Workshop Summary: A Global Estimate of All Sources of Plastic Debris into the Ocean

Ocean Conservancy
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Addressing Marine Plastics
A Systemic Approach

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OCEAN PLASTICS SCIENCE BACKGROUND

A foundational science product that emerged from the National Center for Ecological Analysis and Synthesis (NCEAS) Marine Debris Working Group, supported by Ocean Conservancy in 2015, was a framework to describe the major sources of plastic debris to the ocean, beginning with losses at production (i.e., of industrial resin pellets), through use, and finally at disposal (Figure 1). This conceptual model may be used to identify research strategies to estimate the total amount of plastics entering the ocean. Further, if each of the 8 major sources (bottom row in Figure 1) were quantified and ranked, this information would inform intervention strategies to minimize or prevent future releases to the ocean. These data could inform policy decisions at any scale, from local to global. Of the 8 major sources described in this framework, only one (improperly managed waste generated on land) has been quantified at a global scale (4.9-12.8 million tonnes (Mt); Jambeck et al. 2015).

The goal of this workshop and project, which is continuing work by a subset of NCEAS Working Group members, is to quantify the relative contribution of each of the remaining sources in terms of plastic mass input to the ocean using existing, best available data from a variety of sources, including industry and environmental data. In some cases data limitations might allow estimations only within factors of 10 or 100 (or more). The goal is to determine the largest sources of plastics to the ocean in order to provide a global estimate of total plastic debris entering the ocean, and also to prioritize intervention strategies. An additional outcome of the work will be the assessment of major information gaps and priority areas for future research.

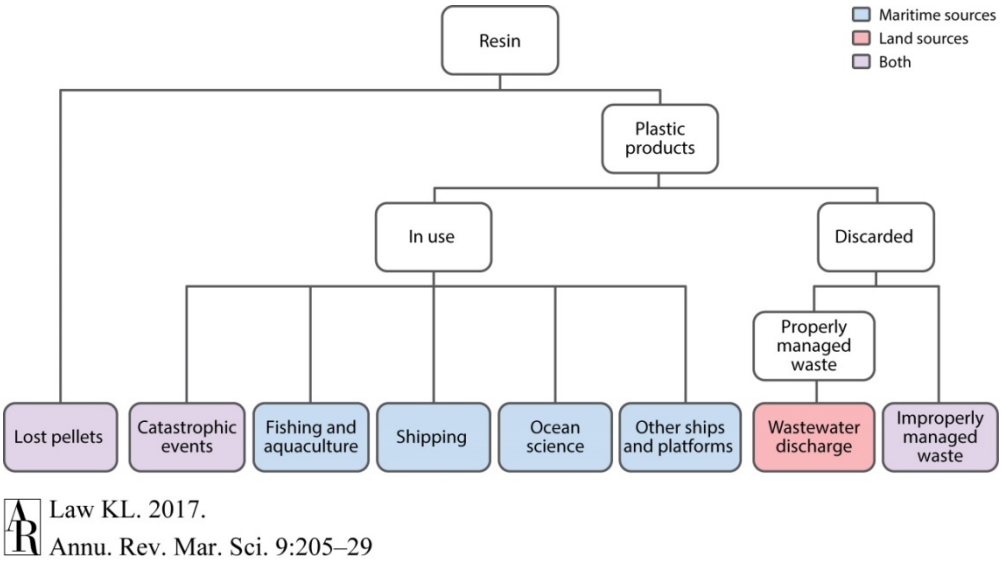

Figure 1. Conceptual framework describing losses of plastics to the ocean from production (Resin) through losses during use (In use) and at disposal (Discarded).

WORKSHOP ACTIVITIES

At a meeting in Portland, Maine, USA in August 2018, the research team (Team) revisited the framework to evaluate critical next steps and to map a plan for submitting a manuscript to the peer-reviewed literature. Workshop participants included:

- Dr. Kara Lavender Law, Sea Education Association
- Jessica Donohue, Sea Education Association
- Dr. Jenna Jambeck, University of Georgia
- Dr. Chelsea Rochman, University of Toronto
- Dr. Roland Geyer, UCSB, Bren School of Environmental Science and Management

The Team added new sources of plastic debris inputs including Fish Aggregating Devices (FADs), microplastics in stormwater/runoff, derelict vessels, marine paint and abrasive blasting, agriculture, and atmospheric deposition. They also agreed to expand the land-based mismanaged waste estimate to include major river watersheds. Not all sources will be estimated in the final analysis, but all will be discussed with justification for analysis inclusion or omission decisions. With the addition of new source categories, the Team recognized the importance of avoiding double counting. For example, industrial pellets might be lost from a ship via a lost container and should only be counted in one source category or the other. Or, large items of mismanaged waste might fragment and enter stormwater as microplastics. The importance of distinguishing between sources (tied to production, use (sector) or disposal of material) and pathways, or the physical mechanism by which plastics are delivered into the marine environment, was also discussed at length; and depending on the question of interest, either sources or pathways, or possibly both, may need to be considered.

In terms of metrics, the relevance of using mass versus count, or both, was explored and ultimately the most appropriate choice depends on the question of interest. In practice, data are reported in one type of unit or the other, so conversions must be made using sensible assumptions to ensure appropriate comparisons can be made.

OUTCOMES AND NEXT STEPS

Key outcomes from the workshop included preliminary estimates were achieved for losses of resin pellets; ocean science activities (i.e. oceanographic tools); FADs; lost shipping containers; and loss of waste generated at sea. Fishing gear loss is complex and extremely difficult to estimate, but the Team believes it could potentially be on the same scale as land-based waste (millions of tonnes per year), while plastic debris generated by aquaculture could be as large as 10,000s of tonnes per year. Strategies were discussed to estimate remaining sources and finalize preliminary estimates. For example, the Team plans to create a regression between tonnage of plastic debris lost in natural disasters and reported insurance losses (US$) from events in which both are known, then use the insurance loss data to infer lost plastic tonnage for all events that occurred in a single year.

By the conclusion of the workshop, the Team drafted an outline of a manuscript to be submitted to a high-level peer-reviewed journal (e.g., *Science)* with a target submission of Q4 2019.