Contribution with respect to threats and risks to vulnerable marine ecosystems and biodiversity in areas beyond national jurisdiction.

A response to UN General Assembly resolution A/RES/58/240 adopted 23 Dec 2003, by the UNEP-World Conservation Monitoring Centre (UNEP-WCMC) in consultation with the UNEP Coral Reef Unit (CRU), The Secretariat of the International Coral Reef Action Network (ICRAN) and the Secretariat of the International Coral Reef Initiative (ICRI).

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1. Background

About 71% of the Earth's surface is covered by the sea to an average depth of 3,800 m, and 64% of this is beyond the 200 nautical mile limit of the Exclusive Economic Zones (EEZs) of coastal states, and are hence beyond national jurisdiction. These 'High Seas' have long been seen as open-access common resources, and as such are particularly susceptible to over-exploitation. Until relatively recently there was little perceived threat to these areas and ecosystems, but human activities on the High Seas are now becoming much more prevalent. Some of these present significant threats, including pollution from land-based agricultural, industrial and urban sources, the disposal of toxic wastes such as sewage sludge, radioactive materials and munitions, deep-sea fishing, extraction of oil, gas and hard-rock minerals, and climate change and associated alteration of ocean currents. Future disposal activities that could be significant by 2025 include deep ocean sequestration of carbon dioxide (CO_2), which is currently assessed as one of the few feasible ways to extract CO_2 from the atmosphere in sufficient quantities to mitigate global warming.

Meanwhile, as fish stocks dwindle in the upper ocean, deep-sea fisheries are increasingly targeted. Deep-sea fish are long-lived, slow growing and very slow to recruit in the face of sustained fishing pressure, making most (perhaps all) of the deep-sea fisheries unsustainable in the long-term. Oil and gas exploitation has begun, and will continue, in deep water, creating significant localized impacts resulting mainly from accumulation of contaminated drill cuttings. The picture for the High Seas is a dynamic one, therefore, and global management strategies must be flexible enough to adapt to major changes, some of them unpredictable. Such strategies must also be based on sound knowledge of the taxonomy, species structure, biogeography and basic natural history of the deep-sea biota, which is currently inadequate. This weakness prevents accurate assessment of the risk to populations and species from large-scale mining and other disturbances. Because we know so little about this remote environment, we run the risk of substantially modifying the deep-sea ecosystem before we understand its natural state.

2. International Consensus

There is a growing acceptance within the international community that action needs to be taken to mitigate human impacts on High Seas biodiversity. The Global Marine Assessment (2003)[1] highlighted the current gaps in monitoring, research and reporting on the High Seas. Other international frameworks have proposed action, including:

- The third UN **Open-ended Informal Consultative Process** (ICP), which in 2002 noted that seamounts, and other underwater features, have high levels of endemic species and constitute a large, as yet unevaluated reservoir of biodiversity that may be threatened by human activities.
- The **World Summit on Sustainable Development** (WSSD), which in 2002 included in its *Plan of Implementation* (paragraph 31a), text which addressed the need for action to conserve High Seas biodiversity and resources.
- The **Convention on Biological Diversity** (CBD), which in 2003[2] noted increasing risks to biodiversity in areas beyond national jurisdiction, and specified desirable actions to mitigate them, and in 2004[3] adopted a long-term target of including 20-30% of each habitat type in effectively managed marine and coastal protected areas.
- **International scientific forums**, such as the 10th Deep-Sea Biology Symposium and 2nd International Symposium on Deep-Sea Corals, which in 2003 led to the "Coos Bay Statement of Concern" over the status of cold-water and deep-sea corals.

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[1] Global Marine Assessment. UNEP-WCMC 2003.
[2] Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) UNEP/CBD/SBSTTA/8/L.11
[3] Seventh Conference of the Parties (CoP7), Kuala Lumpur, Malaysia.

3. Overview of the Submission

The following analysis[4] summarizes what is known to UNEP-WCMC and its collaborators of the threats and risks to vulnerable and threatened marine ecosystems and biodiversity in the High Seas, and highlights options and priorities, consistent with international law and scientific and precautionary principles, for their protection and management. The submission therefore:

- summarizes the status and distribution of key species and habitats that are most vulnerable to human impacts on the High Seas;
- identifies the major threats to High Seas biodiversity;
- suggests approaches to mitigate these threats;
- discusses an approach to using existing data to identify priority areas for future work; and
- highlights the current gaps in our knowledge and some of the groups working on all of the above.

The submission defines the term 'High Seas' to apply to all parts of the oceans that are included neither in the EEZs, territorial seas or internal waters of a state, nor within the archipelagic waters of an archipelagic state. The High Seas are divided for descriptive purposes into pelagic (water column) and benthic (sea floor) components. Further details on divisions of the marine environment are given in **Annex 1**.

4. Summary of Key Habitats and Species

The following geographic features, habitats and/or biological communities are widely seen to be of special scientific, social or economic interest: hydrothermal vents; deep-sea trenches; gas hydrates; seabirds (notably albatrosses); predatory fish; transboundary and other migratory fish stocks; seamounts; deep-sea corals; cold seeps and pockmarks; sub-marine canyons; marine turtles; and cetaceans (see **Annex 2**).

5. Major Threats to High Seas Biodiversity

The main threats to components of biodiversity in the High Seas are described in **Annex 3**. Chief among them are pollution, over-fishing and climate change, but seafloor drilling and mining, cable laying activities have local impacts and alien invasive species, litter and shipping have more distributed impacts. These threats interact with key and vulnerable habitats and species (**Annex 4**) to give areas of particular concern.

6. Data gaps

A number of gaps in information have been identified. These include an incomplete understanding of: (a) the effects of long-term exposure of marine biota to contaminants; (b) basic systematic knowledge about the majority of benthic organisms; (c) the distributions and life histories of many fishery and keystone species; (d) the dynamics of most deep-water food webs (including the role of microorganisms); (e) the distribution and abundance of High Seas taxa and ecosystems; and (f) the potential impacts of invasive alien species on High Seas ecosystems.

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[4] Based partly on *The Status of Natural Resources of the High Seas* by C.M. Baker, B.J. Bett, D.S.M. Billett and A.D. Rogers (WWF/IUCN, Gland, Switzerland, 2001).

