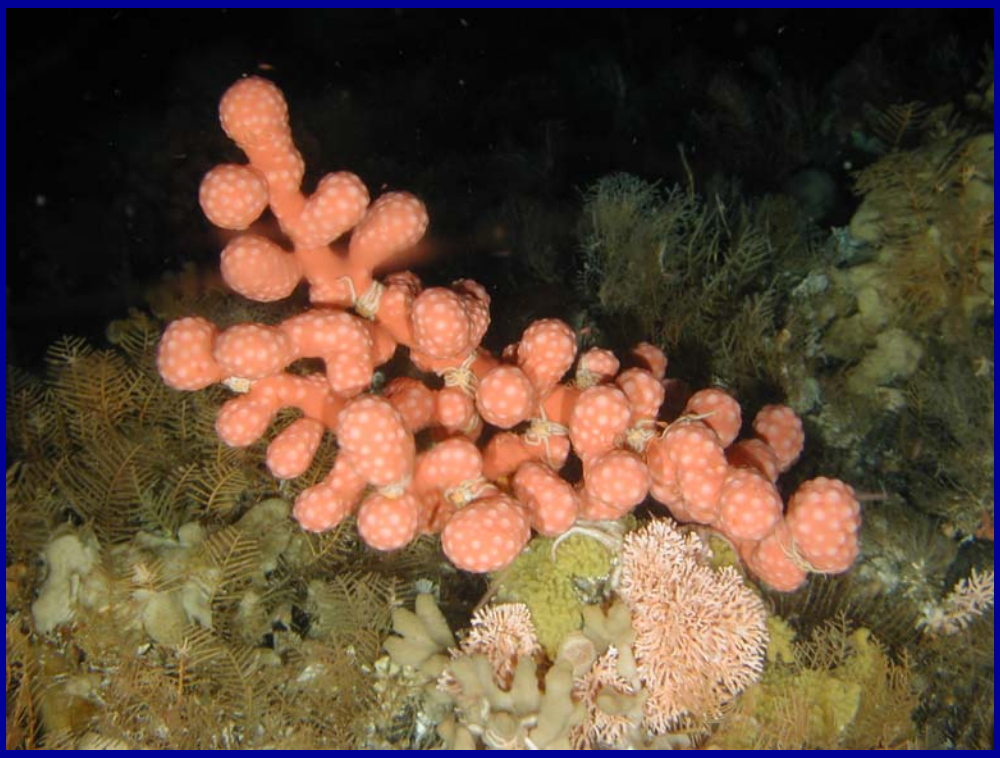
High Seas Bottom Trawl Fisheries and their Impacts on the Biodiversity of Vulnerable Deep-Sea Ecosystems: Options for International Action

Matthew Gianni



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Cover Photography

The author wishes to thank the following contributors for use of their photography.
Clockwise from top right:

A rare anglerfish or sea toad (Chaunacidae: *Bathychaunax coloratus*), measuring 20.5 cm in total length, on the Davidson Seamount (2461 meters). Small, globular, reddish, cirri or hairy protrusions cover the body. The lure on the forehead is used to attract prey.
Credit: NOAA/MBARI 2002

Industrial fisheries of Orange roughy. Emptying a mesh full of Orange roughy into a trawler.
© WWF / AFMA, Credit: Australian Fisheries Management Authority

White mushroom sponge (Caulophecus sp). on the Davidson Seamount (1949 meters).
Credit: NOAA/MBARI 2002

Bubblegum coral (*Paragorgia* sp.) and stylasterid coral (*Stylaster* sp.) at 150 meters depth off Adak Island, Alaska.
Credit: Alberto Lindner/NOAA

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Matthew Gianni

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Matthew Gianni (matthewgianni@netscape.net) is an independent advisor on fisheries and oceans issues as well as an advisor to the Global Marine Programme of IUCN. The views expressed in this report are those of the author and do not necessarily reflect the views of the organizations for whom the report was produced or the individuals who contributed to the production of the report.

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IUCN – The World Conservation Union brings together 79 States, 114 government agencies, and over 800 national and international non-governmental organizations. Its mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. Through its six expert commissions IUCN draws on some 10,000 scientists and other specialists from 181 countries. It has a secretariat presence in over 60 offices around the world.

WWF is one of the world's largest and most experienced independent conservation organisations with almost 5 million supporters and a global network active more than 90 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature: by conserving the world's biological diversity; ensuring that the use of renewable natural resources is sustainable; and promoting the reduction of pollution and wasteful consumption.

Conservation International is a leader and catalyst in biodiversity conservation worldwide, engaging partners in more than 40 countries on four continents to preserve species-rich, threatened ecosystems in the biodiversity hotspots, high-biodiversity wilderness areas and key marine environments.

The Natural Resources Defense Council (NRDC) is a non-profit organization based in the United States with over 1,000,000 members and online activists. With a staff of lawyers, scientists and policy analysts, NRDC is committed to preserve and restore the rich diversity of ocean life.

High Seas Bottom Trawl Fisheries and their Impacts on the Biodiversity of Vulnerable Deep-Sea Ecosystems: Options for International Action

Executive Summary

The deep ocean is increasingly recognized as a major global reservoir of the Earth's biodiversity, comparable to the biodiversity associated with tropical rainforests and shallow-water coral reefs. Though only a small fraction of the oceans' ecosystems found at depths below 200 meters have been studied, research has revealed remarkably high levels of biodiversity and endemism. Estimates of the numbers of species inhabiting the deep ocean range between 500,000 and 100 million.

The development of new fishing technologies and markets for deep-sea fish products have enabled fishing vessels to begin exploiting these diverse but poorly understood deep-sea ecosystems. By far the most widespread activity affecting the biodiversity of these areas on the high seas is bottom trawl fishing. A number of surveys have shown bottom trawl fishing to be highly destructive to the biodiversity associated with seamounts and deep-sea coral ecosystems and concluded that it is likely to pose significant risks to this biodiversity, including the risk of species extinction.

The conservation and management of fisheries and the protection of biodiversity within the 200 n.m. Exclusive Economic Zones is largely a matter of coastal state responsibility. However, the international community as a whole has a collective responsibility to ensure the conservation of fish stocks on the high seas and the protection of biodiversity beyond national jurisdiction.

The United Nations General Assembly in 2002, recognizing the vulnerability of deep-sea biodiversity, called upon the international community to urgently consider the risks to the biodiversity associated with seamounts and other deep-sea areas. The General Assembly reiterated its concern in 2003 and further called on relevant global and regional organizations "*to investigate urgently how to better address, on a scientific basis, including the application of precaution, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity in areas beyond national jurisdiction…*"

This report presents findings on the current extent, location, and value of high seas bottom trawl fisheries worldwide, and the countries involved, drawing on available sources of information. It reviews the current governance of high seas bottom trawl fishing, including the standards and obligations established in several relevant instruments. It further highlights significant gaps in knowledge and oceans governance in relation to high seas bottom trawl fisheries. In light of the known vulnerability of seamounts, deepwater corals and other biodiversity hotspots to high seas bottom trawl fishing, and the lack of a management framework to protect this biodiversity or prevent the serial depletion of targeted species, this report concludes that urgent action, specifically a UN General Assembly moratorium on high seas bottom trawling, is essential to protect these biodiversity hotspots until gaps in knowledge and oceans governance are addressed.

The key findings are as follows:

Deep-sea coral and seamount locations and vulnerability

- Deep-sea coral and seamount ecosystems are widespread throughout the world's oceans.
- Bottom trawl fishing poses a major threat to the biodiversity of vulnerable deep-sea habitats and ecosystems. Losses of up to 95-98% of the coral cover of seamounts as a result of deep-sea bottom trawl fishing have been documented.
- Given the localized species distribution and high degree of endemism associated with seamount ecosystems, bottom trawl fishing is likely to pose a serious threat to a large percentage of species inhabiting these ecosystems, including the threat of extinction.
- High seas bottom trawl fishing has often led to the serial or sequential depletion of targeted deep-sea fish stocks.

Extent of high seas bottom trawling

- Approximately 80% of the high seas catch of bottom species (groundfish, prawns etc) is taken by bottom trawl fishing vessels.
- There has been no systematic study of the geographic extent of bottom trawl fishing in relation to vulnerable deep-sea ecosystems or the extent of its impact on these ecosystems.
- Despite the lack of systematic study, we know that high seas bottom trawl fisheries take place along the continental margin where it extends beyond 200 nautical miles, and on seamounts, oceanic ridges and plateaus of the deep ocean floor in many areas of the world's oceans. This type of fishing is likely to grow in coming years as deep-sea fish stocks within national jurisdiction are depleted and/or increasing restrictions are placed on fisheries within national jurisdiction.
- Most high seas bottom trawl fishing over the past several years has taken place in the Northwest Atlantic Ocean, Northeast Atlantic Ocean, Southwest Indian Ocean and the Southwest Pacific Ocean. The majority of the high seas bottom trawl catch is taken in a relatively small area of the Northwest Atlantic (the shelf and slope area of the international waters of the Grand Banks and the Flemish Cap). However, the damage to seamount, coral and other deep-sea species and ecosystems is likely to be far higher in the other ocean areas where significant high seas bottom trawl fisheries occur because of the greater geographical scope of the fisheries in these regions.

Countries involved

- Fishing vessels flagged to only 11 countries – Spain, Russia, Portugal, Norway, Estonia, Denmark/Faros Islands, Japan, Lithuania, Iceland, New Zealand and Latvia, took approximately 95% of the reported high seas bottom trawl catch in 2001, the last year for which data on catch and value of the catch is consistently available worldwide. Of these, all except Japan (and possibly Denmark on behalf of the Faroes) have ratified, or will soon ratify, the 1995 UN Fish Stocks Agreement.
- European Union countries (including Latvia, Lithuania, and Estonia but excluding the Faroe Islands) took approximately 60% of the high seas bottom trawl catch in 2001. Spain accounted for approximately two-thirds of the European Union catch and some 40% of the overall global high seas bottom trawl catch.

Global catch information

- The reported high seas bottom trawl catch in 2001 was approximately 170,000 – 215,000 mt of fish. This figure represented only about 0.2-0.25% percent of the global marine fisheries capture production of 83.7 million tons of fish in 2001 reported by the UN Food and Agriculture Organization (FAO).
- The overall value of high seas bottom trawl fisheries is not likely to exceed $300-$400 million USD annually at present, a figure equivalent to approximately 0.5 percent of the estimated value of the global marine fish catch in 2001 (approximately $75 billion USD).
- The global high seas bottom trawl catch is not likely to support more than 100-200 vessels fishing on the equivalent of a full-time, year round basis. The actual number of vessels engaged in high seas bottom trawl fishing is higher (many vessels only fish part-time on the high seas) but not likely to be more than several hundred. The UN FAO estimates that there are approximately 3.1 million fishing vessels in operation worldwide.
- The overall contribution of high seas bottom trawl fisheries to global food security is negligible as most of the catch is sold on the European Union, U.S. and Japanese markets.

Management of high seas bottom trawl fisheries

- Virtually all high seas bottom trawl fisheries are presently unregulated insofar as their impacts on deep-sea biodiversity are concerned. Most high seas areas are not covered by a regional fisheries management organization (RFMO) with competence to regulate deep-sea bottom fishing.
- There are serious problems with mis-reporting and under-reporting of high seas bottom trawl catches and accounting for catches made by illegal, unreported and unregulated (IUU) fishing.
- Virtually all high seas bottom trawl fisheries are currently conducted in a manner wholly inconsistent with the conservation and management principles and provisions of the 1995 UN Fish Stocks Agreement and the 1995 UN FAO Code of Conduct for Responsible Fisheries.

Vulnerability of continental margin biodiversity of coastal states

- On the continental margin beyond 200 n.m., coastal states have sovereign rights to explore and exploit sedentary species (UNCLOS Articles 76 and 77), yet these species are vulnerable to damage caused by bottom trawl fisheries on the high seas.
- Given current fishing areas and trends in exploratory fishing, those coastal states most vulnerable are likely to be Canada, Brazil, Uruguay, Argentina, South Africa, Namibia, Angola, Mozambique, Mauritius, Seychelles, India, Norway, Iceland, Australia, New Zealand and several EU countries.

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A number of important gaps in knowledge and ocean governance must be addressed before the sustainability of deep-sea fish stocks and the protection of vulnerable deep-sea habitats and biodiversity from bottom trawling on the high seas can be ensured. These include the need for:

More Complete information

- further identification of biodiversity hotspots beyond the 200 n.m. EEZs through mapping and sampling of seamount ecosystems, cold-water corals and other vulnerable deep sea habitats along continental margins and deep ocean areas under the high seas;
- more complete information on high seas bottom fisheries including data on catch, bycatch, and areas fished, as well as basic data on the biology of targeted species and others impacted by the fisheries;
- more complete information on the number of flag states and vessels involved in high seas bottom fishing, and their reporting to the appropriate international bodies;

Precautionary and ecosystem based management and governance

- the adoption of international management measures for high seas bottom trawl fisheries in keeping with ecosystem-based fisheries management and the precautionary approach, for example through:
  - ✓ determining which deep sea bottom trawl fisheries are straddling stock fisheries and thus subject to the 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN FSA);
  - ✓ ensuring that regional fisheries management organizations (RFMOs) presently competent to regulate these fisheries do so consistent with the principles and provisions for conservation and management of the UN FSA;
  - ✓ establishing new RFMOs consistent with the principles and provisions of the UN FSA to regulate these fisheries where management regimes do not currently exist;
  - ✓ extending the competence of existing RFMOs to these fisheries, again consistent with the principles and provisions of the UN FSA, notably where target species currently regulated by the RFMO are associated with the vulnerable benthic ecosystems noted; and/or
  - ✓ establishing an international regime for deep-water fisheries on stocks and associated species found exclusively on the high seas which, at a minimum, incorporates the principles and provisions of the UN FSA; and
  - ✓ the establishment and implementation of effective mechanisms for monitoring, compliance and enforcement for high seas bottom fisheries, including the elimination of IUU fishing.

It will also be important to resolve the issue of a coastal state's authority to protect the benthic biodiversity of its legal continental shelf (continental margin) beyond its 200 n.m. EEZ from the impact of high seas bottom fishing. Further protections may be achieved through the development of long-term approaches and tools, including gear restrictions, fisheries closed areas, and marine protected areas, consistent with international law and based on scientific information, for the protection of vulnerable deep-sea ecosystems and biodiversity under the high seas.

UN General Assembly moratorium on bottom trawl fishing on the high seas

In the meantime, immediate protection of seamounts, deep-water corals and other biodiversity hotspots from high seas bottom trawling is essential to prevent further depletion of deep-water fish stocks and damage to the biodiversity of these vulnerable areas. A UN General Assembly declared moratorium on high seas bottom trawl fishing is the best short-term solution as it can provide interim protection until long-term solutions can be agreed and effectively implemented. A moratorium, coupled with a process under the auspices of the UN General Assembly to resolve the issues identified above, would be the best approach to establishing more effective governance over high seas fisheries and ensuring the protection of rare and vulnerable deep-sea ecosystems from the adverse impacts of fishing on the high seas.

The opportunity exists now for the international community, individually and collectively, to take preventative action to protect a major portion of the biodiversity on the high seas – the world's global commons. Leading scientists have concluded that the threat posed by deep-sea bottom trawl fishing is real, the potential loss of marine biodiversity is significant, and have called upon the UN General Assembly to declare a moratorium on bottom trawl fishing on the high seas. Currently, the number of countries and vessels involved in high seas bottom trawl fisheries is relatively small. The economic value of these fisheries is a fraction of a percent of the overall value of marine fisheries worldwide. However, these fisheries are likely to expand in coming years.

By taking action now, the UN General Assembly and the international community can make a significant contribution toward the implementation of important international agreements, in particular the 1995 UN Fish Stocks Agreement, and the commitments made at the World Summit on Sustainable Development to reverse the loss of biodiversity on a global scale.

HIGH SEAS BOTTOM TRAWL FISHERIES AND THEIR IMPACTS ON THE BIODIVERSITY OF VULNERABLE DEEP-SEA ECOSYSTEMS: OPTIONS FOR INTERNATIONAL ACTION

Matthew Gianni

INTRODUCTION

"Clearly we are in the midst of one of the great extinction spasms of geological history" E.O. Wilson, *The Diversity of Life*

Throughout human history, the deep ocean has often inspired both wonder and fear. It has been variously seen as a dark and mysterious place entirely inhospitable to life or the home of legendary sea monsters and leviathans that haunted the fevered imaginations of ancient mariners. The deep sea was even perceived as the origin of life itself, the source of the so-called "primordial ooze" which the now famous expedition of the HMS Challenger set out to find in the late 1800s. More recent scientific investigations have served to confirm and increasingly reveal the truly remarkable extent of the mystery and diversity of life in the deep sea.

E.O. Wilson in his widely read book *The Diversity of Life* was referring primarily to the extinction of terrestrial life associated with the destruction of tropical rainforests and island ecosystems. Research into the impacts of fishing in the marine environment suggests that a similar trend involving a threat to marine biodiversity and ecosystems in the deep ocean may also be underway.

The United Nations Food and Agriculture Organization (FAO) in its State of World Fisheries and Aquaculture 2000 reported that 72-78% of major fisheries were fully exploited, over exploited or depleted and that most of the world's marine ecosystems are "...close to full exploitation".[1] The UN FAO assessment may be an underestimate of the scale of the impact of fishing on the world's oceans in light of a number of recent scientific studies indicating the profound changes to ocean and coastal ecosystems as a result of overfishing. Reviewing 40 years of catch data compiled by the UN FAO, Pauly et al. in 1998 calculated that the mean trophic levels of marine ecosystems are in decline as a result of the depletion of top predators such as sharks, cod, tunas, and swordfish – a trend sometimes referred to as 'fishing down the marine food chain'.[2]

More recently, Jackson et al. (2001) reviewed paleoecological, archaeological and historical data on the exploitation and collapse of coastal ecosystems over the past 125,000 years. They concluded that the massive overharvesting of large marine vertebrates including fish species, dugongs, sea cows, sea turtles, whales and other marine mammals has led to major structural and functional changes in coastal ecosystems. This has often resulted in the wholesale collapse of ecological communities and has weakened the ability of these

[1] The State of World Fisheries and Aquaculture 2000. United Nations Food and Agriculture Organization, Rome 2000.
[2] Pauly D. et al. *Fishing Down Marine Food Webs.* Science 279, 860-863 (1998).

ecosystems to withstand the deleterious effects of human impacts such as increased nutrient input into the seas from agriculture or urban development. The authors conclude that the collapse of coastal ecosystems may take decades or centuries to occur after the initial onslaught of overfishing, raising the specter that many more marine ecosystems may yet collapse as a result of the technological intensification and globalization of fishing leading to overexploitation within the past 50 years.[3] Indeed, in a study published in Nature in 2003, Myers and Worm suggest that the world's oceans have lost some 90% of large predatory fish since the advent of industrialized fishing and that the major declines in top predators in coastal ecosystems identified by Jackson et al. have now extended throughout continental shelf and open ocean ecosystems, with potentially serious consequences.[4]

As fishing capacity has grown and coastal ecosystems are overexploited, the fishing and seafood industries have increasingly turned to developing new fisheries and markets for species found in the deep sea. As a result, a new problem has arisen in regard to fishing on the high seas, one that involves a threat to marine biodiversity on a scale as yet unknown but likely to be severe with long-lasting, if not irreversible, consequences for the ecological functioning of deep-sea ecosystems.

The Deep Sea

The deep ocean is one of the last major frontiers of the planet. The ocean floor beyond the edge of the geological continental shelf covers some 50 percent or more of the entire surface of the earth. Only a small fraction of the many ecosystems found on the ocean bottom at depths below 200 meters has been studied. However, research over the past decade has revealed remarkably high levels of biodiversity and endemism associated with many deep-sea ecosystems.

At the same time, the development of new fishing technologies and markets for products has enabled fishing vessels to begin exploiting these diverse but poorly understood ecosystems. While oil and gas exploration, seabed mining and other activities can ultimately have a negative effect on deep-sea species as they expand into these areas, by far the most widespread activity today affecting the biodiversity of the deep-sea is bottom trawl fishing. A number of surveys and studies have shown bottom trawl fishing to be highly destructive to the biodiversity associated with deep-sea ecosystems and concluded that it is likely to pose significant risks to this biodiversity, including the possibility of species extinctions.

The conservation and management of fisheries and the protection of deep-sea biodiversity within the 200-nautical mile (n.m.) exclusive economic zone (EEZ) is largely a matter of coastal state responsibility. However, the international community as a whole has a collective responsibility to ensure the conservation of fish stocks and the protection of the biodiversity of the deep-sea in the two-thirds of the world's oceans beyond national jurisdiction.

In recognition of the vulnerability of deep-sea biodiversity to the impacts of human activities, the United Nations General Assembly in 2002 called upon relevant intergovernmental organizations "to consider urgently ways to integrate and improve, on a scientific basis, the management of risks to marine biodiversity of seamounts and certain other underwater features" within the framework of the United Nations Convention on the Law of the Sea.[5]

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[3] Jackson et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems.* Science, Volume 293, 27 July 2001.

[4] Meyers R. A. and B. Worm. *Rapid worldwide depletion of predatory fish communities.* Nature 423, 280-283 (2003).

[5] United Nations General Assembly Resolution on Oceans and the Law of the Sea. A/RES/57/141. Paragraph 56. 2002.

The General Assembly reiterated its concern in 2003 and further invited relevant global and regional bodies "*to investigate urgently how to better address, on a scientific basis, including the application of precaution, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity in areas beyond national jurisdiction; how existing treaties and other relevant instruments can be used in this process consistent with international law, in particular with the Convention, and with the principles of an integrated ecosystem-based approach to management, including the identification of those marine ecosystem types that warrant priority attention"*[6]

Bottom trawl fleets are increasingly expanding into high seas areas. In many cases these fisheries are not governed by regional fisheries management organizations (RFMOs) because most do not have competence to regulate deep-sea fishing. Where RFMOs do have such competence, many deep-sea fisheries remain completely unregulated because the RFMOs have not yet adopted measures for these fisheries. Those deep-sea fisheries that are subject to conservation and management measures are often compromised by illegal, unreported or unregulated (IUU) fishing. Virtually no bottom trawl fisheries in international waters are currently regulated to protect the biodiversity of the deep-sea from the impact of bottom fishing.

In spite of the international concern over illegal, unreported and unregulated fishing, and the impact of bottom trawling in the deep sea, the extent of bottom fishing in international waters is not well known. The United Nations Food and Agriculture Organization, in its 2002 Report on the State of World Fisheries and Aquaculture, states "It is difficult to assess the development of fishing on the high seas because reports to the FAO of marine catches make no distinction between those taken within EEZs and those taken on the high seas".[7]

This report has been prepared in response to the concern raised by the UN General Assembly and in other fora over the extent and impact of bottom fishing on the biodiversity of the deep-sea. The report attempts to summarize the most recent information on the biodiversity and impacts of fishing in deep-sea areas on the high seas, estimate the extent and value of bottom trawl fisheries in international waters, identify gaps in the information available to the international community, and outline options for international action to minimize the risks to the biodiversity of the deep sea from bottom fishing activities in international waters.

[6] United Nations General Assembly Resolution on Oceans and the Law of the Sea. A/RES/58/240. Paragraphs 51 and 52. 2003.
[7] The State of World Fisheries and Aquaculture 2002. UN FAO, Rome 2002. Page 13, Box 3.

SECTION 1
DEEP-SEA BIODIVERSITY

Most marine biologists agree that the deep sea constitutes a major reservoir of the earth's biodiversity. Estimates of the numbers of species inhabiting the deep sea range between 500,000 and 100 million. While there is considerable debate amongst marine biologists over the extent to which global estimates can be inferred based on limited data, there is general agreement that the diversity of bottom dwelling species in the deep ocean areas is high.[8]

The deep sea starts beyond the shallower continental shelf and includes the slope and rise of the continental margin, deep-ocean basins and plains, trenches, mid-ocean ridge systems, smaller ridge systems, seamounts, plateaus and other underwater features rising from the deep ocean floor. Most of this area lies beyond 200 nautical miles from shore and constitutes over 90 percent of the ocean bottom.[9]

1.1 COLD-WATER CORALS

Deep-sea coral 'reefs', like their shallow water counterparts, have been found on seamounts and along the continental slope throughout the world's oceans and are known to support rich and diverse assemblages of marine life. Detailed knowledge as to the exact location and distribution, as well as the abundance and dynamics of deep-sea coral reefs remains limited though recent research efforts are beginning to reveal aspects of the biology of these ecosystems.

For example, it is now known that some of the continental slope coral systems or reefs are remarkably old. In a bottom trawl fishery for grenadier, orange roughy and deep-water sharks operating between 840 and 1300 meters depth along the continental slope west of Ireland, carbon 14 dating revealed that the cold water coral 'matrix' taken as bycatch in this fishery was at least 4550 years old.[10] Fragments taken from the Sula Ridge cold-water coral reef complex, located within the Norwegian EEZ at a depth of approximately 300 meters and measuring some 14 kilometers in length, have been dated to 8,500 years old. In some areas, the coral reef on the Sula Ridge reaches a height of 35 meters. Studies on four different Norwegian cold-water coral reefs have identified 744 species altogether associated with the reefs but, remarkably, only 15 species were common to all sites, indicating that the numbers of species on the reefs are probably much higher than those identified thus far. Amongst the many species associated with the reefs were commercially fished species such as redfish, saithe, cod, ling, tusk and lobster. The reefs have been rich fishing grounds and experimental longlining has shown that the reefs have produced higher catches of redfish than surrounding, non-coral areas.[11]

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[8] Snelgrove PVR, Smith CR (2002) *A riot of species in an environmental calm: the paradox of the species-rich deep-sea floor*. Oceanography and Marine Biology Annual Review 40:311-342

[9] Garibaldi, L.; Limongelli, L. Trends in oceanic captures and clustering of Large Marine Ecosystems: two studies based on the FAO capture database. *FAO Fisheries Technical Paper*. No. 435. Rome, FAO. 2002. 71p. Table 1.

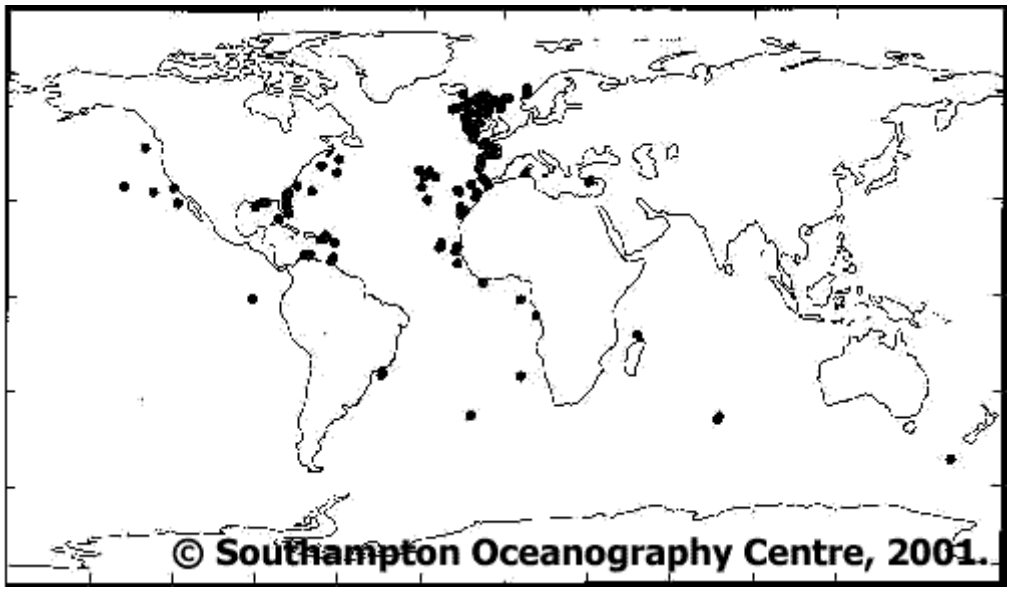
[10] Hall-Spencer J, Allain V, Fossa J H. *Trawling damage to Northeast Atlantic ancient coral reefs.* Proceedings of the Royal Society of London, 2002. 01PB0637.1

[11] *Coral Reefs in the North Atlantic?* Article written by Jan Helge Fossa, Institute of Marine Research, Bergen, Norway, on the ICES website at http://www,ices.dk/marineworld/deepseacoral.asp. Also Freiwald A, Huhnerbach V, Lindberg B, Wilson J B, Campbell J. The Sula Reef Complex, Norwegian Shelf. Facies 47, 179-200. In press.

In the Northeast Atlantic, reefs or mounds of the dominant deep-water coral species, *Lophelia pertusa*, are known to be widely distributed, having been found in waters from the Arctic Circle south along the coast of Norway, Iceland and south along the Reykjanes ridge (part of the Mid-Atlantic Ridge), the Faroe Islands, Ireland and the UK, off Spain and France in the Bay of Biscay and along the Galicia Bank, and around the Azores, Canaries and Madeira Islands. Most other deep-water coral species in the Northeast Atlantic are found in association with Lophelia (*Lophelia pertusa*) reefs.[12]

A good general description of Lophelia corals and their importance to fisheries and marine biodiversity is provided by the Southampton Oceanography Centre in the UK that has conducted extensive research into deep-sea habitats in the Northeast Atlantic and elsewhere:

"Lophelia forms a complicated network that provides a hold and a home for many other animals, including sea fans, sponges, worms, starfish, brittlestars, sea urchins, crustaceans and fish. Several animals bore into the coral skeleton causing it to fall apart. This provides new surfaces for coral colonisation and so the reef grows. The reef is a veritable battle ground of builders and wreckers, but both are important to its health. The number of invertebrate species on a deep-water coral reef is as high as that found in shallow-water reefs.... Lophelia reefs, however, do attract fish aggregations and may serve as an important spawning and nursery ground for some species. Deep-water corals grow only at a rate of 2.5cm per year, similar to slow-growing, massive coral species in shallow water. The deep-sea coral reefs seen today probably date back at least 10,000 years."[13]



Map shows areas where Lophelia reefs have been discovered worldwide.[14]

[12] Report of the Study Group on Cold-Water Corals, Advisory Committee on Ecosystems. ICES CM 2003/ACE:02 Ref. E. May 2003. International Council for the Exploration of the Sea. Also: Commission Staff Working Paper: Deep-Sea Fisheries. Report of the Subgroup Fishery and the Environment (SGFEN) of the Scientific, Technical and Economic Committee for Fisheries, Commission of the European Communities. Brussels 1.2.2002 SEC(2002) 133

[13] From: Southampton Oceanography Centre website http://www.soc.soton.ac.uk/GDD/DEEPSEAS/coralecosystems.html. See also Rogers, A.D. 1999. *The biology of Lophelia pertusa and other deep-water reef-forming corals and impacts from human activities.* International Review of Hydrobiology 84: 315-406.

[14] Rogers AD (1999) *The biology of Lophelia pertusa (Linnaeus 1758) and other deep-water reef-forming corals and impacts from human activities*. International Review of Hydrobiology 84 (4): 315-410.

Altogether, over 1300 species of marine life so far have been recorded in association with Lophelia reefs.[15] Other major reef building coral species include *Madrepora oculata* which, like Lophelia, is found in the North Atlantic, Mediterranean Sea and Gulf of Mexico. *Oculina varicose* reefs are found along the southeast coast of the United States. *Goniocorella dumosa* and *Solenosmilia variabilis* are the most prominent deep-water reef-building species discovered thus far on seamounts and other underwater features in the Southwest Pacific around New Zealand and Australia.[16]

In addition to the value of deep-water corals as areas high in biodiversity and as habitat to commercially caught species of fish, deep-water corals and associated species are potential sources of medicines. Gorgonian corals, for example, produce antibiotics and some coral species contain the pain killing compounds known as psuedopterosians. Seafans contain high concentrations of prostoglandins; compounds used to treat asthma and heart disease.[17] Further research into coral and other deep-sea ecosystems over the coming years may well reveal many more such benefits from species as yet undiscovered by science.

[15] Dr. Murray Roberts, Scottish Association for Marine Science, Oban, Scotland, personal communication.

[16] Freiwald A, Fossa JH, Grehan A, Koslow JA, Roberts J. draft UNEP-WCMC report on cold-water corals. United Nations Environment Programme – World Conservation Monitoring Centre. In press.

[17] Joint Management Plan Review, Proposed Action Plans. A Report to the Monterey Bay National Marine Sanctuary Advisory Council. National Marine Sanctuaries. National Oceanic and Atmospheric Adminsitration. June 2003. http://www.sanctuaries.nos.noaa.gov/jointplan/reptoad/mb_pdf/ecosystem.pdf

1.2 SEAMOUNTS

"*We know that seamounts support large pools of undiscovered species, but we cannot yet predict what is on the unstudied ones. The tragedy is that we may never know how many species become extinct before they are even identified*" Dr. Frederick Grassle, Rutgers University[18]

Seamounts are increasingly recognized as being high in endemic species - isolated islands or island chains of biodiversity beneath the surface of the sea harboring concentrations of endemic species and providing the conditions for the evolution of new species. They are also believed to serve as stepping stones for the dispersal or migration of species across wide oceanic areas.[19]

Corals often form the basic structure of seamount ecosystems, together with other sessile species such as sea fans and sponges. Because of the slow growth and restricted distribution of many of the species associated with seamount ecosystems, they are considered particularly vulnerable to human impacts and the risk of extinction. Precise numbers of seamounts are not known; Smith (1991) estimates that there are some 30,000 seamounts greater than 1000 meters high in the Pacific and between 600,000 and 1.5 million in the Pacific Ocean of all heights.[20] More recently, Rogers (2004) states that there may be up to 50,000 seamounts over 1000 meters high in the Pacific Ocean and 100,000 seamounts altogether worldwide.[21]

Many additional ocean bottom topographical features of several hundred meters or more are believed to exist along continental margins and oceanic ridge systems. These are variously referred to as knolls, hills, pinnacles and mounds as well as seamounts.[22] While the location of the 1000-meter-plus seamounts is generally known, much less is known about the location of these smaller features. In addition to individual seamounts, oceanic ridge systems, deep-sea plateaus, and banks may also be areas rich in biodiversity.

A recent paper by Stone et al. (2003) contains a very good summary of the current status of scientific understanding of the biodiversity associated with seamounts, including those features such as knolls, hills and mounds less than 1000 meters in height:

"One of the most exciting discoveries in the deep-sea ecology in the last decade or so has been the documentation of highly endemic faunas and many new species on seamounts (e.g. de Forges et al. 2000). Endemics are species found at only one restricted location in the oceans. In the case of seamounts, they are defined variously as species found to date only on a single seamount, several seamounts in a chain, or several seamount plus an associated islands in a chain. While the presence of endemics on seamounts has been documented for a long time, our understanding of the magnitude is changing rapidly. In 1987, Wilson and Kaufmann estimated that 12-15% of all species found on seamounts were endemic, and considered this a high value. Since then, several major sampling programs have found much higher levels.

Koslow et al. (2001) found rates of ~35% on seamounts off Tasmania. De Forges et al. (2000) worked south of New Caledonia and recorded rates of 36% on the Norfolk Ridge seamounts and 31% on the

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[18] Dr Frederick Grassle of Rutgers University quoted in "Lost worlds of the ocean threatened by trawlers" by Roger Highfield, Science Editor. UK Telegraph 23/8/2003.

[19] Baker, C.M., Bett, B.J., Billett, D.S.M and Rogers, A.D. (2001). An environmental perspective. In: (Eds. WWF/IUCN). *The status of natural resources on the highseas.* WWF/IUCN, Gland, Switzerland.

[20] DK Smith (1991*) Seamount abundances and size distributions, and their geographic variations.* Reviews in Aquatic Sciences 5: 197-210.

[21] Rogers AD, *The Biology, Ecology and Vulnerability of Seamount Communities.* Paper prepared for IUCN/World Conservation Union. February 2004.

[22] UN Atlas of the Oceans www.oceansatlas.com/servlet/CDSServlet?status=ND00NjQ3MiY3PWVuJjYxPSomNjU9aW5mbw~~

Lord Howe Island seamounts. And Parin et al. (1997) recorded rates of 44% for fishes and 52% for invertebrates on the Nasca and Sala-y-Gomez chains off Chile. These high rates are not universal: a recent compilation of data from the Hawaiian and Emperor seamounts found rates of fish endemism of 17% (Stocks 2003), and a study of the Great Meteor seamount found fish endemism of only 9% (Fock et al. 2002). However, taken together, the recent findings suggest that Wilson and Kaufmann's estimate of 15% endemism is likely substantially too low.

In addition to seamount chains supporting high numbers of endemic species, it also appears that each individual seamount may support a unique community. De Forges et al. (2000) found that adjacent seamounts in the New Caledonia area shared an average of just 21% of their species, and for seamounts on separate ridges ~1000 km apart, this decreased to ~4%; though these levels are not nearly as low for the Nazca/Sala-y-Gomez Chain (Parin et al. 1997) or the Hawaiian/Emperor chain (Stocks 2003). This suggests that each unsampled seamount is a potential source of many undiscovered species.

