United Nations Educational, Scientific and Cultural Organization

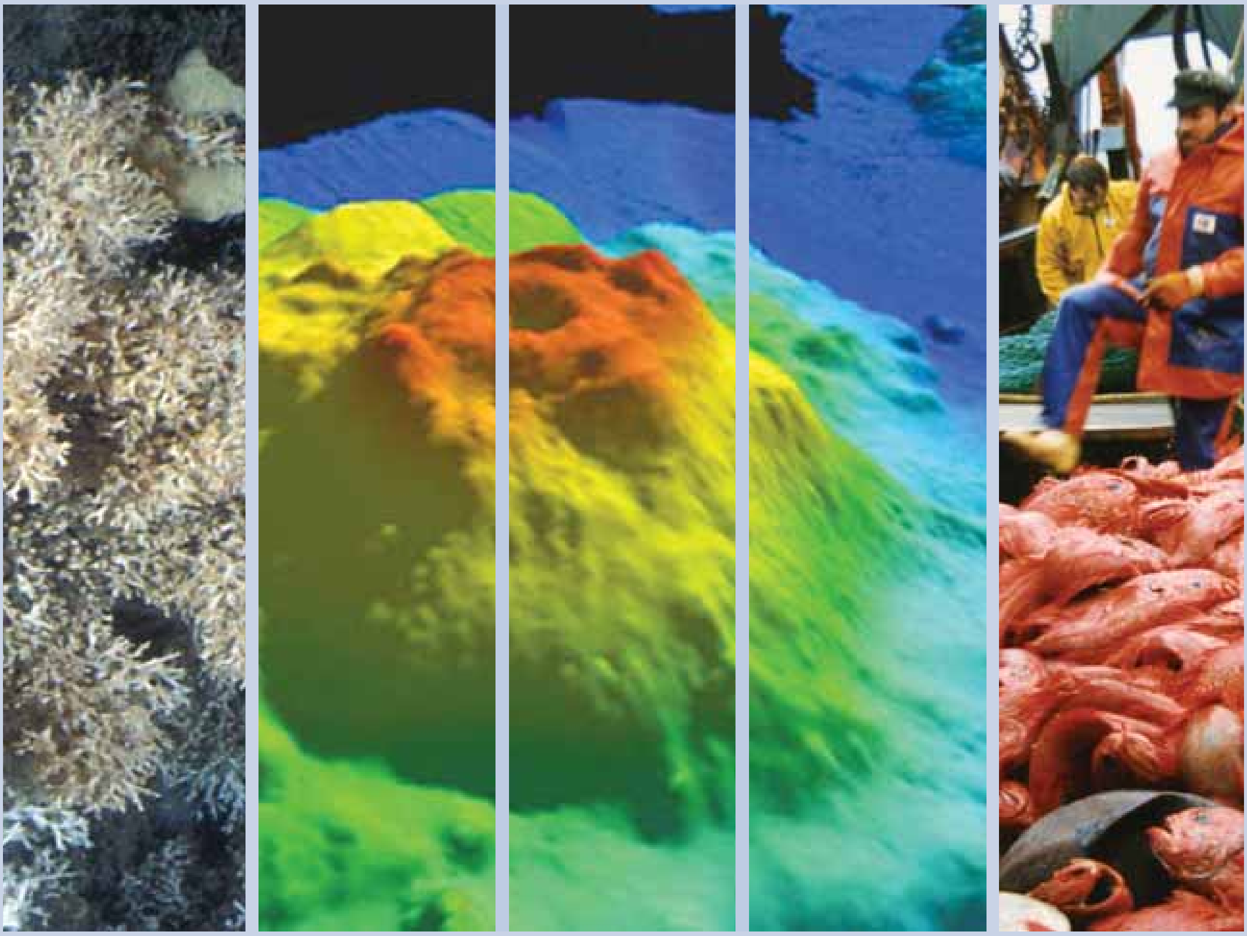
Intergovernmental Oceanographic Commission

