Introduction: Marine Pollution—The Hazards of Producing Waste

Our oceans are so deep and broad that they may seem to go on forever. Perhaps this sense that beyond the horizon the ocean goes on and on endlessly has permitted us to be less aware and concerned about the waste we dump into it. But now we have reached a critical point: The sewage and other **pollutants** we have dumped in the ocean—intentionally and unintentionally—have threatened the balance of life in many marine environments. The question of what to do with our pollutants and how to safeguard against oil-tanker or chemical spills will not go away. But becoming aware of the pollutants and their effects is a good first step toward keeping cities and industries from further damaging our marine environments.

Our rivers, lakes, and other bodies of water do have certain natural properties that help in eliminating pollutants. In one process, bacteria that live in water break down organic wastes. In another process, *nonacidic* (basic) substances in water neutralize destructive acids that fall to Earth in rain and snow. Sunlight penetrating the water also helps to break down certain compounds. And some wastes are destroyed by the simple process of **oxidation**, or being exposed to the oxygen present in water (H_20) and the atmosphere.

Typical Water Pollutants

Pesticides	Chemicals	Radioactive Waste
DDT	acids	radium 226
2–4 D	ammonia	strontium 90
	arsenic chlorides	
	phosphates	
	dyes	
	hydrogen sulfide	
	lead	
	mercury	
	nitrates	
	tars	
	urea	
	zinc	

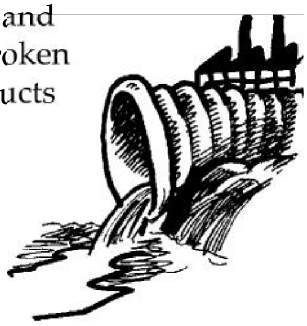
There are, however, limits to the waters' natural purifying properties. If too much waste is dumped into or enters the water, the natural purifying systems become overloaded and cannot break down the pollutants fast enough. This occurs, for example, when too much **raw sewage** enters the marine system. From feeding on the increasing amount of raw sewage, or organic waste, bacteria multiply and begin

consuming more and more oxygen. The oxygen level drops and leaves fish and other marine organism starving for air. When the oxygen level in water can no longer support life, we call the water *dead*.

Marine Pollution Generated by Our Homes, Industry, and Agriculture

People create sewage during their day-to-day living. They create *raw sewage* when they drain water down sinks, bathtubs, and washing machines, and when they flush waste down toilets. The waste from these daily activities includes soaps, detergents, and human excrement. Other examples of *raw* sewage include rainwater and even melted snow runoff from streets. These forms of raw sewage carry soil particles, leaves, and other litter to marine environments. As you can see from this brief list, marine environments have to purify millions upon millions of gallons of water to keep pace with our waste production.

In addition to these pollutants, consider those produced by our industrial and agriculture practices. Many modern industries dump pollutants that are not **biodegradable** into oceans and estuaries. *Nonbiodegradable* pollutants cannot be broken down by the waters' natural systems. Plastic products are a common example of a nonbiodegradable pollutant people dump into marine systems. The plastics will remain unchanged for hundreds of years.



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Another example of nonbiodegradable pollutants are some **pesticides**, which can become concentrated in bodies or organisms and cause a threat to organisms and to those who eat them.

Agriculture and industrial production also create *chemical* pollutants. These pollutants often end up fouling our marine environments. For example, fertilizers and pesticides from agriculture production get washed into our water system. And industry dumps thousands of different chemicals directly into the marine environment. Other wastes from industry enter the marine environment through the air in the form of **acid rain**, which falls on and pollutes the water environments.

Industry also releases heated or cooled water into the waterways, a type of pollution known as **thermal pollution**. Other sources of marine pollution include surface and underground mining operations that produce heavy metals. Uranium mines and nuclear power plants create dangerous radioactive pollutants that take hundreds of years to break down. In addition, ships often pollute the ocean. They spill oil into waterways, either accidentally or by flushing their holds. The oil then clogs the gills of fish and damages the feathers of marine birds and the fur of mammals.

The oil spilled damages the feathers of marine birds.

A major source of marine pollution comes from dredged material from rivers, harbors, and channels. These areas must be dredged periodically to keep them clear of sand buildup so ships can navigate these waterways. The dredged material that is hauled out to sea for disposal contains sediment that has absorbed heavy metals, grease, pesticides, and polychlorinated biphenyls (**PCBs**).

