Ocean Pollution

by Fred Krueger

The oceans are in peril. They cannot protect themselves. But God has endowed humankind with the knowledge to rectify our mistakes, and we are, each one of us, given the choice of what we will do. To harm them, even if we are ignorant of the harm, is to diminish His Creation.

- HAH Ecumenical Patriarch Bartholomew

What we do to the oceans... we also do to God's other creations, including ourselves.

- HAH Ecumenical Patriarch Bartholomew

The oceans provide one-sixth of the animal protein consumed by humans, more than chickens, beef, mutton or pork. Oceans generate half of the oxygen we breathe and cleanse the atmosphere of carbon dioxide that people, automobiles and power plants produce.... But the health of the oceans and seas is severely threatened. We overfish. We pollute. We have nearly exhausted our seas.

- HAH Ecumenical Patriarch Bartholomew

IN THE BOOK OF REVELATION A SCENARIO IS DESCRIBED IN WHICH A SERIES OF EVIL plagues rain down upon the earth. These plagues take shape in the air, the water, the creatures, the land, and the ocean. They are poured down upon the earth by dark spirits who fly through the ethers. In the midst of these plagues a bright angel appears who carries the seal of the living God. The angel announces a message that previous generations considered strange and mysterious. This angel simply declares to the spirits and all who will listen, *"Hurt not the earth, neither the seas nor the trees..."* (Rev. 7:3).

Previous generations were perplexed by this admonition because it seemed impossible to hurt the earth or the seas. "What could this mean?" The earth and the seas are so vast, so immense, it seemed unthinkable that anyone could hurt the earth or

defile the oceans. Today this warning is no longer hard to understand. The angel's message should now be common sense because modern society is defiling the earth and polluting the seas and the great oceans. This guidance by itself can help heal the earth because it is so all-encompassing in its implications.

The oceans are potentially a great storehouse of energy, clean air, protein, enjoyment, and recreation for all people. But the routine activities of society are destroying the bounty of the seas, degrading its vitality, polluting its waters, increasing its temperatures, and causing serious damage to its ability to function in harmony with its divinely appointed purpose.

Almost forty years ago, oceanographer Jacques Costeau warned of the disaster that would follow if the oceans were to die.

> The ocean is earth's principle buffer, keeping balances intact between the salts and gases of which our lives are composed and on which they depend.

Healthy oceans are not just a concern for people in coastal areas. They are essential for life everywhere. The oceans shape continental climate and determine weather patterns; they impel the winds, influence rainfall, stabilize temperatures, and generate most of the world's oxygen. They provide fish, the world's primary source of animal protein for the human diet, more even than cattle, sheep, poultry, or eggs. Even though we don't recognize all of these connections, all life and the systems that support life are connected and dependent on the oceans.

Great diversity fills the oceans. The oceans contain about 17,000 species of fish and up to 190,000 other species of plants and animals. Near the surface of the oceans, "the zone of light" – where sunlight penetrates down to about 600 feet – roughly 50,000 plankton species live. These are mostly single cell organisms like algae and krill, miniature relatives of shrimp, which form the base of the ocean food chain. Below this level, there is a mid-water region where another 20,000 unique species live; crustaceans and chordate fish predominate here, but also strange jellyfish and molluscs. Down in the dark depths of the ocean bottom, oceanographers estimate several hundred thousand more species exist – and many remain unknowable. These dwellers of the deep, from roughly 1,000 feet down to three or four miles below the surface, live in a realm of crushing pressure and a lack of normal oxygen. Many species at these depths may never be caught and named. If they are caught and brought to the surface, their shape changes dramatically because of the huge pressure changes. When all forms of life are counted, scientists estimate more than 300 million different species live in the oceans. The intricacy, diversity and beauty of the undersea world is absolutely amazing.

Despite this abundance, human activity is placing this diversity in danger; the oceans are becoming sick. Their most productive ecosystems are in rapid decline, coastlines and beaches are being destroyed, the waters are becoming speckled with plastic and styrofoam, and the great coral reefs are dying. Additionally, invasive species

are moving into areas where they are causing havoc, ocean acidity is increasing, sea temperatures are warming, food webs are fraying and falling apart, and key species and populations are shrinking and in some cases entirely vanishing. According to detailed maps that chart human impacts upon the seas, oceanographers report that only four percent of the world's oceans remain undamaged by human activity. These remaining pristine areas are located in remote ice-bound regions near the poles, which will soon face new threats as the great ice sheets melt.

In 1973, Jacques Costeau, just beginning his pioneering efforts in ocean exploration, realized that the oceans held important but previously unrecognized keys to life on earth.