Very new evidence is also suggesting that seamounts do not have to be large and isolated in order to support highly endemic faunas. The Tasmanian seamounts noted above as having 35% endemics (Koslow et al. 2001) are from seamounts that average 400m in height above the seafloor and just 40km or so from the 200m isobath around Tasmania. And recent sampling on small seamounts around New Zealand (100-350 m in elevation) just off of the large Chatham Rise have found rates of endemism over 15% (Rowden et al. 2002; Rowden personal communication) and elevated species diversity compared to nearby non-seamount areas (Probert et al. 1997)…

At present, it is not possible to estimate the total number of new species on seamounts worldwide. We cannot simply multiply the average number of new species per seamount by the estimated number of seamounts (30,000+), as we do not understand how overall diversity and rates of endemism may vary with depth, surface productivity, latitude, etc. It has been hypothesized that deeper seamounts may have lower rates of endemism (Wilson and Kaufmann 1987), and are underrepresented in current seamount sampling. And, as more deep-sea sampling occurs, we may find that some of the species thought to be seamount endemics may have larger ranges. Nevertheless, it is clear that seamounts represent large pools of undiscovered biodiversity in the oceans."[23]

[23] Stone G., Madin L., Stocks K., Hovermale G., Hoagland P., Schumacher M., Steve C., Tausig H. *Seamount Biodiversity, Exploitation and Conservation.* Case Study Paper for Defying Ocean's End Conference organized by Conservation International, May 29 - June 3, 2003. In press. References to papers/publications in the excerpt are as follows: 1) de Forges, B., J.A. Koslow, and G.C.B. Poore. 2000. *Diversity and endemism of the benthic seamount macrofauna in the southwest Pacific*. Nature 405: 944-947.; 2) Wilson, R.R. and R.S. Kaufmann. 1987. *Seamount Biota and Biogeography*. American Geophysical Union Geophysical Monographs 43: 355-377.; 3) Parin, N.V., A.N. Mironov, and K.N. Nesis. 1997. *Biology of the Nazca and Sala y Gomez Submarine Ridges, an Outpost of the Indo-West Pacific Fauna in the Eastern Pacific Ocean: Composition and Distribution of the Fauna, its Communities and History*. Advances in Marine Biology 32: 145-242.; 4) Koslow, J.A., K. Gowlett-Holmes, J.K. Lowry, G.C.B. Poore, and A. Willams. 2001. *Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling.* Marine Ecology Progress Series 213: 111-125.; 5) Stocks, K.I. 2003. SeamountsOnline, a Biogeographic Information System for Seamounts. Poster, Frontiers in Biogeography, the Inaugural Meeting of the International Biogeography Society, Mesquite, Nevada, Jan 4-8. http://seamounts.sdsc.edu/Biogeo_2002.ppt.; 6) Fock, H., F. Uiblein, F. Köster, H. von Westernhagen. 2002. *Biodiversity and species-environment relationships of the demersal fish assemblage at the Great Meteor Seamount (subtropical NE Atlantic), sampled by different trawls*. Marine Biology 141: 185-199. 7) Rowden, A.A., S. O'Shea, and M.R. Clark. 2002. *Benthic biodiversity of seamounts on the northwest Chatham Rise*. -21. 2002. Wellington, NZ, Ministry of Fisheries. Marine Biodiversity Biosecurity Report No. 2. 21 pp.; 8) Probert, P. K., D.G. McKnight and S.L. Grove. 1997. *Benthic invertebrate bycatch from a deep-water trawl fishery, Chatham Rise, New Zealand.* Aquatic Conservation: Marine and Freshwater Ecosystems. 7: 27-40.

SECTION 2.
DEEP SEA BOTTOM TRAWL FISHERIES

Deep-sea fisheries are generally considered to be fisheries conducted for bottom dwelling species below 400 meters on the continental slope, seamounts, deep-sea ridges and plateaus and associated underwater features.[24] With current technologies, these fisheries can take place down to depths of approximately 2,000 meters. This report primarily addresses deep-sea bottom trawl fisheries but does include some information and recommendations related to shallower-water bottom trawl fisheries on the high seas and the capture of continental shelf and upper slope species in these high seas fisheries.

Many deep-water fish species are highly vulnerable to overfishing because of their unique biology and adaptation to deep-sea environments. The biology and life history of species targeted or caught as bycatch in deep-sea fisheries are often poorly understood or not understood at all. Basic information needed to determine the level of exploitation that these fish populations (stocks) can sustain is lacking in many cases. Deep-water fisheries are often characterized as 'serial' or 'sequential depletion' fisheries because fishing vessels find and deplete a stock, then move on and repeat the practice. Little is known about the recovery times for these populations but most deep-water species are believed to be slow to recover from overexploitation. The problem of stock assessment is greatly exacerbated in mixed species deep-sea bottom trawl fisheries, which take varying quantities of numerous species of fish, as opposed to more selective forms of fishing.

2.1 HISTORY OF DEEP-WATER FISHING

There has been a long history of traditional and artisanal handline fisheries for deep-water species in the South Pacific and around Madeira and Azores in the Atlantic. Deep-sea longline fishing began in Norway and Sweden in the mid-1800s. Deep-sea bottom trawl fisheries initially developed in the 1950s and 1960s with the advent of factory trawl fishing – a type of fishing technology which involves processing and freezing the catch onboard the fishing vessels. The dominant countries involved in developing deep-water bottom trawl fisheries were the countries of Eastern Europe and the former USSR. The widespread adoption of the EEZs in the late 1970s, coupled with the withdrawal of central government support for distant water fishing associated with the collapse of the Soviet Union in the late 1980s caused the decline of deep-water distant water fishing by Russian and eastern European fleets. However, a number of other countries began developing bottom trawl fisheries within their EEZs along the continental slope and on seamounts throughout the 1980s and 1990s and many of these fisheries have progressively expanded into deeper waters and further offshore. Amongst the most important of these were the development of the New Zealand fisheries for orange roughy beginning in the late 1970s, and the development of deep-water trawling for roundnose grenadier, blue ling and associated species by French trawlers in the northeast Atlantic in the 1980s.

A UN FAO report lists a total of 62 deep-water species and species 'items' – groups of species of a single genus - as currently being reported caught in deep-sea demersal or bottom fisheries in commercial quantities.[25] Of these, a relatively small number make up the bulk of the global catch of deep-water species taken in bottom trawl fisheries, though the species

[24] ICES Advisory Committee on Fisheries Management. 3.13 *Deepwater fisheries resources south of 63°N, Overview* W:\Acfm\Acfmwg\2003\October\Overviews\O-3-13.Doc; pg 408. International Council for the Exploration of the Sea. 2003. http://www.ices.dk/committe/acfm/comwork/report/2003/oct/o-3-13.pdf

[25] Garibaldi, L.; Limongelli, L. Trends in oceanic captures and clustering of Large Marine Ecosystems: two studies based on the FAO capture database. *FAO Fisheries Technical Paper*. No. 435. Rome, FAO. 2002. 71p.

mix may change over time as target species are depleted and markets develop for new species discovered in deep-ocean areas.

Amongst the deep-water species that have been caught in relatively large quantities in bottom fisheries are orange roughy fished on seamounts, ridges, banks and other features in the North Atlantic, Southeast Atlantic, South Pacific and Southern Indian Ocean; alfonsino in the tropics and sub tropics, armourhead along seamount chains in the North Pacific; various species of redfish (*Sebastes* spp) throughout continental slope areas in the North Pacific and North Atlantic; Patagonian toothfish in the Southern Ocean around Antarctica; and oreos in the Southwest Pacific and Southern Indian Ocean.[26] Others include the roundnose grenadier, smoothheads, and blue ling caught in association with banks and ridges and along the continental slope in the Northeast Atlantic, and cardinal fish in the South Pacific. In the Northwest Atlantic there are major high seas fisheries for northern prawns, redfish, Greenland halibut, and grenadiers. These fisheries take place primarily along the slope of the 'nose' and 'tail' of the Grand Banks and the Flemish Cap, which extend beyond the Canadian EEZ. In addition, there is a major high seas bottom trawl fishery on the shallower continental shelf along a portion of this area for skates, with a significant bycatch of American plaice.

The fishery for slender armourhead (*Pseudopentaceros wheeleri*) along the Hawaiian and Emperor seamount chains in the North Pacific, amongst the first of the deep-water fisheries targeting species aggregating on seamounts, largely collapsed by the mid-1970s after intensive fishing by Soviet and Japanese trawl fleets over the previous decade. Similarly the alfonsino fishery along the Mid-Atlantic Ridge in the North Atlantic collapsed after a decade or more of intensive fishing by Soviet fleets. Neither species has shown much sign of recovery.

The bottom trawl fisheries for redfish are largely confined to EEZs, with the exception of a resurgent trawl fishery in the international waters of the Grand Banks, although there is extensive mid-water trawling for 'pelagic deep-sea' redfish (*Sebastes mentella*) in the Northeastern and Northwestern Atlantic on the high seas. Patagonian toothfish is taken almost exclusively using bottom longline gear.

The majority of the catch of bottom dwelling species on the high seas is taken by bottom trawl fleets. The bulk of the high seas bottom trawl catch over the past several years consists of roundnose grenadier, smoothheads, blue ling, orange roughy, alfonsinos, northern prawns, redfish, Greenland halibut, roughhead grenadier and American plaice. Together, these species constitute some 95% of the landed catch by weight in bottom trawl fisheries on the high seas over the past few years.

From the point of view of conservation and the sustainable management of these fisheries, there are two main issues: One is the sustainability of the exploitation of targeted fish populations and species. The other is the ecosystem impacts of deep-water trawl fisheries. The latter needs to be considered at several levels - the impact on non-target populations and species taken as bycatch, trophic level or food web impacts resulting from the removals of large numbers of fish from deep-sea ecosystems, and the damage to unique, vulnerable and/or sensitive marine habitats and species such as corals, sponges and other benthic, or bottom dwelling species which form the base or structure of important deep-sea habitats.

[26] Koslow JA, Boehlert GW, Gordon JDM, Haedrich RL, Lorance P, Parin N, *Continental Slope and deep-sea fisheries: implications for a fragile ecosystem.* ICES Journal of Marine Science, 57: 548-557. 2000

2.2 EXPLOITATION OF DEEP-SEA SPECIES

Deep-sea species are generally considered to be long-lived, slow growing, slow reproducing, low fecundity species and thus more vulnerable to exploitation than most species exploited on the continental shelf, upper continental slope or in open ocean pelagic ecosystems. Most, though not all, species caught in bottom trawl fisheries on the high seas are considered deep-sea species.

The majority of the global catch of deep-sea species in recent years has been taken in the North Atlantic (See Tables 3.7.1 and 3.7.2). There are a number of intergovernmental organizations in the region – the Northeast Atlantic Fisheries Commission (NEAFC), the Northwest Atlantic Fisheries Organization (NAFO), the Oslo and Paris Commission (OSPAR), the International Council for the Exploration of the Sea (ICES), the European Commission - and a variety of national marine institutes and research organizations such as IFREMER in France and the Institute for Marine Research in Norway that have, to varying degrees, undertaken research and assessments of deep-water species and fisheries in the area.

The preeminent organization in the Northeast Atlantic engaged in providing scientific advice to governments on all aspects of fisheries in the region is the International Council for the Exploration of the Sea (ICES). The most recent report (October 2003) of the ICES Advisory Committee on Fisheries Management expressed concern that "fisheries on deep water species have developed rapidly and that the resources, which they exploit are generally especially vulnerable to overfishing" but that "It continues to be a major problem for the assessment of stock status that data on landings and particularly fishing effort are limited or of relatively poor quality"[27] The report goes on to state that:

"Basic statistics on catches and effort are of poor quality and in some cases lacking... There is often insufficient information on the general biology of these species, in particular on age and growth, seasonal behaviour, migration, and stock discrimination. Experience shows that deep-sea stocks can be depleted very quickly and that recovery will be slow. These populations generally have a high proportion of old fish, their fecundities are low, and regeneration and growth are so slow that stock numbers do not increase in the depleted areas in the short or medium term."[28]

Large et al., in a recent assessment of the status of deep-water fisheries in the Northeast Atlantic, state (emphasis added) "Most deep-water fish species are long-lived, slow growing and have low reproductive capacity. These stocks are highly vulnerable to exploitation and can be rapidly depleted with recovery being very slow, often taking decades. In the Northeast Atlantic, a diversity of deep-water fisheries exists for a variety of finfish and shellfish species. **Most of the deep-water species in the Northeast Atlantic have been completely unregulated; the latest stock assessments indicate that nearly all exploited deep-water species are being harvested "*outside safe biological limits*".**[29]

In a similar vein, the Working Group On The Appraisal Of Regulatory Measures For Deep-Sea Species of the Northeast Atlantic Fisheries Commission (NEAFC), in June 2002 reported that in the Northeast Atlantic "The deep-water trawl fisheries have developed recently...For the deep-water trawl fisheries the typical development is a rapid increase in catches when a new resource is discovered followed by a decrease reflecting depletion of the resource. The trends in landings and CPUE for most deep-water fisheries currently indicate that fishing

[27] Op cit. 24, ICES *Deepwater fisheries resources south of 63°N.* pg 408.
[28] Ibid pages 410 & 411
[29] Large, P. A., C. Hammer, O. A. Bergstad, J. D. M. Gordon, and P. Lorance. *Deep-water Fisheries of the Northeast Atlantic: II. Assessment and Management Approaches*. Journal of Northwest Atlantic Fishery Science, Vol 31: 151-163. 2003 http://www.nafo.ca/publications/Frames/PuFrJour.html

pressure is far beyond sustainability."[30] Likewise, a 2002 paper by the European Commission described the orange roughy fisheries in the Northeast Atlantic as being "consistent with a 'mining' approach... aggregations are located and then fished out on a sequential basis".[31]

Echoing their counterparts in the North Atlantic, scientists involved in assessing the sustainability of deep-sea fisheries in the New Zealand and Australian regions and in the Southwest Indian Ocean have come to similar conclusions. For example, Clark (1999) stated that an analysis of commercial catch and effort data in fisheries for orange roughy on seamounts in New Zealand waters, one of the largest deep-sea bottom trawl fisheries in the southern hemisphere, "show strong declines in catch rates over time, and a pattern of serial depletion of seamount populations, with the fishery moving progressively...to unfished seamounts".[32] A recent report by WWF also raises serious concerns over the sustainability of orange roughy fisheries worldwide.[33]

In a global review of deep-water fisheries, Koslow et al. concluded that deep-water fish stocks are "typically fished down, often within 5-10 years, to the point of commercial extinction or very low levels".[34] Rogers, in reviewing data on fisheries on seamounts worldwide over the previous two decades, concluded that fish stocks associated with seamounts have been consistently exploited at unsustainable levels. The most common reasons given are that there is often little or no understanding of the biology of the target and bycatch fish populations; management measures, where they exist, are often based on poor data; and highly efficient trawl fishing on aggregations of fish on or just above seamounts results in intensive fishing pressure.[35] An additional problem common to high seas fisheries is the fact that the management regime is either weak or non-existent, a problem which continues today.

2.3 ECOSYSTEM IMPACTS OF DEEP-WATER FISHERIES

While in most cases, current and past levels of exploitation of species caught in deep-sea fisheries are regarded as unsustainable, the scale and extent of the impact of these fisheries on deep oceanic ecosystems has only been studied in a few locations. The potential ecosystem impacts of deep-sea trawl fisheries can be characterized in two ways. One, the predator-prey, food web and other impacts relating to the removal of large numbers of target and bycatch species from the ecosystems in which these species play a role. Two, the physical impact of fishing on the ocean bottom, in particular on rare or fragile coral, sponge and other organisms attached to the seabed which are keystone species and/or shape the basic structure of the benthic ecosystems in which many of these fisheries take place (ecosystem engineers).

Unfortunately, information is almost entirely lacking in regard to the first of the two types of impacts. According to Butler et al., the effect of the removal of large numbers of top

[30] Meeting of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species. Northeast Atlantic Fisheries Commission Deep-sea Working Group, 11-13 June, 2002. Final Report, Annex 4 – Summary of Expert Presentations. Reports, Meeting on Deep-sea Species 11-13 June 2002, Bergen. http://www.neafc.org

[31] Commission Staff Working Paper: Deep-Sea Fisheries. Report of the Subgroup Fishery and the Environment (SGFEN) of the Scientific, Technical and Economic Committee for Fisheries, Commission of the European Communities. Brussels 1.2.2002 SEC (2002) 133. pg 44

[32] Clark M, Fisheries for orange roughy (*Hoplostethus atlanticus*) on seamounts in New Zealand. Oceanologica Acta (1999) 22, 6, 593-602. p 593

[33] M. Lack, K. Short and A. Willock, "Managing risk and uncertainty in deep-sea fisheries: lessons from orange roughy", A Joint Report by TRAFFIC Oceania and WWF Endangered Seas Programme, 2003.

[34] Op cit. 26, Koslow et al., *Continental Slope and deep-sea fisheries: implications for a fragile ecosystem.*

[35] Rogers AD, The Biology of Seamounts. Advances in Marine Biology Vol. 30, 1994, 305-350. p 339

predators in deep-sea ecosystems is poorly known.[36] Koslow et al. state that there are major questions concerning the long-term ecological implications of depleting mid-to-upper level trophic species in deep-sea ecosystems, and the impacts on prey and predator populations, but that there are few answers to these questions at present.[37] This is an area that requires urgent scientific attention given that deep-sea food webs and ecosystems are not likely to recover easily or quickly, if at all, from major perturbations caused by fishing.

With regard to the second category of ecosystem impacts identified above, there are serious concerns regarding the effect of trawling on deep-sea habitats and, in particular, on corals and other "sessile" species, such as sponges, which form the basic structure of biologically diverse deep-sea benthic ecosystems.

The Advisory Committee on Ecosystems of the International Council for the Exploration of the Sea describes the impact of bottom trawling on coral reefs as follows:

"*The impact of trawled gear will kill the coral polyps and break up the reef structure. The breakdown of this structure will alter the hydrodynamic and sedimentary processes as well as cause a loss of shelter around the reef. Organisms dependent on these features will have a much less suitable habitat and recovery may not be possible or could be seriously impaired. The scale of effects will depend on the scale and frequency of any trawling operations. Damage will range from a decrease in the size of the reef, and a consequent decrease in the abundance and diversity of associated fauna, to a complete disintegration of the reef and its replacement with a low-diversity disturbed community (Fossa et al. 2000).*"[38]

Deep-sea bottom trawling along the continental margin generally involves towing a net directly along the bottom for up to several hours at a time during which the net and associated gear (otter boards or trawl "doors", cables, etc) are in almost continuous contact with the ocean bottom. Fishing on seamounts on the other hand, sometimes involves sweeping a net through the water column, targeting aggregations of fish that may be tens of meters or more above the surface of the seamount. However, a paper prepared for a UN FAO meeting on deep-sea fishing in the Southwest Indian Ocean by the Bureau of Rural Sciences, an independent scientific agency within the Department of Agriculture, Fisheries and Forestry – Australia, stated "Although aggregations may extend up to 100 m off the bottom, orange roughy typically exhibit a "dive-flight" response to approaching fishing gear and a bottom trawl net is needed to catch them."[39]

In a similar vein, Clark and Brodie state that both mid-water and bottom-trawl gear are used to catch orange roughy and other species associated with seamounts: "The commercial species associated with seamounts are targeted primarily with mid-water and bottom-trawl gear. It is generally accepted that a mid-water trawl net is generally of lighter construction and a higher headline height (i.e. size of net opening). Bottom trawl nets are acknowledged as being heavier than mid-water nets, with heavier ground chains, bobbins, and trawl doors, and with a lower headline height. However, while fishers seek to minimize damage or loss of gear, in practice there may be little difference between the two types of gear in terms of potential impacts on the seabed. The use of trawl nets, both mid-water and bottom-trawls, is not restricted or limited to use at their respective levels in the water column. Midwater nets can be placed on the seabed and used in bottom trawling fishing, and bottom trawl nets

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[36] Butler AJ, Koslow JA, Snelgrove PVR, Juniper SK, *Review of the benthic biodiversity of the deep sea.* CSIRO Marine Research, Australia 2001

[37] Op cit. 26, Koslow et al., *Continental Slope and deep-sea fisheries: implications for a fragile ecosystem.*

[38] Report of the Study Group on Mapping the Occurrence of Cold Water Corals. Advisory Committee on Ecosystems, International Council for the Exploration of the Sea. ICES CM 2002/ACE:05 Ref: E, WGECO May 2002

[39] Meeting Document 02/9 - *Predictive modeling of demersal fish distribution in the southern Indian and Southern Oceans*. Bureau of Rural Sciences Australia**.** UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean - Fremantle, Western Australia, 20-22 May 2002, FAO Fisheries Report No. 677, Rome, 2002. www.fao.org/DOCREP/005/Y3992E/y3992e00.htm#Contents

can be used to target fish slightly off the seabed. The result, from a management perspective, is that it is difficult to make any effective distinction between mid-water or bottom-trawl nets."[40]

As of yet, no comprehensive survey of the damage done to coral reefs and other vulnerable deep-sea bottom ecosystems has been conducted, in spite of the fact that bottom trawling on seamounts and along the continental margin has been taking place in some areas for the past several decades. In the Northeast Atlantic, according to the Advisory Committee on Ecosystems (ACE) of ICES, bottom trawling is very widespread throughout areas where Lophelia reefs are located. The ACE (2002) states "Photographic and acoustic surveys have recently located trawl marks at 200–1400 m depth all along the Northeast Atlantic shelf break area from Ireland, Scotland and Norway (Rogers 1999; Fosså et al. 2000; Roberts et al. 2000; Bett 2000). Any trawling over *Lophelia pertusa* is likely to cause harm"[41]

A number of recent surveys in the South Pacific and Tasman Sea, and the North Atlantic have demonstrated the clear and highly destructive impact of bottom trawl fishing on deep-sea coral structures. Hall-Spencer et al. identified clear evidence of bottom trawling in the form of 'scars' all along the continental margin off Ireland, Scotland and Norway in depths down to 1300 meters and widespread damage to cold-water coral reefs, some up to 4,550 years old, along the West Ireland continental shelf break and off West Norway. The authors reported that video surveys of deep-water coral systems off West Norway where bottom trawl fishing took place showed that these systems are "especially fragile and easily reduced to rubble by towed fishing gear".[42] The European Commission, in August 2003, promulgated emergency action to protect an area of approximately 100 square kilometers of deep-water coral structures known as the "Darwin Mounds", off the northwest coast of Scotland. The Commission prohibited bottom trawling in the area, a 'field' of hundreds of small seabed mounds (each averaging approximately 100 meters in diameter and 5 meters in height) containing coral structures in 1000 meters depth of water, stating that the coral structures show signs of damage resulting from bottom trawling and that "the conservation of the habitat in question is under serious threat" from continued bottom trawling.[43] In Norway, The Institute for Marine Research in Bergen estimates that between 30-50% of the cold-water coral within the Norwegian EEZ have been damaged by bottom trawl fishing.[44]

Koslow et al. documented severe damage from bottom trawl fishing for orange roughy to the coral cover of seamounts in a region inside the Australian EEZ, not far from the South Tasman Rise. The area they surveyed by video included a group of four seamounts, each 300-600 meters high. The authors found that unfished seamounts had extensive coral cover whereas on the heavily fished seamounts "data suggest that virtually all coral aggregate, living or dead, was removed by the fishery, leaving behind bare rock and pulverized coral rubble".[45]

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[40] The New Zealand Seamount Management Strategy - Steps Towards Conserving Offshore Marine Habitat. Stuart Brodie, Senior Policy Analyst, Ministry of Fisheries, Wellington, NZ, Dr Malcolm Clark, Principal Scientist, National Institute of Water of Atmospheric Research Ltd, Wellington, NZ 2003

[41] Report of the Study Group on Mapping the Occurrence of Cold Water Corals. Advisory Committee on Ecosystems, International Council for the Exploration of the Sea. ICES CM 2002/ACE:05 Ref: E, WGECO May 2002

[42] Hall-Spencer J, Allain V, Fossa J H, *Trawling damage to Northeast Atlantic ancient coral reefs.* Proceedings of the Royal Society of London, 2002

[43] Commission Regulation (EC) No 1475/2003 of 20 August 2003 on the protection of deep-water coral reefs from the effects of trawling in an area north west of Scotland. L 211/14. Official Journal of the European Union, 21.8.2003. For a good description of the Darwin Mounds, see the Southampton Oceanographic Centre website at: http://www.soc.soton.ac.uk/GDD/DEEPSEAS/darwinmounds.html

[44] Coral reefs in the North Atlantic? Article by Jan Helge Fosså, Institute of Marine Research, Norway on the website of the International Council for the Exploration of the Sea (ICES) http://www.ices.dk/marineworld/deepseacoral.asp

[45] Koslow J.A., Gowlett-Holmes K., Lowry J.K., O'Hara T., Poore, G.C.B., Williams A., *Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling.* Marine Ecology Progress Series Vol. 213: 111-125, 2001.

Of the two heavily fished seamounts surveyed, one had been trawled or towed 693 times, the other 3,069 times. The trawls were typically on the bottom for only 1-10 minutes per tow. However, given the speed at which the trawls are towed in the fishery, a single tow was believed to impact between 7,200 and 72,000 square meters, or approximately 0.1 to 2% of the surface area of a typical seamount in the region. Altogether, Australian Fisheries Management Authority datasets contain records of some 90,000 trawl shots since 1986 in which orange roughy were caught. The datasets cover fishing on seamounts as well as along the continental slope – it is not clear whether the number of trawl shots in the datasets exclusively targeting seamounts is known.[46]

Anderson and Clark of the National Institute of Water and Atmospheric Research in New Zealand documented the fact that large quantities of corals were taken as bycatch in the first year of the trawl fisheries for orange roughy on seamounts on the South Tasman Rise. The fishery targeted orange roughy on a ridge system and five small seamounts or 'hills' in an area straddling the boundary of the Australian EEZ and international waters south of Tasmania. Observers estimated a bycatch of approximately 1.6 tons of coral for each hour of towing a trawl net during the 1997-1998 fishing season – the first year of the fishery. They estimated a total of 1,762 tons of coral were brought up in the trawl nets in the 165 tows observed – averaging over 10 tons per tow. Observer coverage was estimated to be approximately 14.5% of the total number of tows in the fishery in the first year. Extrapolating from these figures, the fishery may have taken over 10,000 tons of coral in the first year of the fishery. This figure would not include coral damaged but not brought to the surface in the net. By contrast, the catch of orange roughy in this fishery was approximately 4,000 tons during the same period. The authors state that the trawl gear used in the fishery is "typically heavy duty, designed to cope with the rough and hard bottom often found on seamounts".[47]

Anderson and Clark state their belief that the South Tasman Rise fishery is the first orange roughy fishery where good data were collected on coral bycatch as the fishery first began and developed. They state that the extent of coral bycatch in other fisheries is not known but that there is considerable anecdotal evidence that large 'catches' of coral species took place in the early stages of orange roughy fisheries in the New Zealand region. Large catches of coral were reported from the Northwest Challenger Plateau fishery in the Tasman Sea and from small seamounts or hills in the Graveyard seamount complex on the Northwest Chatham rise. They stated that (emphasis added) "photographic surveys carried out recently on fished and unfished seamounts in this complex [the Graveyard seamount complex] **showed a very strong contrast in the distribution of coral species** (Clark and O'Driscoll 2003) **with close to 100% coral cover on unfished seamounts compared with only 2-3% coral cover on fished seamounts**."[48]

It is difficult to estimate the impact of bottom trawling on seamount ecosystems. The coral growth associated with seamounts appears to be concentrated on the upper portion and peak of a seamount.[49] Seamount trawling largely targets the peak and upper slope of seamounts. In some cases, bottom trawlers are not able to fish across the entire upper portion of a seamount, at least not with technology currently available, because some areas of the peak or upper slope may be too steep or rocky. Nonetheless, it appears that where

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[46] Op cit. 39, Meeting Document 02/9 - *Predictive modeling of demersal fish distribution in the southern Indian and Southern Oceans.* Bureau of Rural Sciences Australia**.** UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean.

[47] Anderson O.F., Clark M.R., *Analysis of the bycatch in the fishery for orange roughy, Hoplostethus atlanticus, on the South Tasman Rise.* Marine and Freshwater Research, 2003, 54 643-652. Table 5. CSIRO Publishing.

[48] Ibid pg 651. Also Clark M. and O'Driscoll R., *Deepwater Fisheries and Aspects of Their Impact on Seamount Habitat in New Zealand.* Journal of Northwest Atlantic Fishery Science, Vol 31: 151-163. 2003 http://www.nafo.ca/publications/Frames/PuFrJour.html

[49] Op cit. 45, Koslow et al. *Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling.*

seamounts that have been subject to intensive bottom trawl fishing have been surveyed, major damage to the corals and other benthic species has been observed.[50]

In a global review of deep-sea biodiversity prepared for the Australian government, Butler et al., state that the dominant fishes and many of the corals and other species associated with seamounts and underwater ridges "have very long lives and highly variable recruitment; these life-history characteristics render them exceptionally vulnerable to overfishing and incidental damage by fishing techniques." In discussing the threats to these species and ecosystems, the authors conclude:

"The most immediate threat is from bottom-contact fishing, for both fish and corals. Over the past fifty years, seamount fisheries have developed over much of the world's oceans. Most have not been managed for sustainability, and indeed given the life-histories of the fishes it may not be possible to manage them in an ecologically (and also economically) sustainable manner. The process of fishing severely damages the non-target benthos. Unregulated fishing is continuing on newly-opened grounds on ridges in the Indian Ocean. There is no information about the biodiversity there, but from biogeographic patterns elsewhere there is reason to assume that there is high and unique benthic biodiversity, which will be destroyed by unregulated fishing." [51]

Again, as mentioned earlier, some of these reef structures are very old and therefore highly susceptible to very long term, if not irreversible, damage from bottom trawling. Echoing the assessment of Butler et al., the Southampton Oceanographic Centre in the UK states that deep-sea coral reefs in the Northeast Atlantic observed today are probably at least 10,000 years old and are under threat from deep-sea fishing, which occurs in many areas known to contain deep-sea coral ecosystems.[52] In addition to photo-documentation of the damage done to the coral structures which form the Darwin Mounds off the Scottish coast, the DEEPSEAS group of the Southampton Oceanographic Centre has also documented the damage caused by fishing to the corals associated with giant carbonate mounds southwest of Ireland. These mounds can be over 200 meters high and 1000 meters across at the base and are found in 800 meters depth along the continental margin in an area known as the Porcupine Seabight.[53]

The International Council for the Exploration of the Seas (ICES) established the Advisory Committee on Ecosystems (ACE) in 2000 as the Council's official body for the provision of scientific information and advice on "the status and outlook for marine ecosystems, and on exploitation of living marine resources in an ecosystem context".[54] At the request of the Helsinki Commission, the OSPAR Commission and the Directorate General for Fisheries of the European Commission, the ACE issued a report, in December 2002, on the impact of fishing on cold-water corals, among other environmental issues related to fisheries.

[50] Ibid. Also Clark and O'Driscoll, *Deepwater Fisheries and Aspects of Their Impact on Seamount Habitat in New Zealand*. Op cit. 48.
[51] Op cit. 36, Butler et al., *Review of the benthic biodiversity of the deep sea.*
[52] http://www.soc.soton.ac.uk/GDD/DEEPSEAS/coralecosystems.html
[53] Trawling Impacts on Deep-Sea Coral Ecosystems
http://www.soc.soton.ac.uk/GDD/DEEPSEAS/trawlingimpactcoral.html
[54] Section 4.4.1 "Deep-water Biogenic Habitats". Report of the ICES Advisory Committee on Ecosystems, 2002. ICES Cooperative Research Report No. 254. International Council for the Exploration of the Sea, December 2002. pg 32.

The report states (emphasis added):

*"Recent information shows that deep-water trawling does take place in deep-water biogenic habitats. Any fishing gear physically impacting these habitats, by direct contact or by indirect effects such as wash or sedimentation, will cause an effect and therefore give rise to cause for concern...**There is sufficient information to suggest that the most effective way of mitigating the effect of trawling on these habitats is to close such areas to fishing**."*

The ACE report also addressed the impact of other types of fishing gear on cold-water corals. Under the heading 'Set nets' in Section 4, the report states that "Evidence has been found of damage from gillnets on deep-water biogenic habitats...although the damage does not appear to be as extensive as that caused by towed gear". On the subject of bottom longline fishing, the report states "These fishing techniques take place in deep-water biogenic habitats for certain species. Although lost lines have been observed on video surveys of coral areas, no evidence of actual damage has been found. Damage may occur, however, through entanglement and subsequent breakage of coral formations. At this point, there is not sufficient information available to suggest that demersal longlining should be prohibited in deep-water biogenic habitats, but further data are required."[55]

The report concludes that bottom trawling is the most serious threat to cold-water corals and recommends the following: "**ICES advises that the only proven method of preventing damage to deep-water biogenic reefs from fishing activities is through spatial closures to towed gear that potentially impacts the bottom**."[56]

Recalling the discussion in the previous section concerning the degree of vulnerability of deep-sea ecosystems, it is in this context that Roberts concluded, in relation to seamount fisheries, "Many species, it seems, have extremely limited geographical distributions and are restricted to closely spaced ranges of underwater peaks. The potential for trawl damage to cause extinctions is high".[57]

2.4 SCIENTISTS' STATEMENT TO THE UNITED NATIONS GENERAL ASSEMBLY

In light of the above considerations, over 100 scientists participating in the 10th Deep-Sea Biology Symposium and the 2nd International Symposium on Deep Sea Corals signed a statement to the United Nations General Assembly expressing concern over the impact of fishing on deep-sea biodiversity and calling for a moratorium on deep-sea trawling on the high seas.[58] The "Statement of concern to the United Nations General Assembly regarding the risks to seamounts, cold-water corals and other vulnerable ecosystems of the deep-sea" reads:

We, the undersigned, discussed anthropogenic threats to deep-sea biodiversity and ecosystems in light of the request by the UN General Assembly...to `consider urgently' the risks to the biodiversity of seamounts, cold-water corals and other deep-sea ecosystems. We concluded the following:

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[55] Ibid. pg 32-33
[56] Ibid. pg 28
[57] Roberts C. M., *Deep impact: the rising toll of fishing in the deep sea* TRENDS in Ecology & Evolution. Vol. 17 No.5 May 2002.
[58] The "Statement of concern to the United Nations General Assembly regarding the risks to seamounts, cold-water corals and other vulnerable ecosystems of the deep-sea" was transmitted to the UN Secretary General and a variety of UN agencies and organizations on 7 October 2003 by Professors Hjalmar Theil, Andre Freiwald and Robert George on behalf of the signatories. The 10th Deep-Sea Biology Symposium was hosted by the Institute of Marine Biology, University of Oregon, Coos Bay Oregon, USA 25-29 August 2003. The 2nd International Symposium on Deep Sea Corals was hosted by the Institute of Palaeontology, University of Erlangen, Germany on 9-12 September 2003.

** populations of numerous commercially important species of deep-sea fish and precious corals associated with seamounts, ridges, plateaus, continental slopes, coral reefs and sponge fields in the deep sea have been serially depleted by fishing;*
** benthic habitats and communities have been severely damaged by fishing activities;*
** the biological characteristics of most deep-sea species render the deep sea particularly sensitive to anthropogenic disturbance and exploitation;*
** although knowledge of deep-sea biodiversity is limited, evidence to date suggests that deep-water habitats such as coral, seamount, seep and vent ecosystems are likely to harbour distinct assemblages of diverse and highly endemic species.*

In conclusion, the scientists stated that: "the conservation and protection of the biodiversity of the deep sea is the responsibility of all nations, in particular on the global ocean commons – the high seas" and recommended, amongst other actions, that:

"*the UN General Assembly should adopt a moratorium on deep-sea bottom trawl fishing on the High Seas effective immediately*"

In a similar vein, a statement released in February 2004, sponsored by the Marine Conservation Biology Institute and signed by 1,136 scientists, expressed 'profound concern' that "human activities, particularly bottom trawling, are causing unprecedented damage to the deep-sea coral and sponge communities on continental plateaus and slopes, and on seamounts and mid-ocean ridges." The *Scientists' Statement on Protecting the World's Deep-sea Coral and Sponge Ecosystems* asserts that the greatest human threat to coral and sponge communities is commercial fishing, especially bottom trawling and concluded by urging "the United Nations and appropriate international bodies to establish a moratorium on bottom trawling on the High Seas."[59]

[59] Scientists' Statement on Protecting the World's Deep-sea Coral and Sponge Ecosystems. http://www.mcbi.org/DSC_statement/sign.htm

SECTION 3
CURRENT STATUS OF DEEP-SEA BOTTOM TRAWL FISHERIES ON THE HIGH SEAS

As discussed in the previous section, clearly bottom trawl fishing is a threat to coral ecosystems associated with seamounts, ridges, hills, banks, pinnacles and other features found along the continental margins and in other deep-sea areas. The problem occurs in deep-sea bottom fisheries both within national waters and on the high seas beyond countries' 200 nautical mile limits.

