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Issue No. 172 *The American Forum for Global Education* 2001-2002

Space Ships, Whales, Scows, Derricks and People: Are the Seas in Danger?

THE ISSUE STATED

The topic of marine pollution is as vast as the oceans themselves. The seas, the coastline and the rivers and streams that feed into the oceans are inextricably linked, as are the perpetrators and victims of pollution. Historically, pollution was unintentional, but pollution is caused by people and their culture and presently threatens the very existence of the earth as we know it. Unrestrained population growth has made this vast resource, covering over two-thirds of the earth's surface, increasingly fragile and threatened.

Freedom of the seas has traditionally meant that the waters of the world are free to all—for travel, for sustenance, for sport. In recent years, due to advancing technology, the seas have been exploited for oil drilling, ocean-floor mining, fishing on a vast scale, desalination, national defense, and untold other uses. But accompanying all of these uses is pollution—the product of accidents, carelessness or deliberate abuse. This edition of *Issues* will explore various threats to the equilibrium of our world's singularly precious resource, as well as efforts to preserve and protect the waters for generations to come.

What in the World Is Happening in Our Oceans?

In a recent edition of *The Economist* (March 2, 2002, p. 76), a poignant article told of a possible use by the US Navy of a new and innovative Sonar that could easily detect very quiet submarine activity should an enemy wish to employ it. A problem, however, had surfaced: "Under water, no one can hear you scream!" The report went on to describe how the new sonar signals might well be harmful to certain kinds of whales (baleen whales). Such effects as possible deafening, or disturbance of natural patterns of movement, or of mating, might have negative effects upon the whales. The National Marine Fisheries Service is in charge of determining what the effects might be, and whether to proceed with installing the new sonar systems—which the Navy claims will give them enormous advantage in detecting the more advanced silent submarines. But what of the whales? And so just one more polluting factor for the oceans of the world! ■

Yet another intrusive object being thrust into the oceans is SPACE JUNK, some of which may not be free of dangerous contaminants. In a Greenpeace alert in May of last year, that organization announced that "the space station Mir entered the final stages of its re-entry and became widely dispersed in the atmosphere and oceans of the Pacific region." While being complimentary for the successful reentry performance, Greenpeace went on to say that "the public still do not have access to full information relating to the materials and potential contaminants on board, and no one will ever know the precise extent to which such materials will have become distributed through the oceans and atmosphere as a result of break-up and disintegration on reentry. Ultimately, of course, much of the material which did disintegrate in the atmosphere may become deposited in the oceans over a very wide area. Any impacts resulting from the disposal will be virtually impossible to predict and, subsequently, to verify. This will be the case, of course, for all such re-entry events, planned or accidental, especially for those for which the ultimate consequence is disposal at sea. In this regard, Mir serves as an example of a generic problem."

Source: Greenpeace International, "The Final Frontier: the Ocean Dumping of the Space Station Mir and the Need for More Responsible Decommissioning Programmes Within the International Space Industry and National Space Administrations." 2001. <http://www.greenpeace.org/~odumping> (April 17, 2002). ■

Other Threats to the Health of the Oceans

by Peter Benchley and Judith Gradwohl

[Do other threats exist? It's not just huge, newsmaking oil spills that threaten the world's oceans. Here are some eye-opening facts on pollution and other causes of damage to our waters and marine life. How do "you" as an individual contribute to the destruction of a major source of life as we know it. Consider how each of the items relates to you as an inhabitant of the earth. *Ed.*]

Oil spills account for only about five percent of the oil entering the oceans. The Coast Guard estimates that for United States waters sewage treatment plants discharge twice as much oil each year as tanker spills.

Each year industrial, household cleaning, gardening, and automotive products pollute water. About 65,000 chemicals are used commercially in the United States today, with about 1,000 new ones added each year. Only about 300 have been extensively tested for toxicity.

It is estimated that medical waste that washed up onto Long Island and New Jersey beaches in the summer of 1988 cost as much as $3 billion in lost revenue from tourism and recreation.

The most frequently found item in beach cleanups is pieces of plastic. The next four items are plastic foam, plastic utensils, pieces of glass and cigarette butts.

Lost or discarded fishing nets keep on fishing. Called "ghost nets," this gear entangles fish, marine mammals, and sea birds, preventing them from feeding or causing them to drown. As many as 20,000 northern fur seals may die each year from becoming entangled in netting.

Air pollution is responsible for almost one-third of the toxic contaminants and nutrients that enter coastal areas and oceans.

When nitrogen and phosphorus from sources such as fertilizer, sewage and detergents enter coastal waters, oxygen depletion occurs. One gram of nitrogen can make enough organic material to require 15 grams of oxygen to decompose. A single gram of phosphorus will deplete one hundred grams of oxygen.

The Mississippi River drains more than 40 percent of the continental United States, carrying excess nutrients into the Gulf of Mexico. Decay of the resulting algal blooms consumes oxygen, kills shellfish and displaces fish in a 4,000 square mile bottom area off the coast of Louisiana and Texas, called the "dead zone."

In 1993, United States beaches were closed or swimmers advised not to get in the water more than 2,400 times because of sewage contamination. The problem is even worse than the numbers indicate: there are no federal requirements for notifying the public when water-quality standards are violated, and some coastal states don't monitor water at beaches.

The zebra mussel is the most famous unwanted ship stowaway, but the animals and plants being transported to new areas through ship ballast water are a problem around the world. Poisonous algae, cholera, and countless plants and animals have invaded harbor waters and disrupted ecological balance.

There are 109 countries with coral reefs. Reefs in 90 of them are being damaged by cruise ship anchors and sewage, by tourists breaking off chunks of coral, and by commercial harvesting for sale to tourists.

One study of a cruise ship anchor dropped in a coral reef for one day found an area about half the size of a football field completely destroyed, and half again as much covered by rubble that died later. It was estimated that coral recovery would take fifty years.

Egypt's High Aswan Dam, built in the 1960s to provide electricity and irrigation water, diverts up to 95 percent of the Nile River's normal flow. It has since trapped more than one million tons of nutrient-rich silt and caused a sharp decline in Mediterranean sardine and shrimp fisheries.

The United Nations Food and Agriculture Organization estimates that of the seventeen major fisheries areas in the world, four are depleted and the other thirteen are either fished to capacity or overfished.

Commercial marine fisheries in the United States discard up to 20 billion pounds of non-target fish each year—twice the catch of desired commercial and recreational fishing combined.

Almost half of all construction in the United States during the 1970s and 1980s took place in coastal areas.

Within thirty years a billion more people will be living along the coasts than are alive today.

With only 4.3 percent of the world population, Americans use about one-third of the world's processed mineral resources, and about one-fourth of the world's non-renewable energy sources, like oil and coal.

Source: The Smithsonian Institution's "Ocean Planet" exhibition, and Benchley and Gradwohl, *Ocean Planet: Writings and Images of the Sea*, NY: Harry N. Abrams, Inc., 1998. <http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/education_threats.html> (April 9, 2002).

