

3. THE STATUS OF COLD-WATER CORAL COMMUNITIES OF THE WORLD: A BRIEF UPDATE

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INTRODUCTION

For the first time, in 2004 a chapter on ‘Cold-water Coral Reefs’ was included in the Status of Coral Reefs of the World reports. This reflected the rapidly increasing awareness of these communities as biologically diverse and fragile habitats vulnerable to human impacts. Since 2004, there has been a tremendous increase in research on, and action to protect, these cold-water counterparts to tropical coral reefs. This chapter updates recent discoveries and conservation efforts.

Cold-water corals, also called ‘deep-sea’ or ‘deep-water’ corals, are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deeper or colder oceanic waters. Such corals lack symbiotic algae (zooxanthellae) characteristic of most reef-building shallow water tropical corals, and generally grow much more slowly than tropical corals. The calcified skeletons of some branching stony coral species (e.g. *Lophelia pertusa*) can form large reefs in deep water, whereas others, including gorgonians and gold, black and stylasterid corals, do not form reefs, but occur either singly or in tree-like thickets (‘coral gardens’). Both reefs and gardens provide habitats for many fishes and invertebrates and enhance the biological diversity of many deepwater ecosystems, similar to tropical coral reefs.

Cold-water coral assemblages are particularly vulnerable to damage from bottom trawling; thus most recent conservation efforts have focused on preventing fisheries damage. These unique communities may also be damaged by energy exploration and development, deployment of submarine cables and pipelines, and changes in water chemistry (e.g. ocean acidification due to climate change). Recovery may take decades to centuries as most cold-water corals grow slowly.

RECENT DIRECTIONS IN SCIENCE, CONSERVATION AND MANAGEMENT

The proceedings of the 2nd and 3rd International Symposia on Deep-Sea Corals documented the acceleration in the study of these ecosystems and increasing emphasis on their protection and management. Much of the attention is focused in the North Atlantic, North-east Pacific and South-west Pacific; there is increasing recent interest in similar ecosystems near developing countries and small island developing states (SIDS) as well as on high seas seamounts.

Major international programs are expanding knowledge of cold-water coral ecosystems. The 'Hotspot Ecosystem Research on the Margins of European Seas' (HERMES) project (www.eu-hermes.net) is an integrated pan-European project with 50 partners funded by the European Commission on cold-water coral reefs and other deep-sea habitats (e.g. cold seeps, anoxic environments, mounds, canyons and continental slopes), and has established strong links with European and global marine policy makers. HERMES will conclude in March 2009, with 'Hotspot Ecosystem Research and Man's Impact on European Seas' (HERMIONE) starting in April 2009. The Trans-Atlantic Coral Ecosystem Study (TRACES; www.lophelia.org/traces) will establish the first basin-scale study of cold-water coral ecosystems, and workshops in North America and Europe in 2008 developed the TRACES Science Plan. The Census of Marine Life (www.coml.org/) will also coordinate research and information on critical ecosystems including seamounts (CenSeam), the North Atlantic mid-ocean ridge (Mar-Eco) and continental margins (CoMarg-E).

Major international trends in cold-water coral activities since 2004 are expanding:

- Attention beyond cold-water stony coral 'reefs' to include other coral-dominated communities (coral gardens) because gorgonians and black corals are the dominant species in many regions and support diverse deep-sea communities. Some black and gold coral colonies can exceed 2000 years in age; probably the oldest living animals in the world;
- Appreciation of cold-water coral communities on seamounts as there are probably 100 000 seamounts which rise more than 1 km above the seabed: only 350 have been sampled. Most seamounts occur outside national jurisdiction which has stimulated interest in high seas conservation (see recent reviews below);
- Conservation from protecting individual cold-water coral reefs (e.g. efforts by Norway and Canada from 1999 to 2004) to addressing bottom-fishing impacts over larger regions (e.g. major efforts in the US North-east Pacific, 2006, and around New Zealand, 2007), with comprehensive conservation frameworks within Regional Fisheries Management Organizations and Agreements (RMFO/As).

