June 3, 2003 – Plenary Session II

Presentation: Bottom trawling, clearcutting and *tikkun olam* (healing the world)
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Your All Holiness, Excellencies and Eminences, esteemed guests, patient *Symposium* participants, thank you very much for being here.

I want to examine another topic that affects the health of the Baltic Sea. I am not an expert on the Baltic; I mostly work on marine issues in North America, but also focus on some global problems. Although I am a marine ecologist by training, I also studied forests for some years. I am especially interested in the interactions of living things in the ocean , and what we can do to diminish threats to them. So, unlike many people here, I am not so much a theologist as an ichthyologist, a rather different breed of fish. The main topics I will address are bottom trawling, a method of commercial fishing that is disturbingly similar to clearcutting, and its relevance of the Jewish concept of *tikkun olam*.

By way of introduction: Marine Conservation Biology Institute is a small American non-governmental science and conservation advocacy organization that I founded in 1996 in Redmond, Washington. We have staff of about ten people. MCBI is unusual in a number of ways, and one of them is that our acronym is pronounced "Maccabee," and that's not an accident. It refers to a family and their followers, the Maccabees, who fought against near-impossible odds to preserve the integrity of Judaism and the holy Temple in the second century BCE. Indeed, the Maccabees actually retook Jerusalem and held it for a while. The reason I chose that name and acronym is that protecting the integrity of the world's oceans and the Earth as a whole is a near-impossible task that we nonetheless must fight for and win, by harnessing all of our own resources and, perhaps, with help from sources greater than ourselves.

What drives me to work to conserve life on Earth day after day, year after year, is a concept in Judaism that has been central for two thousand years, since at least the 1st Century BCE. In Hebrew it is called *tikkun olam*, which means "heal the world." Rabbi Hillel, one of the greatest Jewish thinkers, taught that *tikkun olam* is the primary obligation of all Jewish people. Many scholars have interpreted *tikkun olam* to mean "heal the problems of humankind." But, as a biologist, I know that humankind is but a very small subset of the world, albeit a very powerful one upon which most people focus nearly all their attention. Because humans are but one of the millions of interacting species on Earth, I interpret *tikkun olam* broadly, recognizing that if we can heal our living planet, we will certainly make life better for all of humankind, now and in the future.

Stimulated by a growing awareness that the living Earth is in ever-deepening trouble, there has recently been movement in a number of religions to explore the religious roots of environmental consciousness as a way to enlist the faithful in protecting Creation. The greatest expression of this that I know of anywhere in the world today is the work of His All Holiness Ecumenical Patriarch Bartholomew I, the people of the Orthodox Patriarchate, and those who have devoted themselves to helping the Patriarchate, especially Mrs. Maria Becket, who has brought us together in this and four previous

Religion, Science and Environment Symposia. This is clearly evident in a 1997 declaration by His All Holiness in Santa Barbara, California, in which he said, "For humans to cause species to become extinct and to destroy the biological diversity of God's creation... these are sins." To my knowledge, this is the most sophisticated and influential statement about humans' responsibility for Creation by any leader of one of the world's great faiths.

I want to talk about the marine environment because the oceans illustrate many of the most pressing environmental dilemmas humankind faces, even though we don't live in them. The sea is the largest realm on Earth, covering 71% of our planet. It provides 16% of humankind's animal protein, more than beef or pork or mutton or chicken. It produces nearly 50% of the oxygen we breathe, and it is crucial in preventing run-away global warming.

Whether you are impressed by its vastness, its production of food, the vital ecosystem services it performs or simply its importance as part of Creation, it is difficult to avoid the conclusion that the sea is important. The bottom of the ocean is particularly important because of the 235,000 animal species known to live in the sea, more than 98% of them live on the seafloor. So if you think about it, the seafloor is the largest part of Creation where we know that life exists.