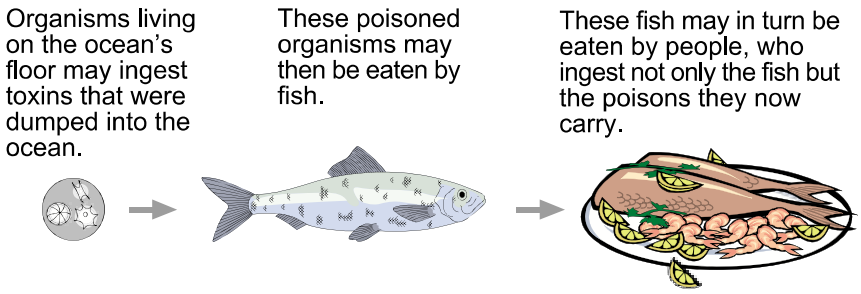
Point- and Nonpoint-Source Pollutants: Tracing Pollution

Pollutants that come directly from a single source are called **point-source pollutants**. Examples of point-source pollutants are wastes carried from a factory or sewage plant into a waterway. Pollutants that have been washed into waterways or that seep into groundwater are **nonpoint-source pollutants**. Surface-water runoff is an example of a nonpoint-source pollutant. Since nonpoint-source pollutants have no single source, it is nearly impossible to trace them back to the persons or organizations responsible for them.

Effects of Marine Pollution

Different pollutants create different effects on the marine environment. Some pollutants will choke the ocean of necessary oxygen and starve many marine organisms over a long period of time. Other pollutants have more immediate consequences. The *chemical* pollutant *dioxin* is a very toxic substance that kills mosquito minnows at concentrations of one drop per 1,000,000,000,000 drops of water! And other chemicals released into the marine environment become even more dangerous *after* they break down into toxic and cancer-causing substances.

Some poisons in the marine environment can travel through food chains and webs. So, for example, organisms living on the ocean's floor may ingest toxins; these poisoned organisms may then be eaten by fish. These fish may in turn be eaten by people, who ingest not only the fish but the poisons they now carry. As you can see, no matter how inconsequential or far away the marine environment may seem, what happens in the ocean and other waterways creates ripple effects that travel quite far.



Human Health: Polluting Ourselves

People become sick by drinking contaminated water, inhaling disease-causing organisms, or by being exposed to contaminants at beaches or pools. Waterborne illnesses are most common where living conditions are poor and water purification is not available. The most serious illnesses from poor water quality are cholera and typhoid fever. These diseases are spread through water or food that has been contaminated with the feces or urine of people with diseases. Cholera is caused by bacteria called *Vibiro*. When Vibiro bacteria is ingested, the victim suffers from diarrhea, vomiting, dehydration, and cramps. Typhoid fever is caused by the bacterium *Salmonella typhi*. Symptoms of this disease include fever, headache, and loss of appetite. If this disease is untreated, the victim may develop internal bleeding. Another disease transmitted by water **contamination** is hepatitis A, a viral disease causing inflammation of the liver.

People often ingest dangerous chemicals when they eat contaminated fish or shellfish. In the 1970s, large amounts of PCBs used in the making of electrical appliances were released in the marine environment in the Hudson River area. The PCBs accumulated in the tissues of fish, some of which were eaten by humans. The PCBs caused liver damage and cancer in many who ate the contaminated fish.

The Health of Marine Life: Damaged by Human Hands

Sewage and fertilizers cause tremendous algae blooms in the marine environment. If algae blooms deplete too much oxygen from the water, much of the marine life will die and beaches will become polluted. Some communities used to dump millions of gallons of sewage into the oceans each day. Today, this practice has been outlawed in the United States.

Pollution by people can harm marine organisms in other ways, too. The pH of water is very important to the health of organisms in marine communities. Acid rain lowers the pH of seawater, often to a level that weakens or deforms fish and other organisms. Suspended sediment from dredging harbor floors can limit light penetration, thereby interfering with plant photosynthesis. Other pollutants in the marine environment, such as plastics, cause animals to starve and strangle. Turtles and seabirds often eat plastic bags and other plastic trash, mistaking them for prey. The animals then starve because the plastic prevents them from digesting real food. In addition, birds become trapped or tangled in plastic six-pack rings and can strangle to death.

Thermal Pollution: Changing Temperatures

Power plants release large amounts of heated water into the marine environment. This water is not changed chemically but is used as a cooling agent to absorb the heat created during the power plant process. When the heated water is released into bays or estuaries, the natural water temperature rises, causing *thermal pollution*. Raising the water temperature of the natural environment reduces the water's ability to absorb oxygen. Lower oxygen levels make it hard for the fish and other organisms to breathe. It also reduces the ability of bacteria to decompose wastes in the water. Higher water temperatures can interfere with the animals' ability to reproduce as well. It may also increase populations of plants and animals that are not native to the area. In Florida, manatees may remain in colder regions due to the warmth generated by power plant waste. When they move out to feed, they may catch cold in the surrounding waters.