CENSUS OF MARINE LIFE

NIWA Taihoro Nukurangi

agriculture, nature and food quality

Seamounts, deep-sea corals and fisheries



Census of Marine Life on Seamounts (CenSeam)
Data Analysis Working Group

UNEP WCMC

Regional Seas

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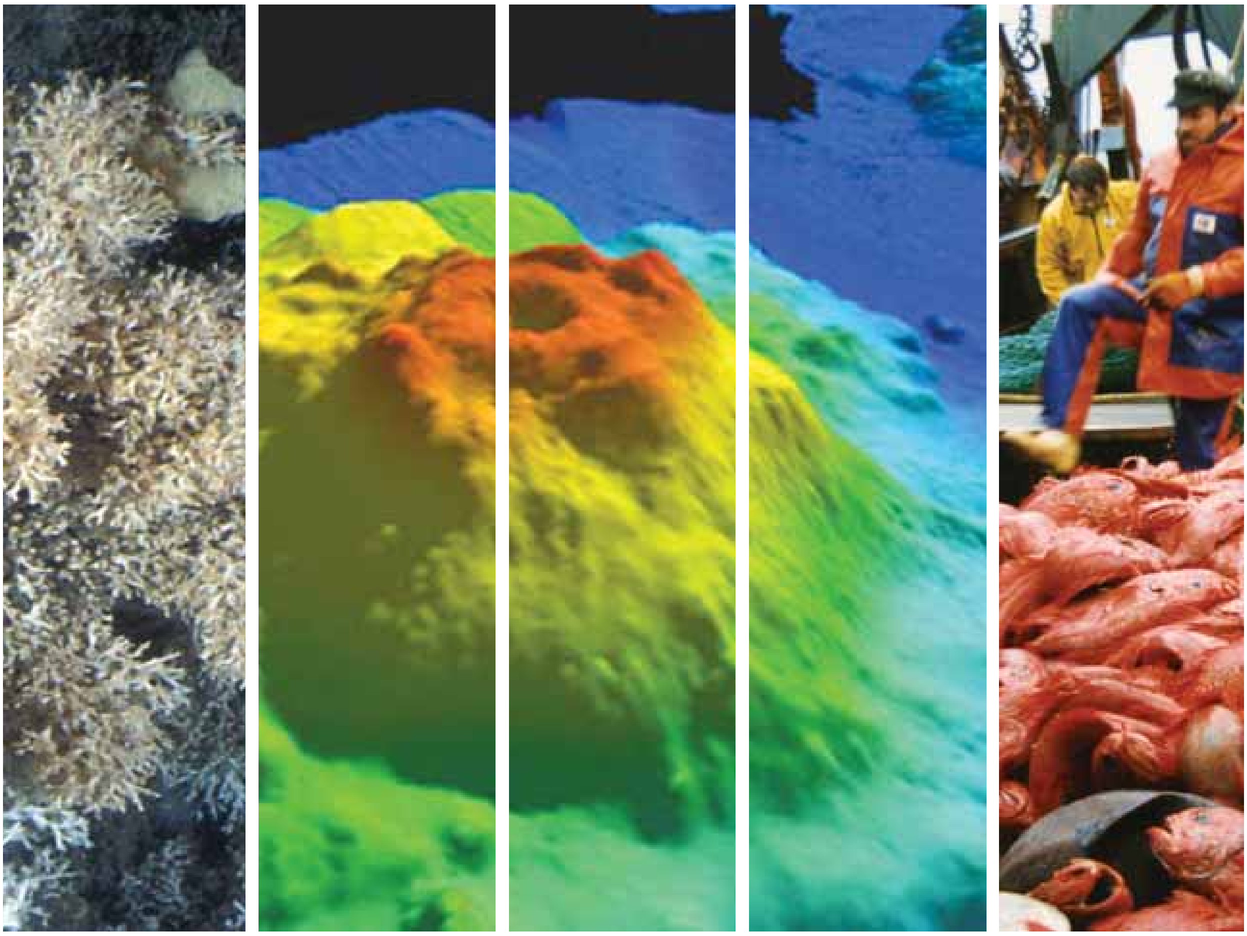
Seamounts, deep-sea corals and fisheries



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Executive summary

The oceans cover 361 million km^2, almost three quarters (71 per cent) of the surface of the Earth. The overwhelming majority (95 per cent) of the ocean area is deeper than 130m, and nearly two thirds (64 per cent) are located in areas beyond national jurisdiction. Recent advances in science and technology have provided an unprecedented insight into the deep-sea, the largest realm on Earth and the final frontier for exploration. Satellite and ship-borne remote sensors have charted the seafloor, revealing a complexity of morphological features such as trenches, ridges and seamounts which rival those on land. Submersibles and remotely operated vehicles have documented rich and diverse ecosystems and communities, which have changed how we view life in the oceans.

The same advances in technology have also documented the increasing footprint of human activities in the remote and little known waters and seafloor of the deep and high seas. A large number of video observations have not only documented the rich biodiversity of deep-sea ecosystems such as cold-water coral reefs, but also gathered evidence that many of these biological communities had been impacted or destroyed by human activities, especially by fishing such as bottom trawling. In light of the concerns raised by the scientific community, the United Nations General Assembly has discussed vulnerable marine ecosystems and biodiversity in areas beyond national jurisdiction at its sessions over the last four years (2003-2006), and called, *inter alia*, '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'.

This report, produced by the Data Analysis Working Group of the Census of Marine Life programme on Seamounts (CenSeam), is a contribution to the international response to this call. It reveals, for the first time, the global scale of the likely vulnerability of habitat-forming stony (scleractinian) corals, and by proxy a diverse assemblage of other species, to the impacts of trawling on seamounts in areas beyond national jurisdiction. In order to support, focus and guide the ongoing international discussions, and the emerging activities for the conservation and sustainable management of cold-water coral ecosystems on seamounts, the report:

1. compiles and/or summarizes data and information on the global distribution of seamounts, deep-sea corals on seamounts, and deep-water seamount fisheries;
2. predicts the global occurrence of environmental conditions suitable for stony corals and identifies the geographic areas where they are most likely to occur on seamounts;
3. compares the predicted distribution of stony corals on seamounts with that of deep-water fishing on seamounts worldwide;
4. qualitatively assesses the vulnerability of communities living on seamounts to putative impacts by deep-water fishing activities;
5. highlights critical information gaps in the development of risk assessments to seamount biota globally.