The majority of deep-sea bottom trawl fishing worldwide currently appears to occur within national waters. Bottom trawl fishing within EEZs is an issue that must be addressed by the relevant coastal states concerned. However, significant deep-sea bottom trawl fisheries do occur on the high seas. As stated in the introduction, the focus of this paper is on high seas bottom trawl fisheries and their impacts on the diversity of vulnerable deep-sea ecosystems.

Precise information on bottom trawl fishing on the high seas, the value of the catch and the proportion of the catch taken by fishing fleets of different nationalities in various parts of the world are not easily or readily available. As mentioned in the Introduction, the United Nations Food and Agriculture Organization, in its Report on the State of World Fisheries and Aquaculture 2002, states: "It is difficult to assess the development of fishing on the high seas because reports to the FAO of marine catches make no distinction between those taken within EEZs and those taken on the high seas."[60]

Amongst the many problems encountered in attempting to determine the extent of bottom trawl fishing on the high seas are that official statistics rarely distinguish between fish caught on the high seas and those caught within EEZs, nor is a distinction often made between fish caught by bottom trawling and other types of fishing gear such as bottom longlines and gillnets. There are also serious problems with under-reporting of catches and the pervasive problem of illegal, unreported and unregulated (IUU) fishing in many high seas areas, often involving vessels flying flags of convenience.

Nonetheless, a review of available catch and market data can provide an indication of the countries currently involved in bottom trawl fisheries on the high seas, and a rough estimate of the volume and value of the high seas catch. It would appear that the majority of the deep-water bottom trawl fishing on the high seas takes place in the North Atlantic Ocean, the Southern Indian Ocean, and the Southwest Pacific Ocean adjacent to the Australian and New Zealand EEZs.

Reasonably good information exists on catches of deep-water species and the extent of bottom trawl fishing on the high seas in the Northwest Atlantic. Similar information, though to a much lesser degree of detail or accuracy, is available for the Northeast Atlantic. In both areas, information on catches on the high seas is compiled by regional fisheries management organizations. However, the area of application of the two organizations - the Northwest Atlantic Fisheries Organization and the Northeast Atlantic Fisheries Commission – extends from approximately 35 degrees north latitude to the Arctic Circle. Very little information exists on high seas bottom fisheries in the North Atlantic south of 35º north latitude.

Some information exists on high seas fishing in the Southwest Indian Ocean as a result of recent efforts to establish regional fisheries management organization to regulate the deep-sea fisheries that have developed over the past several years in the region. There is reasonably detailed information on deep-water fishing on the high seas of the Southwest

[60] Op cit. 7, The State of World Fisheries and Aquaculture 2002. Page 13, Box 3.

Pacific from New Zealand and Australian government sources and scientists working in the region.

In addition to the abovementioned areas, there are substantial deep-sea fisheries in the Southern Ocean around Antarctica. There is good catch information for the Southern Ocean fisheries from countries that officially report the catch by vessels flying their flags. However, there is a serious problem of illegal, unreported, and unregulated (IUU) fishing in the area. Even so, it would appear that virtually all deep-sea bottom fishing on the high seas of the Southern Ocean involves bottom longline fishing, not bottom trawling.
Elsewhere there is very little information on bottom trawl fishing on the high seas that is easily or readily attainable.

Data for the year 2001, the latest year for which catch and market data are consistently available, provides a 'snapshot' of the recent extent and value of high seas bottom trawl fisheries. The following section will outline a brief history of the development of deep-sea bottom trawl fisheries for each of the main high seas fishing regions mentioned above and attempt to estimate the catch, the value of the catch, the numbers of countries and vessels involved in recent years, and identify trends in the fisheries, that is whether they are likely to expand or contract in coming years.

3. 1 SOUTHWEST INDIAN OCEAN

Deep-water trawl fishing has taken place over the past several decades on the high seas of the Southwest Indian Ocean region, with exploratory surveys conducted by vessels from the Soviet Union beginning in the 1970s. Russian and Ukrainian vessels conducted periodic deep-water trawl research cruises on a commercial scale throughout the 1980s and 1990s with catches ranging from a high of 6,029 metric tons (mt) of deep-water species in 1980 to a low of only 10 mt in 1990. Throughout the 1990s, one to three Ukrainian vessels operated on the high seas each year with each vessel fishing only part of the year. Catches in 1996 reached a peak of some 3,500 mt, involving two vessels fishing for a total of 193 days.[61]

Over the last several years however there was a major increase in deep-water trawling on the high seas. The UN FAO Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean provides information on deep-sea fisheries in the international waters of the Southwest Indian Ocean.[62] In 1998, the total high seas catch was reported as 1,622 mt (a single Ukrainian vessel targeting alfonsino). In 1999, the discovery of orange roughy stocks by vessels from New Zealand led to a marked increase in deep-water fishing in the region (although deep-water trawlers from both New Zealand and Australia were reportedly fishing in the region several years prior to 1999).[63] The catch in 1999 reportedly jumped to14,525 mt (of which 5,210 mt were orange roughy). By 2000, the total catch of deep-water species reached an estimated 39,412 mt, of which 12,218 mt were orange roughy.[64]

The dominant bottom fisheries on the high seas of the Southwest Indian Ocean over the past several years have been for alfonsinos (*Beryx spp.*) and orange roughy (*Hoplostethus atlanticus*). Other deep-water species caught in these fisheries include black oreo (*Allocyttus niger*), spiky oreo (*Neocyttus rhomboidalis*), smooth oreo (*Pseudocyttus maculatus*),

[61] Appendix III, Meeting Document 02/7 – Past USSR – Ukrainian Fishing Survey and Exploratory Activities; Table 2: Catch statistics of Soviet/Ukrainian vessels on Southwestern Indian Ridge Seamounts (FAO Statistical Areas 51.01 and 51.02). UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39.
[62] UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39
[63] Ibid: Country Reports, paras 20 and 31.
[64] Ibid: Availability of Catch Data, para 60.

cardinalfish (*Epigonus telescopus*), blue-eye trevalla or bluenose (*Hyperoglyphe antarctica*) and boarfish or pelagic armourhead (*Pseudopentaceros richardsoni*). Deep-water trawlers target either orange roughy or alfonsinos and take a combination of a number of the other species, as well as deep-water sharks, as bycatch. These fisheries are bottom trawl fisheries, which take place on deep-water seamounts, ridge systems and other underwater features (e.g. shoals, escarpments) in the international waters of the Southwest Indian Ocean.

The data in the UN FAO report on high seas catches in1999 - 2001 is based on reporting from 8 countries - Australia, South Africa, Ukraine, Namibia, Seychelles, New Zealand, Japan, and France (with France and the Seychelles stating no vessels from their countries fished on the high seas). However, the report states that the catch data is provisional, based on reported and "inferred' information, and is likely to be considerably lower than the actual catch during this period. The report states that vessels from Cook Islands, Taiwan - Province of China, Korea, Belize, Spain, Portugal, Argentina and Chile were believed to have been fishing in the region but none of these countries provided any catch data to the UN FAO meeting, nor did the European Union. Altogether, forty-nine vessels were believed to have operated in the deep-water fisheries on the high seas between 1999 and 2001, though not all 49 vessels fished in all three years. The depletion of these fisheries was documented in the fishing industry press and acts as a graphic illustration of the speed at which deep-sea fish populations, particularly in unregulated areas of the high seas, can be depleted.

ROUGHY BONANZA IN INDIAN OCEAN![65]
Fishing News International May 2000

"Up to 40 freezers trawlers could be joining in an orange roughy bonanza now developing on newly discovered seamounts spreading over a huge area of the Indian Ocean...

Catches of up to 100 tonnes a day of orange roughy and alfonsino are being taken by the dozens of freezer ships already on the seamounts which are mostly outside national limits.

Ships from Namibia, New Zealand and South Africa are already on the grounds, while others are expected from as far away as Russia and China... Spanish freezer trawlers are being offered for sale to owners seeking to join-in the fishery.

The fishing effort is expected to build up on the seamounts this month and during June and July… However, owners working in or planning to target this fishery are not willing to discuss their operations"

This high seas fishery was virtually unregulated, and difficulties in obtaining catch data are exemplified by the case of the European Union. The report states:

30. No data for deepwater species taken by EU vessels had been reported to the [European] *Commission, despite the obligation to do so and the belief that EU trawlers had been operating in the study area. It was noted that such data have been requested but have not been forthcoming. It was noted that probably the greatest chance of obtaining the data lay in direct contacts with those concerned, as there was little more the* [European] *Commission could do to ensure compliance.*

In 2001, only eight vessels reportedly participated in the fishery, though more were thought to have been involved. By 2002, fishing activity seems to have declined even further. An article from Fishing News International from August 2002 entitled "Half-dozen on Seamounts" reported that "Only half-a-dozen trawlers are still operating in the Indian Ocean Seamount fishery…. The trawlers are doing the rounds of about 100 seamounts in the area taking some

[65] Fishing News International. Vol. 39 No. 5. May 2000

alfonsino but catches of orange roughy are reported at about only 300 tonnes in the past 3-4 months. The fleet comprises, Will Watch, Niko Maru, Bell Ocean I & II, Austral Leader, Southern Champion and a Japanese trawler. Russian trawlers have also been reported coming and going from this fishery".[66] It is worth noting that the time of year referred to in the article corresponds to the main fishing season for orange roughy as this the spawning season.

It appears that 2000 was the peak year of fishing activity after which catch rates fell dramatically. This, combined with anecdotal reports that many vessels involved in the fishery in 2000 did poorly because of lack of experience, prompted most vessels to abandon bottom trawl fishing on the high seas of the Southwest Indian Ocean, at least for the time being.

High Seas catch 2001

Catch data for 2001, the last year for which figures are available, were reported from a total of 8 vessels operating in the region that year. Japan reported that two stern trawlers (each approximately 1150 GRT) began fishing in the region in 2001 targeting alfonsinos. The two vessels had a combined catch of 4,143 mt in 2001, including alfonsinos (2,904 mt), orange roughy (410 mt) and oreos.[67] In spite of substantial catches, they reportedly left the fishery in April 2002, partly because of the uneconomical nature of the fishery as a result of the low market price for their catch in Japan.[68] A Ukrainian vessel operating in 2001 took a total of 810 mt, primarily alfonsinos and C*entrolophidae* (rudderfish or medusafishes). It left the fishery at the end of 2001 and was subsequently scrapped. Two New Zealand vessels caught at least 1400 mt in 2001. The FAO Report does not identify the catch by country for the remaining 1,600 mt caught in 2001, but it would appear, based on country reports provided to the UN FAO meeting, that a substantial portion was taken by one or more Australian vessels.[69]

As of 2002, there appear to be very few vessels fishing in the region. The number of six or so vessels obtained from industry sources as reported by Fishing News International is consistent with the information contained in the UN FAO Report from April 2002. Of these it appears that Australian and New Zealand vessels dominate what is left of the deep-sea fishery.

Catch and Value of the high seas bottom trawl fishery 2001

Given the prominent role played by New Zealand in developing the seamount fisheries in the Southwest Indian Ocean, the port price for orange roughy, alfonsino, oreos and other deep-water species in New Zealand could be used to give an indication of the landed value of the bottom trawl fishery on the high seas of the Southwest Indian Ocean for 2001 – the last year for which catches have been reported.

[66] Fishing News International. Vol. 41 No. 7. August 2002.
[67] Meeting Document 02/5: A Summary of Japanese Trawl Fishery Newly Developed in the Southwest Indian Ocean (FAO Area 51). Annex III. UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39
[68] Ibid. Country Reports, para 36.
[69] Ibid. Country Reports and Appendix III.

Total reported catch in 2001	Approximate Value in US Dollars[70] (based on NZ port price)
Orange Roughy[71] - 1,568 mt	$ 3,092,096
Alfonsino[72] – 3,470 mt	$ 2,690,181
Oreo[73] – 357 mt	$ 138,873
Cardinalfish[74] – 405 mt	$ 92,745
Bluenose[75] – 28 mt	$ 35,000
Misc (incl boarfish)[76] – 2,134 mt	$ 2,214,884
Subtotal:	**$ 8,263,779**

UN FAO statistics indicate that in 2001, China caught 710 mt of orange roughy and 180 mt of oreo dories, Russia caught 210 mt of alfonsinos, and Spain caught at least 12 mt of deep-sea fish (primarily alfonsinos and boarfish) in the Southwest Indian Ocean (FAO Statistical Area

[70] Exchange rate for the New Zealand dollar to the US dollar used for these calculations is: 1 NZ$ = US$ 0.4218 based on calculation of the average rate of exchange between NZ$ and US$ during 2001 by Oanda.com. http://www.oanda.com/

[71] Orange Roughy port price NZ$ per ton: ORH 1 - 4,810.00; ORH 10 - 4,280.00; ORH 2A - 4,370.00; ORH 2B - 4,750.00; ORH 3A - 4,900.00; ORH 3B - 4,280.00; ORH 7A - 5,080.00; ORH 7B - 4,940.00. Average port price = NZ$4676 per ton, equivalent to US$1972 per ton. This is not an entirely accurate calculation of the average port price paid for Orange Roughy in New Zealand. To make such a calculation, the landed tonnage per port as a percentage of the overall tonnage of landings in the country would need to be factored into the equation to provide the relative weight given to the price information from each of the ports in calculating an overall average port price for the country – the author was unable to obtain this information. Furthermore, the port price is a nominal value and actual price fluctuates depending on market conditions. However, the above 'average' gives a reasonable approximation of the landed value of the orange roughy catch in New Zealand in 2001. The same applies to the price calculations for the other species in this section based on New Zealand port price information. Source: The New Zealand Seafood Industry Council - www.seafood.co.nz/doclibrary/seaficgen/PortPrices99_01.PDF. Appendix Two: Port Price Survey Data, 2001.

[72] Ibid Alfonsino port price NZ$ per ton 2001: BYX1 - 1,710.00; BYX10 1,710.00; BYX2 - 1,790.00; BYX3 - 1,930.00; BYX7 - 1,940.00; BYX8 - 1,950.00. Approximate average port price 2001 = NZ$ 1838 per ton, equivalent to $775 USD.

[73] Ibid Oreos port price NZ$ per ton 2001: OEO1- 930.00; OEO10 - 910.00; OEO3A - 910.00; OEO4 - 930.00; OEO6 - 930.00. Average port price = NZ$ 922 per ton, equivalent US$ 389 per ton.

[74] Ibid Cardinal Fish port price NZ$ per ton 2001: CDL1 - 640.00; CDL2 - 610.00; CDL3 - 600.00; CDL4 - 580.00; CDL5 - 520.00; CDL6 - 450.00; CDL7 - 600.00; CDL9 - 450.00; CDL10 - 450.00 Average port price = NZ$544 ton, equivalent to $229 USD ton.

[75] Ibid Bluenose port price NZ$ per ton 2001: BNS1 - 3,150.00; BNS10 - 2,680.00; BNS2 - 2,680.00; BNS3 - 3,350.00; BNS7 - 2,790.00; BNS8 - 3,140.00. Average port price = NZ$ 2965 per ton, equivalent US$ 1250 per ton.

[76] Assuming that the value of the remaining 2,134 mt (2,089 mt listed as miscellaneous and 45 mt boarfish) representing approximately 27% of the weight of the total reported catch on the high seas did not exceed, in value, the average port price per ton of the other species listed above, this would give a value of $2,214,884 USD. This 'miscellaneous' catch – most likely retained bycatch – was probably worth less, on a per ton basis, than the orange roughy, alfonsino and other species targeted in the fishery.

51).[77] Although no distinction is made between catches within EEZs and those on the high seas in the UN FAO database, presumably this catch came from bottom trawl fishing on the high seas. Assuming that this catch was not included in the compilation of catch data in the UN FAO report from April 2002, calculating the value of this catch using the same approach for the species listed above would add an additional $1,642,190 USD to the value of the catch in the Southwest Indian Ocean bringing the total to approximately $9,905,969 USD.

On the assumption that that there were a number of countries which did not report the high seas bottom trawl catch of their flag vessels operating in the region (as was the case in 2000), the amount of the unreported catch or the catch not "inferred" in the UN FAO Report could be as high as 50% of the total listed in the report, this would give an estimate of approximately US$15 million for the value of the high seas bottom trawl catch of deep-water species in the Southwest Indian Ocean in 2001.[78] Given the trends reported in the fishing industry press, the figure for the catch and the value of the fishery in 2002 would likely be much lower.

For the purpose of comparison, the overall reported catch for all species in the Western Indian Ocean (FAO statistical area 51) was 3,948,676 mt in 2001.[79] The 7,962 mt of fish reported caught by bottom trawl on the high seas, plus the 1,112 mt reported in the UN FAO database, represents slightly less than 0.25% or one-quarter of one percent of the total marine catch of fish in the region.

3.2 NEW ZEALAND, AUSTRALIA AND THE SOUTHWEST PACIFIC OCEAN

Trawl fleets from the former Soviet Union began fishing for deep-water species on the high seas in the Southwestern Pacific in the early1970s. They took orange roughy, blue grenadier, oreos and other deep-water species throughout the 1970s and early to mid 1980s. At the same time, New Zealand first developed deep-water trawl fisheries for orange roughy inside its exclusive economic zone in the late 1970s, while in Australian waters, deep-water fishing for orange roughy began in the latter half of the 980s.[80]

According to the UN FAO dataset for Statistical Area 87 covering the EEZ off the east coast of Australia, all of New Zealand and a large area of the Southwest Pacific Ocean including the Tasman Sea (but not the South Tasman Rise), catches of orange roughy by Australia peaked at 37,901 mt in 1990, declining to 16 mt in 2001. The New Zealand fishery peaked at 55,361 mt in 1988, declining to 14,044 mt in 2001. In addition to orange roughy, New Zealand has developed several other deep-water bottom trawl fisheries including fisheries alfonsinos and oreos, with an annual catch of the latter between 14,000-23,000 mt since 1980.[81]

The orange roughy fisheries off the southern and western coasts of Australia began in the late 1980s. With the exception of 1989 and 1990, catches remained low through most of the 1990s. The orange roughy fishery increased dramatically in 1998 corresponding to the

[77] UN FAO Fishstat: Capture Production 1950-2001. FAO Fisheries Department, Fishery Information, Data and Statistics Unit. FISHSTAT Plus: Universal Software for fishery statistical time series. Version 2.3. 2000. United Nations Food and Agriculture Organization. http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp Hereinafter referred to as "UN FAO Fishstat"

[78] For example, the UN FAO Report states that a Korean vessel was reported to be conducting "survey fishing" in 2001 and 2002 and targeting orange roughy. Review of Research Cruises in the Study Area, paragraph 90. UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39

[79] UN FAO Yearbooks of Fishery Statistics, Summary Tables – 2001. Fish, crustaceans, mollusks, etc. – World Capture Production. ftp://ftp.fao.org/fi/stat/summ_01/a1a.pdf

[80] UN FAO Fishstat. Pacific, Southwest (Area 87) – 2001. Op cit. 77

[81] Ibid. Indian Ocean, Eastern (Area 57) – 2001.

development of an orange roughy fishery off southern Tasmania. The catch fluctuated between 5,000 and 7,500 mt in 1998-2000; the catch of orange roughy in 2001 was 5,145 mt.

Currently, New Zealand and Australia dominate the deep-water trawl fisheries in the region on the high seas. The primary areas of international waters where deep-sea bottom trawl fisheries take place are the Louisville Ridge, some 600 kilometers east of the New Zealand EEZ, the South Tasman Rise adjacent to the southern portion of Australia's EEZ (south of Tasmania) and two areas in the Tasman Sea - the Northwest Challenger plateau and the Lord Howe Rise - west of New Zealand's EEZ.

The expansion of the fisheries into international waters began in the late1980s with the development of the orange roughy fishery on the high seas in the Tasman Sea in 1988, followed by the fishery on the Louisville Ridge beginning in 1993 and the South Tasman Rise fishery, which first developed in 1997.[82] New Zealand and Australian vessels dominated these high seas fisheries although vessels from other nations such as Norway, Japan, Korea, Belize and Panama participated at various points over the years.[83]

The orange roughy fisheries in international waters have typically followed the same pattern of sequential depletion as noted earlier in this paper. For example, the New Zealand fishery on the Louisville Ridge on the high seas east of the New Zealand EEZ peaked in 1994/95 at over 11,000 mt, declining to 1,363 mt in the 2000/01 season.[84]

[82] Op cit. 39, Meeting Document 02/9 - *Predictive modeling of demersal fish distribution in the southern Indian and Southern Oceans*. Bureau of Rural Sciences Australia**.** UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean

[83] Clark, M.R.; O'Driscoll, R.L (2002). *Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986-87 to the end of the 2000-01 fishing year*. New Zealand Fisheries Assessment Report 2002/59. December 2002.

[84] Clark M.R.; Anderson O. F. (2003), *The Louisville Ridge orange roughy fishery: an analysis of commercial catch-effort data and stock assessment of the fishery to the end of the 2000-01 fishing year*. New Zealand Fisheries Assessment Report 2003/3. February 2003.

High seas bottom trawl catch in 2001

For the fishing year 2001 (October 2000-September 2001), approximately 3,853 tons orange roughy was taken from the Tasman Sea and the Louisville Ridge by Australian and New Zealand vessels. The break down of the catch is as follows:

Area[85]	New Zealand catch orange roughy 2001	Australia catch orange roughy 2001	Total 2001 (both countries combined)
Tasman Sea: Lord Howe Rise & NW Challenger	1095	565	1660
South Tasman[86] Rise			830
Louisville Ridge	1,363	None	1,363

A further 195 mt of orange roughy was reportedly taken by Ukraine and 47 mt by South Korea, presumably on the high seas, bringing the total reported high seas catch of orange roughy in 2001 to 4,095 mt.[87]

Value of the high seas bottom trawl fishery in 2001

The most approximate means of calculating the ex-vessel price for deep-sea species would be to base it on the declared port price in New Zealand. The port price in New Zealand varies depending on the Quota Management Area (QMA) where the fish was caught and landed, but the figure (as calculated previously in the section on the SW Indian Ocean) of NZ $4,676 per ton as the average port price throughout the country for orange roughy in 2001 would be equivalent to US$1,972 per ton.[88] The total value of the reported high seas catch of orange roughy in the SW Pacific Ocean and Tasman Sea in 2001 would thus be in the vicinity of US$ 9,221,072.

The only other catch of deep-sea species reported on the high seas was 270mt of oreos in the South Tasman Rise fisheries. Using the same approach as was used in the previous

[85] Information on the Tasman Sea and South Tasman Rise fisheries: Table 2 and Table 16, Clark, M.R.; O'Driscoll, R.L (2002). Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986-87 to the end of the 2000-01 fishing year. New Zealand Fisheries Assessment Report 2002/59. December 2002. Information on the Louisville Ridge fishery: Table 3, Clark M.R., Anderson O.F. (2003). The Louisville Ridge orange roughy fishery: an analysis of commercial catch-effort data and stock assessment of the fishery to the end of the 2000-01 fishing year. New Zealand Fisheries Assessment Report 2003/3. February 2003. Strictly speaking the catch information does not cover the calendar year Jan-December 2001. In the paper by Clark and O'Driscoll, they state: "The fishery on the South Tasman Rise (STR) has been managed on the basis of quotas set from 1March–28 February. Therefore, where fishing year is referred to *for the Tasman Rise fishery*, it covers that period, and hence is not comparable with the New Zealand fishing year of October–September (used for Lord Howe Rise and Northwest Challenger fisheries), nor with calendar year figures…". However, for the purpose of this report, they will be used as the basis for deriving an indicative figure for the catch in 2001.

[86] In 2002, the high seas catch of orange roughy on the South Tasman Rise dropped to 190 mt. The author was unable to obtain catch data for the other high seas fisheries for orange roughy in 2002

[87] UN FAO Fishstat - Area 81, 2001. Op cit. 77

[88] See footnote 71 for the calculation of the port price for orange roughy.

section, the value of the oreo catch on the high seas would be approximately US$ 131,820.[89] This would put the total value of the high sea fisheries for deep-water species in the region in 2001 at approximately US$ 9.35 million.

No data is available on the catch for other countries such as China. The FAO indicates that the last year that Russia reported orange roughy catches in the SW Pacific was in 1991. In reference to Russia and China, Clark and Anderson indicate that both countries were fishing in the region recently and state "The size of [Russian and Chinese] vessels, as indicated by their gross tonnage, decreased markedly in 1998-99 and dropped again for 2000-01".[90]

The overall reported marine catch of all species in the Southwest Pacific (FAO statistical area 81) in 2001 was 750,967 mt. The figure of 4,095 mt for the high seas catch of orange roughy and oreos represents about 0.6% of the total marine catch in the Southwest Pacific.

[89] Oreo: port price approximately NZ $830/mt, reported NZ/Aus high seas catch on South Tasman Rise 270 mt: NZ $224,000 = $131,820 USD).

[90] Op cit. 84, Clark and Anderson. The Louisville Ridge orange roughy fishery: an analysis of commercial catch-effort data and stock assessment of the fishery to the end of the 2000-01 fishing year.

3.3 NORTHEAST ATLANTIC OCEAN

Deep-water fisheries in the Northeast Atlantic Ocean date back over a century. Swedish fishermen developed offshore deep-water longline fisheries in the 1860s. In Southern Europe, there are still traditional 'dropline' fisheries still practiced today around the Azores and Madeira Islands for deep-water species such as black scabbardfish. However, most deep-water fisheries in the Northeast Atlantic developed after World War II.[91] Soviet and Eastern European fleets developed deep-water trawl fisheries in the international waters of the Northeast Atlantic along the Mid-Atlantic Ridge and to the west of Rockall Plateau and the Hatton Bank for roundnose grenadier and alfonsino in the 1960s and 1970s. German and French vessels developed deep-water bottom trawl fisheries for blue ling in the 1970s. In 1989, as a result of a French marketing initiative, a number of deep-water species such as roundnose grenadier, black scabbardfish and deep-water sharks, that had previously been caught as bycatch and discarded in substantial quantities in the trawl fishery for blue ling, were retained and marketed. Deep-water trawling rapidly expanded in the Northeast Atlantic in the 1990s, with fleets from Spain, Ireland, the Faroe Islands, Scotland, England, Iceland and Norway developing fisheries for these same species and others such as orange roughy and smoothheads.[92]

The main species caught in deep-water bottom fisheries in the Northeast Atlantic Ocean are the following: Roundnose grenadier (*Coryphaenoides rupestris*), smoothheads (*Alepocephalus* spp.), black scabbardfish (*Aphanopus carbo*), blue ling (*Molva dypterigia*), forkbeards (*Phycis* spp.), ling (*Molva molva*), orange roughy (*Hoplostethus atlanticus*), black-spot seabream (*Pagellus bogaraveo*), tusk (*Brosme brosme*), monkfish (*Lophius* spp.), Greenland halibut (*Reinhardtius hippoglossoides*), alfonsinos (*Beryx splendens* and *B. decadactylus*), argentines (*Argentina silus*), chimaeras or rabbit fish (*Chimaera* spp.) and deep-sea sharks. [93]

In a recent report on the status of deep-water fisheries, the Advisory Committee for Fisheries Management (ACFM) of the International Council for the Exploration of the Sea (ICES) states that there are bottom trawl fisheries in international waters along the mid-Atlantic Ridge for orange roughy, roundnose grenadier, and black scabbard fish and considerable exploratory fishing involving both trawl and longline fisheries on Hatton Bank, in the international waters west of Scotland and Ireland.[94] The report specifically mentions a developing fishery for smoothheads in this area, previously a discard species in bottom trawl fisheries for roundnose grenadier and blue ling. The "mixed species" bottom trawl fishery for roundnose grenadier, blue ling, smoothheads, black scabbard fish and deep-water sharks produces the bulk of the catch of deep-sea bottom trawl fisheries on the high seas of the Northeast Atlantic.[95] These species are taken together, in varying proportions, in fisheries whose primary target is often

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[91] Op cit. 26, Koslow et al., *Continental Slope and deep-sea fisheries: implications for a fragile ecosystem.*

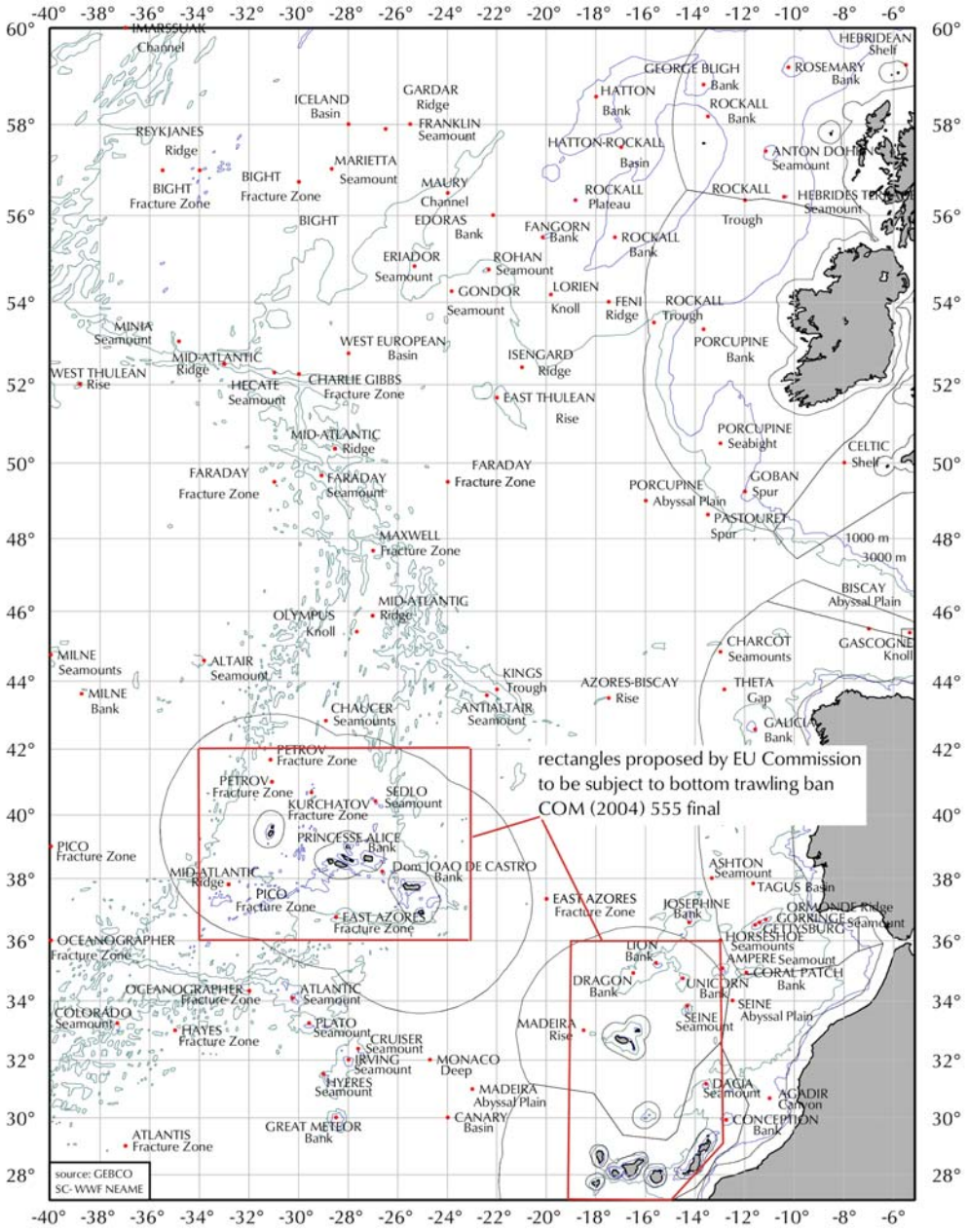
[92] J.D.M. Gordon. *Deep-water fisheries at the Atlantic Frontier*. Continental Shelf Research 21 (2001). 987-1003. Also, Gordon, J. D. M., O. A. Bergstad, I. Figueiredo, and G. Menezes. Deep-water Fisheries of the Northeast Atlantic: I. Description and Current Trends. Journal of Northwest Atlantic Fisheries Science, Vol. 31; 137-150. Northwest Atlantic Fisheries Organization. October, 2003

[93] the most common deep-water sharks caught in the NE Atlantic are Portuguese dogfish (Centroscymnus coelolepis), Leafscale gulper shark (Centrophorus squamosus), Birdbeak dogfish (Deania calceus), Kitefin shark (Dalatias licha), Greater lanternshark (Etmopterus princeps), Velvet belly (Etmopterus spinax), Black dogfish (Centroscyllium fabricii), Gulper shark (Centrophorus granulosus), Blackmouth dogfish (Galeus melastomus), Mouse catshark (Galeus murinus), Iceland catshark (Apristuris spp.).

[94] Op cit. 24, ICES *Deepwater fisheries resources south of 63°N*

[95] The previous footnote list shark species that are often caught but only few are landed in significant quantities. In fisheries catch statistics, deep-water sharks are often combined with pelagic sharks in a 'Sharks, various' category. E.g. see Gordon, J.D.M. (1999) *Management considerations of deep-water shark fisheries.* In: Shotton, R. Case studies of the management of elasmobranch fisheries. FAO Fisheries Technical Paper. No. 378, pp 774 – 818.

roundnose grenadier. These fisheries take place along the continental margin, the Mid-Atlantic ridge and various banks, plateaus and seamounts in the region both on the high seas and within national waters.[96] Bycatch species include bluemouth, mora, greater forkbeard, argentine, deepwater cardinal fish, and chimaeras, depending on the depth of the fishery.



Map of a section of the international waters of the Northeast Atlantic where most high seas bottom trawl fishing takes place. Main fishing areas: Rockall Bank and Hatton Bank (upper right hand corner), the Reykjanes Ridge (upper left hand corner) and the Mid-Atlantic Ridge (centre). Grey lines represent EEZ boundaries. Northern portion of the map roughly corresponds to the southern boundary of Iceland's EEZ.
Source: GEBCO - Intergovernmental Oceanographic Commission and International Hydrographic Organization, and WWF.

[96] Gordon, J. D. M., O. A. Bergstad, I. Figueiredo, and G. Menezes. Deep-water Fisheries of the Northeast Atlantic: I. Description and Current Trends. Journal of Northwest Atlantic Fisheries Science, Vol. 31; 137-150. Northwest Atlantic Fisheries Organization. October, 2003

The main countries reportedly involved in high seas bottom trawl fishing in 2002 were the European Union, Lithuania, Estonia and Russia according to official catch information reported to the Northeast Atlantic Fisheries Commission.[97] The bulk of the high seas bottom trawl catch of approximately 24,000 mt consisted of roundnose grenadier, smoothheads, blue ling, black scabbardfish and sharks and was taken in the area of international waters south of Iceland and the Faroe Islands, west of Ireland and the UK, and north of the Azores. While most of the catch comprised deep-water species, over 2,000 tons of cod and haddock were taken on the high seas, apparently in the Barents Sea outside the Norwegian EEZ and on the Rockall Plateau respectively.

Of the EU deep-sea trawl fleet, over the past decade Spanish and French vessels took most of the fish caught by bottom trawling on the high seas in the Northeast Atlantic, although bottom trawl fishing by French vessels on the high seas appears to have declined in 2000-2001. Scottish and English deep-water trawlers appear to fish mainly on the upper continental slope within European Union waters. Irish vessels, with the help of substantial state subsidies, have rapidly developed deep-water fisheries since 2000, primarily within the EEZ, though some may already have expanded their operations to include fishing in international waters. [98] Spanish trawling for Roundnose grenadier and smoothheads in the international waters around Hatton Bank had, by 2001, expanded considerably since the mid-1990's. This area, together with the Rockall Bank, has been the scene of an "uncontrolled expansion" of deep-water fishing on the high seas since the UK relinquished its claim to a 200-mile limit around Rockall in 1997.[99] A number of Spanish vessels appear to conduct deep-sea fisheries using gillnets in international waters.

Over the past several years, based on reported landings, Russian, Lithuanian, Estonian and Polish vessels have conducted bottom trawl fisheries in the international waters of the Northeast Atlantic. The latter three countries are now members of the European Union as of May 2004. Fishing by Polish vessels, however, appears to have declined significantly over the past few years while the Russian fleet appears to be increasing its fishing effort.[100] Norwegian vessels bottom fish on the high seas in the vicinity of Hatton Bank for tusk, blue ling, Greenland halibut, common mora and deep-water sharks, for the most part using bottom longline gear.[101] In the past, Faroese vessels targeted orange roughy in international waters but more recently appear to have abandoned the fishery. Icelandic and Faroese bottom trawl fishing appears to take place mainly within the respective EEZs (with the exception of deep-water prawn fishing in the Northwest Atlantic, discussed in the following section), and the Norwegian high seas deep-sea bottom fishing fleet in the Northeast Atlantic is predominantly a longline fleet. At least one Russian vessel has been experimenting with deep-sea longline fishing as well. New Zealand reportedly took 450 mt of orange roughy on the high seas of the Northeast Atlantic in 2001, but the vessel (or vessels) involved appears to have either left the area or reflagged to another country.[102]

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[97] Catches of attachment II species in the NEAFC Regulatory Area. Final Data 2002. North-East Atlantic Fisheries Commission (NEACF).