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URL: http://www.globaled.org

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Drip... Drip... Drip... Oil Pollution

When it comes to mixing oil and water, oceans suffer from far more than an occasional devastating spill. Disasters make headlines, but hundreds of millions of gallons of oil quietly end up in the seas every year, mostly from non-accidental sources. Oil pollution is one of the most highly publicized forms of ocean pollution. The majority of oil pollution is from spills or leakages of oil that originate from land or rivers, which in turn flow to the sea. The more direct form of oil pollution occurs when ships transporting the substance leak or crash. Some of the oil washes up on the shore and becomes tar-like lumps; some coats the fur of animals (e.g., sea otters), affecting their temperature regulating system. Also, some oil finds its way to other water sources (such as lakes, rivers, and personal water supplies), causing hazardous water to be consumed. In extreme cases, rivers, lakes and wells have been known to ignite. For example, in 1969, the Cuyahoga River in Cleveland, Ohio ignited.

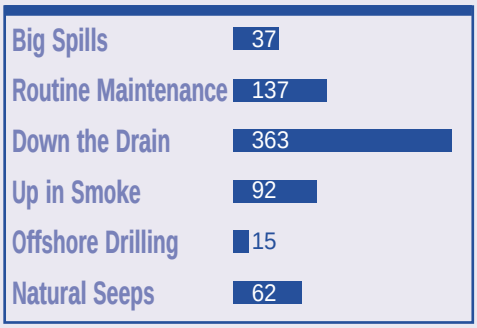
The graph to the right shows how many millions of gallons of oil each source puts into the oceans worldwide each year:

Down the Drain: 363 Million Gallons

Used engine oil can end up in waterways. An average oil change uses five quarts; one change can contaminate a million gallons of fresh water. Much oil in runoff from land and municipal and industrial wastes ends up in the oceans. Road runoff adds up. Every year oily road runoff from a city of 5 million could contain as much oil as one large tanker spill. Other sources are: septic tanks, cars, trucks, boats, and farm, ranch and forest sources.

Routine Maintenance: 137 Million Gallons

Every year, bilge cleaning and other ship operations release millions of gallons of oil into navigable waters, in thousands of discharges of just a few gallons each.



NON-POINT SOURCE POLLUTION, commonly called runoff pollution, can make river and ocean water unsafe for humans and wildlife. In some areas, runoff pollution is so bad that it causes beaches to be closed after rainstorms. In 1992, for example, beaches were closed or advisories issued against swimming about 3,000 times.

Drinking-water supplies can be contaminated by polluted runoff, as can coastal waters containing valuable fish stocks. Experts think there is a link between agricultural runoff and water-borne organisms that cause lesions and death in fish. Humans who come in contact with these polluted waters and affected fish can also experience harmful symptoms.

More than one third of the shellfish-growing waters of the US are adversely affected by coastal pollution.

Source: Commerce Department's National Oceanic and Atmospheric Administration (NOAA), "Ocean Facts on Runoff Pollution" <http://www.yoto98.noaa.gov/facts/pollut.htm> (April 10, 2002).

Up in Smoke: 92 Million Gallons

Air pollution, mainly from cars, and industry, places hundreds of tons of hydrocarbons in the air, some of which finds its way into the seas.

Source: "Ocean Planet," was an exhibition at the Smithsonian Institution's National Museum of Natural History from April 1995 to April 1996; it can now be viewed on the Internet at <http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/peril_oil_pollution.html> (April 10, 2002).

While the solution to this type of pollution may seem clear, the only major US efforts to date point —the Clean Air Act, and Clean Water legislation—have not fully accomplished the goal. The real solution remains an educational process. For example, each individual who owns a car needs to be aware of, and concerned about, potential oil leakage, and to take steps to prevent it. Recent additions to the Clean Water acts have prohibited oceangoing ships from cleaning their ballast, and conducting normal maintenance, cleaning oils and other fluids, and merely dumping the residue in the ocean. Uniform efforts around the globe have yet to be fully accomplished, but initiatives by the United Nations are noteworthy (See page 11). Ed.

Trash Pollution

The following list of discarded items, some caused by accidents, but most by human carelessness, is far from comprehensive, but gives some idea of the dimensions of the problem of human activity in relation to ocean (and beach) preservation. In so many cases, repeated over and over, some of these items are mistaken for the natural food of sea creatures and cause unnecessary death. Plastic bags, condoms, etc., look and feel somewhat like jellyfish, which are a favorite food of sea turtles, but are indigestible and cause underwater tragedy. This accompanies the danger to turtles from boat propellers. That example is but one from multiple instances of these items being dangerous to the health of the inhabitants of the precious sea. This is not an exhaustive list, and each of the categories below should have added to it the term "OTHER." How many other items have you personally seen strewn upon the beach, washed up, or abandoned?

F L O T S A M

AEROSPACE
Satellite parts
Space Shuttle tiles

AIRCRAFT PARTS
Crash debris
Wings
Doors
Wheel/tires
Fire extinguisher

ALUMINUM CANS (UNOPENED)
Beer
Pop
Fruit juice

BONES
Whale
Bird
Human

CANDY
Hershey's Kisses
Riesen (chocolate)
Werther's (butterscotch)

CONTAINER SPILLS
Hockey gear
Bathtub toys
Toy blocks
LEGO toy elements
Nike sneakers

DERELICT VESSELS
Rafts
Buoys
Kayaks/canoes
Life preservers
Nets
Abandoned yacht
Jet Skis

FISHING GEAR
Lightsticks
Drift net floats
Crab pot floats
Plastic floats with ear
Fishing lures
Other

FOOTWEAR
Flip-flops (thongs)
Sneakers

GLASS FISHING FLOATS
Rolling pin
Spherical
Double spheres
Flotation docks
Survival suits

LARGE METAL OBJECTS
900-foot-long pipe
20-40-foot cargo containers

LIGHT BULBS
Incandescent bulbs
Neon lights

MEDICAL WASTE
Prescription drugs
Syringes
Glass/plastic ampules
Blood bags

FLOATING MESSAGES
Beer bottles
Bottles buried in sand
Wooden/plastic drift cards
Scientific bottle releases
Class bottle projects

MILITARY ORDNANCE
Mines
Torpedoes
Target drones
Sonobuoys
Steel spheres

PLASTIC ITEMS
Nurdles (plastic pellets)
Bottles Tote boxes
Planters
Shopping bags
Strainer-like dishes

POTTERY
Shards
Urn/pot

SEEDS
Sea rocket
Black walnut
Sea almond
Hamburger bean
Mary's bean
Sea purse
Nickernut
Coconut

SMOKING
Cigarette butts
Cigar holders
Bales of raw tobacco

STRANDED MARINE CREATURES
Sunfish
DolphinsWhales
Dead sea birds

TOYS
Crackerjack prizes
LEGO elements
False teeth
Soldiers
Rubber ducks

UNMENTIONABLES
Toilet seats
Condoms
Tampon applicators
Roll-On stick

WOOD
Bark
Broken sheets of plywood
Pencil blanks/pencils
Branded logs
Baskets
Dimensional lumber (Storm damage)

MISCELLANEOUS
Human bodies
Jewelry
Surfboard wax
Pumice
Signal flares
Bales of rubber

Source: The Beachcombers' and Oceanographers' International Association, "Worldwide Flotsam Checklist." <http://www.beachcombers.org/flotsam.htm> (April 5, 2002).

To report other types of trash found on a beach, or floating on the ocean surface, contact Dr. Curt Ebbesmeyer, 6306 21st Avenue, NE, Seattle, WA 98115 <curtisebbesmeyer@msn.com>.

PAINTBRUSH DIPLOMACY was founded in 1975 and is the world's longest running international children's art and writing exchange program. The program involves thousands of students from over 100 countries each year. Paintbrush Diplomacy has collaborated with a number of world-class organizations including UNICEF, the Smithsonian Institution, the National Geographic Society, VISA International, Peace Corps and Rotary International.