> Without the oceans, atmospheric carbon dioxide would set forth on an inexorable climb. Because carbon dioxide (CO^2) is a heat-trapping gas, the "greenhouse effect" would engage. Ocean temperatures would rise sharply. The icecaps would melt. The seas would rise perhaps 40 feet in a short span of years. Earth's major cities would be inundated. One third of the world's population would be compelled to flee to hills and mountains, terrains unready to receive these people, and unable to produce enough food for them.

Presently the oceans are in serious decline from overfishing, pollution, oil spills, coral reef death, and a host of other insults and offenses.

In response to this deepening dilemma, U.N. Secretary General Ban Ki-Moon delivered a sobering statement on World Oceans Day 2010. He declared that the oceans are in trouble. While he related how they play a key role in our lives and are integral to achieving sustainable development, he added a stern warning, saying that human activities place an ever-increasing strain on the diversity of marine life:

> If we are to fully benefit from what oceans have to offer, we must address the damaging impacts of human activities. The diversity of life in the oceans is under ever-increasing strain. Over-exploitation of marine living resources, climate change, and pollution from hazardous materials and activities all pose a grave threat to the marine environment.

To understand these threats, a listing of the major issues facing the world's oceans follows. Before we can evaluate the plight of the oceans, we have to describe the problems and their causes. Like a doctor with a patient, the symptoms must be identified and a diagnosis made before a remedy can be applied. Once we identify and understand the problems, then we can reflect on the longterm prognosis and apply some guidance for how we can address these problems.

• Harmful Commercial Fishing Practices

Overfishing is a serious threat to the oceans. Fish are part of a vast underwater community of living things, and crucial to a healthy ocean ecosystem. Fish are more than an edible commodity. They keep the seas clean and and they play a newly recognized role in maintaining a healthy ocean pH – the chemical balance between acidity and alkalinity. But fish stocks are in deep trouble. Over the past thirty years we have lost over 90% of all large edible fish because of overfishing.

The problem is that demand for fish is soaring far beyond supply – and beyond their ability to reproduce. The numbers of some fish species are dangerously low and some species, such as bluefin tuna, may never recover. In the future, seafood may become a rare delicacy, no longer part of the average diet.

To understand how this problem began, reflect on the story of the Atlantic cod. In 1497 when John Cabot explored the Northwest Atlantic, schools of cod were so huge that at times they practically blocked the passage of his ship. In the centuries following, codfishing flourished. But in 1992, the cod stocks abruptly collapsed. In Newfoundland and the surrounding area, over 40,000 people lost their jobs. Twenty years later, the cod fish and the marine ecosystem are still in collapse.

Scientists had repeatedly warned Canadian officials that Atlantic cod were over-exploited and that fishing fleets were using destructive practices. Fishermen refused to reduce quotas and government leaders decided that the loss of jobs was too great to enforce quotas. This short term outlook caused the entire fishery to virtually disappear. What happened in the North Atlantic is crucial to understand because something similar in happening in all of the world's oceans.

A key factor was that fishing methods changed. Until the 1950s, cod fishermen stayed close to shore and used handlines or small nets. The catch of fish was sufficient to feed the regional population. Around 1960, huge factory trawlers emerged. They arrived from the ports of Europe and North America in search of herring, haddock, flounder, and especially the valuable Atlantic cod. They dragged colossal nets and quickly processed all the fish they caught. The volume of fish caught soared. By the late 1960s the cod catch peaked at 800,000 tons per year, compared to 25,000 tons in 1950. The immense factory ships brought unprecedented fishing pressure to the ocean. By 1975 the cod yield dropped to 300,000 tons. The U.S. and Canada both passed legislation that banned foreign fishing fleets within 200 miles of shore.

In the following years catches declined. Scientists called for a closure of fishing so that cod schools could recover. Investors, however, pressured government officials to continue cod fishing. Jobs, investments, and income were at stake. Massive investment poured into huge new "draggers." Draggers are large ships that haul enormous, bag-like nets, as long as a football field. These nets scoured and scraped everything along the ocean bottom. They hauled up whole schools of fish and anything else in the way. These

draggers not only caught fish, they inflicted immense damage on the ocean floor. They were destroying critical undersea habitat, and contributing to a destabilization of the ecosystem of the cod.

The repeated trawling on spawning grounds was highly disruptive and hindered the ability of the fish to reproduce. It is little wonder that cod numbers sharply declined when their habitat was destroyed and their food sources disrupted.