[98] *Deep-Sea Fishing: Background*. Marine Work Group, Friends of the Irish Environment. June 2002. http://www.mwg.utvinternet.com/downloads/Fisheries%20Deep-Sea%20Fishing%20Background.doc

[99] Op cit. 96, Gordon et al. *Deep-water Fisheries of the Northeast Atlantic: I. Description and Current Trends.*

[100] ICES Report of the Advisory Committee on Fisheries Management 3.13.5 *Roundnose Grenadier http://www.ices.dk/committe/acfm/comwork/report/2002/may/rng-comb.pdf*

[101] ICES Report of the Working Group on Biology And Assessment of Deep-Sea Fisheries Resources, Advisory Committee on Fishery Management. ICES CM 2003/ACFM:25 Ref. G. 2003 http://www.ices.dk/reports/ACFM/2003/WGDEEP/directory.asp

[102] Report of the Meeting of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species, ANNEX 5 - *Catches of deep sea non-Regulated Resources, NEAFC Regulatory Area 2001.* Northeast Atlantic Fisheries Commission Deep-sea Working Group, 11-13 June, 2002. Final Report. Reports, Meeting on Deep-sea Species 11-13 June 2002, Bergen. http://www.neafc.org

The bottom trawl fisheries on the high seas of the Northeast Atlantic are conducted by vessels from countries bordering the region. Most of the catch taken in deep-sea bottom trawling in the area is taken from within EEZs (see Table 3.3.1). Many of the high seas bottom trawl fisheries are, in some ways, an extension of the same fisheries from within the EEZs.

In addition to the bottom trawl fisheries, there is a large deep-water trawl fishery for 'oceanic' and 'pelagic deep-sea' *Sebastes mentella* (a type of redfish) in the international waters of the Northeast Atlantic. The official catch of redfish on the high seas in 2002 amounted to approximately 54,000 mt.[103] However, this fishery is consistently referred to as a pelagic or mid-water trawl fishery even though it may at times operate at depths below 500 meters.[104] For the purpose of this report, this fishery is not considered a bottom trawl fishery. However, it would be worth further research to determine the extent, if any, that redfish is caught in bottom trawl fisheries, whether as a target or bycatch species, in the international waters of the Northeast Atlantic, particularly along the Reykjanes and Mid-Atlantic Ridges.

Most species caught in bottom trawl fisheries are considered to be, or likely to be, overexploited. Fisheries on deep-water species in the region, both within and beyond the EEZs, have developed rapidly and the species they exploit are especially vulnerable to overfishing. As noted previously, a recent review of the status of deep-water fisheries in the Northeast Atlantic by eminent deep-sea biologists from Norway, the UK, France and Germany concluded that most deep-water fish species are long-lived, slow growing and have low reproductive capacity. They are highly vulnerable to overexploitation and their populations can be rapidly depleted. Most fisheries on these species have been completely unregulated and nearly all exploited deep-water species are being harvested "***outside safe biological limits***".[105]

Data on high seas catches

As indicated earlier in the report, the data on the deep-water fisheries in the Northeast Atlantic varies considerably, particularly in relation to fisheries on the high seas. This is not surprising given that these fisheries are essentially unregulated fisheries. The ICES Advisory Committee on Fisheries Management states that landings statistics may not reflect the true scale of fishing in international waters and that data on landings and fishing effort are limited, of "poor quality", and in some cases entirely lacking.[106]

Table 3.3.1 lists the estimated catch of a number of deep-water species in international waters in 2001 and 2002. Figures for 2001 are taken from the estimates of the Deep-Sea Species Working Group of the Northeast Atlantic Fisheries Commission (NEAFC), the regional fisheries management organization responsible for high seas fisheries (for species other than highly migratory species) in the Northeast Atlantic. For 2002, the table lists the official reports of high seas catches by member countries of NEAFC – the first year for which countries reported catches of deep-water species (other than redfish and blue whiting) on the high seas within the area of competence of NEAFC, referred to as the NEAFC 'Regulatory Area'.

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[103] Catch Statistics 2002 – Redfish (not final): NEAFC Regulatory Area. Statistics for 2002 catches of main fisheries reported to NEAFC (by fisheries Jurisdiction). Northeast Atlantic Fisheries Organization. http://www.neafc.org/fisheries/redfish.htm

[104] See for example ICES Advisory Committee on Fisheries Management 2003, Northwestern Working Group documents: 7. Redfish in Subareas V, VI, XII AND XIV (O:\ACFM\WGREPS\NWWG\REPORTS\2003\7-REDFISH IN SUBAREAS V.Doc); 9. Deep-Sea *Sebastes Mentella* on the Continental Shelf (O:\ACFM\WGREPS\NWWG\REPORTS\2003\9-DEEP.Doc); and 10. Pelagic Sebastes Mentella (O:\ACFM\WGREPS\NWWG\REPORTS\2003\10-Pelagic Sebastes Mentella.Doc). www.ices.dk

[105] Op cit. 29, Large et al., *Deep-water Fisheries of the Northeast Atlantic: II. Assessment and Management Approaches*. See also Gordon et al. *Deep-water Fisheries of the Northeast Atlantic: I. Description and Current Trends.* Op cit. 96.

[106] Op cit. 24, ICES *Deepwater fisheries resources south of 63°N.* pg 408.

Also listed are the estimated or reported catches of these same deep-water species in the Northeast Atlantic as a whole - the high seas and EEZs catch combined – by the ICES Advisory Committee on Fisheries Management and the United Nations Food and Agriculture Organization (UN FAO). The boundaries of the Northeast Atlantic Fisheries Commission, the ICES statistical area, and UN FAO Statistical Area 27 – Northeast Atlantic, are the same. Thus, data from these sources are comparable insofar as the geographic location of catches is concerned.

The discrepancies in the published catch data for bottom trawl fisheries on the high seas of the Northeast Atlantic are, in some cases, quite large, involving differences of an order of magnitude or more. One of the most conspicuous examples is the data on the Spanish catch of roundnose grenadier in 2001. The ICES Statlant database lists the catch by the Spanish fleet in the entire Northeast Atlantic as 33,099 mt with 31,602 mt taken ICES Area XII – an area of international waters.[107] This figure is identical to provisional data from the Spanish Ministry of Agriculture, Fisheries and Food, the presumed source of the catch figures, and the catch reported by the UN FAO on the FAO Fishstat database.[108]

However, a 2002 report from the ICES Advisory Committee on Fisheries Management puts the estimate of the Spanish catch much lower than the figure contained in the ICES Statlant database.[109] The October 2003 report of the ICES Advisory Committee on Fisheries Management (AFCM) puts, as a preliminary estimate, the overall catch of roundnose grenadier in ICES Area XII by all countries combined as 7,803 mt in 2001.[110] Along similar lines, the Northeast Atlantic Fisheries Commission deep-sea working group estimated the total high seas catch of roundnose grenadier by all EU countries combined at 5,988 mt in 2001.[111] For 2002, NEAFC provisionally reported the total EU high seas catch of roundnose grenadiers at 6,751 mt – a figure roughly consistent with the NEAFC working group estimate of the catch in the previous year.[112]

On the other hand, both the ICES Statlant database and the UN FAO Fishstat database only list 616 mt of smoothheads (*Alepocephalus bairdii*) taken in the Northeast Atlantic in 2001. The October 2003 ICES AFCM report puts the year 2001 catch figure provisionally at 11,942 mt in ICES Areas VI and XII – all taken by Spain vessels apparently fishing in international waters in the area around Hatton Bank. Provisional information from the Spanish Ministry of Agriculture, Fisheries and Food lists the Spanish catch of smoothheads in 2001 at 12,628 mt with almost 11,500 mt taken in ICES Area XII and most of the remainder in Areas VI and XIV.

Another example of major discrepancy in the published estimates of catch information is the case of deep-water sharks. For the year 2001, the report of the ICES Advisory Committee on Fisheries Management lists the catch of deep-water sharks ("squalid sharks") at 9,175 mt in ICES Area XIV, which covers a large area of the Northeast Atlantic off the southeast coast of Greenland that also partly extends into international waters. However, the Statlant database only lists 64 mt of sharks caught in this entire area in 2001.

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[107] ICES Statlant: ICES catch data for 1973-2001. Database contains yearly nominal catches of fish and shellfish officially submitted by 19 ICES member countries in the Northeast Atlantic including over 200 species. ICES Members: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, the United Kingdom, and the United States of America. http://www.ices.dk/fish/statlant.asp

[108] "Initial preliminary" data provided for catch by Spain of all species in the North Atlantic. Spanish Ministry of Agriculture, Fisheries, and Food (personal communication).

[109] ICES Cooperative Research Report No. 255: 3.13.5 Roundnose grenadier (*Coryphaenoides rupestris*), Table 3.13.5.1. ICES Advisory Committee on Fisheries Management, 2002.

[110] ICES Advisory Committee on Fisheries Management, 2003. Nominal catches of Deep-water species, Table 3.13.2.1. Data for 2001 listed as preliminary.
http://www.ices.dk/committe/acfm/comwork/report/2003/oct/o-3-13-2.pdf

[111] Op cit. 102, Meeting of the NEAFC Working Group. ANNEX 5 - *Catches of deep sea non-Regulated Resources*, NEAFC Regulatory Area 2001.

[112] Deep-seas fishery effort *provisional data*. Document Number AM 2003/44 rev1. Annual Meeting 2003, Northeast Atlantic Fisheries Commission. http://www.neafc.org/docs/document/2003_44.xls

Table 3.3.1: Various estimates and reports of select species caught in deepwater fisheries on the high seas of the Northeast Atlantic in 2001 and 2002.

Species	Estimated high seas catch in 2001 – NEAFC working group[113]	Reported high seas catches 2002 – NEAFC Regulatory Area[114]	Total catch in NE Atlantic in 2001 – EEZs and high seas – ICES AFCM[115]	Total catch in NE Atlantic in 2001 – EEZs and high seas - UN FAO[116]
Roundnose grenadier	8,063 mt[117]	9,787 mt	27,708 mt	48,157 mt
Blue ling	4,284 mt	1,891 mt	15,712 mt	19,347 mt
Orange roughy[118]	831 mt	16 mt	3,780 mt	4,243 mt
Tusk	530 mt	203 mt	26,791 mt	26,846 mt
Black scabbardfish	435 mt	870 mt	8,105 mt	10,826 mt
Ling	384 mt	142 mt	33,076 mt	36,988 mt
Argentines	34 mt	128 mt	45,174 mt	48,894 mt
Subtotals	14,561 mt	13,037 mt	160,344 mt	195,301 mt
Other				
smoothheads	not listed	6,756 mt	11,942 mt	616 mt

High seas bottom trawl catch and value in 2001

With the above caveats and difficulties in mind, the following table represents an estimate of the catch, or range of catch, and value of the bottom trawl fisheries on the high seas of the Northeast Atlantic. These figures are based on data from a variety of sources, including official catch reports from national and intergovernmental agencies, provisional data from government sources, scientific reports, published papers as well as port-based market information. These figures should be treated as indicative at best and by no means a precise estimate of the high seas bottom trawl catch and its value. Nonetheless, they represent a "best guess" based on an extensive reading of literature available on the catch of deep-water species on the high seas of the Northeast Atlantic Ocean, and the assumptions described in the various footnotes to Table 3.3.2.

[113] Op cit. 102, Meeting of the NEAFC Working Group. ANNEX 5 - *Catches of deep sea non-Regulated Resources*, NEAFC Regulatory Area 2001.
[114] Op cit. 112, Deep-seas fishery effort *provisional data*. NEAFC Annual Meeting 2003.
[115] ICES Advisory Committee on Fisheries Management, 2003. Nominal catches of Deep-water species, Table 3.13.2.1. Data for 2001 listed as preliminary.
http://www.ices.dk/committe/acfm/comwork/report/2003/oct/o-3-13-2.pdf
[116] UN FAO Fishstat. Op cit. 77
[117] The actual total catch of Roundnose grenadier listed in Annex 5 of Report of Meeting of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species, Bergen, Norway 11-13 June 2002 is 6,349 mt. However, the Russian catch for ICES Area XII is not included in the total catch. The presumption the author has made is that the Russian catch of 1714 mt in Area XII should be added to the estimated catch of Roundnose grenadier in the NEAFC Regulatory Area bringing the total to 8063 mt. This would be consistent with figures used by ICES in estimating the catch in 2001 by Russian vessels in ICES Area XII – e.g. ICES Cooperative Research Report No. 255, 3.13.5 Roundnose grenadier (*Coryphaenoides rupestris*), Table 3.13.5.1. ICES Advisory Committee on Fisheries Management, 2002.
[118] The total catch of 4,243 mt of Orange Roughy listed by the UN FAO for area 27 is likely to be low in that it does not include 450 mt caught by NZ or the 340 mt caught by the Faeroes on the high seas as identified by the NEAFC Deep-sea Working Group. The UN FAO Fishstat database lists no catch of orange roughy for New Zealand in 2001 in the Northeast Atlantic and only 1 mt for the Faeroes.

Table 3.3.2 Estimated catch and value of the catch in bottom trawl fisheries on the high seas of the Northeast Atlantic in 2001.

SPECIES	CATCH 2001[119]	VALUE: US$ 2001[120]
Roundnose grenadier	8,063 – 36,012 mt [121]	13,073,811 – 58,435,411[122]
Smoothheads	12,628 mt [123]	6,566,181[124]
Blue ling	4,016 – 4,725 mt [125]	9,432,901 – 11,098,221[126]

[119] Unless otherwise indicated, all estimates of catch taken from the report of the Meeting of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species, Bergen, Norway 11-13 June 2002. ANNEX 5 - *Catches of deep sea non-Regulated Resources*, NEAFC Regulatory Area 2001. Reports, Meeting on Deep-sea Species 11-13 June 2002, Bergen. http://www.neafc.org

[120] The value of the catch in 2001 for each of the species was variously calculated in Icelandic Krone (ISK), British Pounds (GBP), Spanish Pesetas (ESP), and Euros (€) as explained in the footnotes below. Conversion to US$ in 2001 is based on the following: 1 ISK = 0.01031 US$; 1 GBP = 1.44131 US$; 1 ESP = 0.00539 US$, 1 GBP = 1.44131 US$; 1€ = 0.89650 US$. Average rate of exchange for 2001: FXHistory: historical currency exchange rates (Average 365 days) Time period: 01/01/01 to 12/31/01. Conversion Tables (Interbank rate). http://www.oanda.com/convert/fxhistory

[121] Lower estimate of 8,063 mt from NEAFC working group on Deep-sea species (see previous table). Upper estimate a 'best guess' derived by adding the catches of roundnose grenadier by Russia, Poland, Spain, France, Estonia, and Lithuania in ICES Subareas XII, XIV, and VIb. Most, if not all of this catch presumed to be taken on the high seas by bottom trawl vessels. This figure may include some roundnose grenadier taken within the EU EEZ in Subdivision VIb. On the other hand it does not include the catch of roundnose grenadier by Scotland, UK (England and Wales), Norway and other countries in any of the three areas, the assumption being that the catch by these countries was taken inside the EEZ in VIb or by longline fishing on the high seas. Further, the French catch in Subdivisions VIIc and VIIk was also excluded – assumed to be likely taken along continental margin within the EEZ. One or more of these assumptions could be incorrect. Source of country catch data: ICES Statlant.

[122] The majority of the roundnose grenadier reportedly caught in the Northeast Atlantic in 2001 was taken by Spanish vessels. The average landed value of roundnose grenadier in 2001 was €1.81/kg. Source: landed value Spain, roundnose grenadier (Granadero): Precios en Origen de Productos Pesqueros. Subdireccion General de Comercializacion Pesquera, Secreteria General de Pesca Maritima. Ministerio de Agricultura, Pesca y Alimentacion. The second largest catch in the Northeast Atlantic was taken by French vessels: average port price roundnose grenadier (Grenadier de Roche) at principal port of landing in 2001: €1.68/kg. Prix Moyen Enregistre en Halle a Maree du Boulogne Sur Mer. Prix Moyen 2001. The higher, Spanish, landed value was used to make this calculation.

[123] Spain appears to be the only country to have caught and landed smoothheads in 2001 (though there has been a high bycatch and discard of smoothheads in the French bottom trawl fisheries for roundnose grenadiers over the past decade or so). Figure based on initial preliminary data provided by Spanish Ministry of Agriculture, Fisheries, and Food. The author chose to use this figure – the highest of all figures available – for the catch of smoothheads in 2001. All catches listed as being from ICES Subareas XII and XIV and Divisions XIVb and VIb. Figure is slightly higher than the ICES AFCM figure of 11,942 mt given as the preliminary estimate of the catch of smoothheads in ICES Subareas VI, VII, XII, and XIV in 2001. Source, ICES figure: ICES Advisory Committee on Fisheries Management, 2003. Nominal catches of Deep-water species, Table 3.13.2.1. Data for 2001 listed as preliminary.

[124] Average frozen wholesale price of smoothheads ("talismanes") headed, gutted and tailed, Port of Vigo, Spain, 2001: €0.95/kg. Equivalent to €0.58/kg roundweight using conversion factor of approximately 0.61:1. Value, 7,821 mt – 12,628 mt smoothheads = $4,066,685 - $6,566,181 USD. Source, price information and conversion factor: Vigo Port Authority (personal communication).

[125] Lower figure derived by subtracting the Norwegian catch of 268 mt of blue ling from the total high seas catch in 2001 estimated by the NEAFC deep-sea species working group. The assumption is that the Norwegian catch was taken by bottom longline gear. Upper figure derived by adding the reported Spanish catch (4,390 mt) together with the Estonian, French, Polish, and Lithuanian catches of blue ling in ICES Subareas XII, XIV, and VIb in 2001. Norwegian, Icelandic and UK catches form these areas were not included, the assumption being they were either taken within the EEZ in Area VIb (UK catches) or were taken by using bottom longline gear. Source: ICES Statlant.

Orange roughy	831 mt	2,607,678[127]
Tusk	69 mt [128]	7,918[129]
Black scabbardfish	435 – 1,593 mt[130]	935,956 – 2,399,249[131]
Ling	190 mt[132]	317,460[133]
Argentines	34 mt	18,643[134]
Haddock	908 mt[135]	1,823,032[136]

[126] Estimated value of the high seas catch of blue ling based on landed value of €2.62/kg in the port of Boulogne Sur Mer, France. Unfortunately the author was unable to obtain price information for blue ling landings in 2001 in Spain. Together, France and Spain appear to have taken the majority of the high seas catch of blue ling in 2001. Landed value of blue ling for other major producers in Northeast Atlantic (e.g. Scotland, Norway, Iceland) is considerably less on a per kg or ton basis. Source price information: average port price Lingue Bleue (Blue ling) at Boulogne Sur Mer, a principal port of landing for deep-water trawl species in France: €2.62/kg. Prix Moyen Enregistre en Halle a Maree du Boulogne Sur Mer. Prix Moyen 2001.

[127] Estimated value of the high seas catch of orange roughy based on landed value of €3,138/mt in Ireland – the country with the highest catch of orange roughy (approximately 50-60% of the total catch) in the Northeast Atlantic in 2001. Source price information: Eirestat Spreadsheet Service, Central Statistics Office, Ireland: AFDA - Average price per tonne, live weight (Annual) 2001. Orange Roughy. http://www.eirestat.cso.ie/diska/AFDA020.html

[128] Figure derived by subtracting the Norwegian catch of 461mt of tusk from the total high seas catch in 2001 estimated by the NEAFC deep-sea species working group. The assumption is that the Norwegian catch was taken by bottom longline gear.

[129] Estimated value of the high seas catch of tusk based on landed value of €1.28/kg for tusk ("Brosmes") in the port of Boulogne Sur Mer, France. Source price information: average port price Brosmes (Brosme brosme) at Boulogne Sur Mer, a principal port of landing for deep-water trawl species in France: €1.28/kg. Prix Moyen Enregistre en Halle a Maree du Boulogne Sur Mer. Prix Moyen 2001.

[130] Lower figure taken from the NEAFC deep-sea species working group. Upper figure derived by adding Spanish catch of black scabbardfish (1,318 mt) together with the Estonian, French, Russian and Lithuanian catches of black scabbardfish in ICES Subareas XII, XIV, and VIb in 2001. The UK catch from VIb was not included in this figure - the assumption being that this was taken within the EEZ. Source: ICES Statlant.

[131] Estimated value of the catch of black scabbardfish on the high seas based on landed value of €2.40/kg in France – the country with the highest catch of black scabbardfish in the Northeast Atlantic in 2001. Source price information: average port price Sabre Noir (black scabbardfish) at principal port of landing: €1.68/kg. Prix Moyen Enregistre en Halle a Maree du Boulogne Sur Mer. Prix Moyen 2001.

[132] Figure derived by subtracting the Norwegian catch of 194 mt of tusk from the total high seas catch in 2001 estimated by the NEAFC deep-sea species working group. The assumption is that the Norwegian catch was taken by bottom longline gear.

[133] Estimated value of the catch of ling on the high seas based on landed value of 309.99/kg ESP for ling (Maruca) in 2001 Vigo, principal port of landing in Spain for high seas and distant water fleets. Spain appears to have taken the majority of the high seas catch of ling by bottom trawl vessels in 2001 based on catch information in the ICES Statlant database. Source, price information: Memoria Anual Del Puerto (Annual Port Report) Año 2001. Table 1A.1 "Distribucion de la pesca descargada por especies y precios". Autoriadad Portuaria de Vigo (Port Authority of Vigo) Spain.

[134] Estimated value of the catch of Argentines on the high seas based on landed value of ISK 53,184/kg in Iceland (2002 data). Source price information: Icelandic prices 2002: Average price for landings for January-December 2002, Statistics Iceland. http://www.hagstofa.is/template_lb_frameset_en.asp?PageID=325&intPXCatID=69&ifrmsrc=/temp_en/sjavarutvegur/aflv.asp

[135] Figure derived from the 278 mt of haddock reportedly caught in NEAFC Regulatory area in 2001 by the EU and ICES estimate of the Russian catch of 630 mt of haddock for 2001 in the vicinity of Rockall. The author presumes this catch was taken wholly on the high seas. Norway was also reported to have taken 70 mt of haddock in the area in 2001. However, the Norwegian high seas fleet operating in this area in 2001 was almost exclusively a longline and gillnet fleet. Sources: NEAFC - Report of the 21st Annual Meeting of the North-East Atlantic Fisheries Commission, 12 - 15 November 2002. *Volume 2 – Annexes*. Annex F – Aggregate catches of regulated and non-regulated species – 2001; ICES - Extracts from ACFM report 2003 on Rockall haddock species, AM 2003/21 Document List – 2003 Annual Meeting of the Northeast Atlantic Fisheries Commission (NEAFC); http://www.neafc.org

Deep-sea sharks	1,347 – 3,506 mt[137]	3,006,887 – 7,826,391[138]
Greenland Halibut	1,402 mt[139]	3,582,145[140]
Cod	1,440 mt[141]	1,523,520[142]

[136] Estimated value of the catch of haddock on the high seas based on landed value of 1,393 GBP/tonne in Scotland in 2001 equivalent to $1,823,032 USD. Source Scottish price information: Table 25. Liveweight and value of landings into Scotland by foreign vessels, by main (1) species, 1997 to 2001, Scottish Fisheries Statistics, 2001 http://www.scotland.gov.uk/library5/fisheries/sfs01-27.asp#b10)

[137] Lower figure is derived from the estimated catch of 1,206 mt of large deepwater squalid sharks from all countries combined in ICES Area XII in 2001 plus the 141 mt of landings of sharks from the Hatton Bank fishery in ICES Division VIb in 2001. Total catch by Spain in Hatton Bank fishery in international waters in 2001 estimated to be 1,117 mt (presumably bycatch in the bottom trawl fishery for roundnose grenadier and smoothheads). Source: Deepwater sharks 3.13.12. ICES Advisory Committee on Fisheries Management, ICES Cooperative Research report No 255. 2002. The catch by other countries in Division VIb is not included in the lower estimate as the author made the assumption that the catch of deepwater sharks on Table 3.13.12.1 were either taken in national waters or by longline gear on the high seas. Upper figure calculated by combining the Spanish, French, Russian, Lithuanian, and Estonian catches in ICES Subareas VIb, XII, XIV and XIVb of the following listed species/species groups: Birdbeaked dogfish, Cartilaginous fishes nei, Dogfish sharks nei, Dogfishes and hounds, Leafscale gulper shark, Picked dogfish, Raja nei, and Various sharks nei in 2001 on the ICES Statlant database. The majority of this figure is listed as the catch by Spain of various sharks in ICES Subarea XII. The figure does not include the catch of these species listings for Norway, UK (Scotland, England, Northern Ireland, Wales), Germany, Portugal or Ireland as the catch from these countries was assumed to be either from within EEZs or by longline gear on the high seas. Finally, the author was not able to hazard a guess as to what percentage, if any, of the 9,175 mt of the ICES ACFM estimated landings (preliminary estimate) of squalid sharks in ICES Subarea XIV were taken in high seas bottom trawl fisheries. ICES Advisory Committee on Fisheries Management, 2003. Nominal catches of Deep-water species, Table 3.13.2.1. Data for 2001 listed as preliminary. http://www.ices.dk/committe/acfm/comwork/report/2003/oct/o-3-13-2.pdf

[138] Estimate of the value based on landed value in Spain, the country with the highest reported catch of sharks on the high seas of the Northeast Atlantic. The average ex-vessel prices for deep-water sharks in 2001 on the Spanish market vary considerably, ranging from €1.36/kg for "Quelvacho" and €2.30/kg for "Mielgas nep" to 2.86/kg for "Tollos nep" and 3.89/kg for "Mielga". These terms variously refer to Portuguese dogfish or siki shark (C. coelolpsis), Leafscale gulper shark or false siki (C. squamosis), and Greater lanternsharks and Velvet bellies (Etmopterus spp). The bulk of the shark catch on the Hatton Bank was estimated to be taken by Spain in 2001. The French fleet took an estimated 251 mt of deep-water sharks in ICES Subarea VIb in 2001. The majority of the Spanish and French catch in the area consisted of Portuguese dogsharks. Average ex-vessel price (prix moyen) for Portuguese dogfish ("Pailona Commun") in 2001 in Boulogne Sur Mer, France was €2.08/kg. The author, somewhat arbitrarily, chose to estimate the value of the high seas shark catch using the average ex-vessel price for all species of sharks combined landed in Vigo, Spain (the most important port in Spain for landings of high seas and distant-water trawl fisheries) as this figure appeared to be a reasonable median. Average port price Vigo 2001: 413.82 ESP = €2.49/kg.

[139] Catch estimated based on Spanish catch of 1,338 mt in ICES Area XII, 54 mt taken by Lithuania, Poland and Ireland combined, and 10 mt reported taken by Spain in ICES Subarea XIV as listed on ICES Statlant. Figures for Spanish catch identical to provisional data from Spanish Ministry of Agriculture, Fisheries and Food. The figure does not include the 542 mt reported caught by Norway in ICES Subarea XII as this was assumed to be taken by longline vessels. There was no Spanish catch of Greenland halibut listed for Area VIb on ICES Statlant; of the 564 mt caught in this area in 2001, all but 6 mt was reported taken by Norway and the UK (England and Wales). The author assumes that the Norwegian catch was taken by longline vessels and the UK catch taken within the EEZ. In ICES Subarea XIV, ICES Statlant reports that Spain took 10 mt of Greenland halibut, while Germany, Iceland and Norway took almost all of the remainder. The author assumes that vessels from these countries were fishing wholly within the Greenland EEZ and/or that they were using bottom longline gear to the extent that any vessels from these countries were fishing on the high seas in ICES Subarea XIV in 2001.

[140] Value calculated on the basis of average landed value in Spain in 2001 - Greenland halibut/Fletan Negro 2.85 euros/kg. Total value: €3,995,700 = $3,582,145 USD. Source: Precios en Origen de Productos Pesqueros. Año 2001. Subdirección General De Comercialización Pesquera - Secretaría General De Pesca Marítima, 2001. Minsterio de Agricultura, Pesca y Alimentacion, Spain. (personal communication)

[141] The figure of 1,440 mt of cod (Gadus morhua) comes from the 2002 NEAFC report of Deep-seas fishery effort *provisional data*. NEAFC Annual Meeting 2003. Op cit. 112. The author was unable to find any

Miscellaneous	328 mt	646,914[143]
TOTAL	**31,691 mt – 63,666 mt**	**$43,543,046– $96,852,763**

Summary

Overall, the bottom trawl catch on the high seas of the Northeast Atlantic in 2001 (excluding the blue whiting and redfish fisheries that are caught by 'mid-water' or pelagic trawl on the high seas) was approximately 30,000-65,000 metric tons. This range of figures would appear to represent somewhere between 20%-33% of the overall catch of deep-water species in the entire Northeast Atlantic – the EEZs and the high seas combined. Compared to the overall reported marine fish catch in the entire Northeast Atlantic Ocean (FAO statistical area 27), which in 2001 was 11,164,413 mt, the catch from high seas bottom trawl fisheries would account for approximately 0.27-0.58 percent of the total marine fisheries catch in the Northeast Atlantic region.

The majority of the bottom trawl catch on the high seas of the Northeast Atlantic in 2001 was taken by Spanish vessels. The high seas bottom trawl catch in 2002 appears to be significantly lower than in 2001, primarily because of a major decrease in landings by Spanish vessels. The official, albeit preliminary, reported catch from bottom fisheries (most of which were trawl fisheries) on the high seas by the Northeast Atlantic Fisheries Organization in 2002 amounted to 23,856 mt.

3.4 NORTHWEST ATLANTIC OCEAN

With the advent of factory trawl fishing by western European and USSR fleets, bottom trawl fishing by distant water fleets in the international waters of the Northwest Atlantic for cod, redfish, flounders and other flatfish intensified significantly in the late 1950s and throughout the 1960s. With the Canadian declaration of a 200 mile EEZ in the mid 1970s and the phase out of foreign fishing within the Canadian zone, the bottom trawl fleets operating in international waters concentrated their efforts in the relatively small portion of the Grand Banks which extend beyond the Canadian 200 mile limit, the so-called 'nose' and 'tail' of the Grand Banks, and the Flemish Cap primarily targeting cod, flatfishes and redfish. However, by the early 1990s, these fisheries had largely collapsed as had the fisheries for these species within Canada's EEZ. In response, distant water fleets working in the area then developed bottom trawl fisheries for northern prawn and Greenland halibut in international waters. More recently, there has been a limited resurgence in fishing for redfish on the tail of the Grand Banks.

Over the past several years, bottom trawl fleets operating on the high seas of the Northwest Atlantic have targeted northern prawns, Greenland halibut, redfish and skates. The latter fishery takes place primarily along the continental shelf (on the tail of the Grand Banks) while the others are conducted along the continental slope and the Flemish Cap at depths

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indication of the high seas catch of cod prior to 2002 so decided to use this figure as a 'ballpark' estimate for the high seas catch in 2001.

[142] The author assumed that cod taken on the high seas in 2001 was caught primarily in the Barents Sea. Of the non-coastal states in the region, Spain took the highest share of the catch of cod in 2001. Estimate of the value of cod based on landed value of cod in Spain in 2001. Price per ton cod 2001: €1180/mt equivalent to $1058 USD/mt. Source, price information: Statistics on fisheries for the years 1995 to 2001: Spain. Organisation for Economic Co-operation and Development.
http://www.oecd.org/document/7/0,2340,en_2649_33901_1837127_119656_1_1_1,00.html

[143] The catch figure estimate is based on adding the catch by all countries for deep-sea species not listed on this Table officially reported to NEAFC for the year 2002. The author arbitrarily chose an average price of €2,200/mt to estimate the value of this miscellaneous catch.

ranging from 200 meters to 1000 meters or more. Most of the bottom trawl fishing on the high seas is still concentrated in the relatively small area of the nose and tail of the Grand Banks and the Flemish Cap. Other species of commercial value caught in significant quantities in the bottom trawl fisheries in the area are grenadiers, hakes, cod and flatfishes, though most of the catch of these species is taken as bycatch in fisheries targeting Greenland halibut, redfish and skates.

There is a pelagic trawl fishery for redfish by distant water fleets in the NAFO area. This fishery took almost 7,000 tons of redfish in 2001 on both the high seas and within Greenland's EEZ. However, it is consistently referred to as a pelagic deep-sea fishery and is similar to the pelagic redfish fishery in the Northwest Atlantic, apparently targeting the same stock or population of redfish.[144]

Northern prawns are fished extensively in the northwest Atlantic at between 200-700 meters depth along the continental slope. The fishery is a bottom trawl fishery with the majority of catches taken within the EEZs of Canada and Greenland. However, there is a substantial high seas fishery for prawns on the Flemish Cap in the international waters of the northwest Atlantic and, to a much lesser extent, along the upper continental slope of the nose and tail of the Grand Banks. The Flemish Cap fishery for northern prawns began in 1993, coinciding with the collapse of the Grand Banks cod fishery in 1992. The Flemish Cap fishery for northern prawns is the largest bottom trawl fishery in international waters, equaling approximately one-quarter to one-third of the catch and value of high seas bottom trawl fisheries worldwide.

Of the four major trawl fisheries, the overall biomass of northern prawns on the Flemish Cap appears to be able to sustain the fishery at current catch levels, at least for the time being.[145] It may be that the biomass of northern prawns on the Flemish Cap and in other areas of the continental shelf and slope of the northwest Atlantic may have increased as a result of the overfishing and collapse of populations of higher trophic level predator species. The life-history of prawns may also allow these animals to sustain the current levels of exploitation better than fin-fish stocks though whether this is sustainable over the longer term is unknown. The management of the fishery, however, is not without problems. Canada closed its ports in 2002 to Faroese and Estonian vessels which, together, take approximately 40% of the high seas catch of northern prawns, because of the failure of the two countries to agree to the conservation measures adopted by NAFO for the Flemish Cap fishery.[146]

On the other hand, the biomass of Greenland halibut is believed to be at a very low level and current catch rates are unsustainable.[147] As with the northern prawn fishery, a significant high seas distant water fishery in the Northwest Atlantic for Greenland halibut largely began (in the late 1980s) in response to the depletion of more 'traditional' species. This fishery peaked in the early 1990s with catches of around 45,000 mt per year from 1992-1994.[148]

The fishery for redfish by distant water bottom trawl vessels along the nose and tail of the Grand Banks and on the Flemish Cap is at low levels by historic standards. There is a

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[144] North-Western Working Group of the ICES Advisory Committee on Fisheries Management (2003). Section 10. Pelagic Sebastes Mentella. Estimated catch of 6,791 mt Sebastes Mentella in NAFO Areas 1F, 2J, 2H in 2001. Table 10.1.1 http://www.ices.dk/reports/ACFM/2003/NWWG/10-PELAGIC.pdf

[145] Skuladottir U., The Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2003. Serial No. N4895 NAFO SCR Doc. 03/68 Scientific Council Meeting, September 2003

[146] Canadian Department of Fisheries and Oceans: Integrated Fisheries Management Plan Northern Shrimp - Northeast Newfoundland, Labrador Coast and Davis Strait, Effective 2003. http://www.dfo-mpo.gc.ca/communic/fish_man/ifmpns-pgipcn/index_e.htm

[147] Darby C., Bowering W.R., Mahé J.C., An Assessment of Stock Status of the Greenland Halibut Resource in NAFO Subarea 2 and Divisions 3KLMNO Based on Extended Survivors Analysis with Short and Medium-term Projections of Future Stock Development. Serial No. N4883 NAFO SCR Doc. 03/64, Scientific Council Meeting, June 2003

[148] UN FAO Fishstat – NAFO capture 1960-2002. Op cit. 77

moratorium on the fishery on the nose of the Banks and a limited fishery on the Flemish Cap. There has been a recent increase in the catch of redfish on the tail of the Banks though the extent to which the increase in the catch is a result of a recovering redfish population or a result of increased fishing effort by the Russian trawl fleet is not clear. Russian fleets dominated the distant water fishery for redfish in the Northwest Atlantic throughout the 1960s, 1970s and 1980s but suffered a major contraction in the early 1990s with the collapse of the Soviet Union. However, in recent years the Russian distant water trawl fleet has begun expanding; the Russian catch of redfish in the Northwest Atlantic rose from 15 tons in 1998 to 12,000 tons in 2001. While elsewhere on the high seas in the Northwest (and Northeast) Atlantic, redfish are reportedly caught using pelagic or mid-water trawl, the redfish taken in the international waters of the Grand Banks and Flemish Cap are virtually all caught using bottom trawl gear. The majority of the catch is taken at 350-550 meters depth.[149]

All of the bottom trawl fisheries in the international waters of the Northwest Atlantic take some degree of bycatch, including species of commercial value that have been severely depleted by overfishing. For example, the Scientific Council of NAFO expressed concern that there has been a significant increase in recent years in the catch of American plaice taken as bycatch in the trawl fishery for skate on the tail of the Banks. The American plaice fishery on the nose and tail of the Banks (3LNO) was, historically, the largest flatfish fishery in the northwest Atlantic but, like many other groundfish fisheries in the area, it collapsed and there has been a moratorium on fishing for plaice since 1995.[150] The skate trawl fishery also takes substantial quantities of Atlantic cod as bycatch, another species for which a moratorium is in place. Bycatch rates generally in the skate fishery are significant, ranging from 8.8% to 79% in the skate fisheries conducted by Spain, Russia and Portugal between the years 2000-2002.[151]

Similarly, there are significant quantities of bycatch of redfish in the trawl fisheries for northern prawn on the Flemish Cap. The redfish population on the Flemish Cap is very low and the Scientific Council of NAFO expressed concern over the estimated 22.1 million redfish caught as bycatch in the northern prawn trawl fishery in the area during the 2001/02 fishing season.[152] Likewise there has been a moratorium on fishing for redfish on the nose of the Banks since 1998, in spite of which 840 mt of redfish was taken as bycatch in the Greenland halibut fishery in 2001. At the peak of the redfish fishery in 1987, 79,000 mt were caught on the nose of the Banks.