7. Strategic priorities

7.1 International regulations on marine pollution

For **dumping of toxic chemicals**, new remote sensing techniques (satellite imagery) could be further developed to provide cheap and effective monitoring of dumping. For **land-based sources of pollution,** existing indicators should be used to monitor progress towards internationally agreed targets (e.g. amount of POP per unit of sea water, or levels of land based sources of pollutants in marine mammal fatty tissues). There is a need for international regulation, best-practice definition and enforcement of penalties against infringements of point and non-point sources of pollution. Penalties against infringements need to be 'seen' to be enforced.

7.2 International regulation of High Seas extractive industries

a) High Seas fisheries.

There are a number of options available to policy makers to change the future of fisheries. These include reducing quotas, phasing out subsidies, closing fisheries, establishing High Seas marine protected areas (HSMPAs), and improving the enforcement of international fishing regulations (e.g. by increasing budgets and suppressing corruption). International agreements exist which could be built upon to provide a legal basis for future measures (e.g. UNCLOS, UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks). The uptake and implementation of existing FAO International Plans of Action is also a necessity.

Effective monitoring, control and surveillance systems need to be implemented to ensure that vulnerable marine habitats or species are not negatively impacted. Current regimes could be augmented by wider use of vessel monitoring systems, and satellite data (to monitor illegal, unregulated and unreported fishing). Monitoring of High Seas fisheries and progress towards internationally recognised targets could be facilitated with simple indicators (e.g. the number of overexploited stocks versus the number of commercially exploited stocks, accurate catch per unit effort indices, trends in biological parameters etc.).

One of the key types of data necessary to better inform scientists and policy makers is the level of fishing effort. It is therefore essential that international regulations include the provision of fishing effort by companies and nations, and that a system is adopted to standardize these data for global and regional monitoring purposes. These steps are not only necessary to protect target and by-catch species but also to reduce the impacts on vulnerable ecosystems, such as coral reefs.

b) Oil, gas and other extractive industries.

A more holistic approach to High Seas activities is necessary and should be enshrined in international regulation, best-practice definition and enforcement of penalties against infringements. There should be a greater uptake of the ecosystem approach with regard to all activities. Within the best practice guidelines there should penalties for infringements should be 'seen' to be enforced. A priority is to engage the extractive industries in problem solving, to ensure the development of equitable and sustainable processes.

7.3 A representative network of High Seas marine protected areas

In the first instance it will be necessary to develop appropriate legal frameworks for the development of HSMPAs. These agreements should be should be legally binding ('hard' law). Legal processes arising from contraventions of this law could be enacted through existing mechanisms such as the International Tribunal for the Law of the Sea (ITLOS). International agreements exist which could be built upon to provide a legal basis for the future development of HSMPAs (e.g. UNCLOS, The Convention on Biological Diversity and its Jakarta Mandate).

The Regional Seas Conventions could play an important role in providing the framework, mechanism, development and support for the creation of HSMPAs. The scope of application of the Conventions is specified in the original forming treaty, and they often apply both in areas of national jurisdiction and beyond. As a result, State Parties can agree to restrict their own activities on the High Seas.

Careful HSMPA design would allow recent international agreements to be met, for example the CBD CoP7 resolution on the coverage of marine protected areas. However, monitoring progress towards this target would mot simply mean reporting the size and location of the MPA, but also an assessment and recording of the habitat species included. Experience has shown that fishers and their organizations need to be included in the development and some aspects of management (e.g. monitoring) to enable effective and sustainable MPAs to be established. It is important to note that the development of HSMPAs on their own are not adequate to mitigate all of the listed threats and should be used in conjunction with other measures.

7.4 Research needs

Many institutions are actively engaged in research directed to improve understanding of the marine environment and its biodiversity. Many of these manage databases that are listed in **Annex 5** along with their appropriate Internet locators. Research gaps identified by UNEP-WCMC are summarized below.

a) Biological data

Major uncertainties include:

- The distribution of vulnerable habitats and ecosystems (e.g. coral and vent systems);
- Basic systematic information about the majority of benthic organisms,
- The effects of different toxins on marine mammals and other marine fauna;
- The role of microorganisms (and their diversity) in food webs and aspects of biogeochemical cycling;
- The distributions and life cycles of many keystone species;
- The structure and dynamics of most deep-water food webs;
- The biological pathways for contaminants in deep ocean ecosystems;
- How long-term cycles in the physical environment affect midwater and seabed communities and processes;
- The links between biodiversity, productivity and other ecological processes;
- The impact of removing top predators, such as fish, from the oceanic ecosystems; and
- How to distinguish between natural variation and human-generated change.
- The potential impacts of alien invasive species on different High Seas ecosystems.

b) Fisheries data

Fisheries data are often poor and in many fisheries there are incentives to misreport catches. Many of the stocks are migratory, which compounds the problem of designating appropriate reporting areas and interpreting data on catches and landings. On the other hand, few scientific surveys are carried out on even the most regularly caught commercial species, and many of these survey methods are destructive in themselves. Unknowns and uncertainties include:

- Data to evaluate sustainable catch rates for many deep sea species;
- Stock structure and recruitment for many of the multi-species fisheries;
- The environmental impact of fishing techniques on vulnerable deep-sea ecosystems;

- Life histories for many of the exploited species;
- The delimitation of deep-sea stocks - an urgent requirement that will probably need molecular genetic studies;
- Improvements in the reporting of by-catch and discards;
- The increasing interest in the exploitation of deep-sea species for natural products, pharmaceuticals;
- The potential impacts of alien invasive species on different fishery species; and
- The impact of over-fishing on the genetic diversity of target and by-catch species.

8. The Role of UNEP-WCMC and its Partners

Limited knowledge of the distribution of marine species and habitats, and the impact of human activities on High Seas biodiversity, prevents accurate risk assessment and the prioritization of management interventions. UNEP-WCMC's role is to encourage and enable the acquisition, organization and sharing of information, and the discovery of meaningful patterns that can support the international community in its efforts to negotiate binding agreements and best-practice guidelines for all activities that impact the High Seas and the components of biodiversity therein. Our suggested priorities, plan of work, and links of collaboration with others are as follows.