Seamount characteristics and distribution

A seamount is an elevation of the seabed with a summit of limited extent that does not reach the surface. Seamounts are prominent and ubiquitous geological features, which occur most commonly in chains or clusters, often along the mid-ocean ridges, or arise as isolated features from the seafloor. Generally volcanic in origin, seamounts are often conical in shape when young, becoming less regular with geological time as a result of erosion. Seamounts often have a complex topography of terraces, canyons, pinnacles, crevices and craters: tell-tale signs of the geological processes which formed them and of the scouring over time by the currents which flow around and over them.

As seamounts protrude into the water column, they are subject to, and interact with, the water currents surrounding them. Seamounts can modify major currents, increasing the velocity of water masses which pass around them. This often leads to complex vortices and current patterns which can erode the seamount sediments and expose hard substrate. The effects of seamounts on the surrounding water masses can include the formation of 'Taylor' caps or columns, whereby a rotating body of water is retained over the summit of a seamount.

In the present study the global position of only large seamounts (>1,000m elevation) were taken into account due to methodological constraints. Based on an analysis of updated satellite data, the location of 14,287 large seamounts has been predicted. This is likely to be an underestimate. Extrapolations from other satellite measurements estimate that there may be as many as 100,000 large seamounts world wide.

Numbers of predicted seamounts peak between 30ºN and 30ºS with a rapid decline above 50ºN and below 60ºS. The majority of large seamounts (8,955) occur in the Pacific Ocean area (63 per cent), with 2,704 (19 per cent) in

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the Atlantic Ocean and 1,658 (12 per cent) in the Indian Ocean. A small proportion of seamounts are distributed between the Southern Ocean (898 – 6 per cent), Mediterranean/Black Seas (59) and Arctic Ocean (13) – both less than 1 per cent.

An analysis of the occurrence of these seamounts inside and outside of Exclusive Economic Zones (EEZs) indicates that just over half (52 per cent) of the world's large seamounts are located beyond areas of national jurisdiction. The majority of these seamounts (10,223 – 72 per cent) have summits shallower than 3,000m water depth.

DEEP-SEA CORALS AND BIODIVERSITY

Compared to the surrounding deep-sea environment, seamounts may form biological hotspots with a distinct, abundant and diverse fauna, and sometimes contain many species new to science. The distribution of organisms on seamounts is strongly influenced by the interaction between the seamount topography and currents. The occurrence of hard substrata means that, in contrast to the mostly soft sediments of the surrounding deep-sea, seamount communities are often dominated by sessile, permanently attached organisms that feed on particles of food suspended in the water. Corals are a prominent component of the suspension-feeding fauna on many seamounts, accompanied by barnacles, bryozoans, polychaete worms, molluscs, sponges, sea squirts, and crinoids (which include sea lilies and feather stars).

Most deep-sea corals belong to the Hexacorallia, including stony corals (scleractinians) and black corals (antipatharians), or the Octocorallia, which include soft corals such as gorgonians.

Three dimensional structures rising above the seafloor in the form of reefs created by some species of stony coral, as well as coral 'beds' formed by black corals and octocorals, are common features on seamounts and continental shelves, slopes, banks and ridges. Coral frameworks add habitat complexity to seamounts and other deep-water environments. They offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework. Cold-water corals are frequently concentrated in areas of the strongest currents near ridges and pinnacles, providing hard substrata for colonization by other encrusting organisms and allowing them better access to food brought by prevailing currents. Although the co-existence between coral and non-coral species is in most cases still unknown, recent research is showing that some coral/non-coral relationships may show different levels of dependency. **A review of direct dependencies on cold-water corals globally, including those on seamounts, has shown that of the 983 coral-associated species studied, 114 were characterized as mutually-dependent, of which 36 were exclusively dependent to cnidarians (a group of animals that contains the corals, hydroids, jellyfishes, and sea anemones). A recent study recorded greater than 1,300 species associated with the stony coral *Lophelia pertusa* on the European continental slope or shelf. Thus some cold-water corals may be regarded as 'ecosystem engineers', because they create, modify, and maintain habitat for other organisms, similar to trees in a forest.**

Cold-water corals can form a significant component of the species diversity on seamounts and play a key ecological role in their biological communities. The assessment of the potential impacts of bottom trawling on corals is therefore a useful proxy for gauging the effects of these activities on seamount benthic biodiversity as a whole. However a comprehensive assessment of biodiversity is currently impossible because of the lack of data for many faunal groups living on seamounts.

