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## "Marine Debris — an Overview of a Critical Issue for Our Oceans"

#### What is Marine Debris?

Scientists define marine debris as any manufactured or processed solid waste material (typically inert) that enters the ocean environment from any source (Coe & Rogers, 1997). Debris is more than an unsightly inconvenience for beach-bound vacationers or pleasure boaters; it's one of the world's most pervasive pollution problems affecting our oceans and inland waterways. It affects the economies and inhabitants of coastal and waterside communities worldwide. Cigarette filters and cigar tips, fishing line, rope and gear, baby diapers and nappies, six-pack rings, beverage bottles and cans, disposable syringes, tires – the litany of litter is as varied as the products available in the global marketplace, but it all shares a common origin. At a critical decision point, someone, somewhere, mishandled it – either thoughtlessly or deliberately.

Ocean dumping is not a new phenomenon. It has been a practice for centuries. While our habits haven't necessarily changed, the nature of marine debris has – dramatically. Over the past 30 to 40 years, organic materials (once the most common forms of debris) have yielded to synthetic elements, like plastics, as the most abundant material in solid waste. Durable and slow to degrade, items like beverage bottles, packing straps, tarps, and synthetic fishing line can become debris with staying power. In addition, many of these items are highly buoyant, allowing them to travel in currents for thousands of miles, endangering marine ecosystems and wildlife along the way.

According to the United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), land-based sources account for up to 80 percent of the world's marine pollution (GESAMP, 1991). Much of the debris reaches the ocean after people engaged in beach-going activities have discarded it; the debris is often blown into the water, or carried by creeks, rivers, and storm drains/sewers to ocean areas. Other debris comes from activities on the water, including vessels (from small sailboats to large ships), offshore drilling rigs and platforms, and fishing piers.

While there are laws regulating the dumping of trash at sea and on shore, the global nature of debris, its inability to be confined within territorial boundaries, and the complexity of identifying debris sources have made effective laws difficult to draft and even harder to enforce.

#### What are the Sources of Marine Debris?

Determining where all of the debris originates is no easy task since trash and litter can travel long distances before being deposited on our shorelines or settling on the bottom of the ocean, bay, or riverbed. Marine debris researchers traditionally classify debris sources as either *land-* or *ocean/waterway-based*, depending on where the debris enters the water. Other factors such as ocean current patterns, climate and tides, and proximity to urban centers, industrial and recreational areas, shipping lanes, and commercial fishing grounds influence the type and amount of debris that is found on the open ocean or collected along beaches and waterways or under water.

Land-based debris blows, washes, or is discharged into the water from land areas. Sources include beachgoers; fishermen; materials manufacturers, processors, and transporters; shore-based solid waste disposal and processing facilities; sewage treatment and combined sewer overflows; inappropriate or illegal dumping; and public littering. These materials are transported by:

Sewer overflows & sewage treatment plants – Public wastewater treatment facilities are prohibited from discharging plastics and other materials into the marine environment. Under normal "dry weather" conditions, most wastes are screened out of sewage. However, materials can bypass treatment systems and enter waterways when rain levels exceed sewage treatment facilities' handling capacity. During these times, sewage overflows occur and debris from these discharges may include tampon applicators, condoms, and syringes.

Shore-based Solid Waste Management Practices — Both legal and illegal waste handling practices contribute to marine debris. These include the inadvertent release of debris from coastal landfills and garbage from water transports; recreational beach and roadside litter; and the illegal dumping of domestic and industrial garbage into coastal and marine waters.

Litter – People's mishandling of waste materials – the packaging from convenience items, food wrappings, beverage containers, and a host of other materials – creates the foundation for the marine debris problem.

People also generate marine debris at sea. *Ocean/waterway-based* contributors include commercial fishing vessels; merchant, military, and research vessels; recreational boats and cruise ships; and offshore petroleum platforms and associated supply vessels. Debris can end up in the water through accidental loss or system failure; historical waste management practices; or illegal disposal and indiscriminant littering.

Commercial Fishing – Commercial fishermen create marine debris when they discard ship-generated trash overboard or fail to retrieve fishing gear. Debris associated with commercial fishing includes nets and ropes, salt treatment bags, bait boxes and bags, fish baskets or totes, fish and lobster tags, and gillnet or trawl floats.

Recreational Boaters – Some boaters discard trash overboard. Such debris may contain food wrappers, beverage containers, bags, and monofilament fishing line and other related fishing gear.