UNEP-WCMC Marine and Coastal Programme is proposing to integrate its in-house marine species and habitat datasets with data on the distribution of High Seas species and critical habitats including seamounts. Using global, spatially-referenced fisheries data from the University of British Columbia to ascertain the distribution of fisheries gear and working closely with the FAO's gear technology unit to understand the potential impacts of gear types, UNEP-WCMC will produce tools to facilitate the identification of candidate High Seas Marine Protected Areas. The major outputs would be to produce:

- Internet-accessible datasets and maps of habitat distribution (corals, seamounts, thermal vents etc.) that can be used in research programmes and private sector planning activities. This would allow for the production of large-scale maps that will reveal patterns of biodiversity and endemism on seamounts and other critical habitats; and
- a report on the spatial distribution patterns of marine biodiversity in relation to critical underwater habitats. This would facilitate the prioritization of regions / locations as candidates for High Seas Marine Protected Areas.

UNEP Coral Reef Unit: The CRU is currently producing a report on deep-water and cold-water coral ecosystems. This will include the most up-to-date and comprehensive compilation of known deep-water coral reef locations world-wide, and will provide justification for action. It is already clear that such reefs suffer from anthropogenic impact (such as trawling, mining and cable-laying), but are also susceptible to natural or longer-term changes and fluctuations in environmental conditions (e.g. currents, nutrient supply, etc., often effected by climate change and shore-based pollution). A systematic approach is also needed to identify, assess and evaluate the state and threats of marine habitats in areas beyond national jurisdiction. Here, the Regional Sea Conventions could play an important role – for example, Contracting Parties under the OSPAR Convention have developed criteria for selection of species and habitats, and have applied these in listing threatened and declining species and habitats in the NE Atlantic. show case examples) of the known state and threats of this ecosystem.

International Coral Reef Action Network: As an operational network of the International Coral Reef Initiative (ICRI), ICRAN's mandate is to implement ICRI's Framework for Action. It is concerned with the conservation and management of coral reef ecosystems and their importance to the livelihoods of coastal communities. Therefore, under circumstances where coral reef and associated ecosystems are located in areas beyond national jurisdiction ICRAN and its partnership would advocate the responsible management of these systems.

Annex 1: Divisions of the marine environment.

The marine environment can be divided into **benthic** and **pelagic** components. The benthic environment is the bottom of the ocean, and most species of marine organisms live on or in the seafloor. the pelagic environment includes the ocean water itself. In the pelagic environment are two percent of the total number of marine species; these organisms either float or swim. The pelagic environment can be divided into two zones:

a) The neritic zone extends from the water edge outward to the point where water depth is 200 m.(660 ft). The outer boundary is close to the edge of the continental shelf. Seaward of that boundary is the oceanic province which includes all the water from surface to bottom of most of the ocean volume. The neritic zone includes high biomass shallow waters; they receive large amounts of sunlight as well as abundant nutrients from coastal upwelling or from land sources. This zone is subject to the set of circumstances that affect the coastal ocean.

b) The oceanic zone has been subdivided into a number of subunits on the basis of depth and light penetration, as follows:

- **Light penetration**:
  - Euphotic - top 100 m or less; good light penetration; photosynthesis.
  - Disphotic – 100 to 1,000 m. A tiny amount of light is measurable, but little or no photosynthesis is possible.
  - Aphotic – 1,000 m and deeper, no light.
- **Depth**:
  - Epipelagic - Surface to 200 m; includes the euphotic zone. Near the base of this zone the oxygen content begins to decrease downward and nutrient levels increase downward.
  - Mesopelagic – 200 to 1,000 m; includes O2 minimum water and very high nutrient levels. Essentially no light but some fish with very large eyes may be able to detect some. Inhabited by bioluminescent organisms. Deep scattering layer
  - Bathypelagic –1,000 to 4,000 m
  - Abyssopelagic – 4,000 to 6,000 m. These two zones contain 75% of the water in the ocean. There is no light. Most of the life forms are bacteria or predators.

Annex 2: Status and spatial patterns of biodiversity on the High Seas.

Today it is thought possible that there are more species in the deep sea than in all the other environments on Earth combined. The previously unsuspected high diversity of the deep-sea floor was first revealed in the late 1960s, and remains a major focus for current deep-sea research. In addition to the discoveries of high species richness, more-recent 'mapping' studies are revealing a wealth of different habitats in the deep sea. It is only 25 years since the startling discovery of deep-sea hydrothermal vents and the exotic biological communities that surround them.

The deep-sea environment remains rather poorly studied and understood, however - only some 0.0001 % of the deep-sea floor has been subject to biological investigations. The situation is little better in the rather more accessible upper water column of the open ocean. Major, fundamental discoveries continue to be made, for example: unexpectedly high levels of primary production, the discovery of the pico- and nano-plankton and the prochlorophytes, microscopic plants which are now thought to contribute almost as much to primary production in some regions as all previously known primary producers combined.

Studies of diversity in pelagic communities have revealed some consistent trends related to depth and latitude. The number of pelagic species in the total water column increases from high to low latitudes. The number of species present also increases to a maximum at around 1000m and slowly declines to greater depths. The relatively species poor assemblages that occur at high latitudes tend to be dominated by a very few species. As one moves towards lower latitudes the number of species increases but the dominance decreases. The same trend occurs with increasing depth, at least to a depth of 1000m. However, these trends run counter to the trends on productivity. Where productivity is higher, for example where there is upwelling- the assemblages become less species rich and the dominance by few species increases.

Fewer data are available for the benthic systems, especially for depth of 3km or more. What trend data there are often varies considerably by taxa and depends on the basin that is under scrutiny. The general rule of thumb is that the actual numbers of species and the number of specimens actually decrease with decline at depths below 1-2 km. A detailed study of animals on the deep-sea floor off the eastern United States led to predictions that the global deep-sea floor alone might harbour several million species. Currently it is estimated that approximately 98% of known species are benthic.