DISTRIBUTION OF CORALS ON SEAMOUNTS

One of the data sources utilized for this report was a database of 3,235 records of known occurrences of five major coral groups found on seamounts, including some shallower features of <1,000m elevation. Existing records show that the stony corals (scleractinians) were the most diverse and commonly observed coral group on seamounts (249 species, 1,715 records), followed by Octocorallia (161 species, 959 records), Stylasterida (68 species, 374 records), Antipatharia (34 species, 159 records), and Zoanthidea (14 species, 28 records). These records included all species of corals, including those that were reef-forming, contributed to reef formation, or which occur as isolated colonies.

The most evident finding in analysing the coral database is that sampling of seamounts has not taken place evenly across the world's oceans and that there are significant geographic gaps in the distribution of studied seamounts. **For some regions, such as the Indian Ocean, very few seamount samples are available. In total, less than 300 seamounts have been sampled for corals, representing only 2.1 per cent of the identified number of seamounts in the oceans globally (or 0.03 per cent when assuming there are 100,000 large seamounts).** Only a relatively small number of coral species have wide geographic distributions and very few have near cosmopolitan distributions. Many of the widely-distributed species are the primary reef, habitat or framework-building stony corals such as *Lophelia pertusa, Madrepora oculata* and *Solenosmilia variabilis*.

In most parts of the world, stony corals were the most diverse group, followed by the octocorals. However, in the northeastern Pacific, octocorals are markedly more diverse than stony corals. Most stony corals and stylasterid species occur in the upper 1,000-1,500m depth range.

Antipatharians also occurred in the upper 1,000m, although a higher proportion of species occur in deeper waters than the two previous groups. Octocorals were distributed to greater depths, with most species in the upper 2,000m. Very little sampling has occurred below 2,000m.

There are a number of reasons for the differences in the depth and regional distribution of the coral groups, including species-related preferences of the nature of substrates available for attachment, quantity and abundance of food at different depths, the depth of the aragonite saturation horizon, temperature, and the availability of essential elements and nutrients.

PREDICTING GLOBAL DISTRIBUTION OF STONY CORALS ON SEAMOUNTS

The dataset for corals on seamounts revealed significant areas of weakness in our knowledge of coral diversity and distribution on seamounts, especially the lack of sampling on seamounts at equatorial latitudes. **Thus, to make a reasonable assessment of the vulnerability of corals on seamounts to bottom trawling (and, by proxy, determine the potential impacts of this activity on non-coral assemblages), it was necessary to fill the sampling gaps by predicting the global occurrence of suitable coral habitat by modelling coral distribution.**

An 'environmental niche factor analysis' (ENFA) was used to model the global distribution of deep-sea stony corals on seamounts and to predict habitat suitability for unsampled regions. Other groups of coral such as octo-corals, for example, can also form important habitats such as coral beds. These corals may have very different distrib-utions to stony corals, which would also be useful to appreciate in the context of determining the vulnerability of seamounts communities to bottom trawling. Unfortunately, the available data for octocorals are currently too limited to enable appropriate modelling.

ENFA compares the observed distribution of a species to the background distribution of a variety of environmental factors. In this way, the model assesses the environmental niche of a taxonomic group, i.e. how narrow or wide this niche is, identifies the relative difference between the niche and the mean background environment, and reveals those environmental factors that are important in determining the distribution of the studied group.

The model used and combined:

1. the location data of 14,287 predicted large seamounts;
2. the location records of stony corals (scleractinia) on seamounts;
3. physical, biological, and chemical oceanographic data from a variety of sources for 12 environmental para-meters (temperature; salinity; depth of coral occurrence; surface chlorophyll; dissolved oxygen; percentage of oxygen saturation; overlying water productivity; export primary productivity; regional current velocity; total alkalinity; total dissolved inorganic carbon; aragonite saturation state).

The model predictions were as follows: in near-surface waters (0-250m) habitat predicted to be suitable for stony corals lies in the southern North Atlantic, the South Atlantic, much of the Pacific, and the southern Indian Ocean. The Southern Ocean and the northern North Atlantic are, however, unsuitable. Below 250m depth, the suitability patterns for coral habitat change substantially. In depths from 250m-750m, a narrow band occurs around 30ºN ±10º and a broader band of suitable habitat occurs around 40ºS ±20º. In depths from 750m-1,250m, the North Pacific and northern Indian Ocean are unsuitable for stony corals. The circum-global band of suitable habitat at around 40ºS ±10º narrows with depth (to ±10º). Suitable habitat areas also occur in the North Atlantic and tropical West Atlantic. These areas remain suitable for stony corals with increasing depth (1,250m-1,750m; 1,750m-2,250m; 2,250m-2,500m), whereas the band at 40ºS breaks up into smaller suitable habitat areas around the southeast coast of South America and the tip of South Africa.