Merchant, Military, and Research Vessels – Large vessels with extensive crews typically carry supplies for several months, and therefore produce solid wastes on a daily basis. But any of this debris can end up in the water if not properly disposed of or secured. The maritime and waste management industries have researched ways to better handle and store wastes aboard ships for long voyages.

Offshore Petroleum Platforms and Supply Vessels – Undersea exploration and resource extraction also contribute to the marine debris problem. Daily oil/gas platform operations can create large amounts of trash. Discarded or lost hard hats, sheeting, computer supplies, survey materials, and personal waste produced by platform and supply vessel crews can all become marine debris.

## What are the Impacts of Marine Debris?

#### Human Health and Safety

Items such as broken glass, medical waste, rope, and fishing line pose immediate risks to human safety. Discarded syringes, condoms, and tampon applicators can indicate more serious water quality concerns that affect human health. Swimmers, divers and snorkelers can become entangled in submerged or floating debris. Medical and personal hygiene debris often enters the waste stream through direct sewage outflows or inadequate sewage treatment systems. These items can indicate the presence of invisible

pathogenic pollutants such as streptococci, fecal coliform, and other bacterial contamination. Consumption or contact with water polluted with these pathogens can result in infectious hepatitis, diarrhea, bacillary dysentery, skin rashes, and even typhoid and cholera.

#### Aesthetic and Economic Impacts

Clean and safe beaches promote tourism and economic health. Litter makes shorelines unattractive and potentially hazardous, and forces communities to spend funds to increase beach maintenance. The indirect costs can be even greater. Most coastal communities rely on the income generated by seaside businesses, and the clientele that support them. Marine debris discourages people from fishing, boating, swimming, and visiting coastal areas.

#### Wildlife Entanglement and Ingestion

Many forms of marine debris – especially derelict fishing gear – pose serious threats to wildlife. Debris can hamper an animal's mobility, prevent it from eating, inflict cuts and wounds, or cause suffocation or drowning. Monofilament line, fishing nets and ropes, six-pack rings, and packing strapping bands are some of the more harmful culprits related to entanglements. According to the U.S. Marine Mammal Commission, 136 marine species have been reported in entanglement incidents, including six species of sea turtles, 51 species of seabirds, and 32 species of marine mammals (Marine Mammal Commission, 1996).

The Marine Mammal Commission also reports that ingestion incidents have been documented in six of seven species of sea turtles, 111 out of the world's 312 species of seabirds, and 26 species of marine mammals. Many animals confuse debris for food and cannot regurgitate an item once it has been swallowed; it often becomes lodged in their throats and digestive tracts. Debris that will not pass out of the stomach gives a false sense of fullness, causing some animals to stop eating and slowly starve to death.

Derelict fishing gear also causes damage when abandoned fishing gear and nets continue to catch and kill ocean life. This process is known as *ghost fishing*. In essence, ghost nets are perpetual "killing machines" that never stop fishing (Esteban, 2002). Worldwide, this phenomenon is having an impact on the viability of already stressed fisheries. Although there is increasing recognition of the ghost fishing problem, few studies have been conducted since 1994 (Laist and Liffmann, 2000). Limited evidence from studies conducted in Atlantic areas suggests that discarded gear may cause significant losses of some commercially valuable fish and crab species (Laist, 1997).

#### Habitat Destruction & Alien Species Introduction

Debris affects the water quality of aquatic habitats and also causes physical damage Moved by currents and tides, ropes and nets abrade, scour, break, and destroy living corals. Ensnared debris may also cause increased siltation and turbidity, blocking essential sunlight to, or smothering, sea grass or corals.

Additionally, floating marine debris may serve to transport invasive species. Drifting debris can harbor entire communities of encrusting and attached organisms and carry them great distances – often to areas where they can harm or compete with native species.

#### Vessel Damage

Derelict fishing gear can cause serious damage to vessels. Nets, ropes and other derelict gear entangle vessel propellers and rudders resulting in costly repairs, loss of time, and danger to boaters and crews. Plastic bags clogging and blocking water intakes is a common cause of burned-out water pumps in recreational boats. Such incidents involve costly engine repairs, and disablement. But because most incidents go unreported, the true scope and frequency of damaging encounters between debris and vessels is difficult to calculate.

#### Can Marine Debris be Prevented, Reduced, or Controlled?

Marine debris is one of the most pervasive and *solvable* pollution problems plaguing the world's oceans and waterways. Successful management of the problem requires a comprehensive understanding of both marine debris and human behavior. Education and outreach programs, strong laws and policies, and governmental and private enforcement are the building blocks for a successful marine pollution prevention initiative.