Government and industry were fixated on taking too much and inadvertently caused the cod stocks to dwindle to near-extinction. A lesson is that we now possess the technology to find and annihilate every commercial fish stock and to wreak irreparable damage on the ocean ecosystem. The Atlantic cod fishery might still be thriving if the U.S. and Canada had taken a more cautious and thoughtful approach toward the Atlantic fisheries in the 1970s.

The attitude that led to the collapse of the Atlantic cod is now being repeated in many other places. The once great Peruvian anchovy fishery has collapsed and not recovered. The Monterey Bay sardine fishery collapsed because of overfishing. The same is true for Pacific albacore, the Gulf of Mexico king mackerel, red snapper, bluefin tuna, blue marlin, swordfish, shark, and a hundred other edible fish species.

Another problem is that the global fishing fleet is two times larger than what the oceans can support - meaning humans are consuming far too many ocean fish compared to what can be sustained. A 2010 study on oceans from the WorldWatch Institute reported that 76 percent of the world's fish stocks are fully exploited or overexploited. Several important commercial fish populations have declined to the point where their very survival is threatened. Unless the current situation improves dramatically, stocks of most of the remaining fish species currently used for food will collapse.

The problem is not just that there will be few fish to eat. The decline of fish populations poses a more dangerous threat to life in the ocean. As fish decline, the ocean also declines into a biologically unproductive and unstable condition. Without healthy ecosystems, fish cannot grow and reproduce – they can't survive.

Just as ominous are the unforeseen and possibly permanent changes to the ocean food chains caused by overfishing. Algae levels will increase. Jellyfish numbers will soar. As these increase, the character of the oceans will change dramatically.

Overkill of the ocean's top predators – the sharks, tunas and billfishes – can upset predator-prey relationships. Depleting these key fish populations can diminish the species diversity of the ocean. Because ecosystems are highly dynamic, a slight change in the population of any one species initiates a ripple effect throughout the system, making it unlikely that the damage can be undone. If the threats of overfishing and climate change are not removed, instabilities in the system could have devastating impacts on human beings, the quality of life on land, and the species that depend on the seas.

• Pollution

The world's oceans have become a dumping ground for a wide variety of pollutants and all of them have negative effects on ocean life. These pollutants represent perhaps the greatest threats faced by the oceans. At least a dozen major forms of ocean pollution exist. Some of these include pesticides and agricultural nutrients, urban sewage, manufacturing discharges, oil spills, urban and industrial run-off, commercial accidents, explosions, sea disposal and dumping operations, mining, waste heat sources, and radioactive discharges. All of these are a direct consequence of human activities. Here is some examination of the major ocean pollutants.

Oil Spills and other Oil sources

Petroleum is extremely harmful to ocean health. Oil spills cause enormous harm to deep ocean and coastal fisheries. The immediate effects of toxic and smothering oil may involve mass fish mortality and contamination of fish and other food species, but the long-term effects may be worse. One large spill can disrupt sea and shore life over a wide area. Oil waste poisons the sensitive coastal region, interrupting the food chain on which sea creatures depend, and on which their reproductive success is based. Fishing may be affected permanently. On average, spills from drilling and oil tanker accidents account for about 37 million gallons per year.

Additionally bilge cleaning and other routine ship operations release millions of gallons of oil each year, in tens of thousands of discharges of just a few gallons each. This accounts for an estimated 137 million gallons per year, more than three times as much oil as from all of the oil spills and accidents.

Oil spills attract a lot of media attention, but oil leakage from cars – either as the result of improper oil changes, leaks, or road runoff – represents the single largest source of ocean oil contamination. One oil change released onto the ground releases about five quarts of oil, much of which will leak into the sewer and eventually the ocean. The estimate is that 363 million gallons of oil annually reach the ocean in this way.

Agricultural Wastes

Animal wastes often reach rivers and oceans via runoff across the land surface, or by seepage through the soil. Agricultural runoff containing animal wastes does not receive any "treatment" except what is naturally afforded by microbial activity during its transit. In coastal watersheds, these wastes can flow through river networks that eventually empty into the sea.

Animal wastes from feedlots and agricultural operations (e.g., manure-spreading on cropland) can be contaminated by pathogenic microbes, and these eventually reach coastal waters. Runoff from agricultural areas contains phosphorus and nitrogen, which can cause nutrient over-enrichment in coastal regions that ultimately receive the runoff.

Ocean Dead Zones

As a result of nutrient-enriched agricultural runoff and sewage across the midwestern United States, the Mississippi river transports excess nutrients into the Gulf of Mexico. These nutrients cause algal blooms which kills plants and fish, and robs the sea water of oxygen. The result is that a massive "dead zone" is created. The dead zone at the mouth of the Mississippi covers over 7,500 square miles (an area about the size of the State of New Jersey) and extends beyond the Louisiana-Texas border. It has so little oxygen that essentially no marine life can exist within the dead zone.