CONSERVATION OF COLD-WATER CORAL AND OTHER VULNERABLE ECOSYSTEMS

United Nations General Assembly (UNGA) resolutions from 2004 have addressed the damage to high-seas deep-sea fisheries on vulnerable marine ecosystems (VMEs), including seamounts, hydrothermal vents and cold-water corals. Most notably, the 2006 UNGA Sustainable Fisheries Resolution 61/105, called upon States, individually and through Regional Fisheries Management Organizations and Agreements (RFMO/As) to take actions to sustainably manage fish stocks and protect VMEs from destructive fishing practices, recognizing the immense importance and value of deep sea ecosystems and the biodiversity they contain. In 2008, the UN Food

and Agriculture Organization (FAO) adopted International Guidelines for Deep Sea Fisheries. RFMO/As are using these guidelines in their management efforts to fulfill the UNGA mandate (see the Table below). Also in 2008, the Convention on Biological Diversity (CBD) adopted ‘Scientific Criteria for Identifying Ecologically or Biologically Significant Marine Areas in Need of Protection in Open-ocean Waters and Deep-sea Habitats,’ which are applicable, and refer, to cold-water corals and other marine ecosystems that are vulnerable, fragile, sensitive, or slow to recover.

The following ocean basin summaries contain some of the new information on national and multilateral efforts to understand, conserve and manage cold-water coral ecosystems (there are no major cold-water coral communities known in the Arctic Ocean). Information from developing countries and the high seas, especially in the southern hemisphere, is scarce, indicating an urgent need for further research. This compilation is not exhaustive, particularly with regard to fishery measures in developing countries.

Atlantic Ocean

North Atlantic cold-water corals are among the best studied. The Northeast Atlantic Fisheries Commission (NEAFC) recommended measures to manage fisheries on the high seas in the North-east Atlantic and Arctic Oceans. NEAFC was the first RFMO to institute specific protections for cold-water coral areas, prohibiting bottom trawling and fishing with static gear on four seamounts and a section of the Mid-Atlantic Ridge in 2004. Additional areas were closed or modified in 2007 and 2008. The Northwest Atlantic Fishery Organization (NAFO) plays a similar role and in 2006 and 2008, NAFO closed 4 seamount areas to all bottom fishing until 2010, with an option for exploratory fishing based on scientific advice. NAFO and Canada created a Coral Protection Area closed to all bottom contact fishing for 2008–2012 in a continental slope area within Canada’s Exclusive Economic Zone on the south-west Grand Banks. NEAFC and NAFO are soon expected to adopt comprehensive measures to address significant adverse impacts from fishing on VMEs.

The Southeast Atlantic Fishery Management Organization (SEAFO) manages bottom-fisheries in part of the South-east Atlantic high seas. In 2006 SEAFO identified 13 vulnerable areas (mostly seamounts) and closed 10 to all bottom-fishing for an interim period. The Central Atlantic and South-west Atlantic area is outside national jurisdictions and not currently covered by existing bottom-fishing RFMO(s); and none are under development.

Europe and the North-east Atlantic: The *Lophelia pertusa* reefs in the North-east Atlantic were among the first cold-water coral ecosystems to gain widespread scientific knowledge and conservation attention. Norway was the first country to protect these corals in European waters. Since 2004, research has continued under national and international programs, and protection efforts have accelerated.

Mapping of coral areas off Iceland was initiated in 2004, and 3 areas were protected in 2006. The Santa Maria di Leuca deep coral mounds, the only known large-scale *Lophelia* reefs in the Mediterranean, were protected in 2006, and in 2007 more of the Northwest Rockall Bank and Logachev Mounds protected from bottom-fishing. The OSPAR Commission for the Protection of the Marine Environment of the North-east Atlantic has identified conservation priorities in the North-east Atlantic and in 2008 the ‘coral gardens’ habitat was included among threatened

and declining species and habitats, thereby broadening the previous emphasis on *Lophelia* reefs. Also in 2008, OSPAR adopted a 'Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area', which includes scientific investigations.

Canada – North-west Atlantic: The Department of Fisheries and Oceans (DFO) and the Dalhousie and Memorial University of Newfoundland and Labrador have conducted surveys since 2006 on unexplored deep parts of the continental slope, including the North-east Channel Coral Conservation Area in the Discovery Corridor off south-west Nova Scotia, the Gully Marine Protected Area, Shortland Canyon, Haldimand Canyon and the *Lophelia* Conservation Area at the Stone Fence on the Scotian Slope, and Haddock Channel and Debarres Canyon on the south-west Grand Banks. These surveys have expanded species ranges, and recorded new taxa. Data are recorded in the ARCGIS database on corals and sponges, and habitat associations, combined with by-catch records from groundfish trawl surveys and fisheries observers on commercial vessels. Population genetic analyses, recruitment, growth, ageing and reproductive studies have also been initiated.