Despite the oceans' importance, major religions have had very little to say about marine conservation. They have much more to say about the land. The reason for this, I believe, is that the prophets who founded the world's great religions (Table 1) did so long before scientists knew how the oceans function, particularly before scientists began to study the bottom of the oceans. All the founders of today's major religions—Abraham, who dates back roughly four thousand years, Lao Tzu, Confucius and Siddhartha Gautama, each dating back about twenty-five hundred years, Jesus, Mohammed, Baha'ulla antedate modern scientific understanding of the oceans, which essentially began with the British *Challenger* expedition in the 1870s and accelerated with the invention of scuba by Jacques Cousteau in the 1940s and the development of research submersibles and remotely operated vehicles in the 1960s. The seafloor was *terra incognita* at the time that the greatest religious writings were produced. People knew almost nothing about it. Understandably, nobody was concerned about it then, and the canonical writings of the world's great religions have very little to say about marine conservation.

But I am a firm believer in an insight attributed to Albert Einstein: "The world we have created today as a result of our thinking thus far has problems which cannot be solved by thinking the way we thought when we created them." Although the prophets had nothing to say about conserving life on the seafloor, that does not mean religions are irrelevant and have nothing to say on this topic. All of the world's great religions gave people commandments or principles prescribing responsibilities that can be (and must be) applied to parts of the world whose importance was not understood when the religions were founded.

Fish for human consumption and fishing as an occupation are prominently mentioned in religious texts including the Torah and the New Testament. My 1993 book called *Global Marine Biological Diversity: A Strategy for Building Conservation into Decision Making* explains that there are five major proximate threats to marine biodiversity. They are pollution, which is probably the leading problem in the Baltic Sea,

overfishing, physical habitat damage, introduction of alien species, and global climate change. The five proximate threats to the richness of ocean life are, in turn, driven by five ultimate threats: there are too many of us, we consume too much, our institutions are not effective in conserving biological diversity, we don't know enough and we don't care enough.

But it has become unmistakably clear just in the last few years that one proximate threat to the sea's biological diversity is even worse than the rest. Recent scientific studies by Daniel Pauly of the University of British Columbia in Canada and his colleagues, Jeremy Jackson of Scripps Institution of Oceanography in the USA and his colleagues, and by Ransom Myers of Dalhousie University in Canada and Boris Worm of Kiel University in Germany now make it clear that fishing is the leading threat to the integrity of the oceans.

I want to offer some thoughts on the impacts of fishing, and in particular, one kind of industrialized fishing that I have been studying for a long time.

My first experience with commercial fishing was a night spent on a shrimp trawler in 1971 for the purpose of catching large numbers of the blue crabs that I was studying for my doctoral dissertation. A bottom trawler (Figure 1) is a boat or ship (the biggest ones are 130 meters in length) that pulls a big, heavily weighted net across the seafloor. In doing so it has three environmental effects: it catches the organisms it is intended to catch, which fisheries biologists call the target species. It catches other organisms, which scientists call "bycatch" or "bykill." And it disturbs the marine life on the seafloor.

Figure 2 illustrates the animals caught in a shrimp trawl. In the case of this photograph that I took, about 95% of the organisms by weight were not shrimp. Shrimpers call these other animals "trawl trash". I call them biodiversity. Another name you could call them is God's creations. Unfortunately, astronomical numbers of these animals die on deck and are shoveled overboard after the shrimp are plucked out. Whether that is a tragic waste of precious life or an inevitable consequence of fishing depends on your ethical perspective.

Starting in late 1979 I had the opportunity to work as the Staff Ecologist at the President's Council on Environmental Quality in Washington DC. President Carter was a strong environmental leader of his flock in the same way that His All Holiness has become the leader on environmental issues for his. Soon after I began my job, I read early reports that the world's forests were being clear-cut out of existence. Clearcutting has enormous environmental implications because it is devastating to the many species that need intact forests and to the essential services that forests provide (Figure 3). I was asked to write a chapter of CEQ's *1980 Annual Report* on the status of life on Earth, a fairly broad topic. I called it "biological diversity." Most people now shorten it to "biodiversity." This concept took hold very quickly among people who work on conservation issues, and all around the world people now understand that biodiversity means the integrity of life, and the health of genes, species and ecosystems.