According to the August 15, 2008 edition of *Scientific American,* dead zones are spreading, dotting the east and south coasts of the U.S. as well as several west coast river outlets. A study in *Science* reports that "the rest of the world fares no better — there are now 405 dead zones worldwide, up from 49 in the 1960s — and the world's largest dead zone remains the Baltic Sea, whose bottom waters lack oxygen year-round."

If there is any good news about dead zones, recent events show that they do not always persist. The Black Sea was once the world's biggest dead zone. Through the limitation of nitrogen fertilizers and other pollutants, regional governments and citizens have brought the Black Sea back to life and restored a sustainable fishing industry.

Human Sewage

A major pollutant by volume is sewage. Human sewage largely consists of excrement from toilet-flushing; wastewater from bathing, laundry, and dishwashing; and animal and vegetable matter from food preparation that is disposed through in-sink garbage disposals. Because coastal areas are densely populated, the amount of sewage reaching oceans is of particular concern because these substances harm ecosystems and pose a significant public health threat.

Beach pollution becomes a persistent public health problem because of sewage releases. Annually, thousands of swimming advisories and beach closures are experienced because high levels of disease-causing microbes are found in the water.

Seafood contaminated by sewage-related pathogens sickens untold numbers of people worldwide. Regulatory agencies will close a fishing area when contamination is detected. However, many countries lack regulatory oversight or the resources to monitor their coastal zone fisheries.

Industrial Wastes

Municipal and commercial activities often generate and dispose of liquid wastes through wastewater systems that reach the ocean. Because industrial waste frequently uses the same sewers as domestic and nonindustrial waste, sewage often contains high levels of industrial chemicals and heavy metals, including lead, cadmium, arsenic and mercury. Other industrial pollutants are pipeline discharges and transportation accidents, leaking underground storage tanks, and port and harbor activities. Industrial

chemicals adversely affect the growth, reproduction, and development of marine creatures. Pollutants are present in all of the oceans and seas.

A major public health concern is the safety of seafood as it relates to the chemical pollution of waters used for commercial and recreational fishing. Heavy metals (e.g., copper, lead, mercury) can reach high levels in marine animals, and then be passed along as seafood for humans. A well-known case of human poisoning occurred in Japan, where one industry dumped mercury compounds into Minimata Bay. Methylmercury accumulated in fish and was passed along to humans who consumed the fish. Over 3,000 human victims succumbed to what became known as "Minimata Disease," a devastating mercury-induced illness that affects the central nervous system.

A further public health issue is the increasing mercury contamination of fish. A 2009 U.S. Department of Interior study found mercury traces in each of 315 fish samples taken coast to coast. Of the samples 27 percent exceeded safe levels. Mercury is a dangerous neurotoxin and scientists say no level is safe. The mercury originates from particles in the atmosphere released primarily by coal-fired electrical power plants. The major cause of mercury in Pacific Ocean fish is Chinese electrical plants which use coal. The top predator fish are the biggest source of risk because they bioaccumulate mercury.

• Invasive Species

International ship travel sometimes carries exotic hitchhikers, called invasive species. The introduction of a species new to marine communities can cause imbalances that not only deteriorate environmental integrity but also endanger the survival of native species.

A growing problem in the Atlantic Ocean is the emergence of the lionfish, originally from Indonesian waters. The lionfish is a problem newcomer that is much deadlier than its attractive appearance would suggest. Armed with venomous spines, this colorful fish has become a big nuisance. In the Atlantic the lionfish has no natural predators, and therefore has been able to grow quickly and expand its range. Lionfish affects the fishing industry as they feast on small species such as sea bass and snappers.

On the West Coast, San Francisco Bay is now home to 175 invasive species. These new species crowd out native species and alter the habitat and the food webs.

Up the coast in British Columbia nearly one million Atlantic salmon have escaped from commercial farm pens over the past 15 years. These species are now reproducing in British Columbia rivers and diluting the gene pool of native salmon species by hybridizing with Pacific salmon. New species regularly find homes in our coastal waters and bays by hitching rides in ship ballast water or on ship hulls, escaping from fish farms, and even by being discarded from home aquariums.

