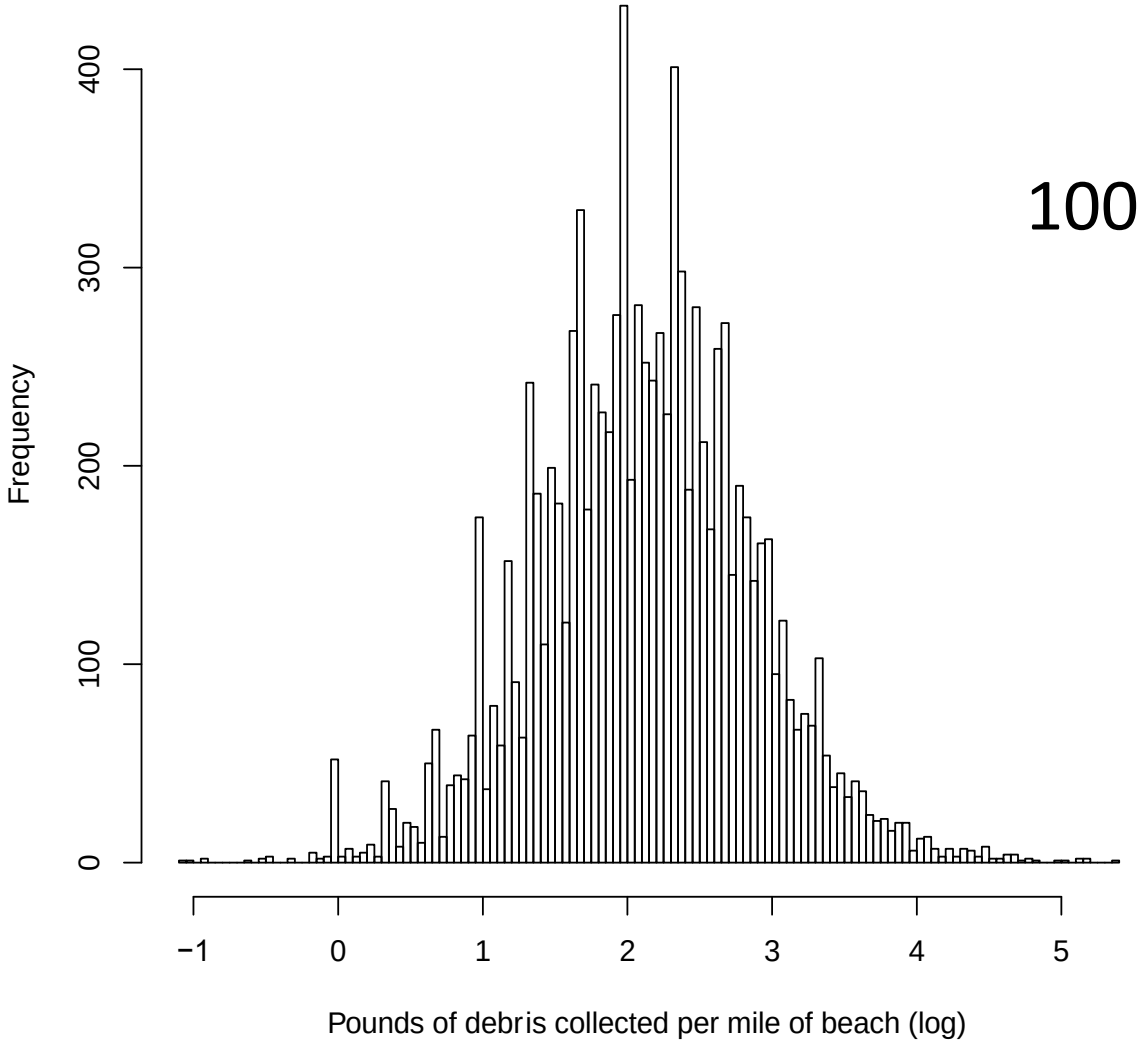
Methods and Statistical Approach

- Generalized additive statistical models
- Modeled load or individual item counts
- Adjusted for sample bias (number of samplers, time of survey, area surveyed)
- Used a range of potential covariates to remove variation from the model (esp. population density, nearest road, land use, beach characteristics)
- Time was a variable (but had little explanatory value)
- Added ‘smooth function’ (map coordinates) which allowed for uncovering spatial patterns