Most people were interested in biological diversity in forests. So, despite the fact that I was a marine ecologist, my first and second books were on conserving forest biodiversity. But after I got a job at an NGO called the Center for Marine Conservation, it became clear that I had a special responsibility to examine the loss of biodiversity in the oceans. Containing contributions from 106 authors, this book—*Global Marine Biological*

Diversity: A Strategy for Building Conservation into Decision Making—was sponsored not only by the Center for Marine Conservation, but also the World Bank, with help from Steve Lintner, the World Conservation Union (IUCN), the World Wildlife Fund, and the United States Environment Program. It got a lot of use during the early years of the deliberations on biological diversity in the United States and in formulating the thinking of an international treaty administered by the United Nations, the Convention on Biological Diversity.

In assembling this book and talking with a lot of people, one thing that I learned was that trawling is a virtually unappreciated but very real problem. So when I founded Marine Conservation Biology Institute in 1996, I pulled together a group of seventeen scientists from Europe, North America, Australia and New Zealand, and we looked at what was known about the effects of bottom trawling worldwide. Astoundingly, nobody had done this before. Scientists had studied trawling impacts to some degree in Europe and to a lesser degree in Australia, but nobody had looked at the global picture. As a result of this scientific workshop, seven papers were published in 1998 in the leading journal in my field, *Conservation Biology*, and we held a news conference, which made trawling the topic of news articles in countries around the world. By talking for the first time to a broad audience of conservation-minded scientists and to the general public, these papers dramatically increased scrutiny of trawling's impacts in North America and elsewhere.

Even putting aside consideration of the astronomical numbers of seafloor animals that come up in trawl nets and die on deck, understanding the impacts of trawling on the seafloor is a crucial global environmental issue. People often envision the seafloor as a featureless expanse of sand or mud, but most of the world's seafloor has complex structure. Some places have geological structures, such as rocky outcroppings, boulders, cobbles and gravel. Almost everywhere there are organisms in and on the seafloor that create structure. As a rule, structures on the seafloor are not as large as the trees and shrubs on land. In some cases they are fairly substantial, such as corals that can reach heights of several meters, but more often structure-forming animals are only a few centimeters high. Yet these biological structures on the seafloor are extremely important to the ecology of the seafloor.

The more structure there is on the seafloor, the more species of fish are found in those ecosystems. Not all fishes and other seafloor animals need structurally complex habitats. Tropical and warm temperate penaeid shrimps—the most important shrimps in world commerce—don't seem to need it, nor do some species of rays, goosefish or some flatfishes, such as turbot.

But a large fraction of organisms in the ocean do. For example, scientists have witnessed commercially important pandalid shrimps orienting their tasty and vulnerable abdomens against sea anemones, apparently to protect themselves. Similarly, lobsters protect their delicious abdomens that predatory fish would like to eat by keeping them under cover. Experiments have shown that young Atlantic cod that can take shelter amongst sponges on the seafloor are much less vulnerable to predation. The structures on the seafloor are essential for living things as feeding places, hiding places and places where they reproduce. Many of species of rockfishes (such as the sharp-chinned rockfish) from the West Coast of the United States are in severe trouble because fishermen have

overfished them and trawled their structurally complex seafloor habitats as flat as my bald head.