#### Monitoring and Education/Outreach Programs

On December 31, 1987, the United States ratified Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). Annex V prohibits the at-sea disposal of plastic wastes and regulates the distance from shore that ships may dump all other solid waste materials. Annex V became effective on December 31, 1988. The Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987 (Public Law 100-220, Title II) implements Annex V legislation and extends the dumping regulations to vessels in all navigable waterways of the United States.

Section 2204 of the MPPRCA requires the U.S. Environmental Protection Agency (EPA) Administrator, the National Oceanic and Atmospheric Administration (NOAA) Administrator, and the U.S. Coast Guard to conduct a public education program in the marine environment. Section 2204 also directs the EPA Administrator, along with the Secretary of Commerce and the U.S. Coast Guard, to encourage the formation of volunteer groups to assist in the monitoring, reporting, cleanup, and prevention of ocean and shoreline pollution. These policies form the basis of The Ocean Conservancy's marine debris programs.

Since its initial work on plastic garbage in the 1980s, The Ocean Conservancy has evolved into an authority on marine debris. The organization produced a report, *Plastics in the Ocean: More Than a Litter Problem*, which was the first study to identify plastic materials as a significant marine debris hazard. The report's findings led the U.S. Congress to enact laws to limit the dumping of garbage from boats and to help control land-based sources of marine debris, such as stormwater systems and combined sewer systems. Citizens have also made great efforts in fighting this problem through beach cleanups and debris monitoring activities across the country and all over the world.

#### International Coastal Cleanup

Since its first beach cleanup in 1986 in Texas, The Ocean Conservancy and its international and domestic partners have grown the International Coastal Cleanup (ICC) into a global annual volunteer effort devoted to the marine environment. To date, all 55 U.S. states and territories and 127 countries bordering every major body of water on the planet have participated in the ICC. In two decades, working one day per year, 5.8 million people have collected more than 100 million pounds of debris from over 158,657 miles of shoreline!

One of the ICC's primary goals is to trace pollution to its source and work to prevent it from occurring. Volunteers record debris information on data cards that identify the types, sources, and activities that produce the debris found along the world's beaches and waterways. Information on the data card is grouped by the behavior associated with the debris, including recreational, beach-going activities, smoking-related activities, ocean and waterway activities, activities associated with legal or illegal dumping, or activities resulting from improper disposal or handling of medical or personal hygiene materials. The result is a unique global database of debris information. Data from the Cleanup provides the framework for government action to limit marine debris and to educate the public about litter and pollution prevention. Information on the ICC, including data and contacts for local cleanup activities, are posted at www.coastalcleanup.org.

#### National Marine Debris Monitoring Program

Through a multi-year cooperative agreement with the U.S. Environmental Protection Agency, The Ocean Conservancy developed and field-tested the National Marine Debris Monitoring Program (NMDMP). This is a scientific marine debris-monitoring program designed to assess the effectiveness of current U.S. marine debris legislation. NMDMP assesses several aspects of debris, including accumulation rates, types and amounts of debris found at specific geographic locations, oceanographic and meteorological conditions, and proximity to land-based or ocean-based sources.

NMDMP has been successfully developed and field-tested through a national network of 700 trained volunteers who monitor 130 sites in 21 coastal U.S. states and two territories (Puerto Rico and U.S. Virgin Islands). The program developed nine regional designations, based on prevailing current patterns, marine debris information, and logistics. The results of this five-year study will provide the required data needed to scientifically assess marine debris trends and sources in the United States. Data collected through NMDMP is posted for public access through The Ocean Conservancy's website at www.oceanconservancy.org/nmdmp.

#### Engage Relevant Stakeholders

To effectively reduce and control marine debris and its environmental impacts, key stakeholders from diverse groups must be involved. This list includes local citizens; governments, agencies and authorities (national, regional, and municipal); organizations (international/ national, civic, religious, nongovernmental, and consumer); institutions (research, education, and medical); businesses (hotels and restaurants, outdoor recreation, manufacturers, and vendors); and industries (fisheries, tourism, waste management, and dive).

Commercial fishing and derelict gear have their own key audiences. The core of this group consists of fishermen ranging from single, subsistence individuals who may or may not own their own boats, to crews on large trawlers. Business and industry associated with equipment and boat manufacturing and marketing are part of this audience, since they produce and sell the gear and materials used by fishermen. The fish processing industry is also part of this group. Last but not least are the government regulatory and resource management entities, which must provide the legal, regulatory, and enforcement framework for this issue.