Data Sources

Site Type	# of unique locations/sites	# of survey dates	Date range
NOAA Accumulation	284 (unique)	894	Jan 2012 – Aug 2016
	1,443 surveys over multiple dates		
NOAA Standing Stock	66 (unique)	372	July 2009 – Aug 2015
	826 surveys over multiple dates		
ICC	6,223 (unique)	517	June 2010– Oct 2015
	12,822 (over multiple dates)		

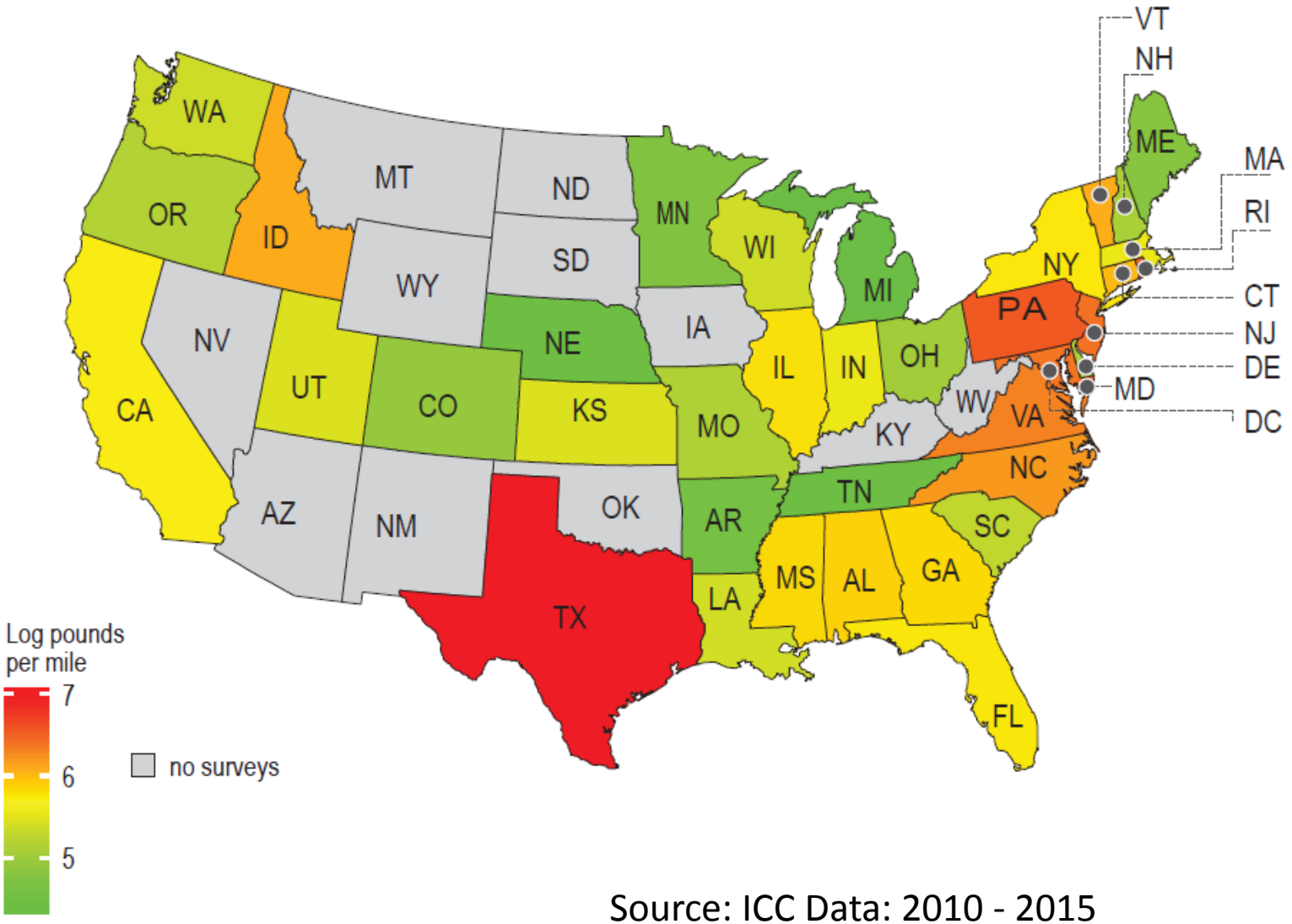
Debris Per Mile of Beach



100 lbs/mile

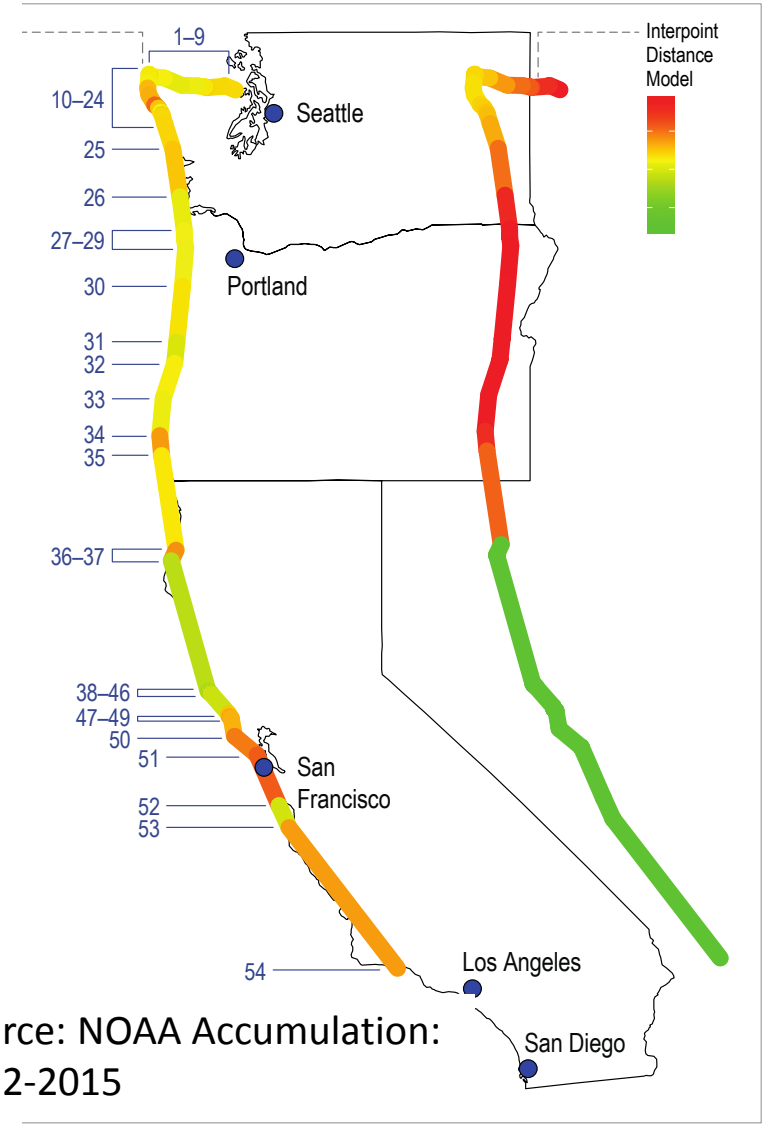
Source: ICC Data: 2010 - 2015

The United States of Trash

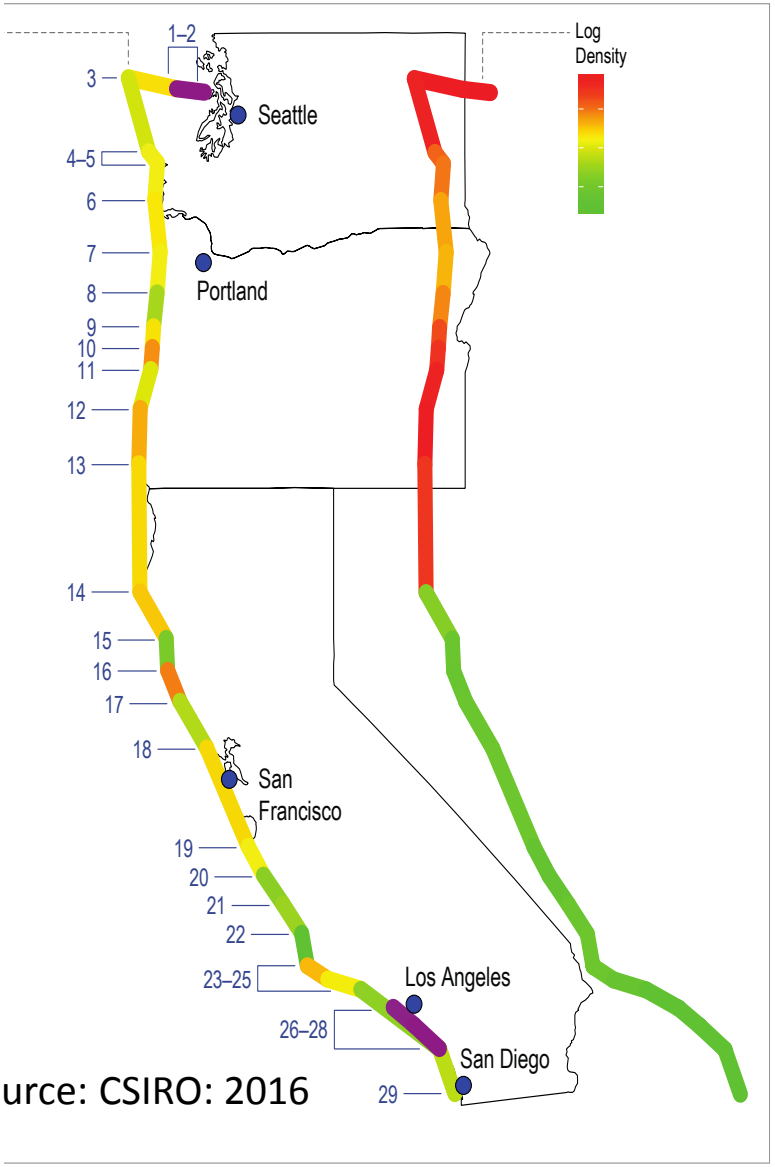


Source: ICC Data: 2010 - 2015

Spatial Variation: Drivers

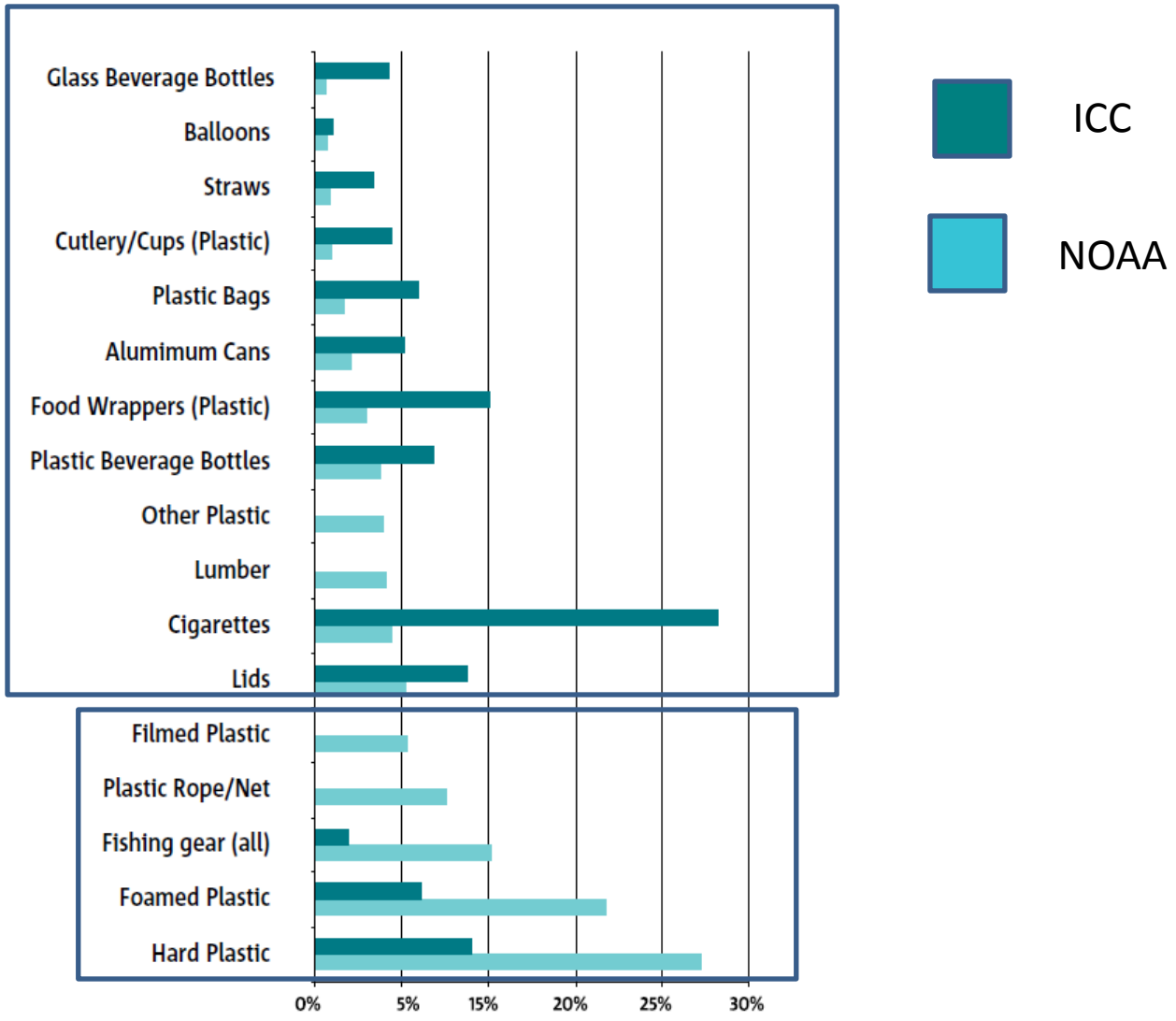


Source: NOAA Accumulation: 2012-2015



Source: CSIRO: 2016