The directed fisheries for skates and redfish on the tail of the Grand Banks, and the bycatch of hakes and roughhead grenadiers in these and other fisheries appear to be entirely unregulated, with the exception of a minimum mesh size regulation in the redfish fishery.[153] Together these species constitute approximately one-quarter of the bottom trawl catch on the high seas of the NAFO region.

Vessels from Russia, Spain, Portugal and Estonia take most of the groundfish, which amounted to some 65,000 mt in 2001. These same countries together with Norway, Denmark (the Faroes), Iceland, Latvia, Lithuania, are the main countries involved in the northern prawn

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[149] Of the 22,099 mt of redfish caught in NAFO Area 3O in 2001, both within the Canadian EEZ and on the high seas (the tail of the Banks), 21,467 were taken by bottom trawl. Only 629 mt were caught by mid-water trawl. Source: D. Power, An Assessment of the Status of the Redfish in NAFO Division 3O. Serial No. N4882 NAFO SCR Doc. 03/63. Scientific Council Meeting – June 2003. Northwest Atlantic Fisheries Organization. Table 3b.

[150] *American Plaice (Hippoglossoides platessoides) in Divisions 3L, 3N, and 3O*. Report of the Scientific Council Meeting 5-19 June, SC 5-19 June 2003. Pg 164.

[151] *Information on thorny skates in Div. 3LNO*. Report of the Scientific Council Meeting 5-19 June SC 6-19, Part D. Northwest Atlantic Fisheries Organization. June 2003. Pg 175

[152] *Redfish (Sebastes spp.) in Division 3M.* Report of the Scientific Council Meeting 5-19 June SC 6-19, Part D. Northwest Atlantic Fisheries Organization. June 2003. Pg 167.

[153] A.Vaskov, Brief Review of Russian Fisheries in Division 3O in 2000-2002. Serial No. N4836, NAFO SCR Doc. 03/26. Scientific Council Meeting – June 2003. Northwest Atlantic Fisheries Organization; and *Roughhead Grenadier (Macrourus berglax) in Subareas 2 and 3*. Report of the Scientific Council Meeting 5-19 June SC 6-19, Part D. Northwest Atlantic Fisheries Organization. June 2003. Pg 195.

fishery that produced almost 60,000 mt in 2001. Altogether these nine countries took approximately 95% of the reported total high seas bottom trawl catch in the international waters of the Northwest Atlantic in 2001.

High seas bottom trawl catch and value in 2001

The following table lists the catch for the high seas bottom trawl fisheries in the Northwest Atlantic in 2001. There are discrepancies in the data from various sources though not nearly on the scale of the discrepancies in the data for the high seas fisheries in the Northeast Atlantic. The NAFO database, UN FAO Fishstat Plus – NAFO capture 1960-2002, lists that catch northern prawns by distant water nations in 2001 as 39,460 mt in NAFO Area 3, the international waters of the Grand Banks and the Flemish Cap. However, two papers presented at the meeting of the Scientific Committee of NAFO in September 2003, put the catch at about 20,000 mt higher than the reported catch. The papers list estimates of catches prawns for nine countries in either NAFO Area 3L (the nose of the Banks) or 3M – the Flemish Cap, for which there are no catches reported on the UN FAO Fishstat Plus - NAFO capture 1960-2002 database.

In addition, there are significant discrepancies between the Spanish catch as recorded by NAFO and the catch reported by the UN FAO. The NAFO database lists the Spanish catch of Greenland halibut in 2001 as 9,141 mt whereas the UN FAO database - UN FAO Fishstat Plus Capture Production 1950-2001, lists the Spanish catch at 11,571 mt. Likewise NAFO lists the Spanish catch in 2001 of roundnose and roughhead grenadiers combined at 6,229 mt whereas NAFO lists the same catch at 3,595 mt.

The Table reflects the catch data published by NAFO, unless otherwise noted. The catch figure for the northern prawn fishery is taken from the papers mentioned above.

Table 3.4 *Catch and value of high seas bottom trawl fisheries in the Northwest Atlantic in 2001*

Species	**Reported Catch in 2001 High Seas[154]**	**Approximate Value in 2001 in US$[155]**
Northern Prawn[156]	59,198 mt	90,149,674[157]

[154] Source: UN FAO Fishstat – NAFO capture 1960-2002, unless otherwise noted. Op cit. 77

[155] The estimate of the value of the catch in 2001 for each of the species listed was variously calculated in Canadian dollars (CAD), Norwegian Krone (NOK), Spanish Pesetas (ESP), British Pounds (GBP), and Euros (€) as explained in the footnotes below. Conversion to US$ in 2001 is based on the following: 1 CAD = 0.66612 US$; 1 NOK = 0.11138 US$; 1 ESP = 0.00539 US$, 1 GBP = 1.44131 US$; 1€ = 0.89650 US$. Average rate of exchange for 2001: FXHistory: historical currency exchange rates (Average 365 days) Time period: 01/01/01 to 12/31/01. Conversion Tables (Interbank rate). http://www.oanda.com/convert/fxhistory

[156] The figure of 59,198 mt for the catch of northern prawn in the international waters of the northwest Atlantic was derived from information from several sources: the UN FAO Fishstat database - NAFO capture 1960-2002, and two reports: Skuladottir U., The Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2003. Serial No. N4895, NAFO SCR Doc. 03/68, Scientific Council Meeting, September 2003 and Orr D.C., Veitch P.J., and Sullivan D.J., Divisions 3LNO Northern pink shrimp (*Pandalus borealis*) – Interim Monitoring Update Serial No. N4892, NAFO SCR Doc. 03/65, Scientific Council Meeting, September 2003. The author used the figures contained in the UN FAO Fishstat database – NAFO capture 1960-2002 where catch data existed as this is based on official reporting by countries. However, there was no catch data for northern prawns in 12 instances where such data did exist, albeit as estimates based on observer data, logbook data, and other such sources, in the papers by Skuladottir and Orr, Veitch, and Sullivan. In these instances, the author chose to include the latter data.

[157] The Canadian Department of Fisheries and Oceans reports that the northern prawn catch in 2001 was 95,457 mt worth approximately $230,000,000 Canadian dollars (CAD). At 2,409 CAD/mt, this would be the equivalent of $1556.50 USD/mt. Of the international fleet, Norway is the country with the highest catch of northern prawns in the Northwest Atlantic (and the country with the highest catch of northern prawns in the Northeast Atlantic). According to official Norwegian statistics, the average price per kilo for deep-water prawns in 2001 in

Greenland Halibut	22,360 mt	57,130,359[158]
Redfish	21,226 mt	33,919,148[159]
Skates	9,380 mt	12,697,846[160]
Roundnose Grenadier	3,066 mt	4,975,090[161]
Hakes (Red, White, Silver)	2,061 mt	4,950,522[162]
American Plaice	1,631 mt	2,952,110[163]

Norwegian ports was 13.42 NOK/kg, equivalent to $1.4947 USD/kg or $1,494.70 USD/mt. Using an average price of $1522.85 USD/mt (the average of the Norwegian and Canadian landed values per ton), the landed value of the 59,198 mt caught in 2001 would be approximately $90,149,674 USD. Source Norwegian price information: "Average first-hand price (nominal) by species 1991-2001" Tabell 3. *Economic and biological key figures from the Norwegian fisheries* (Okonomiske og biologiske nokkeltal fra dei norske fiskeria) 2001. Fiskerdirektoratet, Norway. Source, Canadian information on landed value: Canadian Department of Fisheries and Oceans: Integrated Fisheries Management Plan Northern Shrimp - Northeast Newfoundland, Labrador Coast and Davis Strait, Effective 2003. http://www.dfo-mpo.gc.ca/communic/fish_man/ifmpns-pgipcn/index_e.htm

[158] Spain caught the largest amount of Greenland halibut in the international waters of the Northwest Atlantic in 2001. Value calculated on the basis of average landed value in Spain in 2001 - Greenland halibut/Fletan Negro 2.85 euros/kg. Total value: €63,726,000 = $57,130,359 USD. Source: Precios en Origen de Productos Pesqueros. Año 2001. Subdirección General De Comercialización Pesquera - Secretaría General De Pesca Marítima, 2001. Minsterio de Agricultura, Pesca y Alimentacion, Spain. (personal communication)

[159] Russia took the majority of the redfish caught in the international waters of the Northwest Atlantic in 2001. Unfortunately the author was unable to obtain landed value data for the Russian fleet and found that the port price or landed value of redfish caught in the North Atlantic varied considerably amongst key landing and market countries, both in terms of available information for prices in 2001 as well as more current price information. Values in 2001 ranged from a low of $427 USD/mt ($661CAD/mt) for redfish in Newfoundland to a high of approximately $2,200 USD/mt (€2,450/mt) in Spain. The author chose to estimate the value of the redfish catch based on the value of landings of redfish by foreign vessels in German ports in 2001. Germany is a key market for redfish in Europe and over one-quarter of all groundfish imported into Germany in 2001 came from Russia (source: USDA Foreign Agricultural Service, GAIN Report –GM 3037. Table 11. http://www.fas.usda.gov/gainfiles/200310/145986258.pdf). The assumption is that this approach could represent a reasonably close approximation of the value of the Russian catch of redfish in 2001. Price per ton redfish, foreign vessels landing in German ports 2001: €1,783/mt equivalent to $1,598 USD/mt = $33,919,148 USD total value. Source: Statistics on fisheries for the years 1995 to 2001: Germany, Foreign Landings in Domestic Ports. Organisation for Economic Co-operation and Development. http://www.oecd.org/document/7/0,2340,en_2649_33901_1837127_119656_1_1_1,00.html

[160] Spain caught the largest amount of skates in the international waters of the Northwest Atlantic in 2001. Value calculated on the basis of average landed value in Spain in 2001 – Skates/Rayas, Raja nep. 1.51/kg. Total value: €14,163,800 = $12,697,846 USD. Source: Precios en Origen de Productos Pesqueros. Año 2001. Subdirección General De Comercialización Pesquera - Secretaría General De Pesca Marítima, 2001. Minsterio de Agricultura, Pesca y Alimentacion, Spain. (personal communication)

[161] Spain caught the largest amount of grenadiers in the international waters of the Northwest Atlantic in 2001. Value calculated on the basis of average landed value in Spain in 2001 – Roundnose Grenadier/Granadero 1.81 euros/kg. Total value: €5,549,460 = $4,975,090 USD. Source: Precios en Origen de Productos Pesqueros. Año 2001. Subdirección General De Comercialización Pesquera - Secretaría General De Pesca Marítima, 2001. Minsterio de Agricultura, Pesca y Alimentacion, Spain. (personal communication)

[162] Spain took the largest share of the catch of hakes in international waters in the Northwest Atlantic. The landed value of hake is based on port price information from Vigo, the principal port of landing for fish caught by the Spanish distant water freezer trawler fleets. Price Vigo 2001 "Pesca Congelada/Frozen fish, Merluza/Hake" 445.70 ESP/kg. Equivalent to $2,402 USD/mt; total value = $4,950,522 USD. Source: Memoria Anual Del Puerto (Annual Port Report) Año 2001. Table 1A.1 "Distribucion de la pesca descargada por especies y precios". Autoriadad Portuaria de Vigo (Port Authority of Vigo) Spain

[163] Spain caught the largest amount of flatfish in the international waters of the Northwest Atlantic in 2001. However, the author was unable to obtain landed value data specifically for American plaice, Witch flounder or Yellowtail flounder in Spain for the year 2001. The landed value of these three species is based on averaging the

Roughhead Grenadier	1,423 mt	2,309,052[164]
Witch Flounder	1,350 mt	2,443,500
Yellowtail Flounder	833 mt	1,507,730
Wolffishes	829 mt	1,334,690[165]
Cod[166]	597 mt	1,333,614[167]
Misc[168]	1,044 mt	2,058,768[169]
TOTAL:	**124,169 mt**	**$217,762,103**

Summary

The estimate of the total value of the high seas bottom trawl catch in the Northwest Atlantic in 2001, including the northern prawn and the groundfish fisheries, is approximately $218 million USD. The overall marine fish catch reported in the Northwest Atlantic Ocean (FAO statistical area 21) was 2,238,371 mt in 2001. The estimated 124,000 mt of bottom trawl catch on the high seas represents approximately 5.6% of the total marine catch in the region.

price information in Pesetas per kilogram for the following average port prices in 2001 listed by the Port of Vigo: "Platija/flounder, fluke" 251.44/kg, "Mendo/Whitch" 290.83/kg; "Meiga/Witch" 415.46/kg; "Mendo Limon/Witch" 388.34/kg; and "Solla/Plaice" 335.11/kg. Average price 336.24 ESP/kg, equivalent to $US 1.81/kg. Total value: American plaice - $2,952,110 USD, Witch flounder - $2,443,500 USD, Yellowtail flounder $1,507,730. Source, price information: Memoria Anual Del Puerto (Annual Port Report) Año 2001. Table 1A.1 "Distribucion de la pesca descargada por especies y precios". Autoriadad Portuaria de Vigo (Port Authority of Vigo) Spain.

[164] Value calculated on the basis of average landed value in Spain in 2001 – Roughhead Grenadier/Granadero 1.81 euros/kg. Total value: €2,575,630 = $2,309,052 USD. Source: Precios en Origen de Productos Pesqueros. Año 2001. Subdirección General De Comercialización Pesquera - Secretaría General De Pesca Marítima, 2001. Minsterio de Agricultura, Pesca y Alimentacion, Spain. (personal communication)

[165] The majority of the catch of wolffish in international waters was taken by Spain in 2001. Author was unable to obtain price information on wolfish and arbitrarily selected a landed value of €1.80/kg, equivalent to $1,610 USD/mt.

[166] Source data for catch of cod in international waters in 2001: Historical Nominal Catches for Selected Stocks. Serial No. N4838 NAFO SCS Doc. 03/12, Scientific Council Meeting - June 2003. Northwest Atlantic Fisheries Organization. No information was available on

[167] Portugal took the highest share of the catch of cod in the international waters of the Northwest Atlantic in 2001. Estimate based on landed value of cod in Portugal in 2001. Price per ton cod 2001: €2,492/mt equivalent to $2,234 USD/mt = $1,333,614 USD total value. Source, price information: Statistics on fisheries for the years 1995 to 2001: Portugal. Organisation for Economic Co-operation and Development. http://www.oecd.org/document/7/0,2340,en_2649_33901_1837127_119656_1_1_1,00.html

[168] Includes the catch of Atlantic halibut, haddock, 'Large Sharks', 'Dogfishes (Ns)', 'Flatfishes (Ns)', 'Finfishes (Ns)' and 'Groundfishes (Ns)' in NAFO Area 3 by distant water fishing nations. UN FAO Fishstat – NAFO capture 1960-2002. Op cit. 77

[169] Spain took the majority of the miscellaneous catch in the international waters of the Northwest Atlantic in 2001. The author arbitrarily chose an average price for the landed value of the catch of €2,200/mt, equivalent to $1,972 USD/mt. Total value estimated at $2,058,768 USD.

3.5 OTHER OCEAN REGIONS

Southern Ocean: There is extensive deep-water fishing in the Southern Ocean, primarily deep-water longline fishing for Patagonian toothfish (*Dissostichus eleginoides*). However, The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) reports that there is relatively little bottom trawl fishing on the high seas of the CCAMLR area. Yet, there is considerable interest in exploratory bottom trawl fishing for a number of species on the high seas of the CCAMLR region.[170] In addition, some amount of bottom trawling for deep-sea species does occur within several EEZs in the region. Although there is reasonably good information on catches by most CCAMLR countries, there is a serious problem of unreported, as well as unregulated and illegal fishing in the region.

For the 2000/2001 season (roughly corresponding to calendar year 2001), the Scientific Committee of CCAMLR estimated the total catch of Patagonian toothfish was approximately 56,445 mt. Of this amount, 13,725 mt were reported caught by CCAMLR members within the convention area on both the high seas and within EEZs combined. Most of the other 42,720 mt were considered catch derived from IUU fishing. This figure includes 25,054 reportedly 'legally' caught outside the CCAMLR area, the large majority of which were thought to have been taken in IUU fisheries within the CCAMLR area but intentionally misreported as having been caught outside the CCAMLR area to avoid market restrictions associated with CCAMLR's Catch Documentation Scheme (CDS).[171] At the annual meeting of CCAMLR in 2002, the Commission concurred, stating that "CDS reports of catches from outside the Convention Area in Areas 51 and 57 were unlikely to have come from those areas and most likely to have come from within the Indian Ocean sector of the Convention Area". Furthermore the Commission felt that the uncertainties associated with assumptions underlying the assessment of IUU fishing levels meant that the estimates of IUU fishing in the CCAMLR area were likely to be "minimal", i.e. lower than the actual IUU catch.[172]

Altogether, the high seas catch of Patagonian toothfish for the 2000/01 season, including IUU caught fish, may have amounted to somewhere between 40,000-45,000 tons or more, though it is difficult to estimate or even guess this figure with any real degree of accuracy. Virtually all Patagonian toothfish caught on the high seas are taken in bottom longline fisheries.

Southeast Atlantic: There is little information currently available on the extent, if any, of high seas bottom trawl fishing in the region. Beginning in the mid-1990s, Namibia developed deep-water fisheries for orange roughy, alfonsinos, cardinal fish and oreos within the EEZ. However, a review of the catch of deep-water species on the UN FAO Fishstat database lists virtually no catches by distant water fishing nations for deep-water species in this region in recent years, including 2001. Nonetheless, anecdotal information suggests that some bottom trawl fishing does take place on the high seas in the region with an annual catch of some 2,000-3,000 mt.

Southeast Pacific: Chilean fleets have developed deep-water fisheries for orange roughy, alfonsinos, cardinal fish and oreos over the past several years within the Chilean EEZ. A review of the catch of deep-water species reported by the Chilean National Fisheries Service (Sernapesca) and other sources indicates no bottom trawl catches by Chilean vessels fishing on the high seas. There is a limited high seas fishery for Patagonian grenadier (Hoki/Merluza de Cola) but it appears to be a mid-water trawl fishery.[173] The UN FAO Fishstat database

[170] See footnotes 217, 218, and 220.
[171] Report of the Twenty-First Meeting of the Scientific Committee, Hobart, Australia. 21–25 October 2002. SC-CAMLR-XXI. Scientific Committee for the Conservation of Antarctic Marine Living Resources. page 20 and Annex 5, Tables 3.2 &3 .3
[172] Report of the Twenty-First Meeting of the Commission. Hobart, Australia, 21October – 1 November2002. SC-CAMLR-XXI. Commission for the Conservation of Antarctic Marine Living Resources. page 29
[173] Dr. Juan Carlos Cardenas and Cristian Perez, Ecoceanos. Personal communication.

indicates no reported fishing by distant water fishing nations for deep-water species in this region.

North and Central Pacific, Central Atlantic, Eastern Indian Oceans: There appears to be very little high seas bottom trawl fishing in these areas, based on the reporting of catches of deep-sea species on the UN FAO Fishstat database. A major bottom trawl fishery for slender (sometimes referred to as "pelagic") armourhead developed in the 1960s on the Hawaiian and Emperor seamount chains in the North Pacific. These fisheries had largely collapsed by the mid 1970s and it does not appear that the Russian and Japanese fleets involved redirected their efforts to other seamount fisheries in the region. As indicated in Section 4, there is a possibility that some degree of exploratory fishing for deep-water species may be taking place on the high seas of the Central Atlantic Ocean and the Eastern Indian Ocean and the same may be true of the North and Central Pacific.

Southwest Atlantic: There is extensive bottom fishing by distant water nations in the Southwest Atlantic, most of which appears to be taking place within the EEZs of Argentina and the Falklands/Malvinas Islands. However, the author was unable to research this area in detail. More research would be necessary to determine whether high seas bottom trawling takes place in this region and, if so, the extent to which it would involve deep-water trawling off the continental shelf, given that a significant portion of the continental shelf in the Southwest Atlantic lies outside the boundaries of EEZs in the region.

Mediterranean Sea: There appear to be limited high seas bottom trawl fisheries for deep-water prawns and landings of other species caught primarily as bycatch in the deep-water prawn trawl fishery. Unfortunately the author was unable to research this area in detail. More information on these fisheries would be useful, especially given the fact that few countries in the Mediterranean have established 200 n.m. Exclusive Economic Zones. For the most part, the high seas in the Mediterranean Sea begin beyond the boundaries of the 12 mile limits of territorial waters. However, the continental slope areas begin relatively close to shore suggesting that at least some portion of deep-water trawling in the Mediterranean may take place within territorial waters.

3.6 NUMBERS OF VESSELS INVOLVED IN HIGH SEAS BOTTOM TRAWL FISHERIES

Attempting to estimate the numbers of vessels involved in high seas bottom trawl fisheries over the past several years is a difficult task. Many of these fisheries are exploratory, catches vary tremendously, fish stocks are often fished out within the space of a few years and vessels move on to other areas or target new species. Fisheries targeting spawning aggregations of fish may only last for a few months each year – the period of the spawning season. Many of the trawlers involved often appear to fish on the high seas only for part of the year, in some cases after having reached their quotas in regulated fisheries within EEZs. Some may fish in several different ocean regions during the course of the year.

For example, in the South Pacific, Clark and O'Driscoll state that few vessels have participated consistently in the fisheries for orange roughy on the Lord Howe Rise and the Northwest Challenger Plateau on the high seas of the Tasman Sea adjacent to New Zealand waters, although the datasets they reviewed contained records of 52 and 56 vessels respectively having fished at one point or another in each of the areas over a period of fourteen years. Likewise, many of the vessels involved in the high seas fishery for orange roughy on the South Tasman Rise only fished for one or two years. Only eight vessels were involved in the fishery on a regular basis (defined as four years or more) and only five actually set 20 or more tows per year for the three most recent years for which data was available (a tow may last from less than one hour to several hours, depending on the type of ocean bottom area fished).[174] Most of the vessels involved in the high seas fisheries in the region in recent years are from New Zealand and Australia. To a certain extent, the situation in the Northeast Atlantic high seas bottom trawl fisheries is similar in that most of the vessels involved are from countries bordering the region.

Nonetheless, in spite of the transitory or part time nature of many of these fisheries, it is possible to produce at least a rough idea of the numbers of vessels that high seas bottom trawl fisheries could support on a full time, or year round equivalent, basis.

In the Northwest Atlantic in 2001, the Portuguese fleet operating in international waters consisted of 12 stern trawlers, which caught approximately 15,000 mt of fish. The average catch per vessel was 1250 mt.[175] Over a period of 2-4 months in the same year, a single Russian trawler took more than 2000 mt of silver hake (apparently within the Canadian EEZ under contract to a Canadian company).[176]

In 2001, the Spanish bottom trawl fleet fishing on the high seas of the Northwest Atlantic consisted of 31-35 vessels, including several pair trawlers (two vessels trawling a single net between them).[177] The overall Spanish catch in the region in 2001 was 25,370 mt, making the average catch per vessel between 725 – 820 mt. The Spanish fleet in 2002 numbered 32 trawlers fishing for a total of 5,903 days (averaging approximately 185 days per vessel). Their combined catch was slightly over 30,000 mt. The average catch per vessel was approximately 950 mt per vessel for the year.[178] At least some of the vessels in the Spanish fleet appear to fish on the Hatton Bank and elsewhere in the international waters of the

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[174] Op cit. 83, Clark and O'Driscoll. *Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986–87 to the end of the 2000–01 fishing year.*

[175] Portuguese Research Report for 2001. NAFO SCS Doc. 02/6. Scientific Council Meeting – June 2002, Northwest Atlantic Fisheries Organization

[176] Russian Research Report for 2001. NAFO SCS Doc. 02/4. Scientific Council Meeting – June 2002, Northwest Atlantic Fisheries Organization

[177] Spanish Research Report for 2001. NAFO SCS Doc. 02/7. Scientific Council Meeting – June 2002, Northwest Atlantic Fisheries Organization

[178] Spanish Research Report for 2002. NAFO SCS Doc. 03/11. Scientific Council Meeting – June 2003, Northwest Atlantic Fisheries Organization

Northeast Atlantic as well as in the Northwest Atlantic. If so, this would increase the average catch per vessel per year involved in the North Atlantic high seas bottom trawl fisheries.

In the Northeast Atlantic, Estonia reported that a single vessel caught 1,265 mt tons of deep-sea fish in 2001 and 1,528 mt in 2002 in the NAFO Regulatory Area - the high seas.[179] A single Russian vessel periodically fishing seamounts along the Mid-Atlantic Ridge during March – May of 2002 took 737 mt of roundnose grenadier (and some additional bycatch).[180] A French trawler operating in ICES Statistical Area VII (which straddles the Irish EEZ and the high seas) caught an average of 988 mt per year of orange roughy between 1996 and 2001.[181] Some 28 Spanish trawlers fished on Hatton Bank in the international waters of the Northeast Atlantic in 2001 but only four worked there full-time. The total amount of fishing time for the fleet combined was estimated at 1627 days (involving 26,123 hours of actual trawling) in 2001 with each vessel making 1-4 trips per year, ranging from 1 week to 4 months duration.[182] The Spanish catch on Hatton Bank in 2001 may have been as high as 40,000 mt.

In the Southwest Indian Ocean high seas bottom trawl fishery in 2001, eight deep-sea trawlers vessels reportedly caught 7,962 mt, averaging approximately 1000 mt per vessel.[183] Not all of these vessels fished year round in the area. Of the eight vessels, two Japanese trawlers (each approximately 1150 GRT) took a combined catch of 4,143 of alfonsinos, orange roughy and oreos in 2001.[184] In spite of averaging over 2000 mt of fish per vessel, both vessels left the region the following year, in part because of the uneconomical nature of the fishery due to a low market price for their catch in Japan.[185]
A Ukrainian vessel operating in the region 2001 took a total of 810 mt but left the fishery at the end of the year and was scrapped. Two New Zealand vessels caught at least 1400 mt of orange roughy and other species combined on the high seas of the Southwest Indian Ocean in 2001; three others took the remaining 1,600 mt.

The number of vessels involved in the northern prawn trawl fishery in the international waters Northwest Atlantic, the single largest high seas bottom trawl fishery, is more difficult to assess given the nature of the management measures in place, which effectively set limits on the number of fishing days for each country involved. However, there is information available to provide an idea of the amount of prawns caught per vessel in this fishery. One Portuguese trawler in 2001 spent 61 days on the Flemish Cap and took 420-480 mt of northern prawns (in addition, the vessel was likely to have retained some quantity of other species, such as redfish, often taken as bycatch in this fishery). In 2001, nine Russian vessels fishing a total of 947 days combined, caught 5687 mt of northern prawns on the Flemish Cap. The vessels involved averaged 630 mt of prawns for approximately three and one-half months of fishing per vessel.[186]

A fleet of Canadian offshore freezer trawlers fishes for northern prawns in the Northwest Atlantic, operate primarily, if not exclusively, within Canada's EEZ. This fleet, consisting of 12-13 Canadian deep-sea trawlers, appears to fish most of the year for northern prawns.

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[179] Deep-sea species catch 2002-2003. Deep-seas fishery effort *provisional data*. NEAFC Annual Meeting 2003. Op cit. 112.

[180] Op cit., 101, ICES Report of the Working Group on Biology And Assessment of Deep-Sea Fisheries Resources 2003. Page 16.

[181] Ibid. Pg 10 and Appendix 5

[182] Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources ICES CM 2002/ACFM:16. Advisory Committee on Fishery Management 2002. Pg 28

[183] Availability of Catch Data, para 60. UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39

[184] Ibid. Meeting Document 02/5: A Summary of Japanese Trawl Fishery Newly Developed in the Southwest Indian Ocean (FAO Area 51). Annex III.

[185] Ibid. Country Reports, para 36.

[186] S.V.Bakanev, The Russian Shrimp Fishery (*Pandalus borealis*) on the Flemish Cap, NAFO Division 3M, in 1993-2003. NAFO SCR Doc. 03/88. Scientific Council Meeting – November 2003, Northwest Atlantic Fisheries Organization

According to Canada's Department of Fisheries and Oceans, each vessel in this fleet, under the Enterprise Allocation system, was allocated a quota, on average, of almost 4,000 mt tons (and in some cases higher) of northern prawns and other shrimp. In 2003, the quota per vessel averaged even higher.[187] Although not fishing on the high seas, the quotas and catch per vessel in this fishery provide and idea of the amount of catch that would support a vessel fishing full time year round in the northern prawn trawl fishery.

Conclusion

Clearly the catch per vessel in deep-sea trawl fisheries on the high seas varies enormously. There is no 'average' or typical size vessel engaged in high seas bottom trawl fisheries. They may range in length from 30-40 meters for vessels fishing in high seas areas immediately adjacent to the EEZs of the countries where they are based, to 100 meters or more in length for distant water deep-sea fishing vessels operating far from home ports. The average high seas catch in recent years appears to range from approximately 500 mt to 2,000 mt or more per vessel per year for most vessels, with the lower figure almost certainly representing a part-time catch in most cases.

Nonetheless, based on the above information, it would not be unreasonable to assume, on average, a deep-sea trawler operating on the high seas would take, or require, a catch equivalent to a minimum of 1,000 to 1,500 mt of fish per year to maintain economic viability. The economics of the vessels and fisheries involved would vary, depending on such factors as capital costs associated with the purchase of the vessel and equipment, maintenance costs, the landed value of the catch, relative catch per unit effort, crew size, fuel consumption, proximity to home/offloading port, time spent searching for fish and running time between fishing areas. If this assumption is used, then the estimate of 170,000 – 215,000 mt of bottom trawl caught fish on the high seas world-wide taken in 2001 would support the equivalent of a fleet of approximately 100-200 deep-sea trawlers fishing year round on the high seas.

Even taking into consideration that the average catch per vessel engaged in bottom trawl fishing on the high seas may be much less than the figure above, given that some portion of the high seas fleet fishes some of the year within national waters or with other gear types (e.g. mid-water trawls), the total number of vessels involved in high seas bottom trawl fisheries, including part-timers, is not likely to exceed several hundred per year. By way of comparison, the UN FAO estimates that there are approximately 3.1 million fishing vessels in operation worldwide employing some 27 million fishers.[188] Even assuming 300-400 vessels are engaged in high seas trawling, including those fishing part time on the high seas, the high seas bottom trawl fleet would only constitute approximately 0.01% of the global fishing fleet.

[187] DFO Integrated Fisheries Management Plan: Northern Shrimp Northeast Newfoundland, Labrador Coast and Davis Strait. Effective 2003. Fisheries and Oceans Canada. http://www.dfo-mpo.gc.ca/communic/fish_man/ifmpns-pgipcn/index_e.htm

[188] State of World Fisheries and Aquaculture 2002. Food and Agriculture Organization of the United Nations. Rome 2002. Pg 16-17

3.7 SUMMARY CATCH AND VALUE OF HIGH SEAS BOTTOM TRAWL FISHERIES WORLDWIDE IN 2001

Most of the bottom fisheries for deep-sea species on the high seas are bottom trawl fisheries. There is some limited bottom longline and gillnet fishing on the high seas in the Northeast Atlantic but, based on 2001 and 2002 catch data, these currently appear to constitute less than 5% of the deep-water bottom catch in the region. There is extensive deep-water bottom longline fishing for Patagonian toothfish in the international waters of the Southern Ocean, much of which is IUU fishing. The catch of toothfish, including the estimated IUU catch, amounted to some 20% of the worldwide high seas bottom catch in 2001. Most toothfish are taken in bottom longline fisheries.

There is extensive mid-water trawl fishing for two deep-water species - redfish and blue whiting - in the international waters of the North Atlantic, some of which takes place at depths below 400 meters. Although the high seas fisheries for pelagic redfish ('oceanic' and 'deep-sea' *Sebastes mentella*) in the North Atlantic are consistently referred to as pelagic fisheries (primarily mid-water trawl but, in some cases, deep-water longline), some portion of these fisheries, such as the fishery along the Mid-Atlantic Ridge and the Reykjanes Ridges south of Iceland, may involve bottom trawl fishing.[189] Nevertheless, based on the information reviewed for this report, it would appear that the large majority of deep-sea fisheries on the high seas targeting bottom dwelling species are bottom trawl fisheries. In 2001, bottom trawling probably accounted for somewhere in the vicinity of 80% of the total catch in bottom fisheries on the high seas.

It must be emphasized again that the information available is indicative at best. As mentioned earlier, the International Council for the Exploration of the Sea has identified serious deficiencies in the quality of the catch data on deep-sea fisheries in the Northeast Atlantic and there are clear discrepancies in the catch figures for the Spanish high seas fleet reported by NEAFC, ICES and the UN FAO. The May 2002 meeting on the deep-water fisheries of the Southern Indian Ocean compiled estimates of the high seas catch in the deep-sea fisheries in the Southwest Indian Ocean in part on the basis of 'inferred' information, noting that a number of countries with vessels reportedly fishing in the region did not report catches. In the Southwest Pacific, the present extent of deep-sea trawling by vessels from countries other than New Zealand and Australia is unknown. Elsewhere there maybe significant unreported deep-water trawl fisheries on the high seas. The high seas bottom fisheries in the Northwest Atlantic managed by NAFO appear to be the only fisheries where the collection of reasonably comprehensive data has been consistently gathered; even so there appear to be significant discrepancies in some of the catch data from these fisheries as well.

Similarly, the estimate of the value of these fisheries can only be considered indicative at best given the quality of the data available on high seas catches. Moreover, the estimates for the value of the catch used in this section are best estimates of average ex-vessel prices for the species caught in bottom trawl fisheries on the high seas in the principal countries where the catch is landed. They are by no means a precise calculation of the actual landed value of the deep-sea species listed in the previous section for the year 2001.

With these caveats in mind, based on the assumptions detailed in this section, the estimate of the high seas bottom trawl catch in the Atlantic, Pacific and Indian Oceans in 2001, the latest year for which data is consistently available, is approximately 170–215,00 mt valued at

[189] Total catch of pelagic redfish on the high seas – the NEAFC Regulatory Area – in 2001 was estimated to be approximately 60,000 mt of which some 7,500 mt may have been taken in the NAFO area and another 14,670 mt were IUU caught (primarily Lithuania). Source: Report of the 21st Annual Meeting of the North-East Atlantic Fisheries Commission, 12 - 15 November 2002. *Volume 2 – Annexes*. Annex F – Aggregate catches of regulated and non-regulated species – 2001.

approximately $280-$320 million USD. The figure of $300-400 million USD may be closer to the actual value in 2001, taking into account the value of the bottom trawl catch on the high seas of the South Atlantic Ocean and Mediterranean Sea, which the author was unable to estimate, and unreported bottom trawl catches elsewhere on the high seas.

Based on the estimates listed in Table 3.7.1, eleven countries – Spain, Russia, Portugal, Norway, Estonia, Demark/Faroe Islands, Japan, Lithuania, Iceland, New Zealand and Latvia took approximately 95% of the total high seas bottom trawl catch in 2001. European Union countries (including Latvia, Lithuania, and Estonia but excluding the Faroe Islands) took approximately 60% of the high seas bottom trawl catch in 2001. Spain accounted for approximately two-thirds of the European Union catch and some 40% of the overall global high seas bottom trawl catch.

Most of the catch in 2001 was taken in a relatively small area of the Northwest Atlantic (the shelf and slope area of the international waters of the Grand Banks and the Flemish Cap). The catch in the Northwest Atlantic amounted to slightly over 60% of the overall high seas bottom trawl catch worldwide. However, the damage to seamount, coral and other deep-sea species and ecosystems is likely to be far higher in the other ocean regions where significant bottom trawl fishing takes place because of the greater geographical scope of the fisheries in these regions.

The overall volume of marine capture fisheries worldwide in 2001, as reported by the UN FAO, was 83,663,276 mt. The overall value of global marine capture fisheries in 2001 was approximately $73.4 billion USD.[190] The volume and value of the bottom trawl catch on the high seas represents a fraction of a percent of the reported total marine capture fisheries in 2001, and even less when considering the overall volume and value of global fisheries production in 2001 (including freshwater and aquaculture production), which was approximately 130 million tons and $135 billion dollars respectively.[191]

[190] The UN FAO estimates the total value of capture fisheries worldwide ("World total: Capture fisheries") in 2001 as $79.439 billion USD in *Appendix II - World fishery production: estimated value by groups of species* of the UN FAO Yearbook of Fishery Statistics, Summary Tables – 2001. This figure includes the value of fresh water capture fisheries as well as marine capture fisheries. The estimate of the value of marine capture fisheries in 2001 is derived by taking the"World total" figure of $79.439 billion and subtracting the estimated value of the capture fisheries for the following species groups: Carps, barbels and other cyprinids; Tilapias and other cichlids; Miscellaneous freshwater fishes; Sturgeons, paddlefishes; River eels; Shads; Miscellaneous diadromous fishes; Freshwater crustaceans; Freshwater mollusks. Total estimated value of these freshwater fisheries - $6,034 billion USD. Value of Marine capture fisheries - $73.405 billion USD. Source: UN FAO Yearbook of Fishery Statistics. Summary Tables, Commodities - 2001. Appendix II - World fishery production: estimated value by groups of species. http://www.fao.org/fi/statist/statist.asp

[191] Ibid. Appendix II.