The global extent of habitat suitability for seamount stony corals was predicted to be at its maximum between around 250m and 750m. The majority of the suitable habitat for stony corals on seamounts occurs in areas beyond national jurisdiction. However, suitable habitats are also predicted in deeper waters under national jurisdiction, especially in the EEZs of countries:

1. **between 20ºS and 60ºS off Southern Africa, South America and in the Australia/New Zealand region;**
2. **off north-west Africa; and**
3. **around 30ºN in the Caribbean.**

Combining the predicted habitat suitability with the summit depth of predicted seamounts indicates that the majority of seamounts that may provide suitable habitat on their summit for stony corals are located in the Atlantic Ocean. The rest are mostly clustered in a band between 15ºS and 50ºS. A few seamounts elsewhere, such as in the South Pacific, with summits in the depth range between 0m and 250m are highly suitable. In the Atlantic, a large proportion of suitable seamount summit habitat is beyond national jurisdiction, whereas in the Pacific most of this seamount habitat lies within EEZs. In the southern Indian Ocean, suitable habitat appears both within and outside of EEZs. When analysing the habitat suitability on the basis of summit depth, it should be noted that suitable habitat for stony corals might also occur on the slopes of seamounts, i.e. at depths greater than the summit.

The analysis found the following environmental factors were important for determining suitable habitat for stony corals: high levels of aragonite saturation, dissolved oxygen, percentage of oxygen saturation, and low values of total dissolved inorganic carbon. Neither surface chlorophyll, nor regional current velocity, appear to be important for the global distribution of stony corals on seamounts. Nevertheless, these factors may be important for the distribution of corals at smaller spatial scales, such as on an individual seamount.

The strong dependency of coral distribution on the availability of aragonite – a form of calcium carbonate – is noteworthy. Stony corals use aragonite to form their hard skeletons. A reduction in the availability of aragonite, for example through anthropogenic induced acidification of the oceans through rising CO_2 levels, will limit the amount of suitable habitat for stony corals.

SEAMOUNT FISH AND FISHERIES

Seamounts support a large and diverse fish fauna. Recent reviews indicate that up to 798 species are found on and around seamounts. Most of these fish species are not exclusive to seamounts, and occur widely on continental shelf and slope habitats. Seamounts can be an important habitat for commercially valuable species which may form dense aggregations for spawning or feeding, which are targeted by large-scale fisheries.

For the purpose of this report, the distribution and depth ranges of commercial fish species were compiled from a number of internet and literature sources, including seamount fisheries catch data of Soviet, Russian and Ukrainian operations since the 1960s; published data on Japanese, New Zealand, Australian, EU and southern African fisheries; FAO catch statistics; and unpublished sources. Although known to be incomplete, this is the most comprehensive compilation attempted to date for seamount fisheries, and is believed to give a reasonable indication of the general distribution of seamount catch over the last four decades.

Deep-water trawl fisheries occur in areas beyond national jurisdiction for around 20 major species. These include alfonsino (*Beryx splendens*), black cardinalfish (*Epigonus telescopus*), orange roughy (*Hoplostethus atlanticus*), armourhead and southern boarfish (*Pseudopentaceros* spp.), redfishes (*Sebastes* spp.), macrourid rattails (primarily roundnose grenadier *Coryphaenoides rupestris*), oreos (including smooth oreo *Pseudocyttus maculatus*, black oreo *Allocyttus niger*) and Patagonian toothfish (*Dissostichus eleginoides* and in some areas Antarctic toothfish *D. mawsoni*), which has a restricted southern distribution. Many of these fisheries use bottom trawl gear. Other fisheries occur over seamounts, such as those for pelagic species (mainly tunas) and target species for smaller scale line fisheries (e.g. black scabbardfish *Aphanopus carbo*).

The distribution of four of the most important seamount fish species (for either their abundance or commercial value) are as follows:

1. **ORANGE ROUGHY is widely distributed throughout the North and South Atlantic Oceans, the mid-southern Indian Ocean, and the South Pacific: it does not extend into the North Pacific. It is frequently associated with seamounts for spawning or feeding, although it is also widespread over the general continental slope.**
2. **ALFONSINO has a global distribution, being found in all the major oceans. It is a shallower species than orange roughy, occurring mainly at depths of 400m to 600m. It is associated with seamount and bank habitat.**
3. **ROUNDNOSE GRENADIER is restricted to the North Atlantic, where it occurs on both sides, as well as on the Mid-Atlantic Ridge, where aggregations occur over peaks of the ridge.**
4. **PATAGONIAN TOOTHFISH has a very wide depth range and is sometimes associated with seamounts, but also found on general slope and large bank features.**

The distribution of historical seamount fisheries includes heavy fishing on seamounts in the North Pacific Ocean around Hawaii for armourhead and alfonsino; in the South Pacific for alfonsino, orange roughy, and oreos; in the southern Indian Ocean for orange roughy and alfonsino; in the North Atlantic for roundnose grenadier, alfonsino, orange roughy, redfish, and cardinalfish; and in the South Atlantic for alfonsino and orange roughy. Antarctic waters have been fished for toothfish, icefish, and notothenid cods.

The total historical catch from seamounts has been estimated at over 2 million tonnes. Many seamount fish stocks have been overexploited and without proper and sustainable management, followed a 'boom and bust' cycle. After very high initial catches per unit effort, the stocks were depleted rapidly over short time scales (<5 years) and are now closed to fishing or no longer support commercial fisheries. The life history characteristics of many deep water fish species (e.g. slow growth rate, late age of sexual maturity) make the recovery and re-colonization of previously fished seamounts slow.