#### Implement Legislation and Enforce Regulations

Several laws regulate litter and debris on both land and sea. Unfortunately, laws do not guarantee compliance. In addition to enforcement and penalties, a sense of environmental stewardship among ocean users is essential for laws to be effective. The current laws relevant to the marine debris issue are:

#### 1972 London Dumping Convention (LCD)

The Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, also known as the London Dumping Convention (LCD), entered into effect in 1975 and is administered under the United Nations by the International Maritime Organization (IMO). This treaty established permitting requirements for the disposal of wastes into the sea and functions as the global instrument to control marine pollution from dumping dredge spoils, sewage sludge, and other land-based wastes. Under international law, waste materials carried out to sea for disposal are distinguished from those generated during ship operations.

#### **MARPOL 73/78**

The IMO also manages the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), which provides a comprehensive approach to dealing with ocean dumping by creating international guidelines to prevent ship pollution. MARPOL has six annexes, covering oil discharge (I), hazardous liquid control (II), hazardous material transport (III), sewage discharge (IV), plastic and garbage disposal (V), and air pollution (VI).

Annex V is of particular importance to the maritime community because it prohibits the disposal of plastic materials at sea and regulates the disposal of other garbage at sea. Under Annex V, garbage includes food and domestic and operational waste – excluding fresh fish – generated during normal vessel operations and liable to be disposed of continuously or periodically. Annex V also requires ports and terminals to provide garbage reception facilities for boats and ships. Ships of signatory nations must abide by Annex V regulations at all times in all waters; ships from non-signatory nations must abide by Annex V while in a signatory's waters. To cite a vessel for illegally discharging garbage or plastics into the sea, an individual must witness the event and report, or provide sound evidence, that such a discharge occurred. Many pollution violations go unreported or are never fully pursued due to lack of evidence. As of April 30, 2005, 122 countries had ratified Annex V. Without a doubt, MARPOL has helped to reduce the amount of trash on the beaches and oceans of the world.

#### MARPOL "Special Area" Designations

MARPOL has designated "Special Areas" as locations where, due to the site's unique oceanographic and ecological value, all overboard discharges of garbage (except ground food wastes) are prohibited. Food wastes may not be discharged within 12 nautical miles of the nearest land in Special Areas. To date, MARPOL has designated nine Special Areas – the Mediterranean Sea; Baltic Sea; Black Sea; Red Sea; Persian Gulf; Gulf of Aden; North Sea; Antarctic area; and the Wider Caribbean (including the Gulf of Mexico). However, for the designation to take effect, an area needs to prove it has adequate waste reception facilities at ports to handle the increased volume of trash from ships now prohibited from dumping in the area. So despite their status, many Special Areas are not yet treated as such.

#### Cartagena Convention

The 1987 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region – known as the Cartagena Convention – is the only legally binding environmental treaty for governing marine debris in the wider Caribbean. The Convention and its Protocols constitute a legal commitment by participating governments to protect, develop, and manage their common waters individually or jointly. It requires adopting measures to prevent, reduce, and control pollution from ships, dumping, seabed activities, land-based activities, and airborne pollution. Ratified by 20 countries, the Convention governs the marine environments of the Gulf of Mexico, the Caribbean Sea, and certain areas of the Atlantic Ocean.

## Business/Industry Involvement

A review of the available data and other information on debris found worldwide indicates that the dominant types and sources of debris come from what we consume (including food wrappers, beverage containers, cigarettes and related smoking materials), what we use in transporting ourselves by sea, and what we harvest from the sea (fishing gear we harvest from the sea). Industries affiliated with the aforementioned products and services play a critical role in debris management and abatement. Only with their involvement and support can we create effective solutions to the debris problem (The Ocean Conservancy, 2003).

## So why is marine debris still an issue?

Despite knowing the causes of marine debris and how it enters the environment, we continue to facilitate its deposition. Alternative materials that are less invasive or harmful to the environment exist, but they have not been successfully integrated into the economic mainstream. Lack of enforcement and inadequate compliance with laws that prohibit marine debris make those laws ineffectual. To fight these developments, we must create strategies and opportunities that encourage people to reduce marine debris. We must continue with current efforts by governments and the private sector to increase awareness, establish debris abatement programs, and change behaviors. Controlling and reducing debris in the marine environment is a significant – but achievable – challenge. If we are to conserve our ocean resources responsibly and successfully, it is a challenge that we must all face together.

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