Annex 3: Threats to High Seas Species and Habitats

The past 50 years have seen tremendous advances in the marine biological sciences. Research was stimulated initially by basic questions - the functioning of the sea, relationships with climate conditions and life processes - followed by the need to solve applied problems related to food production, conservation and the impacts of mining, climate change and pollution. Most research has concentrated on coastal and offshore waters; research on the High Seas - including the deep sea - has been far more limited. However, the deep sea is increasingly subject to anthropogenic impacts: nuclear waste dumping and fishing. The spread of fisheries into the deep sea has undoubtedly had the greatest ecological impact to date, both on the target species and on marine habitats and communities generally through disturbance and by-catch. The following section describes some of the major threats to biodiversity on the High Seas. It is not intended to be an exhaustive list but rather a brief description of the anthropogenic pressures that may impact on the key species and habitats. Refer to Appendix: 3 for a list of some of the research initiatives currently underway.

a) Alien species

The primary means of prevention of ballast-mediated aquatic invasives is through exchange of ballast water on the High Seas. At present mid-ocean ballast water exchange remains the primary treatment option recommended for international ship traffic. In most parts of the world ballast water exchange is still on a voluntary basis, but some countries are considering the possibility of a mandatory approach. Whereas numbers of individuals in some taxonomic groups were drastically reduced by water ballast exchange, others groups were not significantly affected. Given the potential high biodiversity coupled with the very restricted understanding of the High Seas, this raises the question of what could be the potential impacts of such a recommendation. It has not been possible to identify evidence of such research at this stage, although it is perhaps a question that should be asked.

b) Cable-laying activities

The cables may come to rest on hard bottoms, sink into softer substrates or be ploughed into deeper layers. The local impact remains limited, and even the ploughing effects of the sediment turnover, and blanketing effects a path no more than a few metres wide. Disturbed areas are recolonized relatively quickly.

c) Litter

Despite regulations controlling the disposal of litter at sea, considerable quantities are still observed at sea and washed up on beaches. There are many records of turtles, whales and large fish being entangled in pieces of fishing line or being choked by plastic. While such mortalities are probably a relatively small supplement to those resulting from other activities, they are avoidable and are contributing to the population declines of some species, such as turtles.

d) Shipping

Currently activities associated with shipping are not of high concern. Considerable advances in reducing discharges have been achieved through MARPOL. Losses of vessels at sea have neither declined nor increased, despite marked increases in the sizes of ships and in the volumes of goods and bulk cargoes being transported, and are also more likely to occur inshore than offshore. The volume of ship movements are likely to continue to increase as global population increases.

e) Pollutants

Many of the anthropogenic substances now being manufactured by industry, do not occur naturally in the environment. These synthetic compounds are often specifically selected for manufacture because they are both persistent and highly toxic to biota. The introduction of such substances into the marine environment seldom has predictable results, especially those (e.g. PCBs) that readily dissolve in lipids (i.e. are lipophilic). These tend to accumulate within body tissues and tissue concentrations tend to increase along food chains (i.e. they are biomagnified). Some of these compounds are highly specific in their toxicity (e.g. the effects of TBTs on molluscs), but by removing specific groups of organisms they disturb food webs and disrupt ecosystem structure. Recent evidence indicates that a wide variety of these substances can also disrupt the functioning of hormonal systems (endocrine disruption). Table 1 summarizes the toxicological effects of a selection of these substances.

Heavy metals. Compared to terrestrial ecosystems, oceanic food chains tend to have more links and cross links, which means that even under pristine conditions top predators and some detritivores naturally accumulate higher concentrations of heavy metals. Enhancement of these naturally high levels by anthropogenically-derived contaminants may have two widely differing outcomes: firstly those species with a high tolerance are unlikely to be affected by the anthropogenic increases, as is clearly the case for species living in the vicinity of hydrothermal vents, while secondly, for species living close to the limits of their physiological tolerance, particularly at certain stages in their life cycles, quite small anthropogenic supplements may cause severe physiological stress. Considerable reductions in anthropogenic inputs of heavy metals have already been achieved through abandonment of ocean dumping and the implementation of MARPOL regulations. While progress in these activities should be maintained, greater emphasis should be placed on reducing atmospheric inputs. Priority should be given to reducing mercury inputs and to the identification of the major anthropogenic sources.

Polychlorinated biphenyls. Concentrations of PCBs in oceanic fauna are low relative to those observed in biota from heavily contaminated inshore environments. High, but very variable, concentrations of PCBs and organochlorine compounds have been identified in whales. Any measures that successfully reduce inputs and concentrations in inshore environments, will also reduce concentrations in the open ocean. Current limitations on the manufacture of PCBs should be extended and greater consideration should be given to the destruction, both of PCBs in storage and PCBs still in use.

Polycyclic aromatic hydrocarbons. The vulnerability of organisms to PAHs often increases at certain stages of the life cycle and fecundity may be reduced. With the extension of the hydrocarbon industry into deep sea environments, concentrations of certain PAHs can be expected to increase locally unless careful controls are placed on their release. The impact of these substances on species from the shelf seas ranges from interference with immune systems, to the mimicking and disruption of hormonal functions, to direct toxic effects.

Other persistent organic contaminants. Traces of persistent organic contaminants are ubiquitous in all compartments of the deep ocean ecosystems. However, as many of these compounds are uniquely anthropogenic their source must be human activities. It is suspected that high concentrations of some persistent organic contaminants could be leading to pathological responses, for example through the depression of immune response.

Radionuclides. The impact of radionuclides on oceanic environments continues to be of considerable concern to many countries. Most of the inputs have resulted from the testing of nuclear weapons, the dumping of wastes in deep water, the floundering of nuclear warships, accidents during transportation and discharges from coastal installations. The majority of these inputs have been drastically reduced. Monitoring has focused on the spread of contaminants from these sources; there have been no studies on their in situ impacts on biological communities. While there is evidence for slight leakage leading to contamination of biota (but not sediments) particularly detritivores, there must be concern as to the long-term impact of these sources.

Carbon dioxide (CO_2). One of the options for storing CO_2 (a greenhouse gas) is in the deep sea. It is possible to dispose of it in different in several different states (gaseous, liquid or solid) depending on the depth and temperature of the water. All three may pose severe localized disruption to the local environment and any species that may come into contact with it.

Table 1: A summary of the toxicological effects of a range of contaminants occurring in the ocean environment.

