THE NATIONAL ACADEMIES
REPORT IN BRIEF

Tackling Marine Debris in the 21st Century

Marine debris from ships and other ocean-based sources—including trash and lost fishing gear—contributes to the spoiling of beaches, fouling of surface waters and the seafloor, and harm to marine animals, among other effects. Unfortunately, international conventions and domestic laws intended to control marine debris have not been successful, in part because the laws, as written, provide little incentive to change behavior. This report identifies ways to reduce waste, improve waste disposal at ports, and strengthen the regulatory framework toward a goal of zero waste discharge into the marine environment. Progress will depend on a commitment to sustained funding and appropriate institutional support.

The debris of modern living frequently finds its way into our waterways and down to the sea. Some enters the oceans as intentional or accidental discharges from ships and platforms; the rest is transported there by rivers, wind, rain, sewers, and beachgoers. Given its diversity, abundance of sources, persistence, and ability to be carried by tides and currents over long distances, marine debris is a global concern that is likely to increase in the 21st century.

Photo by Anthony Amos

Humans once viewed the ocean as limitless, believing that disposal of waste from vessels would do little harm. However, awareness of the impacts of marine debris has grown. The public image of the problem has often centered on horrific images of seabirds, turtles, and marine mammals, dead and dying as a result of ingesting or becoming entangled in debris. It is hard to quantify these impacts, but some have conservation and legal implications. For example, entanglement of Hawaiian monk seals, the most endangered seal in the United States, is arguably the most significant impediment to that species' recovery. Littered beaches and surface waters impair recreational activities and reduce tourism, among other socioeconomic effects.

Regulation of marine debris falls largely under an international convention known as MARPOL Annex V, which entered into force in 1988. In the United States, this convention is implemented through a law known as the Act to Prevent Pollution from Ships. These mandates place restrictions on the disposal of garbage and completely prohibit the disposal of plastics at sea. Yet despite these and other prohibitions, 20 years later, there are still large quantities of plastic and other debris in the marine environment.

In 2006, Congress enacted the Marine Debris Research, Prevention, and Reduction Act. Within this Act, Congress requested that the National Research Council undertake this study to assess the effectiveness of international and national measures to prevent and reduce marine debris and its impacts. In accordance with the charge from Congress, this report focuses on the debris

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discharged at sea from commercial shipping, fishing, recreational boating, cruise ships, and other sources. However, because a substantial amount of marine debris originates from land-based sources, the report's recommendations are framed in the context of the larger marine debris problem.

The report makes several recommendations in four overarching areas in which changes are needed: (1) marine debris management, leadership, and coordination; (2) port facilities for shoreside disposal; (3) the distinct aspects of managing fishing gear as a source of marine debris; and (4) information and metrics with which to assess effectiveness of efforts.

Impacts of Marine Debris

Ingested marine debris, particularly plastics, has been reported in examinations of dead birds, turtles, marine mammals, fish, and squid. Known effects of ingested marine debris on birds include reductions in nutrient absorption and in the amount of space for food, ulceration of tissues, and mechanical blockage of digestive processes. There is also a growing concern plastics can adsorb, concentrate, and deliver toxic compounds to organisms that ingest them. Although studies to date are limited, widespread observations of ingested debris among seabirds suggests a broad and significant ecological impact, at least in some regions such as the North Pacific Ocean.

Entanglements typically involve debris encircling the neck or appendages of marine animals, most commonly by plastic packing straps, followed by rope and line, and net fragments. Once entangled, death rates differ among species, but have been documented to be more than 80 percent for Antarctic fur seals, 44 percent for Australian sea lions, and 57 percent for entangled New Zealand fur seals. Death rates could be even higher because entangled animals may die unobserved at sea. Coral reefs can also be harmed via scouring, abrading, or breakage when marine debris snags or entangles coral skeletons.