Paintbrush Diplomacy's mission is to promote cross-cultural communication and understanding through the celebration of children's creativity. Its permanent collection includes over 2,000 paintings and exemplifies the rich cultural diversity of the world's children. Paintbrush Diplomacy encourages awareness of international issues and supports children's causes through a variety of programs including educational exchanges, community exhibitions and cross-cultural educational programs.

Contact us at (650) 325-6611 or pbdiplomacy@aol.com. Or visit our website at www.paintbrushdiplomacy.org to view some of our magnificent collection.

Right: Change in Environment, Abhiram Banerjee, age 12, India

All of the items mentioned on page 4 have washed up on the beach, but what about those that have not washed up, but have been swirled about in the currents of the seas, some to become tempting tidbits for the denizens of the deep? For example, plastics ranked among the major advances of the 20th century, have only just begun to become biodegradable; most plastics in use today are not. Plastic items accumulate in vast quantities in certain areas of the ocean where the water movement, or tidal action, does not permit dispersal. Research studies in areas of the North Pacific, for example, have found extraordinarily large amounts of plastic bits and pieces, each of which poses immediate and long-term threats to both fish and humans through the food chain. Solutions for this problem range from activist "Clean Up the Beach" Days, sponsored by local beach communities, to educational programs in schools aimed at raising awareness of the need for proper trash disposal. Ed.

Plastics in Our Oceans

By Kimberly Amaral

Strolling through the average supermarket, shoppers find literally hundreds (if not thousands) of items to make their lives easier. Individually wrapped snack cakes, plastic bags to store sandwiches for lunch, unbreakable soda bottles, and disposable razors, diapers, and shampoo bottles. Unless specifically requested, even the bags we use to carry home our goods are often plastic.

To humans, these are items of comfort, if not necessity. But to marine animals, they can be a floating minefield. Plastic—whether it be for a container, a wrapper, or the product itself—has become an everyday part of our lives. This isn't necessarily a bad thing—plastic is also the material diabetics use for their disposable syringes; arthritic patients have for their replaced hips; and construction workers wear to protect their heads.

But when plastic reaches our waters, whether it be plastic bags or drifting fish nets, it poses a threat to the animals that depend on the oceans for food. To a sea turtle, a floating plastic bag looks like a jellyfish. And plastic pellets—the small hard pieces of plastic from which plastic products are made—look like fish eggs to seabirds. Drifting nets entangle birds, fish and mammals, making it difficult, if not impossible, to move or eat. As our consumption of plastic mounts, so too does the danger to marine life.

Before the days of plastic, when fishermen dumped their trash overboard or lost a net, it consisted of natural materials—metal, cloth or paper that would either sink to the bottom or biodegrade quickly. But plastic remains floating on the surface, the same place where many genuine food sources lie—and can remain so for 400 years. Plastic is durable and strong—precisely the qualities that make it so dangerous if it reaches the ocean.

It Can Get There from Here

But how would a syringe that a diabetic uses end up in the ocean? If plastic objects make it into the main sewer system (say, by being flushed down the toilet, or carried by the rain into a street drain), and the water treatment plants are overwhelmed by excessive rain, then those floating objects can float right out to sea. This is precisely what happened on the New York and New Jersey beaches in 1988, when medical waste was floating up onshore. After an unusually dry spring, litter began accumulating on the streets and in storm sewers. When heavy rains arrived in mid-summer, they swept the streets clean and overloaded combined sewers. After floating out to sea, the debris was blown back onto the shores.

In a more direct route, boaters may dump their trash right into the sea. In the past, this has been the main source of plastics in the ocean. In 1975, the National Academy of Sciences estimated that 14 billion pounds of garbage was being dumped into the ocean every year. That's more than 1.5 million pounds per hour. More than 85 percent of this trash was estimated to come from the world's merchant shipping fleet in the form of cargo-associated wastes. According to the Academy, the United States could be the source of approximately one third of this ocean pollution.

Fortunately, since the last day of 1988, it has been illegal for ships to dump plastics into the ocean. But that law is difficult to enforce, and cannot account for the thousands of miles of driftnets and other gear set by fishermen, which can ensnare and kill birds diving for the fish below, or come loose, only to be discovered later by an unfortunate humpback whale.

It's a Great Big World Out There

Anyone who's been on a boat far from the sight of land will tell you how enormous the ocean feels. Wouldn't this debris simply get dispersed, virtually eliminating the possibility of an encounter with a marine animal? The answer is no. While the ocean does disperse the trash, it also runs in currents, which can keep the floating trash traveling constantly in "gyres," concentrating it in areas where currents meet. The largest of these movements is called the Central Gyre. It moves in a clockwise circular pattern, moving inside the Gulf Stream, and dominates the western North Atlantic. Studies begun in 1984 have tracked how these currents keep plastics migrating, with heavy concentrations in the northern Sargasso Sea (coincidentally, a favorite spawning place for fish). The Northeast United States, "upstream" of the central gyre, has currents that keep most of the locally generated marine debris local. Usually the only ways to escape this constant circular pattern is if the plastic decays enough to sink, or lands onshore to be (hopefully) picked up by a passer-by.

And apparently, the ocean isn't large enough to avoid marine life encounters with debris. Plastic's devastating effect on marine mammals was first observed in the late 1970s, when scientists from the National Marine Mammal Laboratory concluded that plastic entanglement was killing up to 40,000 seals a year. Annually, this amounted to a four to six percent drop in seal population beginning in 1976. In 30 years, a 50 percent decline in Northern Fur Seals has been reported.

These curious, playful seals would often play with fragments of plastic netting or packing straps, catching their necks in the webbing. The plastic harness can constrict the seal's movements, killing the seal through starvation, exhaustion, or infection from deep wounds caused by the tightening material. While diving for food, both seals and whales can get caught in translucent nets and drown. In the fall of 1982, a humpback whale tangled in 50 to 100 feet of net washed up on a Cape Cod beach. It was starving and its ribs were showing. It died within a couple of hours.

Along Florida's coasts, brown pelicans diving for fish sometimes dive for the bait on a fisherman's line. Cutting the bird loose only makes the problem worse, as the pelican gets its wings and feet tangled in the line, or gets snagged onto a tree.

Plastic soda rings, plastic bags, plastic foam particles and plastic pellets are often mistaken by sea turtles for authentic food. Clogging their intestines, and missing out on vital nutrients, the turtles starve to death. Seabirds undergo a similar ordeal, mistaking the pellets for fish eggs, small crab and other prey, sometimes even feeding the pellets to their young. Despite the fact that only 0.05 percent of plastic pieces from surface waters are pellets, they comprise about 70 percent of the plastic eaten by seabirds. These small plastic particles have been found in the stomachs of 63 of the world's approximately 250 species of seabirds.

Wildlife is not the only area to suffer from the effects of marine debris. Plastic bags are the leading external cause of marine engine damage in Massachusetts. Other plastic items foul propellers and interfere with fishing tackle.

What's Being Done about Plastics

In 1987, a law was finally passed restricting the dumping of plastics into the ocean. The Marine Plastic Pollution Research and Control Act (MARPOL) went into effect on December 31, 1988, making it illegal for any US vessel or land-based operation to dispose of plastics at sea. It is part of an international treaty, where countries representing at least half of the shipping fleet tonnage in the world agreed to Annex V of the treaty, preventing "pollution by garbage from ships." It prohibits the dumping of plastics anywhere in the ocean, and the dumping of other materials, such as paper, glass, metal, and crockery, closer to shore.