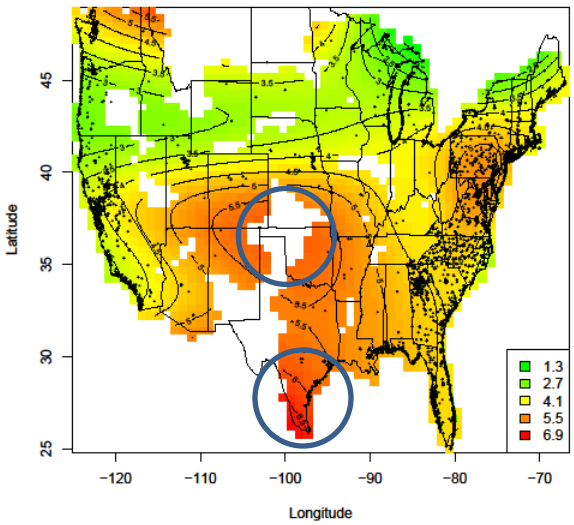
Abundance of Specific Items



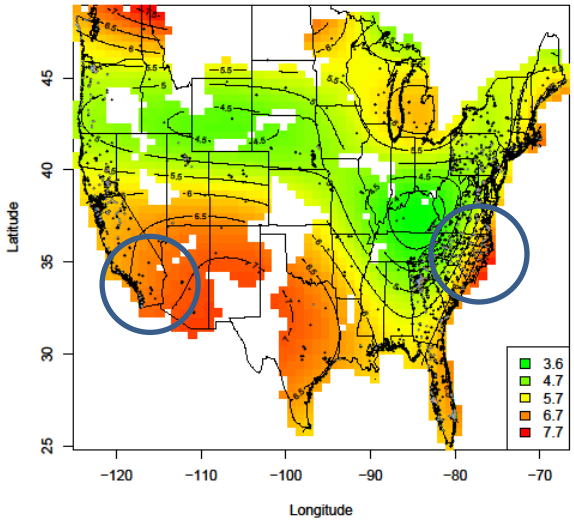
Source: NOAA and ICC Data: 2012-2015

Spatial Pattern of High Threat Items

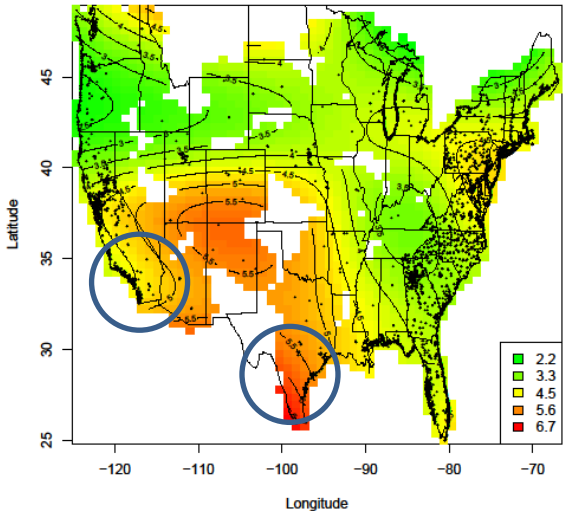
Plastic Bottles



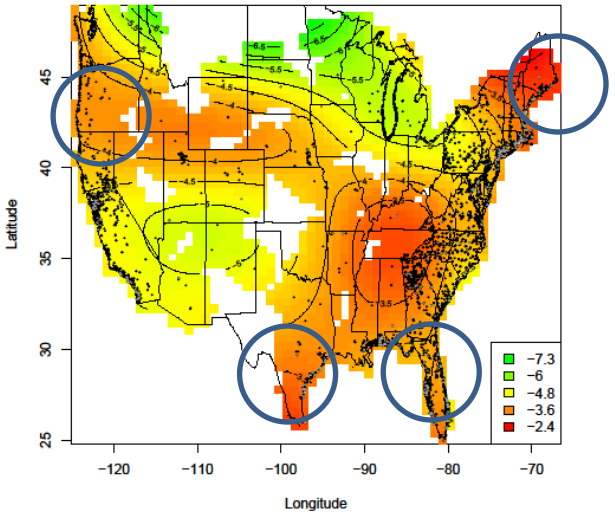
Cigarette Butts



Plastic Bags



Fishing Gear

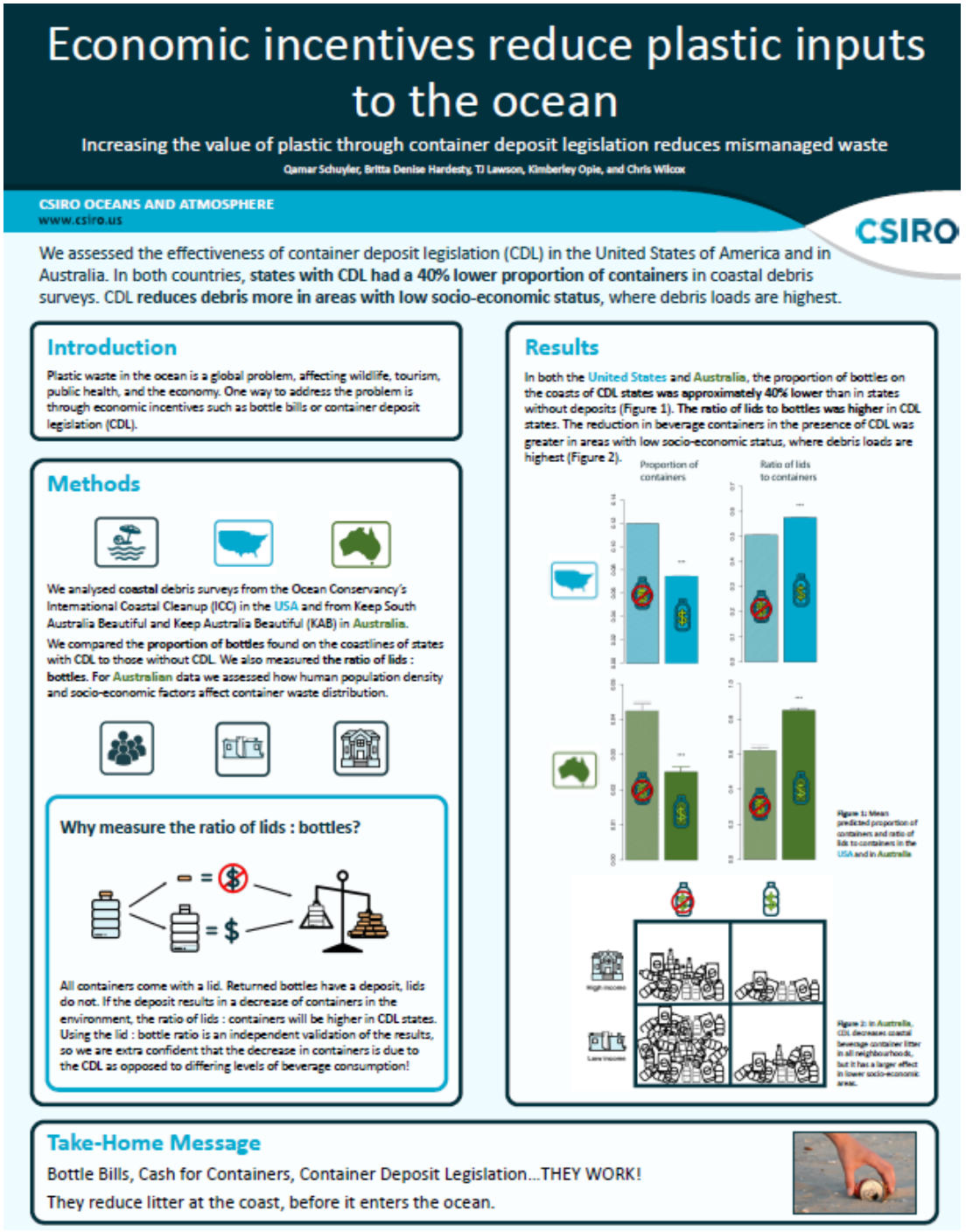


Source:
ICC Data:
2010 - 2015

Effectiveness of Bottle Bills

- Qamar Schuyler
- Tuesday 5:15-7:30 PM
- Garden Pavilion
- Poster # 174

- “Increasing the value of plastic through container deposit legislation reduces mismanaged waste”



Economic incentives reduce plastic inputs to the ocean

Increasing the value of plastic through container deposit legislation reduces mismanaged waste

