Australia's National
Science Agency

Identifying and understanding the sources of marine debris

CSIRO's marine debris team, co-funded by the Australia Packaging Covenant, are working to better understand the sources of debris that end up on our shores and in our ocean. To do this, we developed a model that uses meteorological, geographic and national litter data to predict how litter travels through waterways and to the ocean.

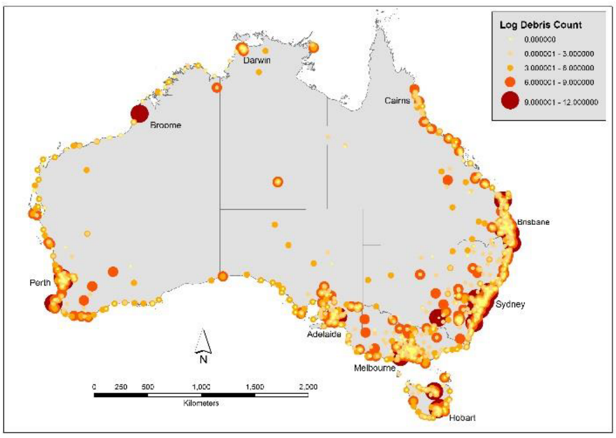
Our research questions

1. What is the relationship between debris in the marine environment and debris from nearby sites?
2. Are there identifiable pathways through which debris reaches and moves into the marine environment?

What we found:

Human deposition was by far the most important in determining the load at a site; transport by water was second, with a discernible but smaller contribution from wind transport.

We identified hotspots of coastal debris which enables us to cost-effectively target regions for waste reduction.



Map of debris hotspots based on all survey data from CSIRO, CUA and KAB. Note higher debris loads in urban cities around Australia's coastline. Data are reported as the log base 10 of the total amount of debris per 1000m^2.

We found that both socio-economic factors and the amount of time people spent at a site played a significant role in the amount of litter left behind. We also found that the context of the site was important, for instance there is less litter in national parks.

We identified a number of variables that affect litter and dumping loads, including population density and accessibility.

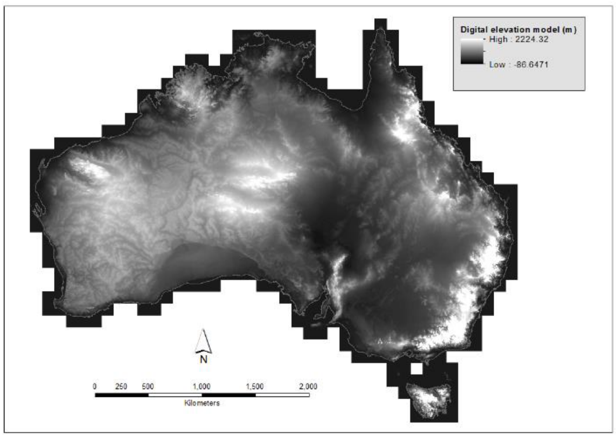
Using the watersheds in the greater Brisbane area, as well as meteorological, geographic and national litter data, we developed a model which allows us to predict the debris load at unsurveyed sites.

The impact of wind and water

While deposition (people dropping litter or dumping) is the key driver of the amount of debris at a site, transport by wind and water are also important.

Areas downwind and downstream act as sinks, accumulating debris from other sites.

Water transport was more important than wind, suggesting that debris traps in both surface and stormwater systems are a useful intervention.



Digital elevation model (DEM) showing topographical elevation above sea level in meters at the whole continent scale.

Debris transported by storm water lodged in the environment

Real opportunities to reduce debris

Our research shows that people are the greatest contributor to marine pollution meaning that to make a real difference, people must be part of the solution.

1. Addressing sites with high littering rates should be the first priority. The strongest effect on loads is direct deposition, which contributed more than transport in determining the load (or debris count) at a site.
2. The two strongest predictors of debris at a site were economic wealth and social disadvantage in the population near the site, providing insight for targeted education and awareness campaigns.
3. The Northern Territory had particularly high loads compared to other states, and is a potential target region for waste management programs.
4. People's activity types in context with land use correlates with the debris found. Places where people go to relax or play such as beaches, playgrounds and landscaped areas have significantly less litter than highways and carparks, indicating one possible way to reduce litter could be to re-think the design of lower value urban spaces to incorporate landscaping and recreational facilities.

Combining findings and future opportunities

1. The highest quality information is concentrated along the coast and in the major cities. Increasing the spatial coverage, and ensuring that important site types are sampled on urban margins and in rural areas will significantly improve the information available.
2. The transport modelling is a useful first step in understanding the movement of debris, and identifying critical intervention points. Increasing the detail will improve the capacity to identify and evaluate intervention points.
3. Using the maps of loads and flows developed in this project, we can now anticipate the amount of debris that would be expected given the location of the litter trap. This information can support allocation of funds and staff time in installing and maintaining infrastructure to maximum efficiency.
4. Watercourses had some of the highest litter loads, likely due in part to direct deposition. Given the propensity for litter to be transported to the ocean, reducing loads in watercourses is a vital action.

There is a significant opportunity for local governments to use this information to positively impact the resources allocated to, and the jobs undertaken by, waste management teams.

We can now look at litter loads where there are no traps and compare them to sites with traps, which allows us to identify critical locations for future investments.

5. The load analysis can be used in conjunction with interventions such as litter signage, bin installation, or community outreach programs to evaluate the impact of these programs on the amount of debris in the environment.

   Our statistical model can be used to predict the expected load. Thus, sites that have had or will have interventions can be compared to assess the effectiveness of the intervention actions on the amount of debris.

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