The plastics industry has also stepped in, taking measures to reclaim plastic resin pellets that often get lost during production or transport. The Society of the Plastic Industry has produced many public service ads for trade magazines, and was a strong supporter of MARPOL Annex V.

Plastics manufacturers are also investigating ways to create "degradable" plastics. Although all materials eventually break down, a plastic soda ring can take up to 400 years to biodegrade. So researchers are working with two types of degradable plastics: photodegradable and biodegradable.

Photodegradable plastics are made to become weak and brittle when exposed to sunlight for prolonged periods. At least 16 states—Massachusetts, New York and Rhode Island included—have passed laws requiring six-pack holders be biodegradable (these are marked by a small diamond between the rings).

Biodegradable plastics are made with cornstarch, so bacteria and other organisms eat away at the plastic, breaking it up into smaller pieces. Neither of these methods, however, solve the problem of plastic in the oceans, since they are only broken up into smaller pieces—creating an even more dangerous situation for animals that mistake smaller plastic pieces for food.

Perhaps the most effective method right now for solving the persistent plastic problem is beach cleaning. Coastal cleanups gather volunteers to collect trash that has washed up on the beach—or has been left by beach-goers to be carried out by the surf—and removed from the marine cycle.

The Center for Marine Conservation (CMC) has been coordinating coastal cleanups since 1986. (The first nationwide cleanup took place in 1988, just four months before the MARPOL treaty took effect. Canada and Mexico joined in on the act in 1989.) The CMC also keeps careful track of all the debris that is collected. Data cards list 85 debris items in eight categories: plastic, plastic foam, glass, rubber, metal, paper, wood and cloth. During the 1993 coastal cleanup, over 3.1 million pounds of trash was collected—more than half of which was plastic.

The CMC also divides their data into debris found, listing the "dirty dozen"—twelve items found most frequently:

Cigarette butts	Plastic caps and lids
Paper pieces	Metal beverage cans
Plastic pieces	Plastic straws
Styrofoam	Glass beverage bottles
Glass pieces	Plastic beverage bottles
Plastic food bags	Plastic foam cups

Debris that can be traced to recreational fishing and boating, galley-type wastes, and cruise ship debris all declined in 1993—perhaps a glimmer of hope resulting from the MARPOL treaty. The laws, enforced by the Coast Guard in the United States, are difficult to monitor. Instead, they rely heavily on an educational campaign, bringing about "voluntary compliance through awareness."

There is still much debris floating around our seas and endangering marine animals. But as more laws are passed, and as more people become involved in projects like beach clean-ups, perhaps the only plastic will be in our supermarkets

Source: Amaral, Kimberly. "The Web and the Web of Life—Plastics in Our Ocean." University of Massachusetts. <http://www.umassd.edu/Public/People/Kamaral/Thesis/plasticsarticle.html> (April 12, 2002).

Toxic Waste: Are We Daily Accessories to Stream and Ocean Murder?

[There are other dangers as well; millions of gallons of runoff water, sewage and other effluvia are emptied into the seas in a variety of ways, despite laws and environmental efforts to curtail, or at least purify, such flows. The practice of dumping garbage has been severely restricted, but the garbage that was dumped over the previous years still remains. *Ed.*]

Toxic waste is the most harmful form of pollution to marine creatures and humans alike. Once a form of toxic waste affects an organism, it (the toxic waste) can be quickly passed along the food chain and might eventually end up as seafood, causing various problems.

Toxic wastes arrive from the leakage of landfills, dumps, mines and farms. Sewage and industrial wastes introduce chemical pollutants such as PCB, DDT, and Sevin. Farm chemicals (insecticides and herbicides) along with heavy metals (e.g., mercury and zinc) can have a disastrous effect on marine life and humans alike.

Radioactive wastes, reactor leaks, natural radioactivity, and radioactive particles which originate from the Atmospheric Testing Program from explosions of nuclear weapons are dispersed in water all over the world. The effect of these radioactive particles is currently being researched.

All of these factors allow seafood to become hazardous to human health. For example, if a fish is contaminated with the metal mercury (by either eating it or consuming a creature who had), birth defects and nervous system damage in humans may result. Also, Dioxin causes genetic and chromosomal mutations in marine life and is suspected of causing cancer in humans.

Medical wastes, such as stale blood vials, hypodermic needles, and urine samples that have been found in oceans around the US are being researched to determine if swimmers are at risk of contracting hepatitis or AIDS from such wastes. Other wastes have been known to cause viral and bacterial diseases such as cholera, typhoid, dysentery, and diarrhea.

Source: The AT&T Virtual Classroom, "Ocean Pollution."<http://www.jp.kids-commons.net/vc96/vc-13/ocean_pollution/ocean1.html> (April 10, 2002). The original source for the material no longer exists, but contact may also be made through <http://www.att.com/learningnetwork>. Permission pending.

Too Dangerous to Dip?

Marine Pollution Makes Swimmers Sick

By Kris Freeman

Reports of illness after exposure to marine water appear to be increasing, and there is evidence that the rate of infection is proportional to both the amount of time swimmers are exposed and the levels of pollution in the waters where they swim. In this issue, researchers from Harvard University led by Sarah E. Henrickson conclude that human activities are contributing to illnesses associated with marine recreation. The team also suggests ways to reduce the incidence of illness by both monitoring pathogens to prevent human exposure and correcting environmental conditions that boost pathogen concentrations in marine waters.

Marine pollution is increasing: up to 90 percent of untreated sewage from urban areas in developing nations is dumped into oceans and streams, and high nitrogen loads from agricultural runoff and other types of pollution may upset the ecological balances that normally keep pathogens in check. Warming oceans and extreme weather events also contribute to the growth of algal blooms that can harbor pathogens.

Research reviewed by the Harvard team suggests that bacterial pathogens can survive in salt water, especially in waters with low salt concentrations (such as those found in estuaries) or high nitrogen loads. For example, marine species of *Vibrio* bacteria have been linked to disease in swimmers, including cases of gangrene and endometritis. Outbreaks of noninfectious disease are also of concern. These include various types of "swimmer's itch" caused by marine larvae, and neurologic symptoms from exposure to algal toxins. Swimmers can be exposed to pathogens through broken and unbroken skin. Exposure to algal toxins can also occur through the lungs when

Undersea World, Enilda Dervishi, age 14, Albania, Paintbrush Diplomacy

the toxins are aerosolized by heavy surf.

Although public health authorities most often test for bacterial contamination, the authors' review of 131 articles suggests that the primary health hazard in coastal waters may not, in fact, be bacterial exposure, but viral instead. The authors examine, for example, one randomized controlled trial of swimming exposure conducted in the United Kingdom in which swimmers became ill even on days when concentrations of fecal coliform bacteria were at acceptable levels. Viruses are extremely abundant in marine waters, where they often survive longer than bacteria. They are also more resistant to sewage treatment. The authors speculate that viruses may be a chief cause of swimming-associated gastrointestinal infections.