Over the last decade, exploratory fishing for deep water species in many areas beyond national jurisdiction has focussed on alfonsino and orange roughy. The depth distribution of the two main target fisheries for alfonsino and orange roughy differ. The former is primarily fished between 250m and 750m, and includes

associated commercial species like black cardinalfish and southern boarfish. The orange roughy fisheries on seamounts, between 750 and 1,250m depth (deeper fishing can occur on the continental slope), include black and smooth oreos as bycatch. Seamount summit depth data was used to indicate where such suitable fisheries habitat may occur in areas beyond national jurisdiction. Combined with information on the geographical distribution of the commercial species, various areas where fishing could occur were broadly identified. Many of these areas are in the southern Indian Ocean, South Atlantic, and North Atlantic. The South Pacific Ocean also has a number of ridge structures with seamounts that could host stocks of alfonsino and orange roughy. Many of these areas have already been fished and some are known to have already been explored, but commercial fisheries have not developed.

ASSESSING THE VULNERABILITY OF STONY CORAL ECOSYSTEMS ON SEAMOUNTS

In order to assess the likely vulnerability of corals and the biodiversity of benthic animals on seamounts to the impact of fishing, the report examines the overlap and interaction between:

1. the predicted global distribution of suitable habitat for stony (scleractinian) corals;
2. the location of predicted large seamounts with summits in depth ranges of the alfonsino and orange roughy fishery; and
3. the distribution of the fishing activity on seamounts for these two species, and combines this with information on the known effects of trawling.

Many long-lived epibenthic animals such as corals have an important structural role within seafloor communities, providing essential habitat for a large number of species. Consequently, the loss of such animals lowers survivorship and re-colonization of the associated fauna, and has spawned analogies with forest clear-felling on land. A considerable body of evidence on the ecological impacts of trawling is available for shallow waters, but scientific information on the effects of fishing on deep-sea seamount ecosystems is much more limited to studies from seas off northern Europe, Australia, and New Zealand. These studies suggested that trawling had largely removed the habitat and ecosystem formed by the corals, and thereby negatively affected the diversity, abundance, biomass and composition of the overall benthic invertebrate community.

The intensity of trawling on seamounts can be very high. Hundreds to several thousand trawls have been carried out on small seamount features in the orange roughy fisheries around Australia and New Zealand. Such intense fishing means that the same area of the seafloor can be repeatedly trawled, causing long-term damage to the coral communities by preventing any significant recovery or recolonization. The impact of trawling on the seafloor biota differs depending on the gear type used. The most severe damage has been reported from the use of bottom trawls in the orange roughy fisheries on seamounts. Information about the potential impact of trawling practices for alfonsino, where midwater trawls are often used on seamounts, is currently lacking. Midwater trawls may have only a small impact if they are deployed well above the seafloor. However, in many cases the gear is most effective when fished very close to, or even lightly touching, the bottom. Thus, it is likely that the effects of the alfonsino fisheries on the benthic fauna would be similar to that of the orange roughy fisheries.

The comparison between the distributions of commercially exploited fish, fishing effort and coral habitat on seamounts highlighted a broad band of the southern Atlantic, Pacific and Indian Oceans between about 30°S and 50°S, where there are numerous seamounts at fishable depths, and high habitat suitability for corals at depths between 250m and 750m (the preferred alfonsino fisheries depth range), and again – but somewhat narrower – between 750m and 1,250m depth (the preferred orange roughy fisheries depth range).

This spatial concordance suggests there could be further commercial exploration for alfonsino and orange roughy fisheries on large seamounts in the central-eastern Southern Indian Ocean, the southern portions of the Mid-Atlantic Ridge in the South Atlantic, and some regions of the southern-central Pacific Ocean. Importantly, since these areas also contain habitat suitable for stony coral, impacts on deep-water corals and seamount ecosystems in general are likely to arise in such a scenario. However, it is uncertain whether fisheries exploration will result in economic fisheries.

A WAY FORWARD

This report has identified sizeable geographical areas with large seamounts, which are suitable for stony corals and which are vulnerable to the impacts of expanding deep-sea fishing activities. To establish and implement adequate and effective management plans and protection measures for these areas beyond national jurisdiction will present major challenges for international cooperation. In addition, the report identified that there are large gaps in the current knowledge of the distribution of seamounts and the biodiversity which they harbour.

In the light of these findings, the report recommends a number of activities to be carried out in a collaborative approach between all stakeholders under the following headings:

How can the impacts of fishing on seamounts be managed in areas beyond national jurisdiction?

Management initiatives for seamount fisheries within national EEZs have increased in recent years. Several countries have closed seamounts to fisheries, established habitat exclusion areas, and stipulated method restrictions, depth limits, individual seamount catch quotas, and bycatch quotas.