When the heated water is released into bays or estuaries, the natural water temperature rises, causing thermal pollution.

Thermal pollution can be reduced by constructing high cooling towers to cool the water before releasing it into the environment. Pumping thermal water into ponds and allowing it to cool before being released into the ocean is also effective.

Oil Pollution: Catastrophes in the Ocean

There has been pollution of the marine environments due to oil-tanker spills and offshore drilling accidents. One of the most familiar and tragic oil spills occurred on March 24, 1989, in Prince William Sound in the Gulf of Alaska. The oil tanker *Exxon Valdez* struck a reef in the sound and spilled about 11 million gallons of oil into the sound. The oil spill had a serious effect on the ecosystem, the inhabitants of the ecosystem, and the fishermen who depend on the area's waters for their livelihood. The remains of about 1,000 sea otters and 34,000 sea birds have been recovered. The less visible creatures affected by the oil spill were intertidal organisms such as starfish, sea urchins, and young embryonic fish. The exact number of animals who died as a result of the spill will never be determined.

Effect of Oil Spills

Oil spills cause catastrophic damage to marine organisms. An oil spill will affect every type of marine organism—bacteria, algae, zooplankton, fish, shellfish, birds, and mammals. Some of these marine organisms die immediately from exposure to oily water. Others die slowly or suffer from long-term problems. Clams, sea urchins, lobsters, starfish, and other benthic animals are destroyed by the oil that sinks and covers the ocean bottom. Sea birds landing on top of the oil slicks are soon covered with oil themselves.

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The oil digested by the eagles coats their intestines preventing the birds from absorbing water and nutrients. The eagles soon die of starvation and dehydration.

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Sea otters do not have a thick layer of blubber; instead, they rely on their thick coat of fur for warmth. When a sea otter is exposed to oily waters, its fur soaks up the oil and loses its ability to keep the otter warm. Otters are also poisoned from oil they swallow as they groom their fur to rid it of the oil.

Cleanup Efforts

Cleaning up an oil spill is not as simple as mopping up spilt milk. Many factors such weather conditions, wave height and speed, the spill's distance from the shore, and the readiness of cleanup crews, determine the success or failure in containing an oil spill. Three of the most commonly used methods to clean up oil spills are **mechanical containment**, chemical dispersion, and burning.

Mechanical Containment

Oil can be contained or trapped in an area by placing floating booms in a ring around the oil. The oil, once it is contained, can then be pumped into storage tanks. Booms usually work best in calm waters and when they are put in position soon after the spill happens.

Chemical Dispersion

Dispersants are chemicals which break up the oil. The chemical dispersants, sprayed on the oil spill by planes and helicopters, separate the oil into tiny droplets, allowing the natural chemicals in the water to more easily break up the oil. Chemical dispersants can be used on large spills but must be applied quickly before the oil spreads.

Burning

If the oil in a spill is particularly thick, then burning may be the best method to rid the area of the spill. Burning, however, is only effective in the early stages of a spill. It also causes problems by introducing noxious chemical by-products into the atmosphere which may return as acid rain.

A Future Method

The use of oil-eating bacteria is the newest method of controlling oil spills, but this is still in the experimental stage.

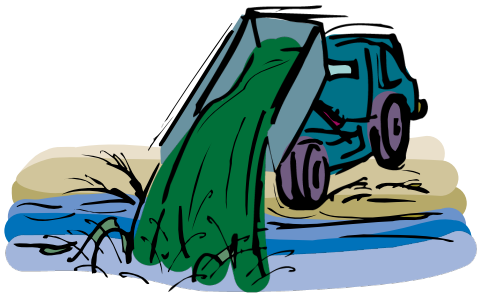
Prevention: Our Only Cure

Since the *Exxon Valdez* tragedy, many regulations have been proposed to prevent future oil spills. Environmentalists strongly promote requiring double-hulled tankers and barges that transport oil. Other suggestions designed to curb oil-spill disasters include better traffic control systems to guide tankers, drug and alcohol screening of ships' pilots, and requiring oil tankers to carry more oil-spill equipment on board.

Summary

The immensity of the oceans may have helped to create a careless attitude about dumping raw sewage and other pollutants in the Earth's waters. We have learned, however, that nonbiodegradable pollutants, both point-source and nonpoint-source, affect not only the health of marine life but also our own. Water has certain natural purifying properties that can reduce some pollutants, but these properties cannot purify all contaminated water.

Dumping hazardous wastes generated by our homes, industry, and agriculture into the marine environment must be regulated. Chemicals (fertilizers, pesticides), thermal pollution, dredging, PCBs, acid rain, and oil spills are some of the pollutants and sources that must be controlled by government regulations and education.



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