CONTAMINANT	EFFECT
Mercury	Nerve toxin, particularly damaging to developing young. Reduces plant growth. Damages gills and disrupts gut absorption and chemoreception in fish. Strongly bioaccumulative.
Cadmium	Affects growth and larval development. Upsets ionic control and calcium metabolism in fish. Accumulates in kidneys and liver of higher animals and disrupts calcium and vitamin D metabolism.
Lead	Damages central nervous system, particularly when the brain is growing. Accumulates in the gills, liver and kidneys of fish and reduces larval survival.
Polychlorinated biphenyls	Highly accumulative. Effects depend on chemical structure; co-planar forms are most toxic. Generally immunosuppresive, some are carcinogens and/or hormone disruptors.
Dioxins and furans	Carcinogenic. Immunosuppressive. Disrupt reproduction. Generally more toxic then co-planar PCBs.
Hexachlorobenzenes	Inhibit haem synthesis and cause porphyria. Brominated flame retardants Toxicity not understood.
DDT	Hormone disruptor. Affects liver enzymes. Causes eggshell thinning in birds.
Toxaphenes	Affect nervous system, particularly in fish that become hyperactive and loose balance control.
Chlordane	Neurotoxic. Carcinogenic. Disrupts immune and reproductive system.
Dieldrin	Carcinogenic. Mirex Affects reproduction and induces cancers in laboratory animals.
Tributyltin	Hormone disruptor, particularly in gastropod molluscs.
Polycyclic aromatic hydrocarbons	Wide range of substances, some are carcinogenic and/or mutagenic.

f) Exploitation of marine resources

The High Seas and deep water areas of the world's oceans harbour living and non-living resources. There has been growing pressure on these resources as fishing fleets increasingly move to the High Seas and extractive industries develop technologies that will enable profitable exploitation of these areas.

Seafloor drilling. Oil and gas drilling. Regular impacts by drilling are introduced into the sea by the discharges of drill cuttings and production water. Recent studies have demonstrated that communities are disrupted up to 750 m from the platform and diversity only appears normal after 1500 - 3000m from the platform. Contamination can spread 2 to 6 km from the platform after 6-9 years.

High Seas Fisheries. Open ocean fishes, especially those inhabiting deep water tend to be vulnerable to overexploitation, because they are at the ends of long food chains, are slow growing and have low fecundities. Evidence is beginning to emerge that the sorts of mechanical damage being inflicted upon benthic habitats and communities by trawling is also being inflicted on some of the deeper ecosystems. The initial indications are that these impacts may not only be quite extensive already but may also be more persistent. Several core samples and seabed photographs have shown clear signs of disturbance, including plough marks, the burial of sponges, strong odours of hydrogen sulphide and snagged nets. There are no data specific to the Atlantic that indicate how long the scars from trawling persist in deeper water, but in the Pacific an experiment was conducted to investigate the impact of possible seabed mining. This experiment showed that plough marks were still clearly visible after seven years and that the macrofaunal populations still showed clear signs of perturbation.

The technical challenges posed by the exploitation of deepwater stocks means that they tend to be fished once other more accessible stocks no longer provide adequate returns, either because of over fishing or because quotas have been filled. Thus fishing for the deeper-living species tends to be more intermittent, less predictable and so less manageable than shallow-living stocks. Deep-living fish assemblages are highly diverse and there are markets for only a few of the species. Hence by-catches and discard rates tend to be high. Recent research has shown that fisheries targetting predatory species have been severely effected over the last few decades. For example, scientists have shown that the abundance of top predators, such as halibut, cod and sharks, in the North Atlantic have decreased by two-thirds over the last 50 years.

The main problems associated in the governance of these stocks is that not all nations comply or have acceded to the 1995 "Agreement For the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks". There are also High Seas fish stocks that are neither highly migratory nor straddling and which remain under conditions of open access, as they are not formally covered by the 1995 UN Fish Stocks Agreement. Although this problem pertains to a very small percentage of the total global marine catch, it should not be considered minor from a biodiversity perspective. Unless the problem is addressed the fate of these stocks is no different to that of any others that lack adequate management.

g) Climate change

While there are close linkages between benthic, pelagic and climatic processes, it is difficult to predict the impact of climate change on deep-sea benthic ecosystems. We can be certain, however, that regional changes in primary production will alter standing stocks in the food-limited, deep-sea benthic ecosystem lying far below. Species ranges and deep-sea patterns of biodiversity may also be altered.

Annex 4: Key Vulnerable High Seas Species and Habitats.

The following is not a complete list of all the habitats in the High Seas and deep water regions (e.g. it does not include the abyssal plain areas) but is a brief description of the status and major threats to key species and habitats.

Table 2: Overview of the habitats present within High Seas areas outside of the jurisdiction of individual states, the potential threats to those resources, and zonal extent of protection at which legislation may be aimed.

CRITICAL HABITATS / SPECIES	DESCRIPTION / STATUS	DISTRIBUTION AND ASSOCIATED SPECIES	THREATS / PRESSURES
1. Hydrothermal vents	Highly localized sites of high temperature fluid-escape from the seabed	Typically located on mid-ocean ridges (10s known, 100s suspected). Typically support abundant biological populations, fuelled by chemosynthesis. Highly specialized fauna, of relatively low diversity, but high endemism. Ephemeral communities are ephemeral (10s of years).	Subject of intensive scientific study – an actual threat. Considerable biotechnology potential– a potential threat. Interest in commercial resource (ores and energy) exploitation – a potential threat.
2. Seamounts	Undersea mountains of volcanic / tectonic origin	May interact with upper water column (e.g. enhancing surface ocean productivity). Found in all ocean, 30-40,000 known. Tops and upper flanks of seamounts may be biological 'hot spots'. Hard substrate suspension feeding communities (sponges, corals etc) may be common. Potentially high species diversity and endemism. May act as 'stepping stones' for transoceanic dispersal of species. Fish and seabird populations may be enhanced over	Considerable commercial fishing – an actual threat. Interest in commercial resource (ores) exploitation – a potential threat.

		seamounts.	
3. Deep-sea trenches	Geological features.	Few in number (37), but up to 1,000s of kilometres in length. Most lie within EEZs. Largely endemic fauna, adapted to extreme hydrostatic pressure.	Interest in biotechnology potential – a potential threat. Interest in use as waste disposal sites – a potential threat. Significant potential for direct influence from terrestrial pollutants – a potential threat.
4. Deep-sea 'coral reefs'	Several species (e.g. Lophelia pertusa) of deep-sea coral are capable of forming 'reefs'	They are widely distributed in the world's oceans, from 10s to 1,000s m water depth. Occur in wide variety of environmental settings. They vary in size from individual colonies (10s cm) to extended patch-reefs of 10 km extent. Provide habitat for high diversity of associated species (few or no obligate associates known).	Extensive damage by commercial trawling evident – an actual threat. Deep-water oil exploitation within areas of known occurrence – an actual threat. Interest in biotechnology potential – a potential threat.
5. Cold seeps and pockmarks	Highly localized sites of low temperature fluid escape from the seabed	Occur in a wide variety of physiographic and geological settings. Typically support abundant biological populations, fuelled by chemosynthesis. Highly specialized fauna, of relatively low diversity, but high endemism. Seeps and their communities may be ephemeral.	Pelagic fisheries /shipping lanes / geological features.
6. Gas hydrates	These are frozen methane gas deposits:	Probably abundant and widespread in deep-sea environments. Associated fauna little known.	Interest in biotechnology potential – a potential threat. Considerable interest in direct exploitation – a potential threat.
7. Submarine canyons	Common deep-sea features that cut across continental slopes	They influence local bottom water flows and may acts as traps for organic matter.	Commercial fishing (trap and long-line) may be important – and actual threat.