My years of working in both marine and forest ecosystems have made it obvious that trawling has impacts that are analogous to clearcutting, but there is a crucial difference: It is much easier to see the effects of clear-cutting. On land, the air is usually clear enough that people—especially in mountainous areas—can see the dramatic differences in structural complexity of the land surface between intact forest ecosystems and clearcuts. In the sea getting an eagle-eye view is much difficult. Most people, even marine scientists and fishermen, have never actually been under the sea or have made only brief visits to its very shallowest areas. I began scuba diving in 1963 and have had the privilege of three trips in research submersibles in the Caribbean and the Gulf of Mexico, but amazingly few people have seen the seafloor with their own eyes. Moreover, even the clearest seawater makes it difficult to get the kind of synoptic views that are possible on land, so one must have pairs of photographs to see the difference between untrawled and trawled seafloors. Fortunately, I have gathered some photos that allow such comparison.

Figures 4 and 5 are photographs by an Australian scientist of a coral-sponge ecosystem in northwestern Australia that had not yet been trawled and one that had been trawled. Figures 6 and 7 show an undredged ecosystem in the Gulf of Maine—dredges are heavy steel trawl-like fishing gears used to catch seafloor animals such as scallops—and what the same spot looks like immediately after a single pass of the dredge. Roughly 90% of those small structure-forming tube-dwelling animals on the seafloor have been removed. On George's Bank off of the Atlantic coast of Canada and the northeastern United States, the difference between untrawled (Figure 8) and trawled (Figure 9) areas is just as obvious. The contrast is particularly strong in untrawled and trawled *Oculina* coral reefs off the coast of Florida in the United States (Figures 10 and 11). The closest I could come to the Baltic Sea is a pair of photographs in the Norwegian Sea. Untrawled *Lophelia* coral reefs (Figure 12) are home for many redfish, which are commercially important in Norway and throughout the cold waters of the North Atlantic, along with hundreds of other species. But after trawlers go through, the ecosystem has been radically changed (Figure 13). And because corals and other deep seafloor species are very slow-growing, this damage is essentially permanent on human time scales.

Coincident with the spread of industrial trawling operations, Atlantic cod (Figure 14)—once a phenomenally abundant species from New England to Europe—have been disappearing. One obvious reason is that people are overfishing, in other words catching cod faster than these fish can replace themselves. But I do not think that is the whole answer. Trawlers are also destroying cod habitat. Specifically, we are destroying the seafloor structures in which little cod find food and hide from predators, and by doing so we are losing cod from the Baltic Sea, the North Sea, Newfoundland, Nova Scotia and New England, all places where fishermen trawl for cod. Scientists are seeing severe population decreases for many species of rockfish in the North Pacific. I suspect that everywhere people trawl, we can expect structure-loving species to disappear. Whether you care about having a sustainable supply of your favorite seafood, about the crucial ecological services that our oceans provide, or you are simply concerned about the integrity of God's Creation, the disappearance of fish and countless other species of marine life is not a good thing.

I know that people have to take food from the sea. We are predators that eat other things to live. But if we have any kind of ethics at all, whether they are religious, spiritual or purely humanistic, I think we are obliged to protect as much of the ocean as possible. Yet we have done a very, very poor job of this. As shown by my friend Callum Roberts of the University of York in the UK, the fraction of the world's oceans that are fully protected from fishing, as well as oil development and ocean dumping and all other harmful things that we can prevent, is exceedingly tiny, probably less than one-tenth of one percent of the world's oceans. Less than one-thousandth. I would argue that is not nearly enough.

So as an ecologist who is deeply impressed by the power of faith to shape people's actions, I would like to leave us all contemplating two questions. The fate of the oceans depends on the answers to these questions. Can we—Jews, Christians, Muslims, Hindus, each of us in our own way—accept the responsibility of *tikkun olam*, the commandment to heal the world? And can we do so before it is too late? This last question—on which so much depends—reiterates the famous challenge that Rabbi Hillel posed in the Talmud more than two thousand years ago: "If not now, when?"