The Harvard team concludes that bacterial indicators are inadequate surrogates for overall pathogen levels and that surveillance methods that focus only on these indicators are no longer adequate to protect human health. They recommend the development of surveillance methods using polymerase chain reaction, fluorescent antibody, or monoclonal antibody techniques. They also recommend monitoring algal populations. To reduce the number of pathogens in marine waters, they recommend reducing nutrient loads through maintenance of wetlands that filter runoff, an increase in the efficiency of sewage treatment and other urban waste disposal systems, and reductions in the use of fertilizers. They cite the example of Sydney, Australia, which greatly reduced health hazards at its beaches by extending sewage outfall to the edge of the continental shelf. The authors also state that reducing emissions from fossil fuel combustion would decrease the amount of nitrogen deposited in marine ecosystems and help prevent long-term warming of the world's oceans.

Source: Freeman, Kris. "Too Dangerous to Dip? Marine Pollution Makes Swimmers Sick." Environmental Health Perspectives, July 2001 <http://ehpnet1.niehs.nih.gov/docs/2001/109-7/ss.pdf> (April 10, 2002).

Yet another major source of pollution is "over-fishing," which is largely due to the present-day fishing methods—the use of trawling techniques that scrape the floor of the ocean and capture not just the desired fish, but all else that the net picks up, such as "bycatch (those fish not desired by fishermen) and all other sea creatures who happen to reside in that area. The damage to marine life populations may wreak havoc with another aspect of the balance of nature. Millions of people depend on the seas for their daily food. Ed.

A World Without Fisheries?

By Joshua S.Reichert

For decades, the operating assumption among marine biologists, fishery managers and policymakers has been that the world's catch of ocean fish has been rising, and that fisheries were keeping pace with the increased demand from a growing global population.

It now appears that this assumption is wrong. In fact, a new study shows that the opposite is true.

Since the late 1980s, the world's fish catch has been declining by about 800 million pounds per year rather than increasing by 700 million pounds—as was previously reported by the Food and Agriculture Organization of the United Nations.

Not only are we exceeding the oceans' capacity to provide fish, but if trends continue, many of the world's commercial fisheries will be wiped out within two to three decades. The Food and Agriculture Organization relied on numbers provided by individual countries to compile its annual list of the world's fish catch. For years, these numbers showed that the world's catch was slowly rising. What the authors of the Nature study found, however, was that China was significantly over-reporting the size of its annual catch. In China, the centralized socialist system had rewarded officials with promotions on the basis of reported production increases, thereby providing an incentive to report ever higher catch levels. Once the Chinese catch statistics were adjusted for accuracy, it turns out that the global catch is actually declining, and that for years we have been catching more fish than the oceans can replace.

Earlier in this century, the bulk of the world's fishing focused on species high in the food chain: tuna, cod, swordfish, hake and salmon. Many of these fisheries, such as North Atlantic cod, are now severely depleted. The loss of the cod fishery in New England and the maritime provinces of Canada provides a textbook example of fishery mismanagement. The decline of this fishery, which resulted in the loss of thousands of jobs and hundreds of millions of dollars in revenue, can be attributed to the unwillingness of both the US and Canadian governments to reduce fishing quotas in the face of scientific evidence that stocks were collapsing. As cod and other species have declined, fishing fleets around the world have turned their attention to the more abundant species lower on the food chain. Boats have targeted the enormous populations of schooling forage fish such as capelin and menhaden, which are primarily used for fishmeal to feed chickens, pigs and other domestic animals.

Now, however, even these populations of smaller fish, which are critical to the marine food web, are declining. The col-

lapse of the world's fisheries is more than an environmental disaster. At present, more than 54 million people worldwide earn their living from fishing. Unless steps are taken soon to address the problem of over-fishing, many people will lose the livelihood upon which they and their families depend. The implications for global food security are even more serious. Fish provide 16 percent of the animal protein consumed by people worldwide. In many developing countries, the percentage is higher. In Asia, for example, fish represent 26 percent of the continent's animal protein intake. In Africa, the figure is 17 percent. (In North and Central America, by contrast, the figure is just 7 percent.) By 2020, scientists project that the per capita consumption of ocean fish will be half of what it was in 1988. Significant reductions of such a crucial protein source from the diet of billions of people worldwide will exacerbate problems of malnutrition, disease and political unrest.

FORTUNATELY, IT IS NOT TOO LATE TO REVERSE COURSE.

First, the world's nations must stop subsidizing the fishing industry by propping up unprofitable fleets and encouraging the construction of new boats. Continuation of these unsound policies will only make the present situation worse.

Second, the world's nations must do a far better job of managing the fisheries under their jurisdiction.

Finally, there need to be stricter international management regimes to ensure that over-fishing is curtailed, agreements are better enforced, and greater cooperative efforts are made to stop pirate fishing in international waters.

The absence of these types of international mechanisms is simply a blueprint for disaster. The findings reported in Nature represent a wake-up call to the world community: Reduce fishing, or face a future with no fish or fishermen to catch them.

Joshua S. Reichert directs the Environment Program at the Pew Charitable Trusts.

Source: Reichert, Joshua S. "A World Without Fisheries?" The Pew Charitable Trusts.

<http://www.pewcharitabletrusts.org/ideas/ideas_item.cfm?content_item_id=893&content_type_id=15&issue_name=Saving%20the%20world%92s%20oceans&issue=16&page=15&name=Op %2Deds%20%28PCT%29> (April 17, 2002). This also appeared as an Op-ed in the *Seattle Post- Intelligencer*, January 24, 2002, and the *San Francisco Chronicle*, December 12, 2002

Coral Reefs:

A Barometer of the Health of the Ocean . . . And Planet?

CORAL REEF ALERT FACT SHEET

Coral reefs around the world are dying. Home to half of all fish species on earth, an estimated 10 percent of coral reefs have already disappeared and an estimated 70 percent of all coral reefs are at risk today. Threatened by pollution, overfishing, dynamite fishing and bleaching caused by rising ocean temperatures, coral reefs are now endangered on a planetary scale. An estimated two-thirds of the world's reefs could become barren skeletons within 50 years, and they could be eliminated from most areas of the world by 2100 unless immediate action is taken.

Called the "rainforests of the sea," coral reefs are the greatest expression of ocean life, a complete community of plants, animals and microscopic organisms comparable to the colorful variety and complexity of life in a tropical rainforest on land.

Today scientists know exactly how much rainforest is being destroyed every day because there is a very detailed map of the rainforests. By contrast, there is no comprehensive map of coral reefs and scientists do not even know the location of many of the world's reefs, much less their present condition or which specifies inhabit them. Therefore, it is impossible to measure with accuracy the rate at which the reefs are disappearing. A global baseline map of coral reefs must be created immediately if they are to be saved.

Lining 60,000 miles of shoreline along 109 countries, coral reefs and their habitats play a vital role in the global economy, providing resources such as

fish and services such as tourism and coastal protection worth an estimated $375 billion a year.

Almost half a billion people—8 percent of the total global population—live within 100 kilometers of a coral reef.

Globally, more than 400 marine parks, sanctuaries, and reserves (marine protected areas) contain coral reefs. Most of these sites are very small—more than 150 are under one square kilometer in size.

At least 40 countries lack any marine protected areas for conserving their coral reef system. Coral reefs are the barometer, or the "canary in the coal mine" for the oceans of the world.

Source: The Planetary Coral Reef Foundation (PCRF). "Coral Reef Alert Fact Sheet." <http://pcrf.org/facts.html> (April 15, 2002). Original source: Reefs at Risk (1998), World Resources Institute.