		They may be biological 'hot spots' with enhanced benthic populations. Fish (and possibly cetacean) populations may also be enhanced.	Significant potential for direct influence from terrestrial pollutants – a potential threat.
8. Seabirds	ca. 22% of the world's seabird species are "threatened" species Many seabirds have low reproductive rates; they are sensitive to additional sources of mortality	Distributed through out the High Seas.	Pelagic and demersal long-lining fisheries are the largest threat to seabirds. Changes in long-lining methods and better regulation may reduce seabird casualties.
9. Cetaceans	Many whale populations have failed to recover despite many years of protection	Distributed through out the High Seas. Some species migrate thousands of miles during their lifetime.	Whale mortalities arise mainly from commercial whaling and fishing .

Annex 5: Current research

DATABASE	DESCRIPTION	URL (30 APR 2004)
Deep Sea Floor Image Database System	Japan Marine Science & Technology Center has collected precious image data of deep sea floor over 250,000 to investigation of deep sea floor by the manned submersible survey vessels, "Shinkai 2000" and "Shinkai 6500",the remote controlled unmanned exploration system, "Dolphin 3K" and the towed deep sea exploration system "Deep Tow Camera". We expect that the number of precious image data, for example video or photography which this center only obtains will increase at the rate of many thousands. The deep sea floor image database system organizes many precious image data on database and it is possible to entry and search the data by simple operations in this system.	http://www.jamstec.go.jp/jamstec/2k.html http://www.jamstec.go.jp/jamstec-e/index-e.html
Ocean Floor databases	The Ridge Multibeam Synthesis is a compilation of multibeam bathymetry data, digital elevation models, and shaded relief images of the seafloor from the world's mid-ocean ridges. This effort is funded by the Marine Geology and Geophysics program out of the Ocean Sciences Division of the National Science Foundation. The primary focus of this data synthesis is to provide open access over the Internet to multibeam bathymetry data collected during scientific research expeditions seeking to understand crustal creation in the deep oceans. The morphology of the seabed at spreading centers represents the superficial record of the fundamental processes of magmatic construction and tectonic disruption which contribute to crustal formation. Bathymetry data also provide an essential integrating framework for interdisciplinary research as basemaps for other physical, biological, and chemical oceanographic studies. Many of the datasets within this compilation were acquired with the support of the RIDGE and now RIDGE200/) programs of the NSF.	http://ocean-ridge.ldeo.columbia.edu/
Evaluation of Sub-Sea Physical Environmental Data for the Beaufort Sea OCS and Incorporation into a Geographic Information System (GIS) Database	The contractor will interpret all available geophysical survey data, geologic data sets, and data from site-specific survey reports for the Beaufort Sea OCS and from Liberty and Northstar pipeline survey projects. This information will be incorporated into a GIS database. Data sets will be created for ice gouging, strudel scour, and other surface and sub-bottom features, including a important marine habitat (i.e., the Boulder Patch) and high profile features of archeological importance.	

Gulf of Mexico GLORIA mapping program	In the late summer and fall of 1985, the USGS conducted surveys of the Exclusive Economic Zone (EEZ) in the Gulf of Mexico and around Puerto Rico and the U.S. Virgin Islands. The 1985 survey abutted an area surveyed in 1982 as part of the Outer Continental shelf geohazards work that focused on the Texas-Louisiana continental slope and preliminary work for the Deep Sea Drilling Project in the Mississippi Fan. The collected GLORIA data was processed and digitally mosaiced to produce continuous imagery of the seafloor. The 1982 and 1985 datasets were combined to produce sidescan coverage of the EEZ in the Gulf of Mexico. A total of 16 digital mosaics of a 2degree by 2degree (or smaller) area with a 50meter pixel resolution were completed for the Gulf of Mexico. The individual mosaics were later combined to produce an overview of the Gulf of Mexico. A reduced version of the completed digital mosaic of the Gulf of Mexico is provided here.	http://coastalmap.marine.usgs.gov/gloria/eastcst/
Petrological Database of the Ocean Floor (PETDB)	A searchable petrologic and chemical database for ocean floor basalts	http://petdb.ldeo.columbia.edu/petdb/
GEOROC	Published chemical and isotopic data as well as extensive "metadata" for rocks, minerals and melt/fluid inclusions including igneous rocks from oceanic islands and large igneous provinces (seamounts, oceanic plateaus, submarine ridges, and oceanic and continental flood basalts)	http://georoc.mpch-mainz.gwdg.de/Start.asp
National Geophysical Data Center	NGDC manages all types of data from the ocean floor. Bathymetry, topography, and global relief imagery. Contains: (a) **Geophysical data** on bathymetry, gravity, magnetics, and sub-bottom profiles (single-channel and multi-channel) collected on thousands of oceanographic surveys covering millions of km from the world's oceans, all searchable online. NGDC also manages sidescan sonar image data; (b) **Geologic data**, with descriptions and analyses of over one hundred thousand seafloor and lakebed cores, grabs, dredges, and drill samples worldwide. Data include an index to marine and lacustrine geological samples, data from international ocean drilling, a marine minerals bibliography and geochemical database, grain size, gridded total sediment thickness data, and other data files; (c) **Bathymetry & Relief** information, including marine trackline and multibeam data, gridded global relief and coastal relief models for the US, hydrographic surveys of US waters, bathymetry of the Great Lakes, estimated depths from satellite altimetry, and digital coastlines. NGDC operates the World Data Center for Marine Geology & Geophysics,	http://www.ngdc.noaa.gov/mgg/mggd.html http://www.ngdc.noaa.gov/mgg/geology/geologydata.html