Table. 3.7.1 Summary of estimated high seas bottom trawl catch in 2001 by country for the Northwest Atlantic, Northeast Atlantic, Southwest Indian Ocean and Southwest Pacific Ocean.

Catch mt[192] Year 2001	**Northwest Atlantic**	**Northeast Atlantic**	**Southwest Indian**	**Southwest Pacific**	**Total 2001**
Spain	25,348	57,702			83,050
Portugal	14,932				14,932
France		784			784
Estonia	12,213	1,200			13,413
Latvia	3,330				3,330
Lithuania	7,596	140			7,736
Poland	315	180			495
Misc/other EU	92				92
EU total[193]	63,826	60,006			123,832
Norway	14,715				14,715
Russia	26,051	2,633	210		28,894
Iceland	5,079				5,079
Faroe Is.	12,280	340			12,620
Japan	3,621		4,143		7,764
Ukraine	405		810	195	1,410
China			890		890
New Zealand		450	1,400	2,458	4,308
Australia			?	565	565
Misc	1,911	328	1,831[194]	877[195]	4,947
Total	**127,888**	**63,757[196]**	**9,284**	**4,095**	**205'024**

[192] Figures listed in this Table are derived from the official catch reports to NAFO, ICES, and the other sources of information used in Sections 3.1-3.4 as explained in those sections.

[193] Estonia, Lithuania, Latvia and Poland only joined the European Union in May 2004. However, for the purpose of attempting to get a picture of the current extent of bottom trawl fishing on the high seas by EU fleets using data from 2001, the catch of these countries is included in the overall estimate of the EU catch.

[194] Some portion of this is likely to consist of the catch by Australian vessels in the Southwest Indian Ocean in 2001

[195] Includes 830 mt catch on South Tasman Rise: New Zealand and Australia combined. Also 47 mt of orange roughy taken by Korea in the SW Pacific.

[196] This estimate corresponds to the upper estimate of the catch in the Northeast Atlantic on Table 3.3.2. There is a slight discrepancy in the total in this Table compared to the upper estimate of the catch in Table 3.3.2 due to the fact that the catch figures the author chose from the ICES Statlant database on a country by country basis (as explained in the footnotes to Table 3.3.2), when combined for the EU as a whole, differ slightly from the estimates in Annex 5 of the report of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species. The latter summarizes the estimated EU catch on the high seas as a whole, as opposed to listing the estimated catch by individual EU Members. Further, the NEAFC estimates were made in 2002; the ICES figures are based on official country reports of catches. Finally, the assumptions made by the author in estimating the portion of the high seas catch based on the information contained in the ICES Statlant database may be incorrect or result in differences with estimates based on alternative approaches.

Table 3.7.2 Summary of the reported catch by country in high seas bottom trawl fisheries in the North Atlantic (east and west) 2002 based on information published by NAFO and NEAFC. [Figures for individual EU countries in the Northeast Atlantic not provided by NEAFC]

Year 2002	Northwest Atlantic NAFO Area	Northeast Atlantic NEAFC Area
Spain	34,092	
Portugal	18,527	
France	0	
Estonia	15,021	1,524
Latvia	1,962	
Lithuania	3,781	1,921
Poland	0	
Misc/other EU	359	
EU total	73,742	22,101
Norway	11,834	[1,352][197]
Russia	22,999	403
Iceland	5,808	
Faroe Is.	8,781	
Japan	3,387	
Total	**126,551**	**22,504**

[197] Norway's high seas bottom fishing in the Northeast Atlantic is likely to be bottom longline fishing – see discussion in Section 3.3

SECTION 4
TRENDS IN HIGH SEAS BOTTOM TRAWL FISHERIES

The current high seas bottom trawl catch is relatively small by global standards. However, there appears to be a considerable amount of exploratory bottom fishing on the high seas and it is likely that high seas bottom trawl fisheries will continue to expand over the coming years.

In the Northeast Atlantic, deep-water fisheries expanded rapidly in the 1990s as a result of marketing initiatives, particularly in France and partly as a result of the "increasingly restrictive management regulations on the traditional fisheries because of [the] decline of many of the stocks on the continental shelf" according to a 2002 European Commission staff working paper reviewing deep-water fisheries by EU fleets. The paper goes on to state "exploratory cruises by commercial fishing vessels continue to identify potential fisheries, particularly in international waters on the Hatton Bank and the Mid-Atlantic Ridge."[198]

Over the last several years, there has been extensive exploratory fishing by Spanish freezer trawlers in the international waters of the Northeast Atlantic. In addition, Norwegian vessels have been engaged in exploratory deep-water fishing on the Hatton Bank with government support, though these have been almost all longline vessels.[199] The Irish government has provided substantial subsidies to develop deep-water fisheries since 2000 through fleet conversion and renewal programs. As a result, there has been a major increase in deep-water catches by Irish vessels, many of which are bottom trawl vessels, primarily with the EEZ in the past three years. However, it appears that at least some Irish vessels are involved in exploratory fishing on the high seas and it would be reasonable to assume that, as deep-sea stocks are depleted within the EEZ, the Irish deep-sea fleet will increasingly move into international waters.

Russian vessels have also returned to fishing along the Mid-Atlantic Ridge for roundnose grenadier and other species in the late 1990s after a lull in Russian distant water fishing following the collapse of the Soviet Union. Russian research vessels have also been involved in surveying the Mid-Atlantic Ridge for commercial fishing opportunities.[200] Even non-commercial research projects such as the MAR-ECO project, an international project designed to map the biodiversity of the Mid-Atlantic Ridge, may be used to expand fishing for deep-sea species in the international waters of the Northeast Atlantic. Various fisheries and oceanographic research institutes in Russia are involved in the MAR-ECO project. Amongst the reasons given for the participation of the institutes is that "It will help intensify the fishing activity of the national fleet on the MAR (Mid Atlantic Ridge) owing to the data obtained within the framework of the project".[201]

The MAR-ECO project and similar projects conducted under the auspices of the Census of Marine Life are essential to advancing the understanding of the biodiversity of the world's oceans. The information generated by the MAR-ECO project should prove invaluable in

[198] Op cit. 31, European Commission Staff Working Paper: Deep-Sea Fisheries.
[199] Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources. Horta, the Azores, Portugal. 4–10 April 2002. Advisory Committee on Fishery Management ICES CM 2002/ACFM:16 Ref. G
[200] Ibid.
[201] V. Vinnichenko, V. Shibanov (N. M. Knipovich Polar Research Institute of Marine Fisheries and Oceanography, Murmansk, Russia), S. Evseenko (P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences, Moscow, Russia), A. Orlov (All-Russia Federal Research Institute of Fisheries and Oceanography, Moscow, Russia). Russian involvement with the international project to study ecosystems of the Mid-Atlantic ridge (Mar-Eco). Presentation to the VII International Congress on the History of Oceanography, Kaliningrad, Russia, September 8-12, 2003 http://vitiaz.ru/congress/en/thesis/48.html

advancing the conservation and protection of fish populations and the biodiversity of the deep-sea. It would be unfortunate, however, if it was also used by deep-sea trawl fleets to develop new and unregulated deep-water fisheries on the high seas.

The research in the North Atlantic appears to be part of a broader effort by the Russian government to expand distant water fishing operations. According to an Interfax wire service story, a meeting of the Russian State Fisheries Committee in September 2003 agreed to organize fishing expeditions to the international waters of the Southeast Pacific as part of a wider program for the development of fisheries in international waters adopted by the Russian government.[202]

In the Northwest Atlantic, the cod, redfish, flounder and other fisheries for groundfish along the continental shelf and upper slope in the international waters of the Grand Banks and Flemish Cap collapsed in the early 1990s. The international fleet operating in the area responded by developing deeper-water fisheries for northern prawn and Greenland halibut. The northern prawn fishery on the Flemish Cap, the largest high seas bottom trawl fishery in the world, as measured by tonnage of catch, began virtually overnight in 1992/3 with the collapse and closure of the cod and redfish fisheries. The Flemish Cap has been a highly productive, heavily fished area for the past several decades. It may be that the population of northern prawns has increased substantially as a result of the depletion of demersal species of fish that prey on prawns, and the recovery of cod, redfish and other demersal species may be impeded by the bycatch and unobserved mortality of these species in the trawl fishery for prawns. If so, the northern prawn fishery would be another example of a global pattern of 'fishing down the marine food chain'.[203]

In the Southern Indian Ocean and Southwest Pacific, New Zealand and Australian deep-water trawl vessels have been increasingly expanding the scope of their operations into high seas areas. As orange roughy stocks were depleted within the EEZ of New Zealand during the 1980s and Australia during the 1990s, trawlers moved into international waters in search of more fish, developing new grounds on the high seas in the Tasman Sea in 1988, followed by the Louisville Ridge fishery (approximately 600 kilometers east of New Zealand) in 1993, the South Tasman Rise fishery on the high seas south of Tasmania in 1997, finally moving into the Southwest Indian Ocean to find orange roughy in the late 1990s.[204] The Southwest Indian Ocean fishery for orange roughy appears to have largely collapsed but anecdotal information suggests that there may be a number of vessels engaged in exploratory fishing for orange roughy around seamounts and ridge systems over a wide area of the Indian Ocean. However, the author was unable to obtain any concrete information in this regard.

The New Zealand catch of orange roughy in, and adjacent to, its waters has declined by 75% since 1988, the peak year for the New Zealand orange roughy catch.[205] This partly explains the reason New Zealand companies and vessels have endeavored to find new orange roughy fishing grounds on the high seas and elsewhere. In addition to developing the Southwest Indian Ocean fisheries, New Zealand reportedly caught 450 mt of orange roughy on the high seas in the Northeast Atlantic in 2001 and New Zealand companies have been involved in the development of orange roughy fisheries off Namibia.[206]

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[202] "Russia to arrange fishing operations to the southeastern Pacific" DATELINE: MOSCOW September 24, 2003. Interfax

[203] see for example Pauly D. et al. *Fishing Down Marine Food Webs.* Science 279, 860-863 (1998) and Pauly D. et al. *Towards sustainability in world fisheries.* Nature 418, 689-695 (2002).

[204] Meeting Document 02/9 - *Predictive modeling of demersal fish distribution in the southern Indian and Southern Oceans*. Bureau of Rural Sciences Australia**.** UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39

[205] UN FAO FISHSAT - Area 87, New Zealand catch: orange roughy. 1950-2001

[206] Op cit. 102, Meeting of the NEAFC Working Group. ANNEX 5 - *Catches of deep sea non-Regulated Resources*, NEAFC Regulatory Area 2001. See also *Orange Roughy*, May 2002 Product Spotlight http://www.seafoodbusiness.com/archives/searchframe.asp

Elsewhere, major deep-water fisheries have been developed in the EEZs of Chile and Namibia within the past several years for orange roughy, cardinal fish and other species. Anecdotal information suggests that the in the Southeast Atlantic there is already substantial deep-water trawl fishing on the high seas. Additionally, the development of exploratory deep-water trawl fisheries in the international waters of the Southeast Pacific adjacent to the Chilean EEZ seems likely given the interest of Russian distant-water fishing fleets in expanding operations in the region.

The same pressures and incentives that led to the rapid development of deep-water trawl fisheries in the Northeast Atlantic are in effect worldwide: the depletion of coastal and continental shelf fisheries, the increasing management restrictions being placed on fisheries within EEZs, rising market demand for fish products in developed countries, and the lack of regulation of high seas areas. These will all continue to provide incentives for deep-water vessels to develop new fisheries on the high seas and, if left unchecked, will almost certainly result in a significant geographic expansion of high seas bottom trawl fisheries in the coming years. The actual catch of deep-sea species on the high seas may or may or not change significantly. The pattern of deep-sea fisheries is often one of serial depletion with fisheries developing for new species or on newly discovered stocks following the rapid depletion or collapse of previously discovered stocks of deep-sea fish. However, the expansion of high seas bottom trawl fisheries in international waters will almost certainly result in continued damage to coral and other vulnerable deep-sea species and ecosystems associated with seamounts, ridges, plateaus, the continental slope and elsewhere in the deep-sea as more of these areas on the high seas are discovered, surveyed and targeted by bottom trawl fishing fleets in search of deep-sea fish.

SECTION 5
MANAGEMENT AND REGULATION OF HIGH SEAS BOTTOM TRAWL FISHERIES

Southwest Indian Ocean

The deep-sea fisheries on the high seas of the Southwest Indian Ocean are virtually unregulated. There is no regional fisheries management regime in place to regulate these fisheries. Several countries have placed limited, unilateral, restrictions on the activities of their vessels engaged in these fisheries. Australia, for example, requires observers on board all vessels and has limited the number of licenses to fish in the region. Both South Africa and New Zealand require any vessel flying their flag to have a license to fish in the area and to report catches. However, there are no restrictions on areas fished, quantity of catch, or new and exploratory fishing. Nor are any of the vessels involved in the fishery subject to bycatch restrictions, area closures or gear restrictions to prevent adverse impacts on non-target species or damage to corals and other habitat associated with the seamount and ridge ecosystems fished in the region. Although there is no information on the biodiversity associated with seamounts and ridge systems targeted in the high seas fisheries in the region, Butler et al. concluded that "from biogeographic patterns elsewhere there is reason to assume that there is high and unique benthic biodiversity, which will be destroyed by unregulated fishing" in the high seas bottom trawl fisheries of the Southwest Indian Ocean.[207]

When orange roughy was first discovered in the region in 1999, a number of countries began a process to negotiate a regional fisheries management organization for the regulation of these and other high seas deep-water fisheries. The first intergovernmental consultation took place in February 2001 and a second consultation in September of the same year. The third set of negotiations did not take place until January 2004. At that time there were still significant differences amongst the parties to the negotiations and it is not clear when an agreement will be reached, much less enter into force.[208] In the meantime, as indicated in Section 3, the bottom trawl fisheries on the high seas of the Southwest Indian Ocean peaked in 2000 and most of the stocks or populations of fish targeted appear to have been depleted or have collapsed by 2002.

Southwest Pacific Ocean

There are no catch restrictions or other management measures in place for the orange roughy fisheries on the high seas adjacent to the New Zealand EEZ – neither the Louisville Ridge fishery to the east of New Zealand in the Southwest Pacific Ocean, nor the Northwest Challenger Plateau and Lord Howe Rise fisheries in the international waters of the Tasman Sea.[209] The South Tasman Rise fishery for orange roughy, in the international waters adjacent to the Australian EEZ south of Tasmania, is jointly managed by Australia and New Zealand through a Memorandum of Understanding between the two countries in effect since 1998. The management of the fishery consists of quotas and an agreement on allocation between the two countries. The quota for the 2000-2001, and the 2001-2002 fishing season was 2,400 mt

[207] Op cit. 36, Butler et al., *Review of the benthic biodiversity of the deep sea.*

[208] *Possible options regarding issues central to the negotiations for the establishment of a South West Indian Ocean Fisheries Commission.* Third Inter-Governmental Consultation on the establishment of the South West Indian Ocean Fisheries Commission. Nairobi, Kenya, 27-30 January 2004. Document: SAFR/DM/SWIO/04/4. UN FAO http://www.fao.org/fi/meetings/safr/swio/2004/default.asp. The next round of negotiations is scheduled to take place in July 2004.

[209] Meeting Document 02/10 - Population Biology of Some Commercial Deepwater Fish Species of the Southwest Indian Ocean - Report on Progress. UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39

of orange roughy per year. The actual catch in the 2000-2001 season was 830 mt (approximately one-third of the quota) and in 2001-2002 the catch fell to an estimated 190 mt. Concern over the absence of significant aggregations of orange roughy during the spawning season over the two year period coupled with a strong decrease in the catch per unit effort (CPUE) strongly suggest fishing has depleted the population or populations of orange roughy on the South Tasman Rise, calling into question the effectiveness of the management measures in preventing overfishing.[210]

None of these fisheries, including the South Tasman Rise fishery, were regulated to prevent damage to corals and other benthic habitat associated with seamounts in the region. Large quantities of coral were recorded as bycatch in the South Tasman Rise fishery when it first began in the late 1990s. As discussed in Section 2, this is an area – the Tasman Sea - where many new species associated with seamount and ridge systems have been discovered and endemism is thought to be high. In addition, where it has been investigated, there is photographic and video survey evidence demonstrating bottom trawling has been highly destructive to coral ecosystems associated with seamounts in this region.

Northeast Atlantic Ocean -- Northeast Atlantic Fisheries Commission (NEAFC)

The Northeast Atlantic Fisheries Commission (NEAFC) is the regional fisheries management organization in the Northeast Atlantic with competence to regulate bottom fisheries on the high seas. Its area of application is from approximately 35 degrees north latitude to the Arctic Circle. The contracting parties to NEAFC are the EU, Norway, Iceland, the Russian Federation, and Denmark on behalf of the Faroe Islands and Greenland. A regional fisheries management organization with competence over high seas fisheries has existed in the Northeast Atlantic since 1953. The Northeast Atlantic Fisheries Commission was established in 1963 with the entry into force of the Northeast Atlantic Fisheries Convention. A new convention was negotiated to accommodate the extension of the EEZs in the North Atlantic in the late 1970s and the incorporation of the European Union (then the EEC) into NEAFC in 1980.

NEAFC has only recently begun to regulate high seas bottom fisheries within the past two years. Until 2002, NEAFC had regulations in place for only five fisheries in international waters. These were the fisheries for blue whiting, herring, mackerel, redfish and haddock. In the past, NEAFC has recommended a ban on salmon fishing on the high seas (1969) and recommended a ban on industrial fishing for herring in the North Sea in 1975 (this was a temporary measure).[211] With respect to bottom trawling, NEAFC has in place a closure of a small area of the Rockall Bank to trawling for haddock – a measure intended for the conservation of haddock.[212]

Until 2003, deep-water species such as roundnose grenadier, orange roughy, blue ling, and deep-sea sharks were referred to as "non-Regulated species", meaning that no regulations were in place to manage the fisheries for these species on the high seas, in spite of the fact that some of these species, such as roundnose grenadier, have been fished in the international waters of the Northeast Atlantic for over 30 years. In 2002, NEAFC members first agreed to 'regulate' fisheries on the high seas for these and other deep-sea species through establishing a cap on fishing effort on some deep-sea species in the NEAFC Regulatory Area

[210] Op cit. 83, Clark and O'Driscoll. *Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986-87 to the end of the 2000-01 fishing year*.

[211] North East Atlantic Fisheries Commission: History of the Organization. http://www.neafc.org/about/about_history.htm

[212] Recommendation Iv from the 22nd Annual Meeting: Regulatory Measures for the Protection of Haddock in ICES Area Vib For 2003 (Decided at the 21st Annual Meeting, November 2003 and effective from 7 March 2004). North East Atlantic Fisheries Commission: Measures, Rockall Haddock 2004. http://www.neafc.org/measures/rockhall_2004.htm

(the high seas) beginning in 2003. In November 2003, parties to NEAFC agreed to the "Recommendation for Ad Hoc and Temporary Conservation and Management Measures for Deep-Sea Species in the NEAFC Regulatory Area in 2004", essentially an extension of the cap agreed the previous year. The operative language of the recommendation is as follows:

"Each Contracting Party undertakes to limit the effort for 2004 put into the fishing for deep-sea species in the NEAFC Regulatory Area. The effort shall not exceed the highest level put into deep-sea fishing in previous years for those species listed below. The effort should be calculated as aggregate power, aggregate tonnage, fishing days at sea or number of vessels, which participated."[213]

Unfortunately, though this recommendation is, on paper, a management regulation, it is not likely to restrain the current level of fishing effort, already unsustainably high, or prevent fishing effort from increasing for deep-sea species. Nor will it do anything to prevent damage to vulnerable deep-sea ecosystems. The following review of the history of fishing on deep-sea species in the international waters of the Northeast Atlantic provides an indication of previous levels of fishing, which the current regulation is designed to cap.

The annual Russian/USSR catch of roundnose grenadier peaked at a high of 29,974 mt in the Northeast Atlantic in 1975, with 22,842 mt, the second highest annual catch, taken in 1986.[214] According to ICES, Poland caught 6,769 mt of roundnose grenadier in 1998 and Spain took 8,251 mt in 1999 in ICES Area XII – an area of international waters covering a portion of Hatton Bank, Rockall Bank, the Mid-Atlantic ridge, the Reykjanes ridge and a number of seamounts, rises, ridges and other banks in the Northeast Atlantic. In addition, French and Spanish trawlers together caught over 8,000 mt of roundnose grenadier combined in 2001 in ICES Area VI, some of which appears to have been taken in international waters, beyond the 200 mile limits around Ireland and Scotland. Further, the UN FAO reports a Spanish catch of over 33,000 mt of roundnose grenadier in the Northeast Atlantic in 2001, most of which - approximately 31,000 mt according to provisional data from Spain - was caught in international waters (ICES Area XII).

Assuming that most, if not all, of the Russian catch in 1986 was taken in international waters, the NEAFC 'cap' on fishing effort could essentially allow a high seas catch of roundnose grenadier of up to 70,000 mt or more for just these four countries combined. In contrast, NEAFC reports (provisionally) that the catch of roundnose grenadier in international waters in 2002 by all NEAFC members combined amounted to 7,108 mt, with an additional 2,769 mt taken by Estonia and Lithuania (which were non-contracting parties at the time). The 'cap' adopted by NEAFC could conceivably mean up to a sevenfold increase in bottom trawl fishing for roundnose grenadier above the level in 2002.

As mentioned earlier, the fishery for roundnose grenadier, one of the two largest deep-water bottom trawl fisheries in the international waters of the Northeast Atlantic, is a mixed species bottom trawl fishery. Roundnose grenadier is the target species but the fishery involves a substantial quantity of bycatch, primarily smoothheads, black scabbardfish, blue ling and deep-water sharks. As with the target species, fishing pressure on bycatch species is not likely to be constrained by the NEAFC regulation.

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[213] The list of species for which the recommendation applies is: Roundnose grenadier, Black scabbardfish, Orange roughy, Blue ling, Ling, Red Seabream, Forkbeards, Greenland halibut, Greater silver smelt, Alfonsinos, Tusk, and the following deep-water shark species - Iceland catshark, Gulper shark, Leafscale gulper shark, Black dogfish, Portuguese dogfish, Kitefin shark, Birdbeak dogfish, Greater lanternshark, Velvet belly, Blackmouth dogfish, Mouse catshark. Recommendation V from the 22nd Annual Meeting: NEAFC Recommendation for Ad Hoc and Temporary Conservation and Management Measures for Deep-Sea Species in the NEAFC Regulatory Area in 2004. http://www.neafc.org/measures/deep_sea_2004.htm

[214] UN FAO Fishstat. Op cit. 77

Furthermore, a substantial deep-water bottom trawl fishery for smoothheads has recently been developed by Spanish vessels on the high sea of the Northeast Atlantic. Smoothheads are caught in large quantities as bycatch in the roundnose grenadier fisheries. The smoothhead fishery is, in effect, an extension of the bottom trawl fishery for grenadiers. The catch, by weight, of smoothheads is now, by some estimates, the second highest in the bottom trawl fisheries after roundnose grenadier.[215] However, smoothheads are not on the list of species covered by the NEAFC regulation. It is not clear to what extent this fishery involves additional fishing effort by deep-water trawlers or is simply a result of the fact that Spanish trawlers targeting roundnose grenadier that previously discarded the bycatch of smoothheads are now retaining these fish for landing and sale.

Finally, NEAFC has not established any restrictions on deep-water trawling on the high seas of the Northeast Atlantic in terms of its impact on seamounts, cold-water corals and other sensitive bottom ecosystems in the region. This is a major concern given the widespread distribution of cold-water corals throughout deep-sea areas of the Northeast Atlantic, their documented vulnerability to bottom trawl fishing in the region, and the high degree of biodiversity associated with deep-sea coral ecosystems. In sum, the current "regulation" of the deep-water bottom trawl fisheries in the international waters of the Northeast Atlantic can hardly be labeled as such. These fisheries continue to be, in effect, unregulated high seas fisheries.

It would appear that extensive exploratory fishing in the region, market interest in new products and species, and a trend toward increasing fishing effort on more 'traditional' deep-water species is likely to result in a significant expansion of deep-water trawling in the international waters of the Northeast Atlantic in the foreseeable future. The NEAFC measures currently in place will not effectively constrain further development of deep-water fisheries, nor regulate these fisheries for sustainability and their impacts on deep-sea ecosystems. Under the current management regime, the likelihood of continued and increasing damage to deep-sea coral ecosystems associated with seamounts, ridges, plateaus, banks and other underwater features on the high seas is high. So is the likelihood of the continued development of new fisheries without the basic scientific information necessary to determine sustainable levels of exploitation of target species much less bycatch species. Furthermore, there is a strong possibility that deep-water bottom trawl fleets will expand their areas of operation into the international waters of the Central Atlantic in the coming years – an area of the high seas where no regime currently exists to manage or regulate deep-water trawl fisheries - assuming that populations of deep-sea species are found in commercially viable quantities.

Northwest Atlantic – Northwest Atlantic Fisheries Organization (NAFO)

The deep-water fisheries in the international waters of the Northwest Atlantic are regulated by the Northwest Atlantic Fisheries Organization (NAFO). These fisheries are, comparatively speaking, the best regulated deep-water trawl fisheries on the high seas. However, the bottom trawl fisheries in the Northwest Atlantic are not without significant problems.

Four main fisheries – the northern prawn, redfish, Greenland halibut and skate fisheries - accounted for over 80% of the bottom trawl catch on the high seas of the Northwest Atlantic in 2001. In the northern prawn fishery, two countries, Estonia and Denmark/Faroe Islands, which took approximately 40% of the catch in 2001, apparently were operating outside of the regulations established by NAFO in 2002. Both countries took a reservation on the management measure for this fishery adopted by NAFO - essentially an effort restriction limiting the number of days vessels from each country are permitted to trawl for prawns on the Flemish Cap. In response, Canada closed its ports to vessels from both countries in 2002.

[215] See Section 3.3 – Northeast Atlantic.

The biomass of Greenland halibut populations targeted by the high seas fishery is considered to be at historic lows. The principal bottom trawl fishery for redfish, on the tail of the Grand Banks in NAFO Area 3O, is apparently unregulated, as is the fourth principal fishery in the area, the directed fishery for skates.[216] Most of the remainder of the catch taken in the bottom trawl fisheries in the international waters of the Northwest Atlantic consists of either 'unregulated' species (e.g. roundnose and roughhead grenadier), or bycatch of species for which directed fishing has been prohibited because of the severely depleted status of the stocks concerned (e.g. American plaice, cod, redfish on the nose of the Banks, and witch flounder on the tail of the Banks).

In some cases NAFO has adopted regulations to reduce the bycatch of depleted species, such as cod, taken in one or more of the four principal fisheries. However, the Scientific Committee of NAFO has repeatedly expressed concern that bycatch levels of depleted species in many of the bottom trawl fisheries are high (and in some cases are growing). In addition to these and other management issues identified in Section 3.4, there are no regulations in place to protect corals or other deep-water habitats from the impact of bottom trawling. Virtually all of the deep-water species caught on the high seas of the Northwest Atlantic, with the exception of several thousand tons of pelagic redfish (*Sebastes mentella*) caught in mid-water trawl fisheries in the Irminger Sea, are taken by bottom trawling.

Southern Ocean – Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

As mentioned in Section 3, there is very little bottom trawl fishing in the Southern Ocean and surrounding area covered by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), although in the past there were extensive bottom trawl fisheries in the region. CCAMLR operates on the basis of an ecosystem approach and has, in some cases, prohibited fishing when there is significant risk to by-catch species. This was the case with the banning of bottom trawling for mackerel icefish around the South Orkney and South Georgia Islands. CCAMLR acknowledges the problem of bottom trawl fishing and states on its website that heavy trawling gear is known to scrape and plough up the seabed with adverse impacts on the marine life on the sea floor. Although such impacts on the "fragile and slow growing communities of the Southern Ocean" have not been assessed, CCAMLR asserts that they are likely to be significant locally and long lasting.[217]

As mentioned in the previous section, there is considerable interest in exploratory fishing in the CCAMLR region. For example, a total of 31 notifications for exploratory fisheries in the 2003/04 season were made by 14 CCAMLR member countries (primarily involving longline vessels), including interest in exploratory fishing by two bottom trawl vessels.

In response, CCAMLR has adopted an increasingly elaborate range of measures over the past several years to regulate exploratory fishing. A number of countries have expressed interest in developing fisheries for toothfish (*Dissostichus* spp) in new areas. As a general condition of doing so, such fishing in the CCAMLR region is only allowed under certain conditions, including limits on the catch, the number of vessels each country can permit in a particular area, detailed reporting requirements on the catch, the placement of at least one independent scientific observer aboard each vessel engaged in exploratory fishing, and a requirement that the number and weight or mass of each species of fish and other organisms

[216] A.Vaskov, Brief Review of Russian Fisheries in Division 3O in 2000-2002. Serial No. N4836, NAFO SCR Doc. 03/26. Scientific Council Meeting – June 2003. Northwest Atlantic Fisheries Organization; and *Roughhead Grenadier (Macrourus berglax) in Subareas 2 and 3*. Report of the Scientific Council Meeting 5-19 June SC 6-19, Part D. Northwest Atlantic Fisheries Organization. June 2003. Pg 195.

[217] *CCAMLR's Management of the Antarctic* http://www.ccamlr.org/pu/E/pubs/am/man-ant/p4.htm#Effects%20of%20Trawling

taken as bycatch be recorded. To the extent that bottom trawl vessels are engaged in exploratory fisheries for toothfish, CCAMLR presumably would require that any catch of corals be measured and reported.[218] At this point it appears that only a single Australian vessel is interested or engaged in exploratory bottom trawl fishing for toothfish on the high seas.[219]

The other exploratory fishery of interest is a multi-species trawl fishery for spiny icefish (*Chaenodraco wilsoni)*; striped-eye notothen *(Lepidonotothen kempi)*; blunt scalyhead *(Trematomus eulepidotus)*; and Antarctic silverfish (*Pleuragramma antarcticum)*.[220] For the 2003/04 season, the fishery is restricted to a single Russian trawl vessel with a "precautionary quota" of 2,000 mt. With respect to the impact of bottom trawling on benthic organisms and the seabed, the fishery is subject to an elaborate research program. Bottom trawl fishing for three of the four target species is restricted to waters 280 meters or less in depth. The fishery is authorized to take place in international waters adjacent to the Antarctic continent south of the western Indian Ocean. For the purpose of a scientific assessment of the fishery, the area is divided into Small-scale Research Units (SSRU). In each SSRU, and in locations where the bottom depth is 280 m or less, the vessel is required to implement the following measures:

"(i) a maximum total of 20 commercial bottom trawls may be conducted in no more than 10 locations, but with no more than four bottom trawls in any one location;

(ii) each location must be at least 5 n miles distant from any other location;

(iii) at each location trawled, three separate samples will be taken with a beam trawl in the vicinity of the commercial trawl track to assess the benthos present and compare with the benthos brought up in the commercial trawl"[221]

The third requirement is, as far as the author is able to determine, the most comprehensive measure in place in relation to bottom trawl fishing on the high seas anywhere in the world. No other regional fisheries management organization even begins to monitor high seas bottom trawl fisheries for their impacts on the ocean bottom (much less regulates the impact). Even in the CCAMLR context, it is not clear whether the Commission requires this level of research and monitoring in all bottom trawl fisheries; it appears that only this particular trawl fishery (and not the exploratory fishery for toothfish) is subject to this extent of monitoring of its impact on the ocean bottom. Nevertheless, this type of measure provides an important model for the types of measures that would be necessary to eventually manage bottom fisheries of all types for their impact on corals and other vulnerable bottom ecosystems on the high seas. It remains to be seen the extent to which CCAMLR would take effective action to prevent damage to deep-water corals and other vulnerable benthic ecosystems in the event such adverse impacts were to be documented. Further, it must be said that if bottom trawl fishing in the CCAMLR area were to ever become a sufficiently attractive economic proposition, current CCAMLR measures have proven inadequate to prevent flag of

[218] Conservation Measure 41-01 (2003). General Measures for Exploratory Fisheries for *Dissostichus* spp. in the Convention Area in the 2003/04 Season. Commission for the Conservation of Antarctic Marine Living Resources. http://www.ccamlr.org/pu/E/pubs/cm/03-04/toc.htm

[219] See, for example, Conservation Measure 41-07 (2003) Limits on the Exploratory Fishery for *Dissostichus* spp. on BANZARE Bank (Statistical Division 58.4.3b) outside Areas of National Jurisdiction in the 2003/04 Season; Conservation Measure 41-06 (2003) Limits on the Exploratory Fishery for *Dissostichus* spp. on Elan Bank (Statistical Division 58.4.3a) outside Areas of National Jurisdiction in the 2003/04 Season; and Conservation Measure 43-02 (2003) Limits on the Exploratory Fishery for *Macrourus* spp. on Elan Bank (Statistical Division 58.4.3a) outside Areas of National Jurisdiction in the 2003/04 Season. Commission for the Conservation of Antarctic Marine Living Resources. http://www.ccamlr.org/pu/E/pubs/cm/03-04/toc.htm

[220] Common names taken from Froese, R. and D. Pauly. Editors. 2004. FishBase. World Wide Web electronic publication. www.fishbase.org, version 04/2004.

[221] Conservation Measure 43-04 (2003). Limits on the Exploratory Fishery for *Chaenodraco wilsoni*, *Lepidonotothen kempi*, *Trematomus eulepidotus* and *Pleuragramma antarcticum* in Statistical Division 58.4.2 in the 2003/04 Season. Commission for the Conservation of Antarctic Marine Living Resources. http://www.ccamlr.org/pu/E/pubs/cm/03-04/toc.htm

convenience and other vessels from evading the rules and engaging in IUU fishing in the region.

Other high seas regions: Southeast Atlantic, Southeast Pacific, Mediterranean Sea

The recently negotiated Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean (SEAFO) covers a large portion of the high seas of the Southeast Atlantic, from about the equator to 50º south latitude and out to the central Mid-Atlantic.[222] It entered into force on 13 April 2003 and has the competence to regulate bottom fisheries on the high seas of the area of application of the convention.[223] The recently amended convention establishing the General Fisheries Commission of the Mediterranean gives it competence to establish regulations in bottom fisheries on the high seas, once in force.

The Framework Agreement for the Conservation of Living Marine Resources on the High Seas of the South Pacific - the "Galapagos" Agreement - covering the fisheries of the Southeast Pacific Ocean, would also have the competence to regulate bottom fisheries in international waters, once in force. However, the Galapagos Agreement lacks the balance between the rights and interests of coastal states and high seas fishing states established in the 1995 UN Fish Stocks Agreement (UN FSA) with respect to fisheries on straddling stocks, calling into question whether it will ever be ratified by distant water states fishing in the high seas of the region. In fact a challenge to the consistency of the Galapagos Agreement with the UN Convention on the Law of the Sea is a component of a case, suspended for the time being, currently pending before the International Tribunal for the Law of the Sea.[224]

In addition, the Galapagos Agreement and, to a lesser extent, SEAFO fail to fully incorporate many of the conservation provisions of the UN Fish Stocks Agreement, including its Article 6 provisions on the application of the precautionary approach. The abovementioned agreements will be less effective in this respect. As will be discussed in the following section, the precautionary approach provisions together with the other conservation provisions of the UN Fish Stocks Agreement provide an effective international legal framework for addressing the impact of bottom trawl fishing on deep-sea species and ecosystems on the high seas.

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[222] Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean. Done at Windhoek, Namibia, 20 April 2001. SEAFC Convention text - Article 4, Geographical application: **"**Except as otherwise provided, this Convention applies within the Convention Area, being all waters beyond areas of national jurisdiction in the area bounded by a line joining the following points along parallels of latitude and meridians of longitude: beginning at the outer limit of waters under national jurisdiction at a point 6° South, thence due west along the 6° South parallel to the meridian 10° West, thence due north along the 10° West meridian to the equator, thence due west along the equator to the meridian 20° West, thence due south along the 20° West meridian to a parallel 50° South, thence due east along the 50° South parallel to the meridian 30° East, thence due north along the 30° East meridian to the coast of the African continent. Information on the convention available at http://www.oceanlaw.net/orgs/seafo.htm

[223] UN General Assembly A/RES/58/14 - Sustainable fisheries, including through 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, and related instruments. Paragraph 7.
http://www.un.org/Depts/los/general_assembly/general_assembly_resolutions.htm

[224] Case concerning the Conservation and Sustainable Exploitation of Swordfish Stocks in the South-Eastern Pacific Ocean (Chile/European Community). Proceedings and Judgments - Docket
List of pending cases and current status, Case No. 7. International Tribunal for the Law of the Sea.
http://www.itlos.org/start2_en.html

National/regional initiatives to protect deep-water ecosystems

There have been a number of initiatives at the national level to begin to address concerns raised by scientists, NGOs, and others regarding the unique nature of deep-water habitats and the impact of deep-water trawling on coral and other sensitive species.