Ghost fishing—the entrapment of fish in lost or abandoned gear such as gillnets, traps, cages, and pots—is a widely acknowledged problem. The impacts are difficult to quantify, but ghost fishing may have implications for both commercial stocks and protected species. For example, one study reported that ghost gillnets may continue to be active for as long as 7 years and account for annual losses of 545 white sturgeon in the Columbia River, a death rate equivalent to about one-third of the commercial harvest.

Marine debris has significant socioeconomic impacts as well. The presence of litter can reduce coastal recreation and tourism revenue; for example, in 1988,

A diver rescues an endangered Hawaiian monk seal from a derelict fishing net. Photo courtesy NOAA.

it was estimated that New Jersey lost between $379 million and $3.6 billion in tourism and other revenue as a result of debris washing ashore. Debris can pose a health and safety hazard to beachgoers and divers and can foul propellers and jet intakes of commercial and recreational boaters. Ghost fishing can reduce the amount of fish and shellfish available for harvest.

Improving Management and Leadership

Despite measures to prevent and reduce marine debris, evidence shows that the problem continues and will likely worsen. One reason for the ineffectiveness of current measures is that, under MARPOL Annex V, shipborne waste management allows for the discharge of most wastes except plastics. Many industries, both on land and at sea, have developed and implemented practices that aim to minimize waste with the goal of zero waste discharge. For example, the Matson Navigation Company has implemented a "zero solid waste discharge" program for its domestic containership route, disposing only of food scraps at sea. Although some vessels already have successfully adopted zero or minimal discharge practices, current regulations do not encourage innovation and adoption of source reduction and waste minimization measures.

The other major impediment to progress is a lack of leadership. Responsibilities and resources for preventing and mitigating marine debris are scattered across organizations and management regimes. Under the Marine Debris Research, Prevention, and Reduction Act, Congress reestablished the Interagency Marine Debris Coordinating Committee to reinvigorate agency coordination, but leadership and governance remain diffuse and ineffective, and current mitigation efforts are episodic and crisis driven. Further, there is a need for a reliable, dedicated funding stream to

support mitigation efforts and a national strategy and framework for identifying priorities for addressing marine debris.

Overarching Recommendation: The United States and the international maritime community should adopt a goal of zero discharge of waste into the marine environment. The United States should take the lead in the international arena in this effort and in coordinating regional management of marine debris with other coastal states. The Interagency Marine Debris Coordinating Committee should develop a strategic plan for domestic marine debris management. Performance measures should be developed by the United States and the international maritime community that allow for assessment of the effectiveness of current and future marine debris prevention and reduction measures.

Specifically, the report recommends that the U.S. delegation to the International Maritime Organization should advocate that MARPOL Annex V be amended to include a general prohibition on discharge of garbage at sea with limited exceptions. In the United States, the Interagency Marine Debris Coordinating Committee or Congress should clearly designate a lead agency to expand cooperative marine debris programs. In addition, the U.S. Coast Guard should promulgate best management practices that reflect the maximum practicable extent to which ships can operate without the need to dispose of garbage at sea.

Encouraging Waste Disposal at Port Facilities

To prevent the discharge of waste at sea and work toward the goal of zero discharge, ships must have the ability to dispose of waste at onshore port facilities and have incentives to do so (or at least they should not face disincentives, for example, high disposal fees). Ships continue to face challenges in offloading their wastes in ports, particularly in remote areas, even in countries that have formally stated they have adequate reception facilities. Despite past recommendations for collaboration, there continues to be a disconnect between land-based and maritime solid waste management systems.

Overarching Recommendation: Domestically, the U.S. Coast Guard should establish minimum qualitative and quantitative standards for port adequacy; provide technical assistance for ports to achieve standards; encourage ports to provide incentives to vessel operators for discharging their waste ashore; and ensure that there are adequate reception facilities and alternative disposal options for waste fishing gear. Internationally, the U.S. delegation to the International Maritime Organization should exert its leadership in an ongoing MARPOL Annex V review process to ensure that similar amendments are incorporated into Annex V.

