MONITORING THE ABUNDANCE OF FLOATING MACRO-DEBRIS

Distance sampling vs strip transect techniques

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VISUAL SURVEY TECHNIQUES

Strip transects
(Fixed width)

Distance Sampling
(Line transects)
Antarctic Circumnavigation Expedition
5 months (Nov 2016 - April 2017)
R/V Akademik Tryoshnikov
2 different observers (4 in total)
9 meters above sea-level
Regular navigation (14-15 knots)
Beaufort state < 4 and good visibility
Size, type, color of all items > 2 cm
Observation slots of 30 minutes
Mean transect length: 12.8 km
GPS start and stop positions
Focus on the Atlantic Ocean (Leg 0-4)
Total: 135 transects in parallel
1727.84 surveyed km (66.5 hours)
DISTANCE SAMPLING
Estimating distances at sea

The distance from an item when abeam, equals the distance traveled by the ship between two consecutive bearings of the same object taken at 45° and 90° to the bow.
DISTANCE SAMPLING

Buckland et al. 2015

This represents the animals inside the ESW which you don’t spot.

This represents the animals outside the ESW which you do spot.

ESW 30.97 m

\[ \hat{D} = \frac{n}{ESW \times L} \]
**DISTANCE SAMPLING**

- # transects 135
- Litter items sighted: 629
- Mean $4.7 \pm 11.5$ items/transect
- 98.87% Plastic objects

**STRIP TRANSECTS**

- # transects 135
- Litter items sighted: 709
- Mean $5.2 \pm 12.1$ items/transect
- 96.82% Plastic objects
STRIP TRANSECTS

- Strip width **20 m**
- Mean **20.43 ± 46.81** items/km²
- Max **391.93** items/km²
- Median **4.03** items/km²
- 95% conf. (11,676 - 27,422)

DISTANCE SAMPLING

- ESW **30.97 m**
- Mean **11.76 ± 28.56** items/km²
- Max **214.37** items/km²
- Median **2.42** items/km²
- 95% conf. (6,8034 - 16,536)

$p$ (same mean): 9,5844E-06
$p$ (same median): 6,4799E-10
6 litter categories were sighted only through distance sampling (buckets, lids, styrofoam boxes, buoys, nets, cardboard/tetrapack).

On the other hand, more plastic fragments were sighted in the belt transects (579 vs 428).
**STRIP TRANSECTS**

- **Colors**
  - Total: 68%
  - Breakdown:
    - White
    - Transparent
    - Blue
    - Red/Orange
    - Green
    - Yellow
    - Black/Brown

- **Buoyancy**
  - Total: 69%
  - Breakdown:
    - +1
    - -1

- **Distance Sampling**

- **Colors**
  - Total: 63%
  - Breakdown:
    - White
    - Transparent
    - Blue
    - Red/Orange
    - Green
    - Yellow
    - Black/Brown

- **Buoyancy**
  - Total: 81%
Correlation
\[ r: 0.9456 \]
\[ r^2: 0.89413 \]
\[ p \text{ (uncorr.): } 1.0247 \times 10^{-66} \]

Bland-Altman difference plot (Bland & Altman, 1986)

LoA +1.96*SD +51.5
Mean diff. +8.66
LoA -1.96*SD -34.23
CONCLUSIONS

• Although yielding very similar results, the two methods are not completely equivalent (density estimates are significantly different, $H_0$ rejected).

• Both methods were successful in identifying litter hot-spots and correctly reported the spatial heterogeneity and debris accumulation areas.

• Distance sampling might be responsible for a certain ‘loss’ of items, especially in high-density areas, where many small pieces are overlooked.

• The diversity of litter in terms of sizes and typologies, is best described using distance sampling techniques (i.e. increasing the sampled area).

• Strip transect on the other hand is easy-to-use, less time consuming (in terms of data analysis) and it is likely to provide more realistic estimates, especially for the smallest size fractions.