In May 2007 the Canadian offshore shrimp and groundfish trawling industry voluntarily closed fishing to protect cold-water corals off Baffin Island, Newfoundland and Labrador. The 12 500 km² coral protection zone contains gorgonian corals, and captains follow a code of conduct to stop fishing in areas they believe corals may exist, even outside the voluntary closure zones.

United States – North-west Atlantic: The US Congress amended the principal fisheries law in 2006, mandating a Deep Sea Coral Research and Technology Program and allowing protection of identified deep sea coral areas. In 2007 an assessment of cold-water coral ecosystems, *The State of Deep Coral Ecosystems of the United States*, was published. The US Atlantic has numerous cold-water coral habitats: gorgonians predominate in rocky areas in canyons in the north-east and the New England Seamount chain. The Oceanographer and Lydonia Canyons, including important cold-water habitats, were closed to fishing for monkfish in 2005. Reef-building cold-water corals, including *Lophelia pertusa*, reach their greatest abundance and development from Cape Hatteras to Florida. The South Atlantic Fishery Management Council is considering protecting several large Habitat Areas of Particular Concern. Reefs also occur in the Gulf of Mexico with abundant gorgonians and black corals; but these are poorly documented.

Caribbean and South Atlantic: The Caribbean contains structure-forming deep-water stony, black, and gorgonian corals, especially in Colombian waters. Information on cold-water coral ecosystems in the South Atlantic remains very sparse. Communities are dominated by *Lophelia pertusa* in the South-east Atlantic from the margin of the Angola shelf. *Lophelia pertusa* and *Solenosmilia variabilis* dominate cold-water reefs off the coast of Brazil and cold-water coral mounds have been found off the Patagonian shelf.

Pacific Ocean

There are extensive un-surveyed cold-water coral areas throughout the Pacific Ocean with the best studied areas being the North-east Pacific (rich gorgonian-dominated slopes and seamounts); the Hawaiian Archipelago and seamounts with harvested precious corals (but probably has no cold-water reefs); and seamounts in the South-west Pacific with rich octocorals and scleractinian reef-forming corals. It is probable that cold-water corals reach their highest

diversity in the Indo-Pacific, similar to tropical corals. There are no existing RFMO/As on bottom-fishing beyond areas of national jurisdiction in the Pacific. A South Pacific Fisheries Management Organisation (SPRFMO) is under development for the area from South America to eastern Australia; a similar body is under negotiation for the North-west Pacific. Interim conservation measures have been agreed for both areas in accordance with UNGA Resolution 61/105.

Canada – Northeast Pacific: Significant cold-water coral habitats exist in deeper waters along the Canadian Pacific coast, similar to those in US waters. Fisheries and Oceans Canada (DFO) has significantly increased the number of cold-water coral species to 80 off British Columbia during surveys on the continental slope from 500–2400 m in response to the expansion of new fisheries in these areas. DFO is drafting, consulting and implementing a Cold-water Coral and Sponge Conservation Strategy for the West Coast of Canada. In 2008 the Bowie Seamount 180 km west of Haida Gwaii (Queen Charlotte Islands) was declared Canada's 7th MPA. It comprises the Bowie, Hodgkins and Davidson seamounts of the Kodiak-Bowie seamount chain with an area of 6131 km². The seamounts have not been fully explored, although many coral species occur there. The MPA regulations prohibit disturbance, damage, destruction or removal of any living marine organism, any part of its habitat or any part of the seabed, including the subsoil; fishing is prohibited in one zone and limited in other zones.

United States – Pacific: Cold-water corals are important structural components in the Gulf of Alaska and Aleutian Islands. U.S. cold-water gorgonians reach their highest diversity in the Aleutian Islands and often form complex 'coral gardens' with stylasterid corals, sponges, and other organisms. In 2006, measures to minimize the adverse effects of fishing on essential fish habitat closed over 980,000 km² to bottom trawling, thereby protecting important cold-water coral habitats on seamounts, continental slopes, and ocean ridges. More trawl closures were instituted in 2008 in the Bering Sea, where soft corals predominate.

The seafloor off Washington, Oregon, and California contains extensive coral communities as documented in trawl survey catch records, supplemented by museum collections and underwater vehicle exploration. In 2006, the U.S. implemented a comprehensive plan to protect essential fish habitat for groundfish, focusing largely on pristine or untrawled habitat and ecosystems such as cold-water corals. More than 336 700 km² were protected from bottom trawling, with selected areas (e.g. several seamounts) protected from all fishing gears that contact the bottom.

Southeast Pacific: There are few data on the cold-water coral fauna of the South-east Pacific: recent studies in Chile revealed large assemblages of black, gorgonian and stylasterid corals in the shallow-water fjords and bycatch of deeper-water corals in fisheries, including on O'Higgins Seamount.