	Boulder, the International Hydrographic Organization Data Center for Digital Bathymetry, and participates in numerous cooperative programs, including multiple international mapping projects	
Vents Programme	Contains data and information about acoustic monitoring, chemical oceanography, geology/geohysics, hydrothermal plume studies, modeling and physical oceanography. Has various interactive sub webpages with maps and data.	http://www.pmel.noaa.gov/vents/
National Data Buoy Center	Hourly observations from a network of about 60 buoys and 60 C-MAN stations that measure wind speed, direction, and gust; barometric pressure; and air temperature	http://www.ndbc.noaa.gov/
NOAA Center for Operational Oceanographic Products and Services	Historical and real-time observations and predictions of water levels, coastal currents and other meteorological and oceanographic data	http://co-ops.nos.noaa.gov/
National Center for Atmospheric Research Selected Data for Oceanic Research	COADS Data Set, sea surface temperature, surface wind and wind stress, air-sea heat budgets, ocean depth and land elevation, buoy data, sea ice and remote sensing data	http://dss.ucar.edu/catalogs/oceanlists/ocean_by_category.html
Fleet Numerical Meteorology and Oceanography Center	Automated numerical meteorological and oceanographic (METOC) analyses and predictions.	https://www.fnmoc.navy.mil/
GOOS	GOOS is a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. GOOS will provide accurate descriptions of the present state of the oceans, including living resources; continuous forecasts of the future conditions of the sea for as far ahead as possible; and the basis for forecasts of climate change.	http://ioc.unesco.org/goos/
Array for Real-time Geostrophic Oceanography (Argo)	Argo is a global array of 3,000 free-drifting profiling floats that will measure the temperature and salinity of the upper 2000 m of the ocean. This will allow continuous monitoring of the climate state of the ocean, with all data being relayed and made publicly available within hours after collection	http://www-argo.ucsd.edu/ http://argo.jcommops.org/
Australian Oceanographic Data Centre	The national data centre for the acquisition, archival and management of physical oceanographic data in Australia	http://www.aodc.gov.au/
British Oceanographic Data Centre	Contains ocean metadata, cruise information and datasets, online datasystems and inventory searches.	http://www.bodc.ac.uk/
Canada Marine Environmental Data	Physical, chemical and biological oceanographic observations reported in daily	http://www.meds-sdmm.dfo-

Service	and historical time frames; national contacts for biological databases within DFO; hyperlinks to regional web sites for satellite data and products within DFO and regional web sites for time series data and products; the National Contaminants Information System; and environmental observations (ex. winds, ice, etc.) from historical offshore oil and gas sites	mpo.gc.ca/meds/Home_e.htm
TMSI/IDM/SISMER	Related oceanographic information: Catalogues, information and data request forms, and hyperlinks to other data sources	http://www.ifremer.fr/sismer/sommaire_e.html
Marine Information Service (MARIS), Netherlands	North sea research projects (oceanography, biology, hydrography, geology, chemistry, meteorology) Offshore oil and gas activities, sand and gravel extraction, and a European directory of marine Environmental Data	http://www.maris.nl/frames.asp?databases.htm
Deutsches Ozeanographisches	Marine Environmental Database, North Sea and Baltic Sea by 1° rectangles Atlantic Ocean by 10° rectangles, stations of the Baltic Monitoring Programme, cruise inventories and North Sea oil spill information	http://www.bsh.de/Oceanography/DOD/DOD.htm http://www.bsh.de/en/Toolbox/Help/index.jsp
Japan Oceanographic Data Center	Temperature, salinity, ocean current, tidal and moored current data	http://www.jodc.go.jp/aboutJODC_work_data.html
NASA Physical Oceanography Distributed Active Archive Center	Primarily remote sensing data on atmospheric moisture, heat flux, collections, ocean wind, sea surface height, sea surface temperature, and tide models	http://podaac.jpl.nasa.gov/
SADCO - South African Data Centre for Oceanography	Hydrographic station and surface data from the southern African coastline, as well as the wider Atlantic, Indian and Southern Oceans	
United States National Oceanographic Data Center	Physical, chemical, and biological oceanographic data collected by U.S. Federal agencies, including the Department of Defense (primarily the U.S. Navy); State, and local government agencies; universities and research institutions; and private industry. Contains many interesting databases such as world ocean database and atlas 2001. See web link for individual datasets. Also contains: (a) Vol.5 Russian Marine Expeditionary Investigations Of The World Ocean Pdf (8.4 Kb) (b) Vol. 3 Hydrochemical Atlas Of The Sea Of Okhotsk; (c) Online Data ; (d) Vol. 2 Biological Atlas Of The Arctic Seas 2000: Plankton Of The Barents And Kara Seas Online Data; and (e) Vol. 1 Climatic Atlas Of The Barents Sea 1998	http://www.nodc.noaa.gov/ Plankton database: http://www.nodc.noaa.gov/OC5/RESEARCH/PLANKTON/plankton.html

The University of Hawaii Sea Level Center (UHSLC)	In-situ tide gauge data from around the world in support of climate research	http://uhslc.soest.hawaii.edu/uhslc/data.html
ESONET	The objective is to produce a practical plan for long term monitoring of the ocean margin environment around Europe as part of GMES (Global Monitoring for Environment and Security) with capability in geophysics, geotechnics, chemistry, biochemistry oceanography, biology and fisheries. ESONET will be complementary to oceanographic networks such as GOOS, (Global Ocean Observing System) EuroGOOS, DEOS (Dynamics of Earth and Ocean Systems) and will work with industries who are deploying sea floor cable networks. ESONET will be multidisciplinary, with stations monitoring the rocks, sediments, bottom water, biology and events in the water column. Both long-term data collection and alarm capability in the event of hazards (e.g. earthquakes) will be considered.	http://www.abdn.ac.uk/ecosystem/esonet/index2.htm
EUROCORE	Concerted action within the framework of the EC-DGXII Marine Science & Technology Program (MAST). EUROCORE addresses a fundamental problem relating to marine sample data management within Europe and will enable, and streamline, exploitation of an important, existing raw data resource - the very large number of sediment cores collected by, and stored at, European research centres, universities and core repositories. After they have served the primary data requirement for which they were collected, seafloor samples are normally stored in controlled environments for further use	http://www.maris.nl/eurocore.htm www.eu-seased.net
ChEss, Biogeography of Deep-Water Chemosynthetic Ecosystems	One of the aims of ChEss is to create a web-based database (ChEssBase) for all species from deep-water hydrothermal vents and cold seeps. The information will be obtained by both literature research and participation of laboratories, institutions andresearchers willing to include their vent and seep data. ChEssBase will be a dynamic relational database. ChEssBase will be geo- and bio-referenced and will be available in the ChEss web site and through OBIS. At the biological level, the database will provide taxonomical, biological, ecological and distributional information, including photographies, video, references, links to specific data (quantitative samples, cruises) and scientific contacts in a user-friendly interphase. At the geographical level, the database will include information on the location of vent and seep sites, general characteristics of the sites, faunal community description and references.	http://www.soc.soton.ac.uk/chess/database.html