The government of Australia, in 1999, designated a deep-sea area of 370 square kilometers south of Tasmania a permanent reserve, off limits to bottom trawl fishing. The area contains 12 seamounts whose peaks rise to within 1300-1700 meters below the surface, for the most part beneath the depths generally targeted by orange roughy trawlers operating in surrounding areas.[225] The government of New Zealand, in May 2001, closed 19 seamounts within the EEZ to bottom trawl fishing, 18 of which were unfished. Altogether there are an estimated 800 seamounts in New Zealand waters.[226] Both the New Zealand and Australia initiatives to close seamounts to bottom trawl fishing within their EEZs, while limited to a small portion of the overall area vulnerable to fishing, nevertheless represent important first steps to protect cold-water corals and other deep-sea ecosystems within their jurisdiction.

The United States has initiated a process to formally incorporate the Davidson Seamount, off the coast of central California, into the Monterey Bay National Marine Sanctuary. Similarly the Canadian government has initiated a process to designate the Bowie Seamount off the Pacific coast of British Columbia as a marine reserve. If successful, these would be the first seamount habitats to be afforded some degree of protection from bottom trawl fishing in U.S. and Canadian waters. Both countries have also undertaken efforts to protect at least some areas of cold-water corals along the continental shelf and margin. A program to map and protect cold-water coral concentrations along the continental shelf break and deep-water canyons off the coast of Nova Scotia is currently underway in Canada. The U.S. has also designated the *Oculina* Banks off the Atlantic coast as off limits to bottom trawling, although trawling in the area has destroyed much of the *Oculina* coral on the Banks to date.[227]

Norway has recently closed large areas of cold-water coral reefs to bottom trawl fishing. The Norwegian government has established a program of mapping the EEZ to determine the location of cold-water corals. When new reefs are found, measures have been relatively quickly put into place to close these areas to bottom trawling. Norway has probably done more than any other country to protect cold-water corals from bottom trawl fishing. Even so, Norway's Institute for Marine Research estimates that between 30-50% of cold-water corals in Norwegian waters have already been damaged by bottom trawling.[228] Elsewhere in the Northeast Atlantic, the Irish government announced in December 2003 that four large areas of deep-water coral reefs within its EEZ will be designated as Special Areas of Conservation (SAC) under the EU Habitats Directive.[229] Unfortunately, bottom fishing – the most immediate threat to these coral reefs and mounds - is exempt from regulation under the EU Habitats Directive. Nonetheless, SAC designation could serve as a first step in ultimately protecting these areas from bottom trawling.

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[225] Op cit. 45, Koslow et al. *Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling.*

[226] Clark M. and O'Driscoll R., *Deepwater Fisheries and Aspects of Their Impact on Seamount Habitat in New Zealand.* Journal of Northwest Atlantic Fishery Science, Vol 31: 151-163. 2003 http://www.nafo.ca/publications/Frames/PuFrJour.html

[227] Bowie Seamount Marine Protected Area. Oceans Directorate, Fisheries and Oceans Canada. http://www.pac.dfo-mpo.gc.ca/oceans/mpa/bowie_e.htm. *Deep Water Corals* - Article on the website of the Coral Reef Information System (CoRIS) of the National Oceanic and Atmospheric Administration, NOAA. U.S. Department of Commerce. http://www.coris.noaa.gov/about/deep/deep.html

[228] Institute of Marine Research, Bergen, Norway. http://www.imr.no/coral/fishery_impact.php

[229] "Ireland to protect huge coral reefs off its coast" Agence France Presse, 29.12.2003. The EU Habitats Directive - EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

The Darwin Mounds, a complex of cold water coral mounds off the northwest coast of the UK within the 200 n.m. EEZ, were first discovered in the late 1990s. In August 2003, the European Commission noted that although deep-water coral reefs such as the ones found in the Darwin Mounds are included in Annex I of the EU Habitats Directive as natural habitats whose conservation requires the designation of special areas of conservation, the European Union had not taken measures to protect such areas even though a number of other coastal states had begun to do so and in spite of pressure from NGOs.[230]

At the request of the UK government, the Commission promulgated 'emergency' action under the Common Fisheries Policy to close the area of the Darwin Mounds to bottom trawling for a period of six months pending an agreement on permanent measures.[231] As of February 2004, a permanent closure had not yet been agreed by the EU Council of Fisheries Ministers because of resistance from at least one EU member state.[232] The Commission then extended the temporary closure for another six months and in March 2004 a permanent ban on bottom trawl fishing in the area of the Darwin Mounds was adopted by Council. As justification for closing the area to bottom trawl fishing, the European Council regulation states "Scientific reports show that those types of aggregations constitute habitats that host important and highly diverse biological communities... According to the scientific evidence, recovery from damage to coral produced by trawl gear towed through the bottom is either impossible or very difficult and slow. It is therefore appropriate to prohibit the use of bottom trawls and similar gear in the area surrounding the Darwin Mounds."[233]

There are many other areas of EU waters where deep-water corals are known to exist or believed to be located. Amongst these areas are the waters around the Azores, Madeira and the Canary Islands. The fisheries in these areas have been managed by the regional governments of the island groups since Portugal and Spain joined the European Union in the mid 1980s. However, the European Council regulation that afforded these areas protection from deep-sea trawlers is set to expire in August 2004. It will be replaced by a regulation that would effectively open up the majority of the EEZs around the Azores, Madeira and the Canary Islands to fishing vessels from other European Union countries, including bottom trawl vessels potentially interested in fishing on seamounts, ridges and other deep-sea features within the EEZs of the islands, unless the European Council of Ministers decides otherwise.[234] In response, the European Commission has proposed a ban on trawl fishing to protect deep-water corals in an area roughly corresponding to the EEZs of the three island groups – an area covering several hundred thousand square kilometers or more.[235] It remains to be seen whether the European Union member states will adopt the Commission proposal.

At the regional level, seamounts and cold water corals have been recently included in the OSPAR List of Threatened and/or Declining Species and Habitats in the Northeast Atlantic.

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[230] Proposal for a Council Regulation amending Regulation (EC) No 850/98 as regards the protection of deep-water coral reefs from the effects of trawling in an area north west of Scotland. Commission of the European Communities, Brussels, 27.8.2003 COM(2003) 519 final, 2003/0201 (CNS).

[231] Commission Regulation (EC) No 1475/2003 of 20 August 2003 on the protection of deep-water coral reefs from the effects of trawling in an area north west of Scotland. Official Journal of the European Union, L 211/14, 21.8.2003.

[232] Dr. Monica Verbeek, Seas at Risk, personal communication.

[233] Council Regulation (EC) No 602/2004 of 22 March 2004 amending Regulation (EC) No 850/98 as regards the protection of deepwater coral reefs from the effects of trawling in an area north west of Scotland. L 97/30. Official Journal of the European Union. 1.4.2004

[234] Council Regulation (EC) No 1954/2003 of 4 November 2003 on the management of the fishing effort relating to certain Community fishing areas and resources and modifying Regulation (EC) No 2847/93 and repealing Regulations (EC) No 685/95 and (EC) No 2027/95. Official Journal of the European Union 7.11.2003 L 289/1. Amongst other measures, the Regulation, in Article 5, would effectively allow access by EU deep-water fleets to fish in the portion of the EEZ between 100 and 200 nautical miles from the coast.

[235] Proposal for a Council Regulation amending Regulation (EC) No 850/98 as regards the protection of deep-water coral reefs from the effects of trawling in certain areas of the Atlantic Ocean. Commission of the European Communities, Brussels, 3.2.2004 COM (2004) 58 final 2004/0020 (CNS).

Moreover, Parties to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, at the Ministerial Meeting in June 2003, adopted the "Bremen Statement" in relation to the protection of cold-water corals in the region. The Bremen Statement, in paragraph 12, reads as follows:

"We are particularly concerned about the status of vulnerable cold-water coral reefs, many of which are threatened with destruction. Bearing in mind the ecological importance of these reefs and the practical irreversibility of their damage, we shall take immediate measures to protect coral reefs from further damage due to use of active fishing gear on the reefs. Furthermore, we shall ensure that steps are taken by 2005 to identify additional threats to the cold-water reefs and that measures are taken to protect the reefs against these threats."[236]

Clearly the European Union (including Poland and the Baltic States), together with the other members of the OSPAR Commission – Norway, and Iceland – have made a political commitment to the protection of cold-water corals from bottom trawl fishing. The responsibility for implementing this commitment rests with the OSPAR countries at the national level and, with respect to fisheries in high seas areas, members of the Northeast Atlantic Fisheries Commission.

These recent initiatives are amongst the first efforts to protect deep-water coral reefs, seamounts and other deep-sea areas within national jurisdiction in response to the growing awareness of the damage caused by bottom trawl fishing. Norway has gone furthest of any country in recognizing the importance of protecting corals for sustainable fisheries as well as biodiversity values. The steps taken by the OSPAR Commission, the European Union and Norway are essential to protecting deep-sea biodiversity given the extent of bottom trawl fishing in the Northeast Atlantic, the majority of which takes place within the EEZs. From the perspective of the conservation and protection of deep-sea biodiversity on the high seas, measures taken by the EU and the proposals put forward by the European Commission are an encouraging sign given that EU fleets are responsible for the majority of bottom trawl fishing in international waters.

[236] In this context "active fishing gear" refers to bottom trawling – towing a net along the ocean bottom – as opposed to "passive" fishing gear, a term generally used to describe longline, bottom gillnet/setnet and other types of fishing gear which are set onto the bottom to fish and then retrieved without dragging them across the ocean floor.

SECTION 6
FRAMEWORK FOR INTERNATIONAL ACTION

Given that the high seas bottom fisheries for deep-sea species are, for the most part unregulated, what are the legal instruments that provide a basis for the international community to address this problem?

As mentioned in the introduction, the United Nations General Assembly, in its Resolution on Oceans and the Law of the Sea, adopted in November 2003 reiterated its call "*for urgent consideration of ways to integrate and improve, on a scientific basis, the management of risks to the marine biodiversity of seamounts, cold water coral reefs and certain other underwater features...*" and invited relevant global and regional bodies "*to investigate urgently how to better address, on a scientific basis, including the application of precaution, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity in areas beyond national jurisdiction*"

6.1 UNITED NATIONS CONVENTION ON THE LAW OF THE *SEA* (UNCLOS)

The basic international legal framework for international action is the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Amongst the provisions of UNCLOS most relevant to this issue are the Part VII provisions relating to cooperation in the conservation of living marine resources of the high seas (Articles 116-119) and the obligation to protect and preserve the marine environment in Part XII, including through adopting measures necessary "to protect and preserve rare and fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life" as required under Article 194.5.

The framework provided by UNCLOS is supplemented by a number of additional instruments. The two most important of these vis-à-vis high seas bottom trawling – the Convention on Biological Diversity and the 1995 UN Fish Stocks Agreement - are discussed below. In addition, two relevant voluntary instruments are also discussed in brief.

6.2 CONVENTION ON BIOLOGICAL DIVERSITY

There are a number of instruments that provide a framework or blueprint for the international community to address the problem of unregulated bottom fishing on the high seas and its impacts on marine biodiversity. Amongst these are the Convention on Biological Diversity (CBD) which is particularly relevant, given its general obligations to conserve biodiversity, the provisions of Article 8 emphasizing the need for protected areas to conserve biodiversity, and the relevant provisions of Articles 3-5 which establish the obligation of parties to conserve biodiversity with respect to activities under their control beyond the limits of national jurisdiction. The applicability of the CBD to the question of conserving biodiversity in the deep sea is reinforced by various decisions of the parties, including the Jakarta Mandate, and the linkage expressly made within the convention to the United Nations Convention on the Law of the Sea.

In response to the request by the UN General Assembly, the 7th Conference of Parties to the Convention on Biological Diversity, which met in February of 2004, urged the General Assembly to take urgent action with respect to the threat to deep-sea biodiversity on the high seas. Specifically, COP-7 adopted the following decision in relation to marine and coastal biodiversity:

"57. Recalling paragraph 32(a) and (c) of the Johannesburg Plan of Implementation from the World Summit on Sustainable Development, that calls on the international community to "maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction";

"58. Notes that United Nations General Assembly in its resolution 58/240 of 23 December 2003, paragraph 51, has reiterated "its call for urgent consideration of ways to integrate and improve, on a scientific basis, the management of risks to the marine biodiversity of seamounts, cold water coral reefs and certain other underwater features";

59. Recalls paragraph 52 of General Assembly resolution 58/240, in which the Assembly "invites the relevant global and regional bodies, in accordance with their mandate, to investigate urgently how to better address, on a scientific basis, including the application of precaution, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity beyond national jurisdiction; how existing treaties and other relevant instruments can be used in this process consistent with international law, in particular with the Convention, and with the principles of an integrated ecosystem-based approach to management, including the identification of marine ecosystem types that warrant priority attention and to explore a range of potential approaches and tools for the protection and management";

"60. Concerned about the serious threats to the biological diversity, stresses the need for rapid action to address these threats on the basis of the precautionary approach and the ecosystem approach, in marine areas beyond the limits of national jurisdiction, in particular areas with seamounts, hydrothermal vents, and cold-water corals, other vulnerable ecosystems and certain other underwater features, resulting from processes and activities in such areas;

"61. Calls upon the United Nations General Assembly and other relevant international and regional organizations, within their mandate, according to their rules of procedure, to urgently take the necessary short-term, medium-term and long-term measures to eliminate/avoid destructive practices, consistent with international law, on scientific basis, including the application of precaution, for example, consideration on a case by case basis, of interim prohibition of destructive practices adversely impacting the marine biological diversity associated with the areas identified in paragraph 60 above.

"62. Recommends Parties to also urgently take the necessary short-term, medium-term and long-term measures to respond to the loss or reduction of marine biological diversity associated with the areas identified in paragraph 60 above."[237]

The 7th Conference of Parties has clearly recognized the UN General Assembly as the principal international body capable of coordinating international action to protect marine biodiversity beyond national jurisdiction. COP-7 has explicitly called on the General Assembly to take short term actions, including interim prohibitions on destructive practices affecting the biodiversity associated with cold-water corals, seamounts and other underwater features, and vulnerable ecosystems in these areas. Equally important, COP-7 called upon all States Parties to the Convention on Biological Diversity to individually take both short and long term measures to protect these same ecosystems.

The call made by COP-7 is consistent with a general commitment made by the Sixth Conference of Parties to the Convention on Biological Diversity in April 2002, which adopted the Hague Ministerial Declaration, stating: "*We ... resolve to strengthen our efforts to put in place measures to halt biodiversity loss, which is taking place at an alarming rate, at the global, regional, sub-regional and national levels by the year 2010*". In a similar vein,

[237] Decision VII/5 of the Seventh Conference of Parties to the Convention on Biological Diversity on Marine and Coastal Biological Diversity, paras 57-62. February 2004. http://www.biodiv.org/decisions/default.aspx.

governments have committed to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, "including in areas...beyond national jurisdiction"; to develop and facilitate the use of diverse approaches and tools, including the "ecosystem approach" and "the elimination of destructive fishing practices..."; and "the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012" in the Plan of Implementation, paragraphs 32 (a) and (c), of the September 2002 World Summit on Sustainable Development. These elements of the Plan of Implementation were reiterated and further endorsed by the UN General Assembly Resolution on Oceans and the Law of the Sea adopted in December 2002.[238]

6.3 THE 1995 UNITED NATIONS FISH STOCKS AGREEMENT

The 1995 UN Fish Stocks Agreement, an UNCLOS implementing agreement, is the most important multi-lateral agreement for the conservation and management of fisheries since the conclusion of the Law of the Sea negotiations in 1982.[239] It establishes a clear set of obligations for international cooperation in the conservation and management of straddling fish stocks and highly migratory fish stocks on the high seas, and contains detailed provisions concerning the management of fisheries on the basis of an ecosystem approach. It is particularly relevant in relation to bottom fisheries on the high seas for three reasons:

(1) a significant portion, if not a significant majority, of the current catch in deep-sea bottom fisheries on the high seas is most likely taken from straddling fish stocks;
(2) most of the countries that have been involved in deep-sea bottom fishing on the high seas during the last several years are parties to the Agreement (or, in the case of the Baltic states, will soon become parties to the UN Agreement by virtue of having recently joined the EU). These include EU member countries, Australia, New Zealand, Russia, Norway, Iceland, and the Ukraine, which together took over 90% of the high seas bottom trawl catch in 2001[240]; and
(3) many of the coastal states likely to be impacted by unregulated deep-sea fishing on the adjacent high seas – whether due to direct fishing on straddling stocks or the impacts of these bottom fisheries on species forming part of the same 'straddling' ecosystems – are also parties to the Fish Stocks Agreement.

Straddling Stocks

Although sufficient biological information on the distribution of deep-sea species in the Northeast Atlantic is lacking, there is good reason to suspect that many of the stocks of these species taken in high seas bottom trawl fisheries, including the three species that comprised the majority of the catch in 2001 - blue ling, roundnose grenadier and smoothheads - are straddling stocks, if for no other reason than the fact that these fisheries are often prosecuted both within and beyond the 200 mile limit in close proximity to the EEZ boundaries in the region. Similarly, a large portion of the deep-sea trawl catch in the international waters of the Northeast Atlantic is taken in association with two underwater features - Hatton Bank and the Rockall Plateau – both of which straddle the boundaries between EEZs and the high seas. Furthermore, in the Northeast Atlantic, cold-water corals are recognized as important habitat for a number of commercially fished species, including some, such as redfish, which are recognized or believed to form straddling stocks of fish. Gordon states that the majority of the

[238] United Nations General Assembly Resolution: Oceans and the law of the sea. A/Res/57/141, para 53.
[239] 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
[240] See Table 3.7.1

deep-water species targeted in the high seas fisheries of the Northeast Atlantic fall within the category of highly migratory and straddling stocks.[241]

In the Northwest Atlantic, it would appear that most of the deep-water fisheries on the high seas take place on straddling stocks with the possible exception of the Flemish Cap fisheries (although these may also be in part, or wholly, straddling stock fisheries). It is likely that a substantial portion of the high seas bottom trawl fishing in the North Atlantic, both east and west, targets straddling fish stocks or takes fish from such stocks as bycatch. In addition, as discussed in Section 2, given the apparent importance of cold-water corals as habitat for species of redfish, several of which, such as *Sebastes mentella* and *Sebastes marinus* form straddling stocks in both the Northeast and Northwest Atlantic, as well as other commercially important species, the high seas bottom trawl fisheries may well be impacting important habitat for straddling fish stocks in the region.

The orange roughy fisheries on the South Tasman Rise and the Northwest Challenger Plateau maybe targeting straddling fish stocks as both features straddle the boundary between the high seas and the Australian and New Zealand EEZs respectively. In the Southwest Indian Ocean, the majority of the fisheries for orange roughy, alfonsino and associated species on the high seas are likely targeting discrete high seas populations associated with individual seamounts or seamount clusters, ridge systems and other underwater features in the area. In the Southeast Atlantic, however, at least some of the orange roughy stocks off South Africa and Namibia may be straddling stocks.[242]

Even though not all bottom trawl fisheries on the high seas necessarily target straddling fish stocks, it would be difficult for states parties to the UN Fish Stocks Agreement to justify applying lower standards for the conservation and management of bottom trawl fisheries targeting discrete high seas stocks than for bottom trawl fisheries targeting straddling fish stocks on the high seas.

Amongst the coastal states that are parties to the UN Fish Stocks Agreement and potentially concerned over the impact of deep-sea fishing currently conducted in high seas areas adjacent to their EEZs are Canada, Iceland, the EU, Norway, Namibia, South Africa, Mauritius, Australia and New Zealand. India, Senegal, Brazil and several South Pacific nations are amongst additional parties to the UN Fish Stocks Agreement that may be vulnerable to the impacts of unregulated deep-sea fishing in adjacent high seas areas on straddling fish stocks and associated species.

Articles 5 & 6 of the UN Fish Stocks Agreement

The 1995 UN Fish Stocks Agreement obligates states to prevent overfishing, consistent with the precautionary approach, and establishes an ecosystem approach to fisheries through its requirements that states (1) prevent overfishing, (2) assess and minimize bycatch and the impact of fishing on non-target, associated and dependent species and ecosystems, (3) protect habitats of special concern, (4) apply the precautionary approach, and (5) protect biodiversity in the marine environment. On the basis of the information outlined in previous sections of this report, a brief review of the bottom trawl fisheries on the high seas in relation to these obligations follows below.

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[241] Op cit. 92, Gordon. *Deep-water fisheries at the Atlantic Frontier*. (2001)

[242] "…the known distribution of orange roughy off Namibia and the bathymetry of the continental slope off southern Africa suggest that discreet straddling stocks of orange roughy may occur in that region." Meeting Document 02/9 - *Predictive modeling of demersal fish distribution in the southern Indian and Southern Oceans.* Bureau of Rural Sciences Australia**.** UN FAO, Report of the Second Ad Hoc Meeting on Management of Deepwater Fisheries Resources of the Southern Indian Ocean. Op cit. 39.

***Prevent overfishing**:* Article 5 (h) requires states to "take measures to prevent or eliminate overfishing" As indicated earlier, in the Northwest Atlantic, many of the fisheries are on overexploited stocks, or are unregulated, and the high seas bottom trawl fisheries continue to exploit depleted or collapsed populations of fish taken as bycatch in these fisheries. The only high seas bottom trawl fishery in the Northwest Atlantic where the target stock appears not to be overexploited is the northern prawn fishery on the Flemish Cap. However, this may be due to the overexploitation and depletion of species which are predators of the northern prawn population as much as it is a result of the current management measures in place in the fishery.

In Northeast Atlantic, most deep-water bottom trawl fisheries on the high seas have been completely unregulated. As reported by ICES in its 2003 assessment of the deep-water fisheries of the Northeast Atlantic south of 63º N: "It continues to be a major problem for the assessment of stock status that data on landings and particularly fishing effort are limited or of relatively poor quality".[243] Even so, the latest stock assessments indicate that nearly all targeted deep-water species are being harvested "*outside safe biological limits".*[244] There is very little information on the status of targeted deep-water stocks in the Southwest Indian Ocean. In the Southwest Pacific, orange roughy stocks targeted on the high seas are generally either overexploited or their status is unknown.

Assess the impact of fishing: Article 5(d) requires states to "assess the impacts of fishing [on] species belonging to the same ecosystem or associated with or dependent upon the target stocks". In addition, Article 5(j) requires states to collect "complete and accurate data concerning...catch of target and non-target species". Aside from the Northwest Atlantic fisheries, basic information is lacking in most high seas bottom trawl fisheries on the extent of bycatch (and in many cases the targeted catch as well). In addition, information on the biological characteristics of bycatch species and others likely to be impacted is either lacking or insufficient to determine the impact of fishing on these species. In the case of deep-water corals, the limited data which does exist clearly demonstrates the highly destructive nature of the impact bottom trawling.

Minimize the impact of fishing: Article 5(f) requires states to "minimize...catch of non-target species" and "minimize...impacts on associated or dependent species, in particular endangered species". In the Northwest Atlantic fisheries, there are measures in place to regulate the bycatch of several species in high seas bottom trawl fisheries; however, the bycatch of most species in these fisheries is unregulated. Elsewhere, there are few restrictions in effect to regulate the impact of deep-sea bottom trawl fisheries on non-target species on the high seas, with the exception of the exploratory trawl fisheries in the CCAMLR area.

***Protect habitats of special concern**:* Article 6.3(d) requires states to "...adopt plans which are necessary... to protect habitats of special concern". Corals, as well as sponges, sea fans and other sessile organisms form important habitats for deep-water species. Some coral species, in particular *Lophelia pertusa,* form extensive reefs along continental margins and others, such as *Solenosmilia variabilis,* form complex habitat on seamounts. None of the regional fisheries management organizations imposes any restrictions on, much less prevents, the destruction of coral and other vulnerable species and habitats in deep-water trawl fisheries on the high seas.

Apply the precautionary approach and protect biodiversity: Articles 6.1 and 6.2 require states to "apply the precautionary approach widely" and "The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures". Furthermore, Article 5(g) requires states to "protect biodiversity in the marine environment". In spite of the fact that the best scientific information available

[243] Op cit. footnotes 24 and 27, ICES *Deepwater fisheries resources south of 63°N.* pg 408
[244] Op cit. 29, Large et al., *Deep-water Fisheries of the Northeast Atlantic: II. Assessment and Management Approaches*.

indicates that deep-sea species are particularly vulnerable to exploitation and that sensitive deep-sea habitats are likely to be adversely impacted by bottom trawl fishing, states and regional fisheries management organizations, for the most part, have postponed or failed to take any conservation and management measures to conserve and protect these species, habitats, and biodiversity.

***New and exploratory fisheries*:** In addition, Article 6.6 requires that for new or exploratory fisheries, states "shall adopt as soon as possible cautious conservation and management measures" which shall remain in force until "there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks". Only then shall states "if appropriate, allow for the gradual development of the fisheries".

Exploratory bottom trawl fishing continues unrestricted in most high seas areas where deep-sea fishing currently takes place (Southwest Indian Ocean, Northeast Atlantic, and the Southwest Pacific Ocean) and is likely to expand into other high seas areas if it has not already done so. There has been a major expansion of deep-sea bottom trawl fisheries over the past ten to fifteen years. With the exception of the exploratory trawl fisheries in the CCAMLR area, none of these fisheries have been subject to cautious conservation and management measures pending the collection of sufficient data to allow for the gradual development of sustainable fisheries. To the contrary, as the Deep Sea Working Group of the Northeast Atlantic Fisheries Commission stated in its 2002 report: "For the deep-water trawl fisheries the typical development is a rapid increase in catches when a new resource is discovered followed by a decrease reflecting depletion of the resource"; a view echoed by scientific assessments of deep-sea fisheries on the high seas in other ocean regions. This is an issue of particular concern regarding the impact of bottom trawling on corals as most of the damage is likely to occur in the first few months of fishing a new area. [245]

In conclusion, it seems clear that bottom trawl fisheries on the high seas not only fail to fulfill most or all of the requirements of the conservation provisions of the 1995 UN Fish Stocks Agreement, with few exceptions, *they fail to meet virtually any of the requirements* of the Agreement.

[245] Op cit. 30, Meeting of the NEAFC Working Group on the Appraisal of Regulatory Measures for Deep-Sea Species. Northeast Atlantic Fisheries Commission Deep-sea Working Group. 2002. Final Report, Annex 4. Also, Dr. Tony Koslow – personal communication

6.4 THE UN FAO CODE OF CONDUCT FOR RESPONSIBLE FISHERIES

Although the provisions of the UN Fish Stocks Agreement are only binding on fisheries for straddling stocks and highly migratory fish stocks, it can be argued that Articles 5 & 6 of the Agreement provide generally recommended international minimum standards for the conservation and management of fisheries in general, within the meaning of UNCLOS, Article 119.1(a). Furthermore, most of the conservation provisions of the UN Fish Stocks Agreement, including those relating to bycatch, the precautionary approach, the ecosystem approach, preventing overfishing, and the impact of fishing on the marine environment, are contained in the Code of Conduct, in many cases verbatim.[246] The Code has been endorsed by all members of the United Nations Food and Agriculture Organization. It has also been endorsed by various resolutions of the UN General Assembly, the World Summit on Sustainable Development and other high-level international fora. As such, the 1995 UN FAO Code of Conduct for Responsible Fisheries reinforces the 'universal' applicability of the Agreement's conservation provisions

In some cases the Code calls for more specific action than that required under the UN Fish Stocks Agreement. For example, Article 5(f) of the UN Fish Stocks Agreement obligates states to minimize the catch of non-target species through, amongst other means, the development and use of selective fishing gears. Article 6.6 of the FAO Code states "Where proper and environmentally safe fishing gear and practices exist, they should be recognized and accorded a priority in establishing conservation and management measures for fisheries." The Code further states, in Article 7.6.4, that "The performance of all existing fishing gear, methods and practices should be examined and measures taken to ensure that fishing gear methods and practices which are not consistent with responsible fishing are phased out and replaced with more acceptable alternatives."

Altogether, these provisions of the UN Fish Stocks Agreement and the UN FAO Code establish a straightforward set of binding and voluntary responsibilities of a complementary nature designed to assess and minimize the adverse impacts of fishing on the marine environment within the context of an ecosystem approach. In addition to their direct applicability to fisheries on straddling fish stocks on the high seas, the provisions of Articles 5 & 6 of the UN Fish Stocks Agreement, and the relevant provisions of the UN FAO Code of Conduct should apply to all deep-sea fisheries on the high seas as generally recommended international minimum standards.

FAO International Plan of Action on Illegal, Unreported and Unregulated Fishing

Over the past several years, the issue of illegal, unreported and unregulated fishing has received significant international attention. In the words of the report of the United Nations Secretary General on Oceans and the Law of the Sea in 2000, "the prevalence of Illegal, Unreported and Unregulated (IUU) fishing is considered to be one of the most severe problems currently affecting world fisheries. It is likely to have far-reaching consequences for the long-term sustainable management of fisheries…"[247]

[246] see e.g. UN FAO Code of Conduct for Responsible Fisheries: Articles 6.6 and 7.2.2(g) and 7.6.9 relating to minimizing bycatch and the impact of fishing on associated and dependent species, corresponding to UN FSA Article 5(f); and UN FAO Code: Articles 6.5, 7.5.1 and 7.5.2 relating to the application of the precautionary approach, corresponding to UN FSA Articles 6.1, 6.2 and 6.3(c).

[247] Report of the Secretary General of the United Nations on Oceans and the Law of the Sea, UN General Assembly document A/55/61. 20 March, 2000. para 120

In 2001, the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing was adopted by the United Nations Food and Agriculture Organization. Amongst the definitions of IUU fishing is the following found in Article 3.3.2:

"Unregulated fishing refers to fishing activities: in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law."

As discussed in Section 5, the high seas bottom trawl fisheries in the Southwest Pacific and Southwest Indian Oceans are effectively unregulated. Some of the vessels involved in these fisheries are required by their flag states to have an authorization to fish on the high seas and to report their catch to national authorities. However, with the possible exception of the South Tasman Rise fishery, there are no regional management organizations in place to regulate these fisheries, nor are any of these fisheries subject to even the basic measures essential to the regulation of any fishery – e.g. catch limits, quotas and other regulations designed to prevent overfishing. Furthermore, for those countries which are parties to the UN Fish Stocks Agreement, the lack of measures designed to minimize the impacts of fishing on the marine environment, protect biodiversity and apply the precautionary approach further qualify these fisheries as IUU fisheries as per the definition of unregulated fisheries (those conducted in a manner inconsistent with State responsibilities under international law) in Article 3.3.2 of the UN FAO Plan of Action on IUU fishing.

For the bottom trawl fisheries on the high seas in the Northeast Atlantic, although technically a regulation to cap fishing effort is in place, this regulation places no constraints on the current level of fishing in spite of the fact that the International Council for the Exploration of the Sea has expressed clear concern over the unsustainable nature of most of the deep-water bottom trawl fisheries on the high seas of the Northeast Atlantic. While several of the member countries of the Northeast Atlantic Fisheries Commission do impose some unilateral restrictions on the activities of their bottom trawl fleets operating in international waters, it would be difficult to argue that these fisheries are regulated insofar as measures adopted by the regional fisheries management organization is concerned. Again, for countries that are parties to the UN Fish Stocks Agreement, far more stringent measures would need to be implemented in these fisheries before they could be considered to be regulated as defined by the FAO Plan of Action as consistent with "State responsibilities under international law", in this case the UN Fish Stocks Agreement.

Conclusion

A clear framework in international law has been established for international action on a precautionary basis to address the impacts of bottom trawl fishing on deep-sea biodiversity as well as concerns over the sustainable exploitation of the targeted fish species involved. The international community has negotiated several relevant instruments over the course of the previous decade including the 1995 UN Fish Stocks Agreement and the Convention on Biological Diversity. In addition, governments have agreed to important international goals and commitments such as the implementation of the ecosystem approach and the restoration of fish stocks agreed at the 2002 Johannesburg World Summit on Sustainable Development. Virtually all bottom trawl fisheries on the high seas, with the exception of the exploratory fisheries permitted in the CCAMLR area, are currently operating in a manner inconsistent with the conservation and precautionary measures established by the UN Fish Stocks Agreement.

The problem of bottom trawl fishing on the high seas and the threat to the biodiversity of deep-sea areas is an important test case for the efficacy of these instruments in guiding or determining the international course of action. A course of action consistent with the provisions of the Fish Stocks Agreement reinforces the value of the UN Fish Stocks Agreement as well as the commitments and targets agreed by the WSSD and other fora. Conversely,

failure to take action consistent with the goals, principles and obligations agreed by the international community risks undermining the value of these instruments and commitments.

The concern over the risks to the biodiversity of the deep-sea in areas beyond national jurisdiction has been clearly raised by the UN General Assembly. The manner in which this issue is resolved may ultimately determine the extent to which these agreements, in particular the UN Fish Stocks Agreement, serve as effective instruments for promoting and ensuring sustainable fisheries and the protection of marine biodiversity on the high seas within the context of a precautionary and ecosystem based approach.

SECTION 7
OPTIONS FOR INTERNATIONAL ACTION

The UN General Assembly has called for urgent consideration of the risks to the biodiversity of seamounts and other deep-sea ecosystems. In view of the role of the UN General Assembly in promoting and coordinating international action with respect to the high seas, the Seventh Conference of Parties to the Convention on Biological Diversity has, in turn, called on the General Assembly to take urgent short-term action, as well as long-term actions, to address destructive practices adversely impacting the biodiversity of these areas beyond national jurisdiction.

The protection and preservation of the marine environment beyond the 200 mile limits and the conservation of fish populations on the high seas are the collective responsibility of all nations. High seas "marine living resources" and biodiversity form part of the global commons. The questions of who benefits from the fisheries on the high seas, their contribution to world food security, the impact of high seas fishing on the overall health of the world's oceans, and who bears the burden of unsustainable fisheries practices and damage to vulnerable deep-sea ecosystems, are important and urgent questions for the international community to address.

There are numerous concerns regarding bottom fisheries in international waters that must ultimately be resolved over the longer term. These include the absence of regional fisheries management regimes to regulate bottom fisheries in many high seas areas; the lack of basic data on high seas bottom fisheries including data on catch, bycatch, numbers of vessels involved and areas fished; the potential impact of trawling and other forms of bottom fishing on benthic ecosystems recognized as highly likely to be fragile, vulnerable, and rich in rare and endemic species; questions concerning the ability of at least some deep-sea fish species to sustain any level of commercial exploitation; the lack of widespread implementation of an ecosystem based approach to the management of high seas fisheries consistent with the 1995 UN Fish Stocks Agreement and the UN FAO Code of Conduct for Responsible Fisheries; pervasive IUU and flag of convenience fishing and the lack of effective monitoring, control, surveillance and enforcement in high seas fisheries; and the issue of equity in relation to the fact that at present a relatively small number of technologically developed countries are benefiting from the exploitation of deep-sea resources on the high seas with potentially major adverse impacts on a global reservoir of biodiversity that are part of the global commons, of which the conservation, protection and sustainable use is a matter of interest to all nations.

As the legal competence to regulate bottom trawling on the high seas is presently very limited and, where it exists, inadequately exercised, the international community as a whole has the responsibility to remedy this situation before further, extensive and irreversible damage to the biodiversity of the deep sea occurs. In this regard, the UN General Assembly has the opportunity to play a key, coordinating role in defining the immediate or short-term actions needed to protect the biodiversity of deep-sea areas beyond the 200 n.m. limits.

The UN General Assembly has called for urgent action to manage the risks to the biodiversity of deep-sea areas on the high seas. As humankind's uses of the marine environment intensify in these areas, the risks they pose will require concerted international action to resolve, working through a variety of international processes and fora, which will take some time. In the meantime, the threat to the biodiversity of deep-sea areas from bottom fishing on the high seas is immediate, clearly documented, and likely to grow. The protection of the biodiversity associated with seamounts and cold-water corals, in extended continental margin areas and beyond national jurisdiction, requires short-term as well as long-term solutions.

The UN General Assembly Role

The United Nations General Assembly has acted upon the interests of the international community as a whole in dealing with fisheries issues on the high seas on a number of occasions. The most relevant examples from recent history are the resolutions adopted by the General Assembly in 1989-1991 calling for a moratorium on large-scale pelagic driftnet fishing on the high seas, and the resolutions that established and endorsed the outcome of the 1993-1995 UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks.