In comparison, fisheries beyond areas of national jurisdiction have often been entirely unregulated. There are 12 Regional Fisheries Management Organizations (RFMOs) with responsibility to agree on binding measures that cover areas beyond national jurisdiction, including some of the geographical areas identified in this report that might see further expansion of exploratory fishing for alfonsino and orange roughy on seamounts. A RMFO covers parts of the eastern South Atlantic where exploratory fishing has occurred in recent decades, and where further trawling could occur. However, the western side of the South Atlantic is not similarly covered by an international management organization. There have been recent efforts to improve cooperative management of fisheries in the Indian Ocean, although there are no areas covered by an RMFO. In addition, efforts are underway, for example in the South Pacific, to establish a new regional fisheries convention and body which would fill a large gap in global fisheries management. However, it should be noted that only the five RFMOs for the Southern Ocean, Northwest Atlantic, Northeast Atlantic, Southeast Atlantic and the Mediterranean currently have the legal competence to manage most or all fisheries resources within their areas of application, including the management of deep-sea stocks beyond national jurisdiction. The other RFMOs have competence only with respect to particular target species like tuna or salmon.

In the light of the recent international dialogues concerning the conservation and sustainable management and use of biodiversity in areas beyond national jurisdiction held within and outside the United Nations system, various fisheries bodies are becoming more active to up-date their mandates and to include benthic protection measures as part of their fisheries management portfolio. **It appears that a growing legislation and policy framework, including an expanding RFMO network in particular in the southern hemisphere, could enable the adequate protection and management of the risks to vulnerable seamount ecosystems and resources identified in this report. In order to be successful, a number of challenges will have to be overcome, including:**

1. **Establishing adequate data reporting requirements for commercial fishing fleets. Some unregulated and unreported fishing activities take place, even in areas where there are well defined fishery codes of practice and allowable catch limits (e.g. Patagonian toothfish fishery). Some countries require vessels registered to them to report detailed catch and effort data, but many do not. Therefore it is difficult at times to know where certain landings have been taken.**
2. **Ensuring compliance with measures, especially in areas that are far offshore and where vessels are difficult to detect. Compliance monitoring is also acute in southern hemisphere high seas areas, where there are no quotas for offshore fisheries.**
3. **Facilitating RFMOs, where necessary, to undertake ecosystem-based management of fisheries on the high seas.**
4. **Establishing, where appropriate, dialogue to ensure free exchange of information between RMFOs, governments, conservation bodies, the fishing industry, and scientists working on benthic ecosystems.**

The experiences gained by countries in the protection of seamount environments in their EEZs and in the management of their national deep-water fisheries can provide useful case examples for the approach to be taken under RFMOs. Other regional bodies, such as Regional Sea Conventions and Action Plans, might be able to provide lessons learned from the regional cooperation to conserve, protect and use coastal marine ecosystems and resources sustainably, including the implementation of an ecosystem approach in oceans management and the establishment of marine protected areas (MPAs). Regional Sea Conventions and Action Plans also provide a framework for raising the awareness of coral habitats in deep water areas under national jurisdiction, and coordinating and supporting the efforts of individual countries to conserve and manage these ecosystems and resources sustainably.

In calling for urgent action to address the impact of destructive fishing practices on vulnerable marine ecosystems, paragraph 66 of United Nations General Assembly resolution 59/25 places a strong emphasis on the need to consider the question of bottom trawl fishing on seamounts and other vulnerable marine ecosystems on a scientific basis and a precautionary basis, consistent with international law. The United Nations Fish Stocks Agreement (FSA) Articles 5 and 6 – 'General principles' and the 'Application of the precautionary approach' – also establish clear obligations for fisheries conservation and the protection of marine biodiversity and the marine environment from destructive fishing practices. The articles also establish that the use of science is essential to meeting these objectives and obligations. At the same time, the

FSA recognizes that scientific understanding may not be complete or comprehensive and in such circumstances, caution must be exercised. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

A precautionary approach, consistent with the general principles for fisheries conservation contained in the FSA, as well as the Food and Agriculture Organization of the United Nations Code of Conduct for Responsible Fisheries and the principles and obligations for biodiversity conservation in the Convention on Biological Diversity, would require the exercise of considerable caution in relation to permitting or regulating bottom trawl fishing on the high seas on seamounts. This is because of the widespread distribution of stony corals and associated assemblages on seamounts in many high seas regions, and the likelihood that seamounts at fishable depths may also contain other species vulnerable to deep-sea bottom trawling even in the absence of stony corals. In this regard, a prudent approach to the management of bottom trawl fisheries on seamounts on the high seas would be to first ascertain whether vulnerable species and ecosystems are associated with a particular area of seamounts of potential interest for fishing, and only then permitting well regulated fishing activity provided that no vulnerable ecosystems would be adversely impacted.

Further and improved seamount research

The conclusions of this report apply only to the association of stony corals with large seamounts. In order to consider other taxonomic groups on a wider range of seamounts further sampling and research is required.