Table 1. Dates for the founding of major religions and crucial dates in marine science. BCE = Before Common Era; CE = Common Era

Founding prophet (Religion)	**Century**
Abraham (Judaism)	?19th BCE
Zoroaster (Zoroastrianism)	7th BCE
Confucius (Confucianism)	6th BCE
Lao Tzu (Taoism)	6th BCE
Siddhartha Gautama (Buddhism)	6th BCE
Vardhamana Mahavira (Jainism)	6th BCE
Jesus (Christianity)	1st CE
Mohammed (Islam)	6th CE
Guru Nanak (Sikhism)	15th CE
Baha'Ulla (Baha'i)	19th CE
HMS Challenger expedition	19th CE
scuba diving	20th CE
research submersibles and remotely operated vehicles	20th CE

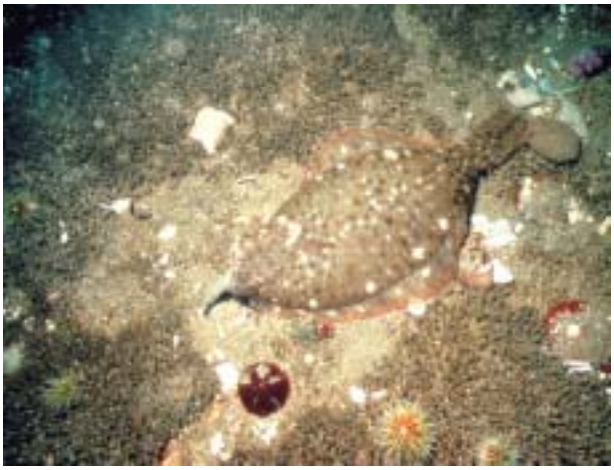
Figures:

Figure 1. Bottom trawlers drag large, heavy nets across the seafloor, catching animals they target and other wildlife species, and disturbing life on the seafloor (MCBI).

Figure 2. Shrimp and other animals in a shrimp trawl haul, Sea of Cortez, Mexico. Note that shrimp comprise only about 5% of the catch. The other species—called "trawl trash"—die and are thrown overboard (Elliott Norse).

Figure 3. Clearcuts and forest remnants, Olympic National Forest, Washington, USA (Elliott Norse)

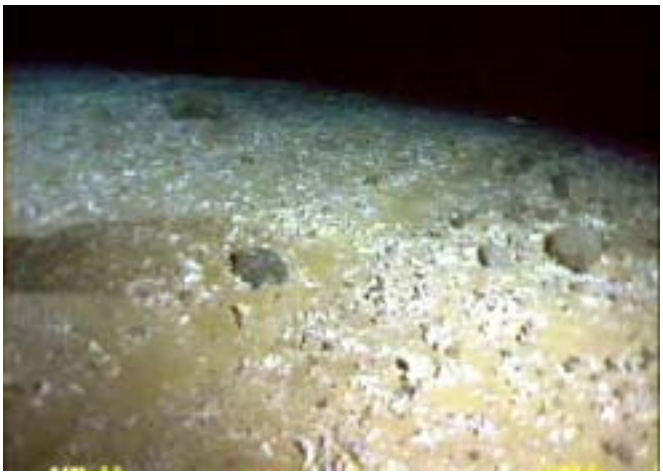
Figures 4 and 5. Untrawled and trawled coral-sponge communities, northwest Australia (Keith Sainsbury).



Figures 6 and 7. Undredged and dredged seafloor, Swan's Island, Gulf of Maine USA (Peter Auster).

Figures 8 and 9. Untrawled and trawled seafloor, Georges Bank, Canada-USA (Page Valentine)

Figures 10 and 11. Untrawled and trawled Oculina coral reef, Florida, USA (R. Grant Gilmore, Fig. 9, and Christopher Koenig, Fig. 10)



Figures 12 and 13. Untrawled and trawled Lophelia coral reef, Norway (Martin Hovland, Fig. 11, and Jan Helge Fosså, Figure 12)

Figure 14. Atlantic cod, a species that has been disappearing in areas of intense trawling in the Baltic Sea, North Sea, Newfoundland, Nova Scotia and New England (Peter Auster)