

The Rozalia Project has found higher average densities of floating trash in North American urban harbors than in the mid-ocean garbage patches.

To investigate the existing amount of trash in our urban waters, the Rozalia Project launched the first phase of the Urban Waters Surface to Seafloor Marine Debris Study. This research aims to determine the density, distribution, and type of marine debris collecting in all levels of the water column. In addition, this study will be the foundation of efforts to innovate marine debris detection and removal methods. This initial research focused on floating debris in the harbors of ten major North American cities.

METHODS

Samples were collected in 10 urban harbors using a neuston net, towed off of various vessels. Each sample was inspected for manmade items, either floating on their own or clinging to organic material.



Photo 1: A neuston tow being conducted off Rozalia Project's 60 ft sailing vessel, the *American Promise*, in Boston Harbor. A neuston tow captures objects floating in the neuston layer, the area where the surface of the water meets the air.

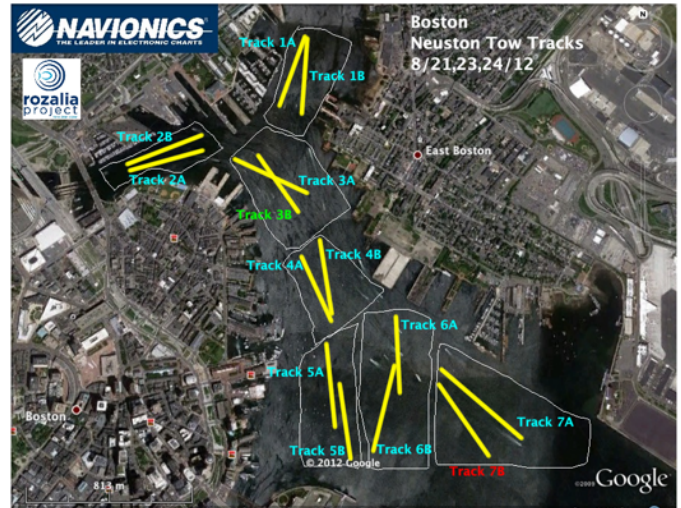


Figure 1: Diagram of all the tows done in Boston harbor. All the tracks were selected at random and recorded using Navionics and MacENC software. None of the tracks were diverted to pick up visible debris (any visible debris outside the track was picked up with a dip net and recorded separately from this study).

RESULTS

1. Overall, Los Angeles had the highest average concentration and the tow with the highest concentration of trash in the study; Vancouver had the lowest overall average. See Figure 2 for individual harbor results.
2. 92% of the 100 total tows completed had at least one piece of marine debris.
3. The cities with tows that came up clean were: Chicago, San Francisco, Seattle, and Vancouver.
4. In terms of materials, the top items were:
 1. Pieces of microplastic: Found in 100% of the harbors and the number 1 item found in 90% of the harbors.
 2. Pieces of foam: Found in 90% of the harbors and the number 1 item in Los Angeles.

- Pieces of monofilament: Found in 90% of the harbors. It was the number 2 item in Vancouver and San Diego.
- The types of trash found in these harbors were surprisingly homogenous. Overall, there were only 5 major categories of trash: foam pieces, plastic pieces, monofilament, food wrappers, and paper. Foam and plastic pieces comprised 92% of the trash in these 5 categories.

Urban Harbor	Average concentration of trash: pieces/km ²	Tow with the lowest concentration of trash	Tow with the highest concentration of trash
Los Angeles: Marina del Rey: 8 tows	282,000	12,000	728,000
Long Beach/Port of LA	87,000	12,000	264,000
Philadelphia: Delaware River	83,000	12,000	284,000
New York City: southern end of Manhattan	74,000	20,000	224,000
Boston: inner harbor	58,557	17,388	141,588
San Francisco Bay: near Golden Gate and Bay bridges	24,000	0	80,000
San Diego: off Shelter Island	21,000	4,000	56,000
Seattle: Lake Washington	14,000	0	80,000
Chicago: south of Navy Pier	8,500	0	16,000
Vancouver: off Jericho	3,500	0	12,000

Figure 2: Results from all ten of the harbors towed, ranked from the highest density to the lowest.



Figure 3: This infographic represents the number of pieces of trash one would hit if they were swimming one length of an Olympic-sized pool with a concentration the same as in one of the studied harbors.



Figure 4: A visual representation of the average concentration of trash found in each harbor.