SeamountsOnline	The SeamountsOnline database is designed to hold records of species of all metazoan types that have been found on seamounts globally. The data held within this system are primarily from published literature, with a few electronic data sets that have been provided by researchers. This is a work in progress, with new data being added periodically - please see the Data Contents page for more information and a description of the current holdings.	http://seamounts.sdsc.edu/
Marine zones	Database containing shapefiles of offshore and high seas marine zones	http://www.nws.noaa.gov/geodata/catalog/wsom/html/marinezones.htm
High Seas Salmon	The High Seas Salmon Research Program has accumulated a number of sets of data. Our data come from US salmon tagging and research cruises in the North Pacific Ocean and Bering Sea, cooperative tagging and research cruises with Canadian, Japanese, and Russian fishery agencies, measurements of salmon scales for stock identification and growth studies, examination of salmon stomach contents carried out aboard Japanese research vessels, and salmon research cruises of the former Bureau of Commercial Fisheries, predecessor to the US National Marine Fisheries Service. We also maintain the high-seas tag release and recovery databases for the NPAFC (these data are jointly controlled by the national sections of NPAFC). We hope to provide some of our data sets through this page in the future.	http://www.fish.washington.edu/research/highseas/research.html#data
Ocean Optics	The Worldwide Ocean Optics Database is a collection of several hundred ocean optics data sets gathered over time that encompass much of the world's oceans. Because WOOD is comprised of so many different data sets, multiple parameters are available, gathered by many different instruments, and possesing varying levels of quality and editing. Because numerical representation of all data in the database is quickest and easiest, all of this "metadata" is stored as numerical codes by the database.	http://wood.jhuapl.edu/
MAR-ECO	MAR-ECO is one of the ongoing CoML field projects and its overriding aim is to describe and understand the patterns of distribution, abundance and trophic relationships of the organisms inhabiting the mid-oceanic North Atlantic, and identify and model ecological processes that cause variability in these patterns. The project focuses on pelagic, benthopelagic and epibenthic macrofauna, and analyse distribution and abundance patterns in relation to the abiotic and biotic environment, as well as trophic relationships and life history strategies. Fish,	http://www.efan.no/midatlcensus/

	crustaceans, cephalopods and gelatinous plankton and nekton have the highest priority in the study.	
MarLIN	MarLIN will: (a) provide a structure for linking available data on marine life around Britain and Ireland; (b) improve the access, display and interpretation of information in support of environmental management, protection and education.; and (c) be the most comprehensive and easily used source of information about marine habitats, communities and species around Britain and Ireland and their sensitivity to natural events and human activities.	http://www.marlin.ac.uk/
CPR	The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is an international charity registered in the UK, that operates the Continuous Plankton Recorder (CPR) survey. The Foundation has been collecting data from the North Atlantic and the North Sea on biogeography and ecology of plankton since 1931. The CPR database currently contains information for 185902 samples with 2198052 plankton entries (every second sample analyzed yet all preserved).	http://www.sahfos.org/
Azores database	Most relevant databases are geo-referenced distribution of coastal habitats and species of Nature 2000 sites; mesopelagic fishes of the North-eastern Atlantic Region, based on data from museum collections mining and recent cruises (334 stations); marine mammals, based on annual acoustic and visual census and fisheries observers programs; tuna, based on fisheries observers programs; sea-birds and breeding colonies, based on annual census and fisheries observers programs; sea-turtles based on annual census, fisheries observers programs and standard tagging and satellite tracking; coastal fishes, based on visual census; demersal and seamount fishes, based on fisheries cruises; and sets of images for ocean color and temperature analysis within physics oceanography. Main habitats and ecosystems covered are: open-ocean; seamounts and banks; coastal areas (intertidal and subtidal); hydrothermal vents (both shallow and deep sea).	http://www.horta.uac.pt/
BATS zooplankton	We are developing a multi-species inventory of zooplankton and micronekton at the Bermuda Atlantic Time-Series Study (BATS) station, a 13-year, ongoing oceanographic time series situated in the western North Atlantic subtropical gyre, or Sargasso Sea.	http://www.vims.edu/bio/zooplankton/BATS/
CephBase	CephBase is a dynamic relational database-driven web site. The purpose of CephBase is to provide taxonomic data, life history, distribution, images, videos, references and scientific contact information on all living species of cephalopods	http://www.cephbase.utmb.edu/

	(octopus, squid, cuttlefish and nautilus) in an easy to access, user-friendly manner.	
Global Ballast	Global ballast assessment unit of the IMO is currently looking at the impacts of invasive alien species on the marine environment	http://globallast.imo.org
Census on Marine Life	The Census of Marine Life (CoML) is a ten-year international research program with the goal of assessing and explaining the diversity, distribution and abundance of marine organisms throughout the world's oceans. The emphasis of the program is field studies, which are to be conducted in poorly known habitats as well as those assumed to be well known. In both coastal and deep waters, projects will identify new organisms and collect new information on ocean life.	http://www.coreocean.org/
OBIS SEAMAP	As part of the Ocean Biogeographic Information System (OBIS), a group of investigators, led by Andrew Read of Duke University, will create a digital database of marine mammal, seabird, and sea turtle distribution and abundance. Partners with Duke include UC San Diego, University of Washington, College of the Atlantic, St. Andrews University, British Antarctic Survey, SAHFOS, NMFS Southeast Fisheries Center, and several industries. The web-based system will allow the interactive display, query, and analysis of Digital Archive in conjunction with environmental data. Goals include: (a) facilitating study of potential impacts on threatened species; (b) enhancing our ability to test hypothesis about biogeographic and biodiversity models; (c) supporting modeling efforts to predict distribution changes in response to environmental change; and (d) develop a strong public outreach component	http://obismap.env.duke.edu/data/