Coral Reefs: Land-based Sources of Marine Pollution

Land-based sources of marine pollution pose some of the greatest threats to coral reefs because of their widespread impact on water quality. Accounting for 80 percent of all marine pollution, land-based sources of marine pollution include coastal development, agricultural practices, industrial activities, and inland deforestation. Coral reefs and other coastal ecosystems are damaged by sewage disposal, run off of sediments, industrial discharges, run off of phosphorus and nitrogen used in agriculture, and discharges of heavy metals and persistent organic pollutants. On a worldwide scale, only a fraction of the total domestic waste receives proper treatment and disposal and ultimately is deposited untreated in coastal waters. These activities result in degraded water quality, reduced light levels (affecting growth), and eutrophication* of reef communities.

* The process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

According to the recently published report "Reefs at Risk" (1998) by the World Resource Institute, land-based pollution from coastal development, inland pollution, and erosion are among the greatest threats to reefs worldwide. Globally, 58 percent of all reefs were found to be threatened by human activity, with 30 percent classified as threatened by coastal development and 22 percent by inland pollution and erosion. In the Caribbean and Atlantic Ocean, the analysis reports that almost two-thirds of the reefs are at risk, with four of the five major threats from land-based sources of pollution.

Minimizing land-based sources of pollution can not only protect coral reefs but also restore reef health. Kaneohe Bay, Hawaii, is a classic example of a polluted reef system that underwent revitalization once the primary land-based source of pollution was removed. After 30 years of being polluted with sewage, this stress was removed in 1978 when wastewater treatment programs were installed. Improvements in the health of the bay, including an increase in water clarity, a reduction in plankton, and a decline in inorganic nutrient concentrations, were documented within weeks of the stress removal. Coral coverage doubled between 1971 and 1983 before stabilizing.

Approaches to the Problem Both Locally and Globally

The importance of addressing land-based sources of marine pollution was established by the International Coral Reef Initiative (ICRI), which noted that one of the three most significant threats to reefs is "inadequate planning and management of coastal land use, including upland activities." ICRI further emphasized the importance of integrated coastal management approaches for addressing land-based sources of pollution.

The most significant global-level effort to address land-based sources of marine pollution is the Global Program of Action, which seeks to prevent the degradation of the marine environment from land-based activities. Negotiations

for the Global Program of Action were hosted by the US Department of State in 1996. The Global Program of Action is designed to guide states and regions in developing responses to pollution and physical alterations caused by land-based activities. The Global Program of Action facilitates states' efforts towards preserving and protecting the marine environment individually or jointly, in accordance with their respective policies, priorities, and resources. It identifies effective measures to combat land-based sources of marine pollution. The GPA also offers instruction on how to involve the relevant United Nations institutions in the implementation effort.

The US is supporting implementation of the GPA through assistance and capacity-building support for water-related and/or coastal-related activities in more than 30 countries. Attention is given to wastewater treatment, pollution prevention and control, watershed management, coastal zone management, agricultural irrigation, water conservation, coastal water quality management, and aquatic habitat protection and management.

Solutions and approaches to address land-based sources of marine pollution can also be adopted at local levels:

- Promote integrated water and coastal management programs, which integrate land and sea-based activities into ecosystem-based management programs that will better address the negative impacts of land-based sources of pollution on the marine environment.
- Minimize the runoff from sewage disposal, deforestation, erosion, pesticide runoff and industrial waste disposal through best-use practices.
- Provide development assistance and capacity-building support for water-related and/or coastal-related activities in developing countries.

Fact sheet courtesy of the United States State Department.

Source: What You Need to Know About. "Environmental Issues." <http://environment.about.com/library/weekly/blcoast8.htm> (April 12, 2002). Permission pending.

Convention on the Law of the Sea

Life itself arose from the oceans. The ocean is vast, covering 140 million square miles, some 72 per cent of the earth's surface. Climate and weather, even the quality of the air people breathe, depend in great measure on an interplay between the ocean and the atmosphere in ways still not fully understood. Not only have the oceans always been a prime source of nourishment for the life they helped generate, but from earliest recorded history they have served for trade and commerce, adventure and discovery. Oceans have kept people apart and brought them together. Even now, when the continents have been mapped and their interiors made accessible by road, river and air, most of the world's people live no more than 200 miles from the sea and relate closely to it.

Attempts have been made through the years to regulate the use of the oceans in a single convention that is acceptable to all nations. This effort finally culminated with the adoption of the 1982 United Nations Convention on the Law of the Sea, which has gained nearly universal acceptance since its entry into force on 16 November 1994.

The 1982 United Nations Convention on the Law of the Sea provides, for the first time, a universal legal framework for the rational management of marine resources and their conservation for future generations. Rarely has such radical change been achieved peacefully, by consensus of the world community. It has thus been hailed as the most important international achievement since the approval of the United Nations Charter in 1945.

While many institutions, some created by the Convention and others part of the United Nations system, are responsible for governing areas on specific aspects of the ocean under their jurisdiction, the Convention itself remains the central instrument for promoting stability and peaceful uses of the seas and oceans. It is not, however, a static instrument, but rather a dynamic and evolving body of law that must be vigorously safeguarded and its implementation aggressively advanced.

Source: Excerpted from the United Nations, Division of Ocean Affairs and the Law of the Sea <http://www.un.org/dept/los/index.htm> (April 11,2002).

The United Nations Convention on the Law of the Seas

A Historical Perspective

The oceans had long been subject to the freedom-of-the-seas doctrine—a principle put forth in the seventeenth century essentially limiting national rights and jurisdiction over the oceans to a narrow belt of sea surrounding a nation's coastline. The remainder of the seas was proclaimed to be free to all and belonging to none. While this situation prevailed into the twentieth century, by mid-century there was an impetus to extend national claims over offshore resources. There was growing concern over the toll taken on coastal fish stocks by long-distance fishing fleets and over the threat of pollution and wastes from transport ships and oil tankers carrying noxious cargoes that plied sea routes across the globe. The hazard of pollution was ever present, threatening coastal resorts and all forms of ocean life. The navies of the maritime powers were competing to maintain a presence across the globe on the surface waters and even under the sea.

A tangle of claims, spreading pollution, competing demands for lucrative fish stocks in coastal waters and adjacent seas, growing tension between coastal nations' rights to these resources and those of distant-water fishermen, the prospects of a rich harvest of resources on the sea floor, the increased presence of maritime powers and the pressures of long-distance navigation and a seemingly outdated, if not inherently conflicting, freedom-of-the-seas doctrine—all these were threatening to transform the oceans into another arena for conflict and instability.

In 1945, President Harry S Truman, responding in part to pressure from domestic oil interests, unilaterally extended United States jurisdiction over all natural resources on that nation's continental shelf—oil, gas, minerals, etc. This was the first major challenge to the freedom-of- the-seas doctrine. Other nations soon followed suit. In October 1946, Argentina claimed its shelf and the epicontinental sea above it. Chile and Peru in 1947, and Ecuador in 1950, asserted sovereign rights over a 200-mile zone, hoping thereby to limit the access of distant-water fishing fleets and to control the depletion of fish stocks in their adjacent seas. Soon after the Second World War, Egypt, Ethiopia, Saudi Arabia, Libya, Venezuela and some Eastern European countries laid claim to a 12-mile territorial sea, thus clearly departing from the traditional three- mile limit. Later, the archipelagic nation of Indonesia asserted the right to dominion over the water that separated its 13,000 islands. The Philippines did likewise. In 1970, Canada asserted the right to regulate navigation in an area extending for 100 miles from its shores in order to protect Arctic water against pollution.