CONCLUSIONS

There is a lot of trash in our urban harbors, and it is more than just ugly - it is dangerous

The consequences of high concentrations of marine debris require attention because of the wide range of dangers it poses to marine habitats, marine creatures and humans alike. Beyond the well-documented hazards of entanglement, ingestion, strangulation, dangers to boat traffic and economic losses due to trashed beaches, plastic marine debris poses a potential direct threat to our human food chain.

Plastic, in its current oil-based form, does not dissolve or biodegrade. Instead, it breaks up into pieces of microplastic, some too small for the human eye to see unaided. This microplastic is ingested by all sizes of marine life from plankton to the great whales. Persistent organic pollutants (POPs) adsorb onto marine-borne plastic (they do not permeate the plastic, but hitch a ride). It has been shown that when microplastic is ingested, these POPs can transfer to the tissue of the animal. Much like mercury has done in salmon, these harmful chemicals can bioaccumulate and travel up the food chain, endangering humans in a very direct health-related way. This could, potentially, cause substantial economic loss in the form of fishery collapse, due to contamination and lack of consumer confidence.

We need to focus on our urban waters for solutions, not the ocean's gyres

Fifty percent of the harbors researched in this study have much higher average concentrations of trash than their corresponding mid-oceanic gyre.

Urban Harbor	Average pieces/km²	Adjacent Gyre	Average pieces/km² (<i>Sesini, 2011</i>)
Los Angeles	282,000	North Pacific	25,000
Long Beach	87,000	North Pacific	25,000
Philadelphia	83,000	North Atlantic	25,000
New York City	74,000	North Atlantic	25,000
Boston	58,557	North Atlantic	25,000

Our data underscores the need to focus our attention as it relates to finding solutions to the problem of marine debris on our land-sea interface, especially in urban harbors. Eighty percent of marine debris comes from land, as opposed to offshore sources. Because the majority of our population is concentrated in urban areas, these coastal cities are major point sources of marine debris. The total urban population of just the 10 cities studied here is around 20.938 million people. Focusing our restoration and prevention efforts on these areas is more effective than attempting to clean the ocean gyres. Initiatives should be varied and include shoreline and harbor cleanup programs, prevention through education for all ages, properly managed municipal trash cans, recycling infrastructure, storm drain innovation and maintenance, and innovations in packaging. Rozalia Project also wants to inspire people to see value in all materials, especially those that comprise our trash. By recognizing this, materials in our trash could be reused to make new products, significantly lowering the negative effect trash currently has on the marine environment.

FUTURE: OPPORTUNITIES FOR ACTION

Rozalia Project plans to continue this study on marine debris from the surface to the seafloor, revisiting cities in the current study at different times of year and including additional cities in the Gulf of Mexico and on inland lakes and rivers.

We see the results of this study as an opportunity for action, here, at the land sea interface.

From the onset, we can prevent marine debris through education programs inspiring individual responsibility for trash and materials use and connecting people, in a personal way, to the problems and threats marine debris poses to their lives and the lives of their loved ones.

We believe that a majority of microplastic comes from storm drain run off. Therefore, innovation in urban waste management from using solar compacting trash and recycling bins to seeking effective physical barriers on storm drains will make a significant impact in reducing marine debris.

As is shown in the results, the types of trash floating in our urban waters are fairly homogenous. This gives us an opportunity to make a big difference with relatively small changes. Our observations are that much of the microfoam we found was from dock float breakdown and degradation. Seeking innovations such as a biodegradable alternative to foam; plastics with better resistance to UV for the outer shell of the floats as well as proper inspection, maintenance and replacement programs in large marina areas like Marina del Rey will go a long way in reducing potentially harmful debris floating in our urban harbors.

There were concentrations of plastic microbeads in 60% of the urban harbors we tested. Microbeads are small balls of plastic that originate in many exfoliating health products such as body washes and even toothpaste. They are too small for water treatment centers to catch. Their presence in urban waters supports current proposed legislation to ban their use, favoring natural, biodegradable exfoliants such as apricot shell, jojoba, sugar or even coffee grounds!

An additional item of interest found in 60% of the samples was resin pellets. Resin pellets are the raw material for manufacturing plastics and represented, by far, the largest amount of pre-consumer items we found. In order to help prevent resin pellet loss, Rozalia Project is a supporter of Operation Clean Sweep, an industry-led initiative to share best practices and other information helping stop pellet loss into the marine environment.

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