Australia – South-west Pacific: In 2007 the Southeast Commonwealth Marine Reserve Network was approved, encompassing 13 zones with varying levels of protection from total fishing bans through to multiple-use reserves. This expands the Tasmanian Seamounts Marine Reserve to cover 220 000 km² of underwater canyons and seamounts. The objectives of the Network are to include representative areas of major seafloor features and fauna from the Great Australian Bight through Tasmanian waters to southern New South Wales. Some protected seamounts

were surveyed in 2007 and 2008 and confirmed the presence of cold-water corals and high biodiversity. The orange roughy fishery on the South Tasman Rise was closed by Australia and New Zealand in 2007. This region contained large quantities of coral (mainly *Solenosmilia variabilis*) in orange roughy bycatch.

New Zealand – South-west Pacific: The closure of 19 seamounts to all bottom trawling and dredging in 2001 was recently expanded with 17 new Benthic Protected Areas (BPAs) in the New Zealand EEZ. These areas cover 1 200 000 km², about 30% of the EEZ: the network was proposed by the New Zealand fishing industry and adopted by the government in November 2007. The main objective was to protect pristine benthic ecosystems where there has been little or no fishing. The biota communities are poorly known, although cold-water reefs are present. The closures include many seamounts, including the 19 previously protected, and hydrothermal vents. Bottom trawling is banned and other contact operations are closely monitored by government observers. Outside the BPAs most bottom trawling is regulated solely by setting commercial fish species quotas but coral bycatch continues to be a concern in some areas where fishing has expanded to new grounds.

There has been continued research on the effects of trawling on seamounts especially the impacts on corals. Some seamount features are monitored off the east coast of New Zealand which clearly shows that corals are severely damaged by heavy ground gear of deepwater trawls. Some patches of reef remain on heavily fished seamounts where lava flows or rocky bottoms prevent trawling. There is evidence of recent stylasterid coral settlement on fished seamounts that were protected in 2001. Research has also continued on biodiversity (including taxonomy and at-sea identification), biogeography, growth and ageing, and invertebrate identification guides have been produced. Rapid Vulnerable Marine Ecosystem (VME) identification guides are being produced for use by observers in international waters of the South Pacific and Ross Sea.

Indian Ocean

Information is sparse on Indian Ocean cold-water coral communities. Cold-water scleractinian corals have been recorded within Indian waters and the Southwest Indian Ocean, but very few sites have been sampled and fewer protected. Trawl fisheries are likely causing damage to cold-water coral habitats. Southwest Indian Ocean orange roughy fisheries underwent rapid exploitation and decline from 1998 to 2003, and a similar pattern of bottom-trawl fisheries could threaten seamount ecosystems in the central-eastern southern Indian Ocean. Indian Ocean deep-sea fisheries are managed through the South Indian Ocean Fisheries Agreement, but there are no management measures to address the impacts of these fisheries on VMEs. In 2006, the Southern Indian Ocean Deepwater Fishers' Association voluntarily refrained from bottom-trawling in several Indian Ocean areas with cold-water corals.

Southern Ocean

The Southern Ocean surrounds Antarctica and the northern border is generally identified as the Antarctic Convergence (between 50°S to 60°S). The area is relatively depauperate in cold-water corals, but includes some structure-forming species in the best studied areas around the Antarctic Peninsula below South America, and south of Australia and New Zealand. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is responsible for managing marine living resources in this region. In 2007, member States of CCAMLR

adopted comprehensive measures for all bottom fishing activities, requiring assessments by flag States and the CCAMLR Scientific Committee and biennial reviews to assess effectiveness of conservation.

EMERGING ISSUES

The 2004, GCRMN report identified a number of potential threats to cold-water coral communities, including bottom trawling and other bottom fishing, hydrocarbon exploration and production, submarine cable and pipeline placement, bioprospecting and destructive scientific sampling, waste disposal, dumping and pollution, and coral exploitation and trade. Since then, there has been tremendous activity to address fishing impacts, however, there has been increased information on, and concern about, the potential future impacts of ocean acidification and seabed mining.