Qamar Schuyler, Britta Denise Hardesty, TJ Lawson, Kimberley Opie, and Chris Wilcox

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We assessed the effectiveness of container deposit legislation (CDL) in the United States of America and in Australia. In both countries, **states with CDL had a 40% lower proportion of containers** in coastal debris surveys. CDL **reduces debris more in areas with low socio-economic status**, where debris loads are highest.

Introduction

Plastic waste in the ocean is a global problem, affecting wildlife, tourism, public health, and the economy. One way to address the problem is through economic incentives such as bottle bills or container deposit legislation (CDL).

Methods

We analysed coastal debris surveys from the Ocean Conservancy's International Coastal Cleanup (ICC) in the USA and from Keep South Australia Beautiful and Keep Australia Beautiful (KAB) in Australia.

We compared the **proportion of bottles** found on the coastlines of states with CDL to those without CDL. We also measured **the ratio of lids : bottles.** For Australian data we assessed how human population density and socio-economic factors affect container waste distribution.

Why measure the ratio of lids : bottles?

All containers come with a lid. Returned bottles have a deposit, lids do not. If the deposit results in a decrease of containers in the environment, the ratio of lids : containers will be higher in CDL states. Using the lid : bottle ratio is an independent validation of the results, so we are extra confident that the decrease in containers is due to the CDL as opposed to differing levels of beverage consumption!

Results

In both the United States and Australia, the proportion of bottles on the coasts of CDL states **was approximately 40% lower** than in states without deposits (Figure 1). **The ratio of lids to bottles was higher** in CDL states. The reduction in beverage containers in the presence of CDL was greater in areas with low socio-economic status, where debris loads are highest (Figure 2).

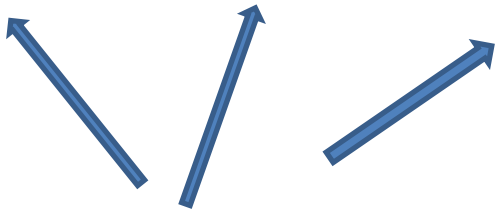
Take-Home Message

Bottle Bills, Cash for Containers, Container Deposit Legislation...THEY WORK!

They reduce litter at the coast, before it enters the ocean.

Take Home Message:
About 2 Billion Items on US Shores

	NOAA Standing	NOAA Accumulation	ICC	CSIRO
Items/m coastline	0.13 +/- 0.05	1.49 +/- 0.13	1.22 +/- 0.10	12.1 +/- 0.50
Number on US Coast	19.9 million	229 million	187 million	1.8 billion



Big Stuff (> 2.5 cm)

Big Stuff (> 2.5 cm)
And
Small Stuff (2mm – 2.5 cm)

Potential Next Steps

- Quantitatively sample (CSIRO) the rest of US coastline
- Use NOAA and ICC data to better understand hot spots and policy effectiveness in the US
- Evaluate land-based vectors in key hot spots
- Analyze non-US ICC data to provide international insights
- Expand International Coastal Cleanup to further engage and empower citizen scientists and ocean champions


Thank You!