• Ocean Acidification

One of the most worrying threats to the planet, say marine biologists, is ocean acidification. As carbon dioxide rises in the atmosphere, about one-third is absorbed into

the oceans where it turns into carbonic acid. The oceans currently absorb about a third of human-created CO^2 emissions, roughly 22 million tons a day. A first consequence is that the ocean's chemistry is changing and becoming more acidic. Carbonic acid inhibits shell growth in marine animals and causes reproductive disorders in some fish. This rising level of acidity is beginning to kill off coral reefs and shellfish beds and it threatens fish stocks plus crabs and lobster. Very little can live in water that gets too acidic.

Projections based on current numbers show that by the end of this century, most shell-forming animals including corals, oysters, shrimp, lobster, many planktonic organisms, and some fish species will be gravely affected. Many species will go extinct.

Equally worrisome is the fact that as the oceans absorb more CO^2, their capacity to store carbon could diminish. This means more carbon dioxide will remain in the atmosphere, further accelerating global climate change.

Scientific awareness of ocean acidification is relatively recent, and researchers are just beginning to study its effects on marine ecosystems. So far the oceans are now about 30 percent more acidic than they were a century ago. Among the early warning signs are the recent failures of commercial oysters and other shellfish beds on the Pacific coast. In addition, coral reefs have suffered serious disintegration in many regions. At high latitudes, where acidification is particularly serious, tiny shellfish called pteropods – a basic food of fish, whales and seabirds – have suffered noticeable drops in numbers. In each case, the culprit is ocean acidification.

The problem of ocean acidification was recently highlighted by Dr. Jane Lubchenco, head of the U.S. National Oceanic and Atmospheric Administration. She called ocean acidification global warming's "equally evil twin." It is a powerful comparison, but of the two, the crisis facing our seas has received far less attention.

• Coral Reef Death

Perhaps the biggest casualties of humanity's lifestyle involve our effects upon the world's coral reefs. Although they cover only 1 percent of the oceans' floors, they support nearly 25 percent of all ocean life. Already over half of the world's coral reefs are in danger from sun and acid bleaching.

Coral reefs are in trouble for a variety of reasons. The unsustainable overfishing of keystone species causes disruption to food chains vital to reef life. Fishing further impacts the reef through increased pollution from boats, by-catch of unwanted species (such as dolphins and turtles) and reef destruction from trawling, anchors and nets. Sewage is another problem as it causes diseases and algae blooms that block sunlight. Fertilizer is also a problem because it overloads sea water with nutrients which removes the oxygen. Perhaps the most shortsighted threat to reefs is the use of destructive fishing practices such as cyanide and other poisons to stun and capture fish, or the use of explosives such as dynamite to kill fish.

The largest cause of coral reef death is that the oceans are becoming warmer and more acidic because of human activity. This is disrupting the bottom of the oceanic food chain, hindering the chemical ability of shellfish, crabs, lobsters and sea creatures to maintain their shells, and inhibiting their ability to continue their existence.

• Plastic in the Oceans

Scientists are alarmed at the massive floating garbage patches that are building up in the calm centers of the world's oceans. The best-known patch, dubbed the Great Pacific Ocean Garbage Patch, consists of an estimated 100 million tons of plastic debris. It is estimated to cover an area twice the size of Texas and possibly much more. Plastic from this slow swirling vortex is increasingly washing up on Hawaiian atolls and being found in the guts of dead seabirds and fish. And the problem is growing.

An estimated 100,000 marine mammals die each year in the North Pacific alone from eating plastic debris or entanglement. Hence the garbage patch's other nickname: "the Plastic Killing Fields."

Birds are dying in even larger numbers. On Midway Island in the Pacific, an estimated 500,000 albatross chicks are born annually. Almost half now die from consuming plastic fed to them by their parents. One dead chick was found to have 305 small pieces of plastic in its belly.

Plastic is also smothering the beaches. The nineteen islands of the Hawaiian archipelago receive huge quantities of plastic trash. Some beaches are buried under five to ten feet of refuse, most of it plastic.

Plastic in the sea doesn't biodegrade like other garbage. Instead, it slowly breaks up into smaller and smaller pieces. It may take years to finally float into the ocean gyres. These plastic patches are environmental disaster zones. Plastic contains other toxic chemicals and it absorbs and accumulates other dangerous substances already present in the ocean, such as carcinogenic PCBs and DDT. It is estimated that 80 percent of ocean plastic comes from the land, while the remainder is litter from cargo ships, cruise boats and other sea vessels. About 10 percent of all plastic produced winds up in the ocean.

While much of the debris is large and conspicuous, most of it has disintegrated after years of washing around the ocean. The plastic pieces are usually five millimetres across or less and must be scooped up in nets finer than a window screen. "It's not quite what people think. It's like a soup," observed Marieta Francis, executive director of the Algalita Marine Research Foundation, in Long Beach, California.