Specifically, the report recommends that the U.S. delegation to the International Maritime Organization advocate that MARPOL Annex V be amended to include explicit qualitative and quantitative standards for adequate port reception facilities, and that the International Maritime Organization provide assistance to achieve these standards. In addition, approval of port certificates of adequacy of waste reception facilities should be conditioned on formal coordination between ports and solid waste management systems.

Improving How Fishing Gear is Managed

Fishing gear and fish aggregating devices (man-made floating objects designed to attract fish, known as FADs) that are constructed from durable synthetic fibers can be lost or abandoned at sea. As marine debris, derelict fishing gear can be particularly hazardous to marine life. Current regulations do not include accountability measures for gear loss, and fishermen and fisheries management organizations have few incentives and several disincentives to take responsibility for the impacts and for cleanup. For example, inadequate port facilities and high disposal costs are an impediment to the proper disposal of waste and derelict gear.

The international convention MARPOL Annex V contains some exemptions that contribute to the problem. The exemption for "the accidental loss of synthetic fishing nets, provided that all reasonable precautions have been taken to prevent such loss" does not provide sufficient guidance to regulators and the fishing industry. Moreover, because of exemptions related to minimum length and gross tonnage of ships, certain MARPOL Annex V requirements do not apply to a substantial number of fishing vessels. In addition, because derelict fishing gear and abandoned fish aggregating devices fall under both MARPOL Annex V (and corresponding domestic laws) and fisheries management treaties and regulations, the legal overlap has complicated implementation of measures to prevent and reduce these sources.

Overarching Recommendation: MARPOL Annex V and international and domestic fisheries treaties and regulations should be revised to clearly identify and prohibit preventable losses of fishing gear, including fish aggregating devices. The International Maritime Organization, fisheries management councils and

organizations, and other relevant entities should adopt gear accountability measures and facilitate proper disposal.

Specifically, the U.S. delegation to the International Maritime Organization should advocate that MARPOL Annex V be amended to improve regulation of fishing gear, including explicit definitions of "accidental losses" and "reasonable precautions" with respect to synthetic fishing nets. To clarify overlapping authorities, Congress should direct the U.S. Coast Guard and the National Oceanic and Atmospheric Administration (NOAA) to undertake a joint rulemaking to develop clear regulations related to disposal of waste fishing gear and prevention of accidental loss of fishing gear.

In the United States, Congress should consider adding a national standard to the Magnuson-Stevenson Fishery Conservation and Management Act that fishery conservation and management measures should be designed to minimize the risk of gear loss. NOAA should convene a workshop to explore innovative and cost-effective approaches for identification or marking of trawls, seines, gillnets, longlines, and fish aggregating devices to foster gear identification and adopt a "no fault" policy regarding the documentation and recovery of lost fishing gear. NOAA should require that the U.S. purse seine fleet submit a fish aggregating device management plan.

U.S. Coast Guard should incorporate the ability to receive used and derelict fishing gear into minimum standards in the assessment criteria for the certificates of adequacy for port reception facilities.

Information and Metrics to Assess Progress

Although there is clear evidence that marine debris is a problem, there has not been a coordinated or targeted effort to thoroughly document and understand its sources, fates, and impacts. This confounds the ability to prioritize mitigation efforts and to assess effectiveness of measures that have been implemented.

Overarching Recommendation: The Interagency Marine Debris Coordinating Committee should, through planning and prioritization, target research to understand the sources, fates, and impacts of marine debris. It should support the establishment of scalable and statistically rigorous protocols that allow monitoring at a variety of temporal and spatial scales. These protocols should contain evaluative metrics that allow assessment of progress in marine debris mitigation. The United States, through leadership in the international arena, should provide technical assistance and support for the establishment of additional monitoring and research programs worldwide.

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This report brief was prepared by the National Research Council based on the committee's report. For more information or copies, contact the Ocean Studies Board at (202) 334-2714 or visit http://nationalacademies.org/osb. Copies of *Tackling Marine Debris in the 21st Century* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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