And then there was fishing. Large fishing vessels were roaming the oceans far from their native shores, capable of staying away from port for months at a time. Fish stocks began to show signs of depletion as fleet after fleet swept distant coastlines. Nations were flooding the richest fishing waters with their fishing fleets virtually unrestrained: coastal States setting limits and fishing States contesting them.

. . . the tranquility of the sea was slowly being disrupted by technological breakthroughs, accelerating and multiplying uses, and a super-power rivalry that stood poised to enter man's last preserve—the seabed . . . The dangers were numerous: nuclear submarines charting deep waters never before explored; designs for anti-ballistic missile systems to be placed on the seabed; supertankers ferrying oil from the Middle East to European and other ports, passing through congested straits and leaving behind a trail of oil spills; and rising tensions between nations over conflicting claims to ocean space and resources.

The oceans were generating a multitude of claims, counterclaims and sovereignty disputes. The hope was for a more stable order, promoting greater use and better management of ocean resources and generating harmony and goodwill among States that would no longer have to eye each other suspiciously over conflicting claims.

Third United Nations Conference on the Law of the Sea

On 1 November 1967, Malta's Ambassador to the United Nations, Arvid Pardo, [called] for "an effective international regime over the seabed and the ocean floor beyond a clearly defined national jurisdiction."

. . . It set in motion a process that spanned 15 years and saw the creation of the United Nations Seabed Committee, the signing of a treaty banning nuclear weapons on the seabed, the adoption of the declaration by the General Assembly that all resources of the seabed beyond the limits of national jurisdiction are the common heritage of mankind and the convening of the Stockholm Conference on the Human Environment. What started as an exercise to regulate the seabed turned into a global diplomatic effort to regulate and write rules for all ocean areas, all uses of the seas and all of its resources. These were some of the factors that led to the convening of the Third United Nations Conference on the Law of the Sea, to write a comprehensive treaty for the oceans.

The Conference was convened in New York in 1973. It ended nine years later with the adoption in 1982 of a constitution for the seas—the United Nations Convention on the Law of the Sea.

The Convention

In short, the Convention is an unprecedented attempt by the international community to regulate all aspects of the resources of the sea and uses of the ocean, and thus bring a stable order to mankind's very source of life . . .

[Because of the nature of this newsletter, the only provisions of the Convention cited here are those applicable to the protection of the marine envi-

ronment. By referring to the source below, all of the remaining provisions of the Convention can be viewed. *Ed.*]

Protection of the Marine Environment

There are six main sources of ocean pollution addressed in the Convention: land-based and coastal activities; continental-shelf drilling; potential seabed mining; ocean dumping; vessel- source pollution; and pollution from or through the atmosphere.

The Convention lays down, first of all, the fundamental obligation of all States to protect and preserve the marine environment. It further urges all States to cooperate on a global and regional basis in formulating rules and standards and otherwise take measures for the same purpose.

Coastal States are empowered to enforce their national standards and anti-pollution measures within their territorial sea. Every coastal State is granted jurisdiction for the protection and preservation of the marine environment of its Exclusive Economic Zone (EEZ). Such jurisdiction allows coastal States to control, prevent and reduce marine pollution from dumping, land-based sources or seabed activities subject to national jurisdiction, or from or through the atmosphere. With regard to marine pollution from foreign vessels, coastal States can exercise jurisdiction only for the enforcement of laws and regulations adopted in accordance with the Convention or for "generally accepted international rules and standards."

On the other hand, it is the duty of the "flag State," the State where a ship is registered and whose flag it flies, to enforce the rules adopted for the control of marine pollution from vessels, irrespective of where a violation occurs. This serves as a safeguard for the enforcement of international rules, particularly in waters beyond the national jurisdiction of the coastal State, i.e., on the high seas.

Furthermore, the Convention gives enforcement powers to the "port State," or the State where a ship is destined. . . The port State can enforce any type of international rule or national regulations adopted in accordance with the Convention or applicable international rules as a condition for the entry of foreign vessels into their ports or internal waters or for a call at their offshore terminals.

Finally, as far as the international seabed area is concerned, the International Seabed Authority, through its Council, is given broad discretionary powers to assess the potential environmental impact of a given deep seabed mining operation, recommend changes, formulate rules and regulations, establish a monitoring programme and recommend issuance of emergency orders by the Council to prevent serious environmental damage. States are to be held liable for any damage caused by either their own enterprise or contractors under their jurisdiction.

The necessity to combat the degradation and depletion of fish stocks, both in the zones under national jurisdiction and in the high seas, and its causes, such as over-fishing and excess fishing capacity, by-catch and discards, has been one of the recurrent topics in the process of implementation of the programme of action adopted in Rio de Janeiro [at the 1992 Conference on Environment and Development (UNCED)]. In this respect, among the most important outputs of the Conference was the convening of an intergovernmental conference under United Nations auspices with a view to resolving the old conflict between coastal States and distant-water fishing States over straddling and highly migratory fish stocks in the areas adjacent to the 200 nautical- mile exclusive economic zones.

Marine Scientific Research

With the extension of the territorial sea to 12 miles and the establishment of the new 200-mile EEZ, the area open to unrestricted scientific research was circumscribed. The Convention thus had to balance the concerns of major research States, mostly developed countries, which saw any coastal-state limitation on research as a restriction of a traditional freedom that would not only adversely affect the advancement of science but also deny its potential benefits to all nations in fields such as weather forecasting and the study of effects of ocean currents and the natural forces at work on the ocean floor.

On the other side, many developing countries had become extremely wary of the possibility of scientific expeditions being used as a cover for intelligence gathering or economic gain; particularly in relatively uncharted areas, scientific research was yielding knowledge of potential economic significance.

The developing countries demanded "prior consent" of a coastal State to all scientific research on the continental shelf and within the EEZ. The developed countries offered to give coastal States "prior notification" of research projects to be carried out on the continental shelf and within the EEZ, and to share any data pertinent to offshore resources.

The final provisions of the Convention represent a concession on the part of developed States. Coastal State jurisdiction within its territorial sea remains absolute. Within the EEZ and in cases involving research on the continental shelf, the coastal State must give its prior consent. However, such consent for research for peaceful purposes is to be granted "in normal circumstances" and "shall not be delayed or denied unreasonably," except under certain specific circumstances identified in the Convention. In case the consent of the coastal State is requested and such State does not reply within six months of the date of the request, the coastal State is deemed to have implicitly given its consent. These last provisions were intended to circumvent the long bureaucratic delays and frequent burdensome differences in coastal State regulations.

Source: United Nations, Division of Ocean Affairs and the Law of the Sea. Originally prepared for the International Year of the Ocean, 1998. <http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm> (April 11, 2002).

CLASSROOM INSTRUCTIONAL SUGGESTIONS

MARINE DEBRIS

Grades: 3 – 6

(Lesson is adaptable through Middle School level)

FOCUS QUESTION

What characteristics of trash affect the likelihood that it will become marine debris?

LESSON AT A GLANCE

Students will perform experiments to examine if debris will float, or blow in the wind. The effects of these characteristics on the marine debris are then discussed.

KEY CONCEPTS

Debris that floats or is easily blown around is more likely to become marine debris. The choices we make effect the environment.

OBJECTIVES

Students will be able to:

- Define marine debris
- Categorize different types of debris
- Determine how a material can influence what becomes marine debris

TIME

One class period. An extension beach clean-up.