Several problems emerge from all this plastic. It's making its way into the food chain and releasing toxins that disrupt genetic activity. In some areas the concentration of tiny plastic particles is six times greater than the presence of plankton. This is a grim statistic for aquatic life and humans because all of this plastic is winding up inside of us and contributing to an increasing body burden of industrial chemicals.

Medical researchers are just now evaluating how the ingredients in plastic interact with human and animal biochemistry. Generally plastic is a petroleum-based mix of polymers to which additional chemicals are added to provide a variety of other qualities. When we examine these new chemical substances, few of them have ever been studied for their effects on people because they were never intended for consumption. Regardless, the entire ocean is now becoming saturated with plastic particles that do not break down, that are genetically disruptive, and that are toxic to all forms of life. The consequences and volume of improperly discarded plastic continues to grow.

• Global Warming

Global climate change will have dramatic effects upon the world's oceans. From coral bleaching to sea level rise to higher ocean temperatures and acidity levels, entire ecosystems are rapidly changing. All forms of sea life are already having a difficult time dealing with the impacts which are already being experienced. Whole species of marine animals and fish are at risk as well as changes in ocean chemistry. Many species simply will not be able to survive these changing conditions.

As atmospheric CO^2 levels rise, the atmosphere will retain more of the sun's warmth. This will cause polar ice to melt and sea levels to rise. The oceans thus become a leading indicator of climate change: they are affected by climate change and in turn they affect the climate. The changes that happen to the atmosphere are accompanied by changes to the oceans in ways that will effect the sea level, temperature, currents, and biologically important features such as nutrient upwelling from the depths.

These changes have serious implications for marine biodiversity and the natural processes of the oceans – changing both the characteristics of the marine world and the mechanisms that deliver nutrients and transport larvae. These changes jeopardize the ability of thousands of marine life species to sustain themselves and hundreds of millions of humans who depend upon them as sources of food. A key consideration is that these changes are caused by human activity, a finding that is affirmed by the U.S. National Academy of Sciences, by the national science academies of all the G-8 countries, and by all peer-reviewed science. Any denial of this basic understanding originates from voices with ulterior political, economic or social motives underlying their advocacy. In any assessment of scientific information, always insist on peer-reviewed studies.

• Other Ocean Issues

This list is a quick introduction to the list of the assaults on oceans and their integrity. In addition we should include tourism and the insensitive development of fragile coastal wetlands. Coastal development causes more than 20,000 acres of sensitive coastal habitats to disappear each year. Cruise ships, carrying hundreds of thousands of people every year, travel the world's waterways, often discarding waste into the oceans. Some tourism however is responsible and has contributed positively to the marine environment, especially efforts at "green" or sustainable tourism.

The oceans are often used as dumping grounds for toxic wastes, trash, and in the past nuclear waste. Military action and deep sea mining are major sources of destructive noise pollution from sonar, engine motors and carelessness in testing its systems. It is particularly insensitive to the plight of whales, dolphins and other marine mammals as its underwater testing of sonar detection systems causes these great animals to become deaf and die. Aquaculture concentrates ammonia and pharmaceuticals in the ocean and sometimes introduces exotic species. Maritime shipping dumps waste into the sea and further adds to noise and accidents on the oceans. Undersea mining and petroleum extraction is often plagued with leakage and the use of highly toxic chemicals.

Dr. Jane Lubchenco, Administrator for the National Oceanic and Atmospheric Administrtion (NOAA), has emphasized,

> It will take a Herculean effort to reverse the current trajectory and leave healthy ocean ecosystems to our children and our grandchildren.

Reflection

The plight of the oceans is serious. The oceans are assaulted by our callous use of fossil fuels, by carelessness with plastic, by our wanton disregard for the health and welfare of creation. We may be called to do God's will *"on earth as it is in heaven*," but we're not paying attention. Instead we are making a terrible mess of the world and the deepening plight of the oceans characterizes our inadequate level of care and stewardship.

The primary cause for the insensitive way we treat the ocean is that we forget God. This is why the problem of the ocean is a moral, ethical and spiritual problem. The sins of greed, arrogance, ignorance, and what the Church Fathers called "stony insensibility" underlie the defilement of the oceans. Greed is central to the problem because we take too much and the oceans are unable to sustain the profligacy of our desires. Arrogance is involved because we have tried to manage the seas without remembrance of God, and therefore without sensitivity for the oceans and the need to safeguard their integrity and vitality. Ignorance is part of the equation because we have sought to use and exploit what we never appreciated nor understood. Stony insensibility is evident because we approached the oceans with hardened hearts that failed to discern the intricacy, balances, and living relationships within these great bodies of water and their role in the orchestration and moderation of the world's climatic forces.