Spatial coverage of sampling of seamounts is poor and data gaps currently impede a comprehensive assessment of biodiversity and species distributions. Only 80 of the 300 biologically surveyed seamounts have had at least a moderate level of sampling. Existing surveys have tended to concentrate on a few geographic areas, thus the existing data on seamount biota are highly patchy on a global scale and the biological communities of tropical seamounts remain poorly documented for large parts of the oceans. Most biological surveys on seamounts have been relatively shallow and thus the great majority of deeper seamounts remain largely unexplored. Very few individual seamounts have been comprehensively surveyed to determine the variability of faunal assemblages within a single seamount. In addition to the previous spatial gaps in sampling coverage, there are a number of technical issues that make direct comparisons of seamount data sometimes problematic. These issues relate to the availability of non-aggregated data, differences in collection methods, and taxonomic resolution.

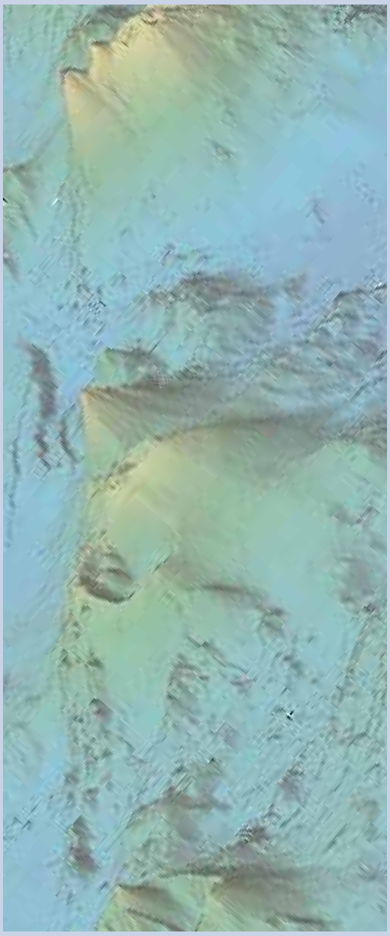
In order to expand the type of analyses conducted for this report to other faunal groups common on seamounts, and to work at the level of individual species, certain steps should be taken. These include the adoption of a minimum set of standardized seamount sampling protocols; more funding for existing taxonomic experts and training of new taxonomists; increased accessibility of full (non-aggregated) datasets from seamount expeditions through searchable databases; and the further development of integrated, internet-based information systems such as Seamounts Online and the Ocean Biogeographic Information System.

It should be noted that the activities under the two headings above are closely interrelated and interlinked. Increased research and collaboration between scientists and fishing companies will not only improve the amount and quality of data, it will also expand the scientific foundation for reviewing existing measures (e.g. those which were taken on a precautionary basis in the light of information gaps); and for developing new, focussed management strategies to mitigate against negative human impacts on seamounts and their associated ecosystems and biodiversity. Requirements in this context include:

1. obtaining better seamount location information; addressing geographic data gaps (including the sampling of other deep-sea habitats);
2. assessing the spatial scale of variability on and between seamounts; increasing the amount and scope of genetic studies;
3. undertaking better studies to assess trawling impacts; assessing recovery from trawling impacts; undertaking a range of studies to improve functional understanding of seamount ecosystems; and
4. implementing the means to obtain better fisheries information.

Without a concerted effort by a number of organizations, institutions, consortia and individuals to attend to the previously identified gaps in data and understanding, the ability of any body to effectively and responsibly manage and mitigate the impact of fishing on seamount ecosystems will be severely constrained. Considering what this report has revealed about the vulnerability of seamount biota, particularly deep-sea corals, to fishing – now is the time for this collaborative effort to begin in earnest.

DRAFT SUMMARY
full report to follow



Seamounts, deep-sea corals and fisheries

An ubiquitous ocean floor feature, a key marine ecosystem and an important human activity: together these have created one of the most critical ocean issues.

Seamounts, deep-sea corals and fisheries reveals the global scale of the vulnerability of habitat-forming stony corals on seamounts – and that of associated marine biodiversity and assemblages – to the impacts of trawling, especially in areas beyond national jurisdiction. It provides some of the best scientific evidence to date to support the call for concerted and urgent action on the high seas to protect seamount communities and their associated resources from the adverse effects of deep-water fishing.

Seamounts, deep-sea corals and fisheries describes the results of data analyses that were used to understand the global distribution of deep-sea corals on seamounts, to model the distribution of suitable habitat for stony corals, and to appreciate the extent of trawl fisheries on seamounts in areas beyond national jurisdiction. These results were combined, along with knowledge of the effects of trawling on corals and other seamount species, to identify the main areas at risk from the impact of current and future trawling on the high seas. In particular, seamount ecosystems in the Indian, North and South Atlantic, and South Pacific Oceans are threatened by the expansion of alfonsino (250-750 metres) and orange roughy (750-1 200 metres) fisheries.

Seamounts, deep-sea corals and fisheries aims to raise the awareness of managers, decision makers and stakeholders about the distribution of deep-sea corals on seamounts and their vulnerability to trawling. It provides facts and information to support and guide the international processes within and outside the United Nations system to find solutions for the conservation, protection and sustainable management of seamount ecosystems – before it is too late.

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