MATERIALS

Notebook or journal to record observations of marine debris; deep pan or sink; electric fan; water

TEACHER BACKGROUND

Marine debris is trash that is found in or by the sea. Any object foreign to the marine ecosystem can be considered marine debris but the term is usually reserved for human-created trash. Two major factors that effect whether an item will enter the marine environment are buoyancy and the ability to be blown by the wind. As a rule of thumb, if the item can fly and/or float it is more likely to enter the marine environment and end up on our beaches. Plastics readily fly and float, and decompose very slowly. Not surprisingly, plastics are one of the most frequently collected type of marine debris. Negligence in disposal (from land and sea) is a large cause of the problem.

In 1991 the Center for Marine Conservation (CMC) listed the 12 most frequently collected marine debris items:

1) cigarette butts
2) plastic pieces
3) plastic foam pieces
4) plastic food bags and wrappers
5) paper pieces
6) glass pieces
7) plastic caps and lids
8) metal beverage cans
9) glass beverage bottles
10) plastic straws
11) plastic beverage bottles
12) plastic foam cups

Extensions: Make arrangements for the class to visit a local beach and conduct a clean-up, or, if you don't live near a beach, simulate one with trash scattered around the room before the children arrive for the day.

PREPARATION AND PROCEDURE

A variety of marine debris items should be collected from local beaches. Glass bottles or worn beach glass (smooth edges) should be included for the discussion but should not be gathered by the students to prevent accidents in transportation and collection. Have the students separate the trash into different piles (plastic, glass, rubber, metal, paper, wood, and cloth). Have the students address the following questions about the items:

- Will the item float or sink?
- How do you think this item ended up in the ocean?
- What plants or animals could be affected by the presence of this item?
- Test each of the items for buoyancy in the pan. Record the results.
- Which items do you think will be blown around easily?
- Is there a group of items that behaves similarly, (glass or metal, etc.)?
- How far do you think the item can travel?

Discuss the impact humans have on their surrounding environment.

Brainstorm ideas about how people can help reduce the amount debris in our oceans. Every one of us makes daily choices about products we buy, where to discard trash, and if we want to help clean up a mess that someone else left. The debris in the marine environment eaffects different animals and plants depending on the material, shape and size of the item.

Source: Bishop Museum's Science Information Network, Northwest Hawaiian Islands Expedition, "Marine Debris" <http://explorers.bishopmuseum.org/nwhi/debriact.shtml> (April 12, 2002). Permission pending.

WHAT'S WRONG WITH THIS PICTURE?

DESCRIPTION

In this lesson students will predict causes of ocean pollution and possible effects of pollution on tidepool organisms. Students will engage in an on-line activity to discover actual sources of ocean pollution. Students will collaborate in teams to discover solutions to everyday sources of ocean pollution. Students will post their proposals on the classroom web page.

OUTCOMES

Students will be able to:

- Brainstorm possible "types of ocean pollution" and "sources of ocean pollution"

- Use the Internet to discover everyday sources of ocean pollution using a specific website activity <http://www.epa.gov/kids/whatswrong.htm>

- Identify sources of ocean pollution

- Problem-solve and create written solutions to pollution problems. Students will collaborate in a groups to create posters identifying "pollution solutions" (with illustrations and in written form)

- Share ideas and solutions with the entire class

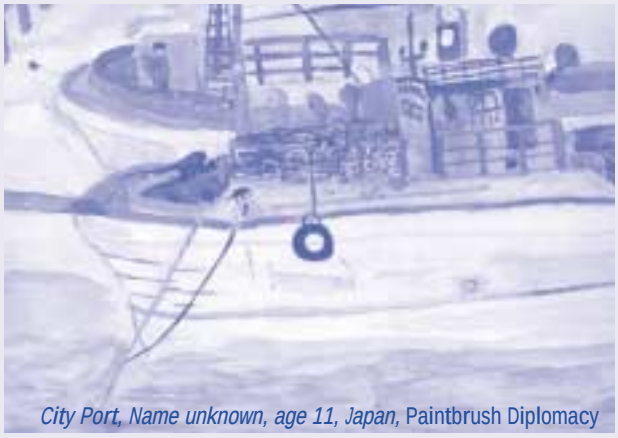
ON-LINE ACTIVITIES

As a whole group, small group, or individually, students will engage in an on-line activity <http://www.epa.gov/kids/whatswrong.htm> where they will look at an illustration depicting various human causes of ocean pollution.

Students will read the causes and effects of pollution on-line using shared reading.

In the on-line illustration students will be able to discover everyday sources of pollution and the effects of various types of pollution upon marine life and tidepool organisms.

In a culminating activity students will post their "pollution solutions" on the classroom website.



City Port, Name unknown, age 11, Japan, Paintbrush Diplomacy

OFF-LINE ACTIVITIES

As a whole class students will brainstorm "types of ocean pollution" and "sources of ocean pollution" and create a class list.

After gathering information from the on-line activity, students will collaborate in small groups and choose a pollution topic from the website activity.

Collaborative teams will create a "pollution solution" for one of the causes of ocean pollution.

Students will create a "pollution solution" poster that includes written and illustrated solutions.

Collaborative teams will orally share their "pollution solution" posters with the entire class.

Students can look at their "pollution solutions" on the classroom website.

DESCRIPTION OF COLLABORATIVE ACTIVITIES

Students will collaborate in small groups to choose a pollution problem.

Collaborative teams will problem-solve and create "pollution solutions" posters.

Collaborative teams will share their "pollution solutions" with the entire class.

Students will share "pollution solutions" globally as they post their ideas on the classroom website.

Students may share their ideas with their "keypals" at other schools.

MATERIALS

One computer with Internet capabilities <http:// www.epa.gov/kids/whatswrong.htm>

Two pieces of butcher paper for "types of ocean pollution" and "sources of pollution" brainstorming activity

Markers

Large pieces of butcher paper for each collaborative "pollution solution" group

A classroom website (optional)

ASSESSMENT

Students will evaluate their group's performance.

Students and teacher will evaluate "pollution solutions."

Teacher will assess student participation.

Rubric assessment.

Source: Orr,Doris and Dentoni, Brigid. "What's Wrong with This Picture?" The Santa Clara County Office of Education (SCCOE),1999-00 Internet Institute (I99), <http://etc.sccoe.org/I99/I99Prj/sci/TSurf/text/whatswrong.html> (April 16, 2002).

Additional Instructional Suggestions

HTTP://PROJECTS.EDTECH.SANDI.NET/GRANT/OCEANPOLLUTION
(GRADES 4-6)

HTTP://EDWEB.SDSU.EDU/TRITON/POLLSOL/POLLSOL.HTML
(GRADE 7, ENGLISH/SOCIAL STUDIES)

HTTP://EDUCATE.SI.EDU/LESSONS/CURRKITS/OCEAN/POLLUTION/ESSAY.HTML
(INTERDISCIPLINARY)

HTTP://WWW.EECS.UMICH.EDU/MATH-SCIENCE/FUNEXPERIMENTS/AGESUBJECT/LESSONS/BOTTLEDOCEAN.HTML
(ELEMENTARY)

HTTP://SCHOOL.DISCOVERY.COM/LESSONPLANS/PROGRAM/FINITEOCEANS
(ELEMENTARY/ADAPTABLE TO SECONDARY)

"We need to understand that what we do to the ocean, we do to ourselves."

Dr. Sylvia Earle, Founder and Director of Deep Ocean Engineering, Former Chief Scientist of the National Oceanographic and Atmospheric Agency (NOAA) Planetary Coral Reef Foundation Advisor