In religious symbolism we associate the flow of water with the movement of the Holy Spirit. It should follow that when the rivers of life join together and empty into the great oceans, in the correspondence of earth to heaven, the oceans must represent the wisdom of God. If the oceans can be likened to an earthly reflection of heavenly wisdom, it is no accident that the oceans contain such amazing diversity, fruitfulness, and vitality of life.

The keys to healing the ocean are also the keys to spiritual formation and to restoring all of the other aspects of God's creation. First, we must be willing to obey God. From the beginning we have been told to have dominion (i.e., to treat the world as the Lord would treat it) and to dress it and keep it from harm. Like the fruit from the Tree of Good and Evil that was placed before Adam and Eve, the fruits of creation are set before us, but we may righteously partake only as we observe all that has been commanded of us. This means we must not only invoke God's blessings, but also the entire content of the commands given to humanity in the Scriptures. The further implication is that we must acquaint ourselves with the basic teachings of the Church in regard to the care and keeping of the earth. There is no excuse for ignorance of God's laws regarding creation.

Second, we must repent. It is clear that we must change how we live or we will experience an end of society, not by God's hand, but by our addiction to fossil fuels and intoxication with the wealth that we have taken beyond our needs and beyond the carrying capacity of the earth. To heal the oceans, we must be willing to live simply, to be careful and cautious in our use of creation's bounty, and to spread an understanding of the role of the oceans in the life of the world.

Third, sacrifice will be necessary to heal the oceans. We must voluntarily divest of the many options that we take for granted and for the supply of things that we arrogate to ourselves above and beyond our genuine needs and beyond the ability of the earth to sustain our collective extravagance.

For all of us, it is a continuing challenge to appreciate what a great gift of life we have been given to live in this world and experience its beauties, its challenges and tests, and the opportunity to participate in the unfoldment of the mystery of creation. Almost two thousand years ago when the Evangelist John received his Revelation, how prophetic and prescient it was that the central pillars of a healthy creation could have been so precisely identified when the angel speaks of how to counter the plagues that are being poured down onto the world by the demonic forces.

The bright angel's words, *"Hurt not the earth, neither the seas nor the trees..."* captures the strategy that we must now follow if we would heal the earth and maintain it so that it might be transfigured into the New Earth which Christ has initiated.

The words of the angel (in Rev. 7:3) should guide our actions and behavior, despite the inconveniences and struggles. This is what is necessary if we are to avoid an end to civilization that would be of our own making and not by the hand of God.

In addition, we need to be focused and deliberate in our efforts to end our assaults on the integrity and health of the oceans. If we are willing to change our habits, hope still remains. But it will take concerted and determined efforts from all people working together. Here are some specific things that you can do to help address the problems of the ocean in your own home or parish.

What You Can Do – Recommendations for Action

◆ **Reduce Energy Consumption**
Watch your carbon footprint. This is important. Reduce the effects of climate change on the ocean by leaving the car at home when you can and by being conscious of your energy use. Ride a bike, walk, carpool, or use public transportation. Reduce unnecessary travel. Use high efficiency appliances. Turn off appliances when they aren't in use. Turn up your thermostat a few degrees in summer and down a turn it down few degrees in winter. Switch to LED or compact fluorescent light bulbs; take the stairs instead of the elevator whenever you can.

◆ **Make Safe, Sustainable Seafood Choices**
What you eat makes a big difference. When shopping or dining out, choose seafood that is healthful and sustainable. Ask questions about where seafood originates. What kind of fish is it? Where is it from? How was it caught? Avoid fish that are from a depleted species, that were caught illegally, that were caught by bottom trawling, or by a process that results in a large by-catch. Avoid farmed seafood products such as prawns and ranch salmon. Generally eat lower on the marine food chain. It is healthier for you and for the ocean.

◆ **Reduce the Use of Plastic**
Plastic that ends up as ocean debris contributes to habitat destruction. It entangles and kills tens of thousands of marine animals each year. To limit your impact, carry a reusable water bottle, store food in nondisposable containers, bring your own cloth bag when shopping, and recycle whenever possible. If possible, eliminate the use of plastics.

◆ **Help Take Care of the Beach**
Whether you enjoy diving, surfing, or relaxing on the beach, always clean up after yourself. Explore and appreciate the ocean without interfering with wildlife or removing rocks and coral. Go even further by encouraging others to respect the marine environment and to participate in local beach cleanups.