UN Driftnets Resolutions

The issue of large-scale pelagic driftnet fishing on the high seas was first raised by South Pacific Island nations and New Zealand at the UN General Assembly in 1989. By the end of December of that year, the General Assembly had adopted the first of a series of resolutions to address the problem that, in many ways, was similar to the problem of bottom trawl fishing on the high seas today. UN General Assembly Resolution 44/225, adopted in December of 1989, called upon the international community to take several actions. First, to halt any further expansion of high seas driftnet fishing. Second, to phase out high sea driftnet fishing in the South Pacific by 1 July 1991. Third, to review the "best available scientific data" on the impact of large-scale pelagic driftnet fishing by 30 June 1991. Fourth, to agree to impose moratoria on all such fishing by 30 June 1992 in those regions where it was conducted unless effective conservation and management measures were taken to "prevent unacceptable impact of such fishing practices on that region" based upon a "statistically sound analysis to be jointly made by concerned parties of the international community with an interest in the fishery resources of the region".[248]

The basis of the call for action was twofold. One was the unregulated and potentially unsustainable nature of high seas pelagic driftnet fishing in terms of the impact on highly migratory species targeted by the driftnet fleets and the fisheries for these species within coastal states' waters. The other was concern over the impacts on non-target species and high seas ecosystems as a result of the bycatch of a range of species in these fisheries, in particular marine mammals, seabirds and sea turtles.

UN General Assembly Resolution 45/197, adopted in 1990, essentially reaffirmed the General Assembly's commitment to the implementation of Resolution 44/225. The action taken by the General Assembly culminated in December 1991, with the adoption of Resolution 46/215. This resolution asserted that, based on reviews of the best scientific data available, primarily in relation to driftnet fisheries on the high seas of the North Pacific, the "grounds for concern expressed about the unacceptable impact of large-scale pelagic drift-net fishing…have been confirmed and that evidence has not demonstrated that the impact can be fully prevented". On this basis, the General Assembly called on all members of the international community to "ensure that a global moratorium on all large-scale pelagic drift-net fishing is fully implemented on the high seas of the world's oceans and seas" by 31 December 1992.[249]

However, there are two important differences between the driftnets issue and that of high seas bottom trawling. In the case of bottom trawl fishing, the scientific information available suggests that the scale of the threat to marine biodiversity, including the possibility of species extinction, is greater than was the case with the large-scale pelagic driftnet fishing on the high seas. The scientific community has expressed clear concern over the impact on

[248] United Nations General Assembly Resolution A/RES/44/225 – Large-scale pelagic driftnet fishing and its impact on the living marine resources of the world's oceans and seas. Operative paragraphs 3-4.
[249] United Nations General Assembly Resolution A/RES/46/215 – Large-scale pelagic driftnet fishing and its impact on the living marine resources of the world's oceans and seas. Preambular paragraphs 13-14 and Operative paragraph 3.

seamounts, deep-sea corals and the threat to the biodiversity of the deep-sea and called upon the UN General Assembly to take concrete action.

Second, and arguably the most important, the UN General Assembly today has a much firmer basis in international policy and law for taking action on bottom trawl fishing on the high seas. Over the past decade, states have adopted a number of international instruments discussed in the previous section that elaborate obligations to conserve, protect and sustainably use marine biological diversity within and beyond national jurisdiction and to conserve and manage high seas fisheries on a precautionary and ecosystem basis. These include the Convention on Biological Diversity, the 1995 UN Fish Stocks Agreement, and the UN FAO Code of Conduct for Responsible Fisheries.

Whereas in 1989, the term "unacceptable impacts" did not have a precise definition under international law, in 2004, Articles 5 & 6 of the UN Fish Stocks Agreement serve to provide a clear legal standard against which to measure the 'acceptability' of these fisheries. They offer a rationale for (and indeed, essentially require) taking precautionary action, including the use of interim measures, such as interim prohibitions or a moratorium. In addition, in the event that the UN General Assembly decided to take an approach similar to that used in the case of large-scale driftnet fishing and declare a moratorium on high seas bottom trawl fishing, Articles 5 & 6 of the UN Fish Stocks Agreement, together with similar provisions in the UN FAO Code of Conduct, establish clear international standards for determining under what conditions a resumption of bottom trawl fishing on the high seas could ultimately take place.

UN Conference on Straddling Fish Stocks and High Migratory Fish Stocks

The resolution establishing the Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (UN GA RES 47/192) emerged from the outcomes of the 1992 UN Conference on Environment and Development. It set in motion a three-year process of negotiation leading to the adoption, and subsequent entry into force, in 2001, of the UN Fish Stocks Agreement.

States parties to this Agreement have been convening an annual informal consultation in New York, and a review conference is planned for 2006. Amongst other measures, the parties to the Fish Stocks Agreement, reinforced through the UN General Assembly, could consider whether and how to extend this Agreement, and in particular its Articles 5 & 6, to cover high seas fisheries on deep-water fish stocks not currently subject to the UN Fish Stocks Agreement.

Coastal States and the Continental Margin beyond 200 nautical miles

In addition to the lack of effective fisheries management regimes on the high seas, coastal states may be concerned over the impact of high seas bottom fishing on the continental margin beyond the 200 nautical mile limits. The UN Convention on the Law of the Sea (UNCLOS), in Article 76, gives the coastal state sovereign rights over sedentary species along its continental margin, even when it extends beyond 200 nautical miles.[250] High seas bottom trawling may damage or destroy the biodiversity of these underwater areas and the coastal state's 'sedentary' species, such as corals.

[250] Where the continental margin (submerged prolongation of the land mass of the coastal state) extends beyond 200 n.m. from the baseline of the territorial sea, this forms part of the coastal state's *legal* continental shelf, whose outer limits are defined in Article 76 of the UN Convention on the Law of the Sea. The coastal state exercises sovereign rights for the purpose of exploiting the natural resources of its legal continental shelf. For living resources, these consist of organisms belonging to sedentary species, as defined in Article 77.4. The United States, for example, states in its law that a number of varieties of coral, crab, mollusks and sponges are included within the sedentary species subject to US continental shelf jurisdiction.

The coastal state has the right to control direct exploitation of these sedentary species beyond 200 n.m. in the event that fishing vessels on the high seas are actually targeting them. However, in spite of the potential importance of coral-based ecosystems and habitat along the outer continental margin, the actions a coastal state may take to prevent the 'incidental' or collateral destruction of its sedentary species by a vessel flying the flag of another state engaged in bottom trawl fishing for groundfish or demersal species beyond 200 n. m, are less clear. The ambiguities regarding coastal state rights and duties vis-à-vis high seas bottom fishing in this area need to be addressed.

There are over 30 nations whose continental margins are believed to extend beyond 200 n.m. in the North and South Atlantic, Pacific, and Indian Oceans. Amongst developing countries, these include Angola, Argentina, Brazil, Ecuador, Fiji, Guinea, Guyana, India, Indonesia, Madagascar, Mauritius, Mexico, Federated States of Micronesia, Myanmar, Namibia, Seychelles, South Africa, Suriname, and Uruguay. Others include Norway, Iceland, Canada, Russia, New Zealand, Australia, the United States and several European Union member states.[251] Of these states, only Russia has initiated the process for determining the outer boundary of its continental margin set forth in UNCLOS, Article 76. For most states, the lack of a clear outer boundary complicates their ability to assert continental margin resource rights vis-à-vis foreign bottom trawlers.

Dispute Settlement/International Tribunal for the Law of the Sea

Dispute settlement offers another potential means of taking action with respect to bottom trawl fishing on the high seas, based on the obligations contained in the UN Convention on the Law of the Sea, the UN Fish Stocks Agreement, and other provisions of relevant international law. One of the real advantages of the UN Fish Stocks Agreement is that it allows for the use of the UNCLOS dispute settlement mechanisms for resolving disputes amongst parties to the Agreement.

Regarding unregulated high seas bottom trawl fishing that adversely affects fish stocks and/or biodiversity associated with deep-sea areas beyond national jurisdiction, one state could argue that such fishing activities are inconsistent with the duty of all states under UNCLOS and other international agreements to conserve marine living resources of the high seas. If the fishing state has refused to cooperate with other states in conserving these resources, the challenging state could argue this additional point.

Moreover, bottom trawling that causes serious damage to seamounts, cold water corals and other vulnerable deep-sea ecosystems and habitat clearly is inconsistent with UNCLOS Article 194.5, with its obligation to protect rare and fragile ecosystems and the habitat of depleted, threatened or endangered species. High seas bottom trawling on seamounts that threatens the extinction of rare or endemic species also would appear contrary to the general conservation obligations under UNCLOS and the CBD. For States parties to the UN Fish Stocks Agreement, under its general principles and precautionary approach, the obligation to minimize the impact of fishing on associated and dependent species, the obligation to protect biodiversity in the marine environment, and the obligation to protect habitats of special concern apply in relation to fisheries on straddling fish stocks and highly migratory fish stocks on the high seas as discussed in the previous section.

The question is whether a state can acquire the standing to bring a dispute against another state under these general obligations, utilizing one or another of the dispute settlement options under UNCLOS or the UN Fish Stocks Agreement. If such a dispute is accepted, then a state party to the dispute may seek provisional measures pending a final decision.

[251] UN Document SPLOS/64 – Issues with respect to Article 4 of Annex of II to the United Nations Convention on the Law of the Sea. Eleventh Meeting of States Parties to the United Nations Convention on the Law of the Sea, May 2001. Footnote 2, page 2.

One of the strengths of the UNCLOS dispute resolution procedures is that Article 290 allows a court or tribunal with jurisdiction over a dispute submitted to it to prescribe 'provisional measures' (pending the final outcome of the dispute settlement process) to prevent "serious harm" to the marine environment. This provision is reinforced in the UN Fish Stocks Agreement, Article 31, which allows for provisional measures "to prevent damage to the stocks" subject to dispute. In either case this could involve a temporary halt to fishing activity until the dispute is resolved.

Regarding high seas bottom trawl fishing on the continental margin beyond 200 miles, a coastal state might seek to enact and enforce measures to protect its sedentary species vis-à-vis foreign flag vessels, pursuant to UNCLOS and/or the Fish Stocks Agreement if applicable, and enter into a dispute settlement process if violations occurred. Again, it could seek a temporary halt to the fishing activity as a provisional measure under Article 290 to "preserve the respective rights of the parties to the dispute", in addition to preventing serious harm to the marine environment, pending the outcome of the dispute.

These dispute settlement options are a potential avenue for resolving the compatibility of bottom trawl fishing on the high seas with obligations under international law, and ultimately for protecting the biodiversity of the deep-sea. To the extent that such disputes can be taken to, and arbitrated by, the International Tribunal for the Law of the Sea, the Tribunal offers a means to establish an authoritative body of 'case' law to further elaborate upon the practical implications of the general obligations in relation to the conservation and management of fisheries on the high seas in UNCLOS, the UN Fish Stocks Agreement and other relevant instruments.

UN General Assembly moratorium on high seas bottom trawl fishing

Over the short term, the best option for international action is a UN General Assembly declared moratorium or interim prohibition on deep-sea bottom trawling on the high seas. This would provide a means of temporarily protecting the biodiversity of the deep-sea in international waters until more permanent solutions can be developed, agreed and applied. In addition to providing temporary protection, a moratorium could serve as the foundation or catalyst to negotiate longer-term solutions through an inter-governmental process under the auspices of, or coordinated by, the UN General Assembly to resolve a range of issues identified earlier and others, such as governance and jurisdictional issues surrounding the establishment of marine protected areas on the high seas. This process could be designed to address or include the following elements:

a. A scientific assessment of the extent and distribution of the biodiversity associated with seamounts, deep-sea corals and other deep-sea ecosystems, the vulnerability of these ecosystems to fishing; the damage caused to date by bottom trawl fishing on the high seas; and the relationship of these ecosystems to pelagic and migratory species and the overall functioning of continental margin and open ocean ecosystems;

b. A scientific assessment of the extent to which deep-sea species can be exploited on the high seas, and under what conditions;

c. Further international measures needed to prevent, deter and eliminate the problem of IUU fishing on the high seas, including fishing by vessels flying flags of convenience;

d. The options available to coastal states to prevent or deter damage to sedentary species over which they exercise sovereign rights under UNCLOS Articles 76 & 77 along the continental margin beyond the 200-mile limit resulting from high seas bottom fishing;

e. Whether the extension of 1995 UN Fish Stocks Agreement to cover all high seas fisheries, extension of the coverage and mandates of existing regional fisheries management organizations (RFMOs), negotiation of new RFMOs, and/or a new global convention is the best approach to ensure the

effective regulation of all deep-water fisheries on the high seas, and negotiate or agree to any new instruments as necessary;

f. identifying and mapping biodiversity hotspots and ecotypes/bioregions, and rare or fragile ecosystems (as per UNCLOS Article 194.5) in the deep-sea on the high seas;

g. establishing an international framework and process for the designation of high seas marine protected areas, marine reserves and or/areas closed to bottom trawl fishing;

h. global equity – determining the rights and responsibilities of states fishing on the high seas in regard to the allocation of fisheries resources and the protection of the biodiversity in relation to bottom fisheries in deep-ocean areas.

A number of international organizations, agencies and conventions are relevant and essential to the resolution of one or more of these issues. However, the process of resolving these issues and advancing more comprehensive governance over high seas areas will require effective international cooperation and coordination. Whether as the convenor of a formal intergovernmental process, or as the coordination mechanism amongst the relevant global and regional bodies concerned, the UN General Assembly has a primary role to play in the process. The process could be designed as a time-limited procedure, after which the moratorium could be revisited and possibly lifted under appropriate conditions. These conditions should include, inter alia, that any resumption of bottom trawl fishing should only be allowed consistent with Articles 5 & 6 of the UN Fish Stocks Agreement and the complementary provisions of the UN FAO Code of Conduct for Responsible Fisheries, that rare and fragile deep-sea ecosystems are protected, and the implementation or resolution of the additional issues outlined in points a-h above.

SECTION 8
CONCLUSION

Bottom trawl fishing poses a serious threat to the biodiversity of the deep-sea associated with seamounts, cold-water coral reefs and other vulnerable deep-sea ecosystems. The Convention on Biological Diversity requires states to ensure the conservation and sustainable use of biodiversity. The 1995 UN Fish Stocks Agreement requires states to take action, on the basis of the precautionary approach, to protect biodiversity in the marine environment from the adverse impacts of fishing on the high seas.

The United Nations General Assembly has called on the international community to urgently consider the threats to the biodiversity of seamounts, cold-water corals and other deep-sea ecosystems on the high seas. In response, the Seventh Conference of Parties to the Convention on Biological Diversity has called on the UN General Assembly to take urgent short term action, including interim prohibitions of destructive practices, as well as long term action to protect the biodiversity associated with these deep-sea ecosystems. Two petitions from the scientific community with over one-thousand signatures, one arising out of international symposia on cold-water corals and the biology of the deep-sea, both signed by many prominent marine biologists, have called on the UN General Assembly to declare a moratorium on bottom trawl fishing on the high seas. A growing number of NGOs have also called upon the UN General Assembly to do the same.

There are major gaps in the governance of high seas fisheries. Most high seas areas are not covered by a regional management organization with the legal competence to regulate bottom trawl fisheries. Where such organizations do exist, they have failed to regulate bottom trawling for their impacts on deep-sea ecosystems.

The best scientific information available, coupled with the application of a precautionary approach as called for by the UN General Assembly, and required under the UN Fish Stocks Agreement, argues for strong short-term action -- specifically a moratorium on bottom trawl fishing on the high seas --to address the immediate threat to biodiversity at hand. The UN General Assembly has established a precedent for such action in its declaration of a moratorium on large-scale pelagic driftnet fishing on the high seas which took effect in 1992.

A UN General Assembly moratorium on bottom trawl fishing on the high seas is entirely consistent with international law and policy, in particular the 1995 UN Fish Stocks Agreement, the UN FAO Code of Conduct for Responsible Fisheries, and the Convention on Biological Diversity. A UN General Assembly moratorium would only address the immediate problem at hand, but would also serve to strengthen the efficacy of these instruments. Conversely, the failure of the international community to act in a manner consistent with or required under relevant international agreements may weaken these agreements and set unfortunate precedents for action on other issues related to fisheries conservation and the protection of marine biodiversity.

The economic value of high seas bottom trawl fishing currently is relatively small in global terms, no more than $300-$400 million US dollars per year – a small fraction of the overall value of marine capture fisheries estimated to be worth approximately $75 billion in 2001. Altogether the current catch in bottom trawl fisheries on the high seas is not likely to support more than 100-200 trawlers (out of a global fleet of 3.1 million fishing vessels) on a full-time, year round, equivalent basis. There are relatively few countries with a significant financial stake in the industry at this point in time – only eleven countries accounted for approximately 95% of the total bottom trawl catch on the high seas in 2001. Five European Union member countries took over one-half of the high seas bottom trawl catch in 2001 and 2002. Of the

remaining six, four are developed countries. All but one or two of these countries are, or will soon be, parties to the 1995 UN Fish Stocks Agreement.

In light of the above, it is likely to be much easier to restrict deep-sea fishing on the high seas now rather than in five or ten years time. The expertise, technology and market opportunities are improving for these fisheries. Given the current trend toward increasing demand and restricted supply for marine capture fisheries products worldwide, the scale of bottom trawl fishing on the high seas is likely to grow in coming years.

It is not inconceivable that a major biodiversity crisis is in the making and in fact may already be underway in the deep-sea. Given the biological characteristics of deep-sea ecosystems, many thousands of species may be vulnerable to depletion or extinction from bottom fishing on coral and other vulnerable ecosystems on seamounts, along continental margins, and elsewhere on the high seas. If so, the legacy of the impact of bottom trawl fishing in these areas would not be measured in terms of decades or even generations but in thousands or possibly millions of years. In the context of evolutionary biology, the threat to marine biodiversity endemic to seamounts and other deep-sea areas may be comparable to, if not equivalent to, the threat to terrestrial biodiversity associated with the destruction of tropical and temperate rainforests. Unlike rainforests however, bottom trawl fishing on the high seas does not support tens of millions of people worldwide. Moreover, the fish caught in these areas does not contribute to global food security but rather is destined for high value markets.

The regulation of fishing within EEZs is largely a matter for individual nations to decide based on their rights and obligations under the UN Convention on the Law of the Sea. However, on the high seas, all nations have a responsibility to cooperate and ensure the protection of the biodiversity of the deep-sea. The challenge to protect seamount ecosystems from the negative impact of fishing in the deep-sea in international waters is relatively straightforward by comparison with the challenge to protect other major reservoirs of the earth's biodiversity such as ancient tropical and temperate rainforests and shallow-water tropical coral reefs.

The opportunity exists for the international community, individually and collectively, to take preventative action now, consistent with the concerns raised by marine scientists and the application of the precautionary approach. If the international community cannot prevent the destruction of the wealth of deep-sea biodiversity on the global commons from bottom fishing by a relatively small number of countries and vessels, what hope is there that we can halt and reverse the decline of earth's biodiversity overall for future generations? Alternatively, decisive action by the international community to prevent further damage of deep-sea ecosystems by bottom trawl fishing on the high seas will make a significant contribution toward the implementation of the commitments made by governments at the World Summit on Sustainable Development and other fora to halting and reversing the loss of biodiversity on a global scale.

ANNEX I

The text of relevant provisions of Article 5 and Article 6 of the 1995 UN Fish Socks Agreement:

*** Prevent overfishing**

"States shall:

5(h) "take measures to prevent or eliminate overfishing and excess fishing capacity"

*** Assess the impact of fishing**

"States shall:

5(j) "collect and share, in a timely manner, complete and accurate data concerning fishing activities on, inter alia, vessel position, catch of target and non-target species and fishing effort, as set out in Annex I..."

5(d) "assess the impacts of fishing [on] species belonging to the same ecosystem or associated with or dependent upon the target stocks"

6.3(d) "develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment..."

*** Minimize the impact of fishing**

"States shall:

5(f) "minimize...catch of non-target species, both fish and non-fish species, (hereinafter referred to as non-target species) and impacts on associated or dependent species, in particular endangered species through measures including, to the extent practicable, the development and use of selective, environmentally safe and cost-effective fishing gear and techniques;"

6.5 "Where the status of...associated or dependent species is of concern, States shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new information"

*** Apply the precautionary approach and protect biodiversity**

"States shall:

5(g) "protect biodiversity in the marine environment"

6.1 "States shall apply the precautionary approach widely to conservation, management and exploitation of straddling fish stocks and highly migratory fish stocks in order to protect the living marine resources and preserve the marine environment."

6.2 "States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."

6.3(c) "take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities on non-target and associated or dependent species, as well as existing and predicted oceanic, environmental and socio-economic conditions;"

6.3(d) "...adopt plans which are necessary to ensure the conservation of such [associated and dependent] species and to protect habitats of special concern."

6.6 "For new or exploratory fisheries, States shall adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures shall remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment shall be implemented. The latter measures shall, if appropriate, allow for the gradual development of the fisheries."

UN Fish Stocks Agreement Annex II

3. "Precautionary reference points should be stock-specific to account, inter alia, for the reproductive capacity, the resilience of each stock and the characteristics of fisheries exploiting the stock, as well as other sources of mortality and major sources of uncertainty."

4. "Management strategies shall seek to maintain or restore populations of harvested stocks, and where necessary associated or dependent species, at levels consistent with previously agreed precautionary reference points."

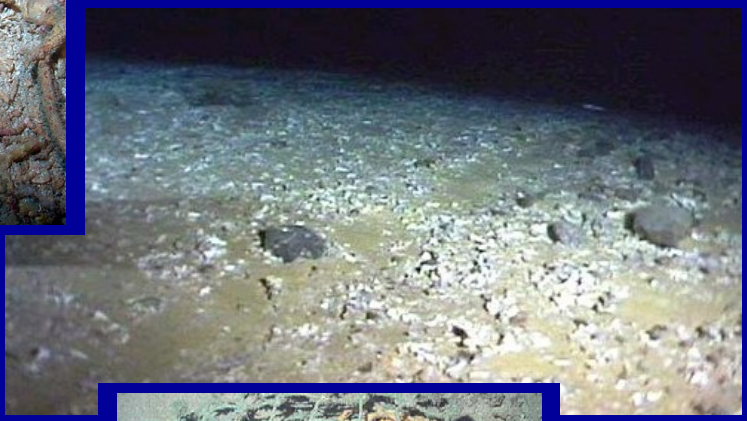
deep sea biodiversity

Left: Rockfish in between hydroids and sponges, off Adak Island, Alaska
Credit: Alberto Lindner/NOAA

Below: Coral 'forest' off Adak Island, Alaska
Credit: Alberto Lindner/NOAA

Right: Octopus near a hydrothermal vent in Endeavour Marine Protected Area (Canada) at a depth of more than 2000m
Credit: Prof Verena Tunnicliffe

deep sea destruction

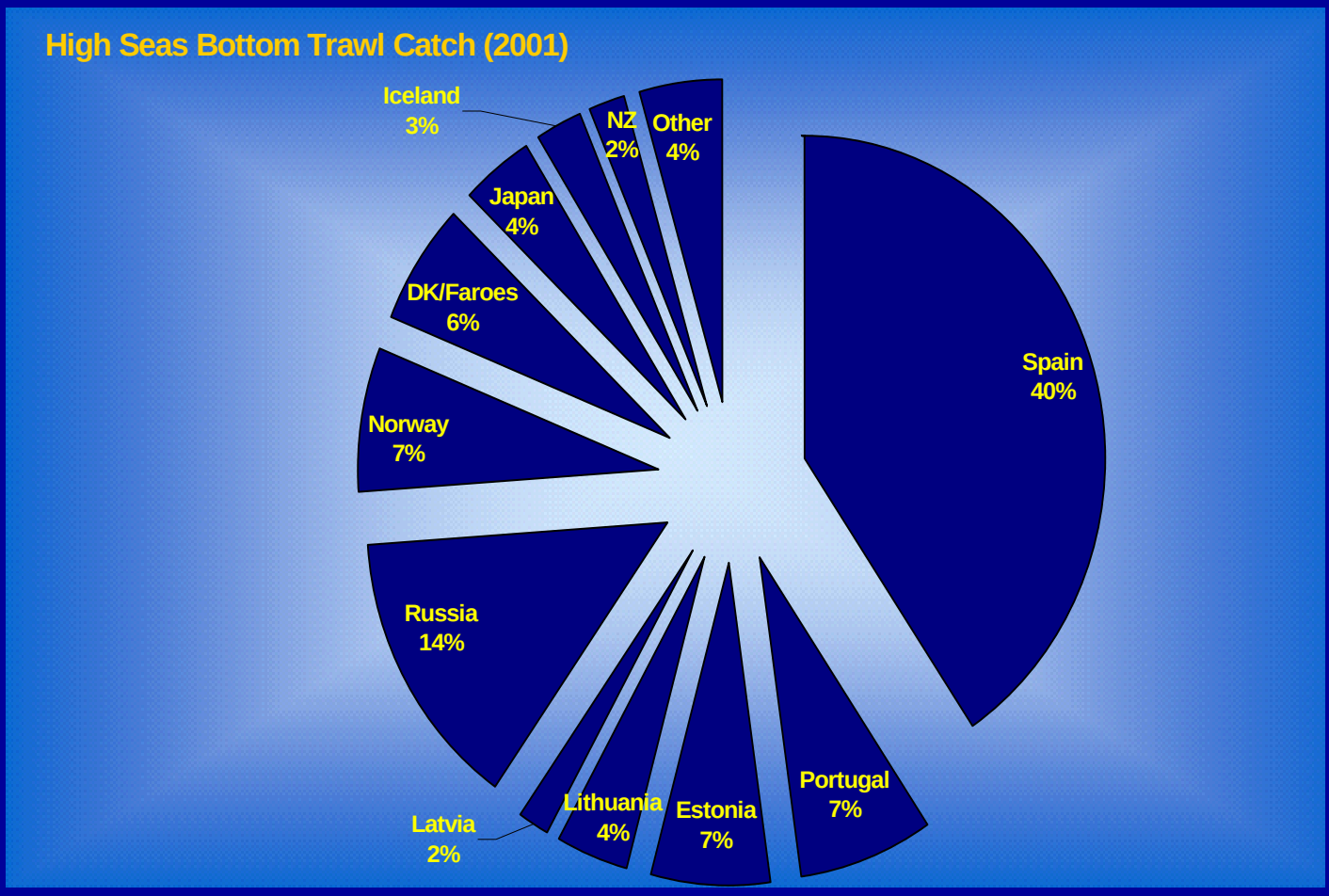


Above: Oculina rubble left by bottom trawl in Atlantic Florida
Credit: HBOI/NOAA/USGS

Right: Trawl marks left by heavy fishing gear following bottom trawl on Lophelia reef in Norway
Credit: Jan Helge Fossaa/IMR

Below right: Trawl net on Oculina Reef, Atlantic Florida
Credit: HBOI/NOAA/USGS

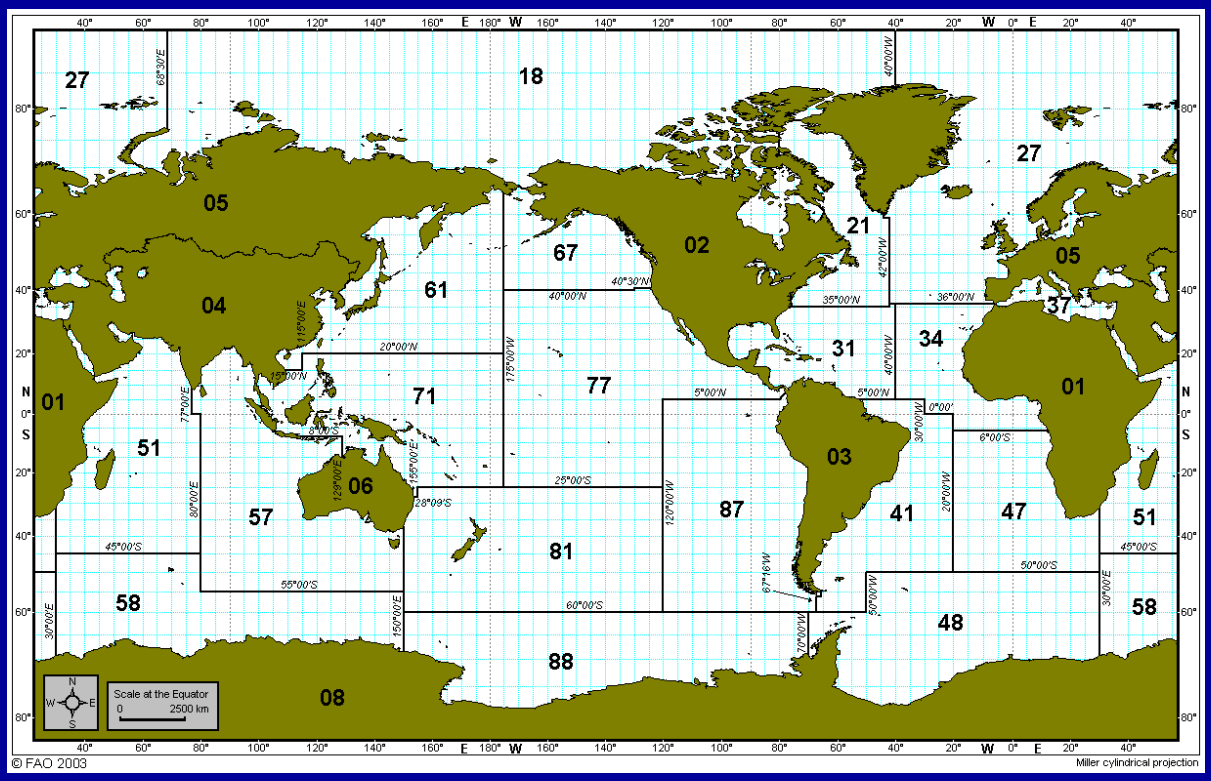
facts and figures



This graph illustrates the fact almost all bottom trawling activities are carried out by only eleven countries, with almost 60% attributable to EC members.

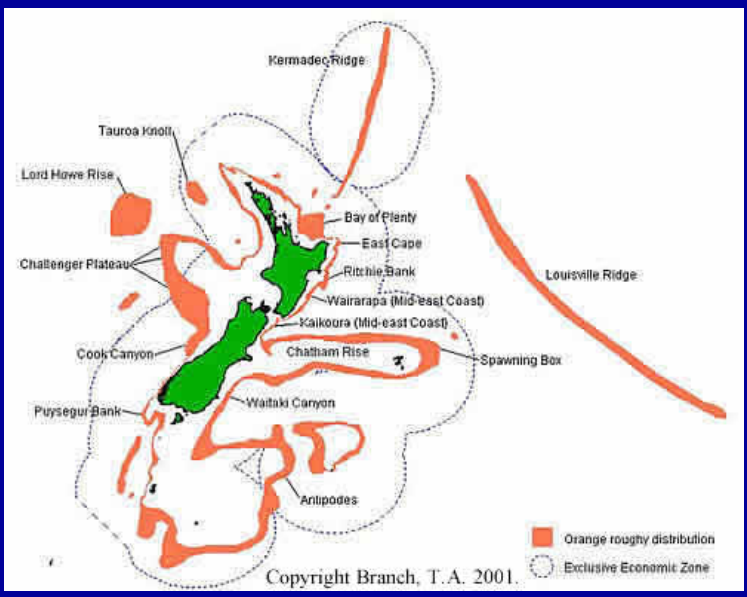
See Section 3.7, p48-51 for more about the catch figures and value of high seas bottom trawl fisheries.

where in the world?

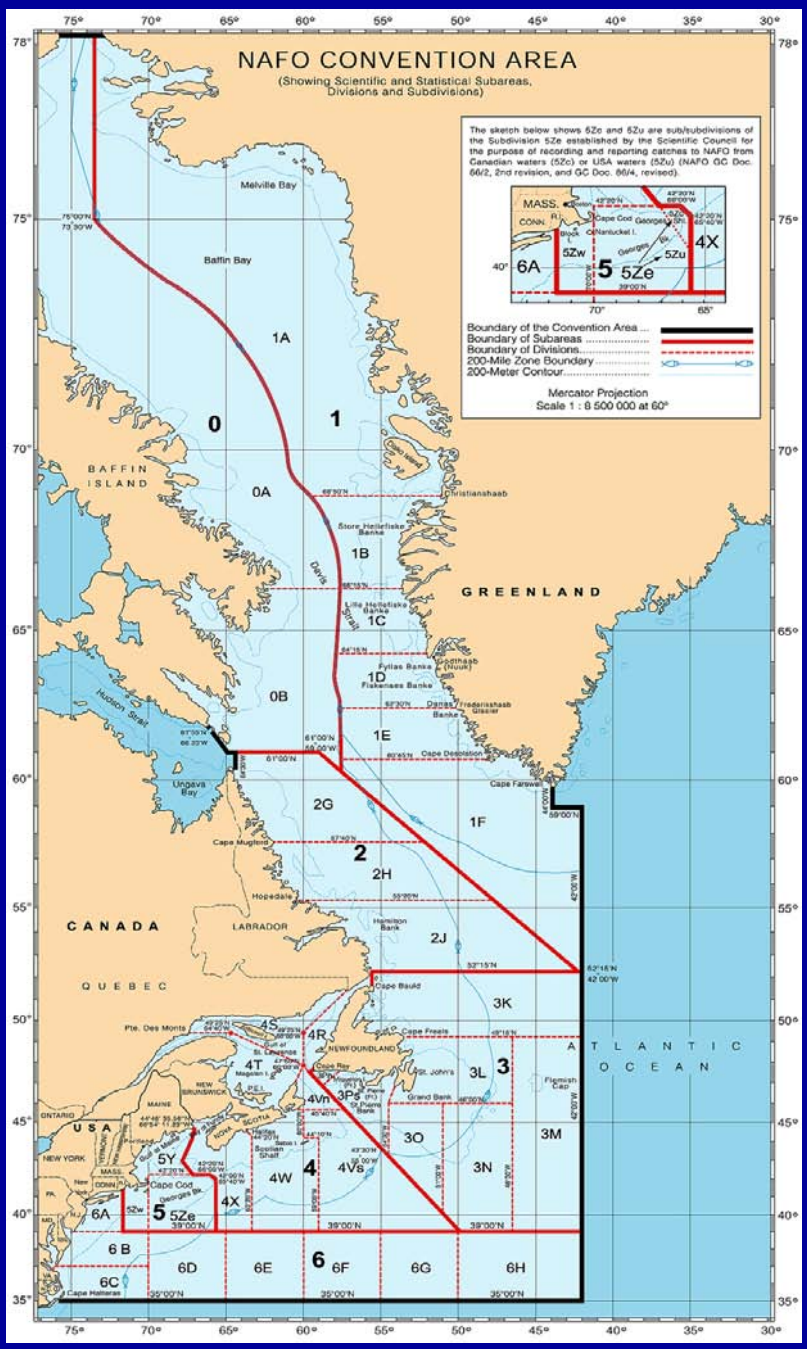


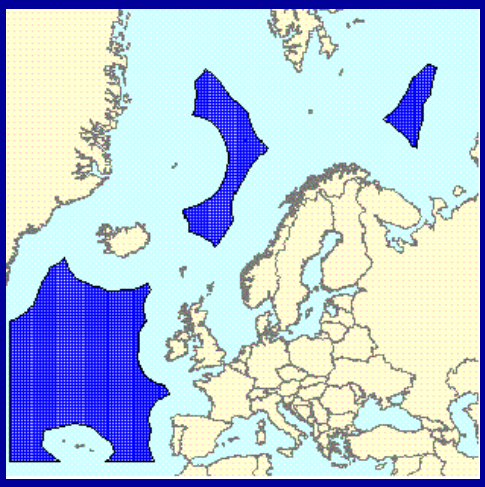
Above: Map of major fishing areas worldwide divided into UN FAO statistical areas (Source United Nations Food and Agricultural Organisation - see website www.fao.org/fi/statist/statist.asp). See Section 3 (pages 19-51) for detailed information on high seas bottom trawl fisheries on a regional basis.

Right:
Map of principal orange roughy fishing grounds inside and outside New Zealand EEZ.
Source: Branch 2001.
See Section 3.2 p24-25 for more details about New Zealand, Australia and the Southwest Pacific Ocean.



spotlight on the North Atlantic





Above:
Map of the high seas areas regulated by the North East Atlantic Fisheries Commission - the NEAFC 'Regulatory Area'. The shaded area represents the international waters of the Northeast Atlantic. Source: NEAFC http://www.neafc.org/about/map.htm
For more information on the Northeast Atlantic bottom trawl fisheries, see Section 3.3, p28-37

Left:
Map of the area covered by the Northwest Atlantic Fisheries Organisation. Virtually all bottom trawl fishing in the area is concentrated around the shelf and slope of the portion of the Grand Banks extending into international waters (Areas 3L, 3N, and 3O) and the Flemish Cap (Area 3M). Source: NAFO
For more information on the Northwest Atlantic bottom trawl fisheries, see Section 3.4, p37-42.

DR KEITH SALISBURY / CSIRO

Before Bottom Trawling **After Bottom Trawling**

The deep ocean is increasingly recognised by scientists as one of the planetary reservoirs of biodiversity with up to 100 million species believed to inhabit the deep sea. However, bottom trawling, coupled with the virtual absence of protective regulations for affected areas, is by far the biggest threat to deep ocean ecosystems and species.

Further copies of this publication, as well as more information on this subject can be obtained from the following addresses:

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