◆ **Don't Purchase Items That Exploit Marine Life**
Avoid purchasing items such as coral jewelry, tortoiseshell hair accessories (made from hawksbill turtles), and shark products. When shopping for your fish tank, leave fragile coral reef habitats untouched by buying products that aren't made of real coral.

◆ **Be an Ocean-Friendly Pet Owner**
Read pet food labels and consider seafood sustainability when choosing a diet for your pet. Never flush cat litter down the drain, as it can contain pathogens that are harmful to marine life, especially sea mammals. Avoid stocking your aquarium with wild-caught saltwater fish, and never release aquarium fish into the ocean or other bodies of water, a practice that can introduce invasive, non-native species which may be harmful to existing ecosystems.

◆ Use Less Fertilizer

When fertilizers are used in agriculture or gardening, the excess eventually ends up in the ocean. The result is a "dead zone"—an area with very low levels of oxygen. Since all marine life requires oxygen, including fish and shrimp, they must either flee the area or die. Use fertilizer sparingly and remember more is usually not better.

◆ Properly Dispose of Hazardous Materials

Motor vehicle oil and other hazardous materials often drain into sewers and from there into coastal waters if they are not disposed of properly. Never pour oil, chemicals, pharmaceuticals, solvents, or paint down into drain or toilets. Check with your county hazardous waste program to properly dispose of them and keep them out of rivers and oceans. Improper disposal pollutes the water and harms the health of the oceans. Always dispose of hazardous waste in an environmentally safe way. Even better, try to avoid the use of all toxic or hazardous materials.

◆ Pick Up Garbage and Litter

Much of the plastic and other debris found in the ocean begins as stream, riverbank, or beach litter. As beach crowds increase, so does the amount of trash left behind. Don't let a day at the beach contribute to the pollution of the ocean. When you visit a beach, bring a trash bag along for your garbage; volunteer to pick up other litter as well.

◆ Influence Change in Your Community

Research the ocean policies of public officials before you vote. Contact your elected officials and encourage them to support marine conservation projects. Support only those restaurants and stores that offer sustainable seafood. If you spot a threatened species on the menu or at a seafood counter, tell the manager about your concerns and ask that the restaurant or store provide only sustainable seafood choices.

◆ Travel the Ocean Responsibly

Practice responsible boating, kayaking, and other recreational activities on the water. Never throw anything overboard. Be aware of the marine life in the waters around you. If you plan to take a cruise for your next vacation, do some research to identify the most eco-friendly option.

◆ Educate Yourself About Oceans and Marine Life

All life on Earth is connected to the ocean and its inhabitants. The more you learn about the issues facing the oceans, the more you will want to help ensure its health. Do what you can to share that knowledge and thereby educate and inspire others.

◆ Use Biodegradable Soaps and Detergents

Choose green detergents and household cleaners. Besides being far better for your health, these products are safer for the environment since what goes down the drain can often end up in the ocean.

◆ Maintain Clean Streams and Rivers

Do all that you can to keep local waterways clean and free from pollutants. Never pour oil or chemicals into the gutter, down the drain or into waterways. Pick up trash alongside creeks and streams. Teach young people the importance of recycling and avoiding the thoughtless discard of bottles, plastic or other waste. Some of this refuse can eventually make its way into the oceans.

◆ Visit the Oceans

Whether you live far inland or on the coast, we are all connected to the ocean. Take the time to organize or participate in activities that restore and celebrate the ocean. Enjoy time at the beach and use some of that time to reflect on the mysteries of creation and the great task that has been given to humanity to steward this earth.

◆ Help Others to Understand the Issues

Talk to your parish, friends and family about the problems – and the solutions – that impact our oceans. Write letters to the editors of your local newspapers and call attention to marine issues. Every action helps. Nothing is too small to overlook. Everything we do counts, in so far as its effort upon the environment is concerned.

To protect the oceans is to do God's work. To harm them, even if we are ignorant of the harm we cause, is to diminish His divine Creation.

- HAH Ecumenical Patriarch Bartholomew
Stockholm, Sweden, June 7, 2003

For the human race as a whole, there is now a kairos, a decisive time in our relationship with God's creation. We will either act in time to protect life on earth from the worst consequences of human folly, or we will fail to act. On behalf of all of us..., allow me to offer up a public prayer: "May God grant us the wisdom to act in time.

- HAH Ecumenical Patriarch Bartholomew
September 9, 2007

We invite you to join in pledging to protect the oceans as an act of devotion.... If we love God, we must love His creation.

- HAH Ecumenical Patriarch Bartholomew
June 7, 2003