Ocean acidification: The ocean is the largest net sink for absorbing CO₂ from the atmosphere and ultimately storing it as carbon compounds and carbonates in the deep. Oceanic absorption of human derived CO₂ has, and will, result in profound changes in water chemistry. The 4th IPCC Assessment Report states that the ocean has become more acidic by 0.1 pH units since 1750 and the saturation state of the calcium carbonate minerals calcite and aragonite has been lowered. These minerals are used to form shells and skeletal structures in many marine organisms including corals. These changes in ocean chemistry will reduce the ability of corals to produce calcium carbonate skeletons and increase reef dissolution. There is a natural boundary in the oceans, the ‘aragonite saturation horizon’, below which corals cannot maintain calcium carbonate structures. As CO₂ levels increase, this aragonite saturation horizon will become shallower and affect numerous stony cold-water coral communities with under-saturated conditions in the next decades, thereby severely limiting their growth and distribution. Projected increases in ocean acidity could result in severe ecological changes for cold-water corals and all organisms associated with the reefs.

Seafloor Mining: Mining the deep seafloor for metals is not a viable commercial enterprise – yet, there has been increased interest and investment in mineral exploitation. Potential targets for seabed mining include cobalt-enriched crusts, which occur as thin layers on the flanks of volcanic islands and seamounts at 1000 to 2500 m depth, where cold-water corals also occur. Any mineral exploitation outside areas of national jurisdiction would be governed by guidelines established by the International Seabed Authority (ISA) (www.isa.org.jm). Potential environmental impacts associated with the cobalt mining and massive seafloor sulfide deposits were recently reviewed in an ISA workshop.

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SELECTED REFERENCES

- Cairns SD (2007) Deep-water corals: An overview with special reference to diversity and distribution of deep-water scleractinian corals. *Bull. Mar. Sci.* 81: 311–322.
- Clark MR, Tittensor D, Rogers AD, Brewin P, Schlacher T, Rowden A, Stocks K, Consalvey M (2006). Seamounts, deep-sea corals and fisheries: vulnerability of deep-sea corals to fishing on seamounts beyond areas of national jurisdiction. UNEP-WCMC, Cambridge, UK.
www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/25.htm
- Davies A, Roberts JM, Hall-Spencer JM (2007). Preserving deep-sea natural heritage: emerging issues in offshore conservation and management. *Biological Conservation* 138: 299–312
- de Oliveira Pires D (2007). The azooxanthellate coral fauna of Brazil. *Bull. Mar. Sci.* 81:Supplement 1: 265–272
- Freiwald A, Roberts JM (eds) 2005. Cold-water corals and ecosystems. Springer-Verlag Berlin, Heidelberg. 1243 pp.
- George RY, Cairns SD (eds) (2007a). Conservation and Adaptive Management of Seamount and Deep-Sea Coral Ecosystems. Rosenstiel School of Marine and Atmospheric Science. Univ. Miami. *Bull. Mar. Sci.* 81:Supplement 1: 324 pp.
- George RY, Cairns SD (eds) (2007b). Seep-Sea Coral Ecosystems: Biology and Geology. Proceedings of the 3rd International Symposium on Deep-Sea Corals. *Bull. Mar. Sci.* 81: 309–559.
- Guinotte JM, Orr J, Cairns S, Freiwald A, Morgan L, George R (2006). Will human-induced changes in seawater chemistry alter the distribution of deep-sea scleractinian corals? *Frontiers in Ecology* 4: 141–146
- Häussermann V, Försterra G (2007). Large assemblages of cold-water corals in Chile – a summary of recent findings and their implications. *Bull. Mar. Sci.* 81:Supplement 1: 195–209.
- IPCC (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. 996 pp.
- Lumsden SE, Hourigan TF, Bruckner AW, Dorr G (eds) (2007). The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3, Silver Spring, Maryland. 365 pp. <http://www.nmfs.noaa.gov/habitat/dce.html>
- Pitcher TJ, Morato T, Hart P, Clark M, Haggan N, Santos R (eds) (2007) Seamounts: Ecology, Fisheries & Conservation. Blackwell Publishing, Oxford U.K. 527 pp.
- Roberts JM, Wheeler AJ, Freiwald A. (2006). Reefs of the deep: the biology and geology of cold-water coral ecosystems. *Science* 312: 543–547.
- Venkataraman K. (2007). Azooxanthellate hard corals (Scleractinia) from India. *Bull. Mar. Sci.* 81: Supplement 1: 209–214.

This table details closures to bottom-trawl fishing gear (and in some cases other bottom-contact fishing gear) intended to protect cold-water corals or other potentially-vulnerable deep-water habitats (Adapted from Davies et al. 2007).

Country/Area	Year designated	Areas Protected to Conserve Cold-water Coral Habitats
ATLANTIC		
Norway	1999	Sula Reef. Cold-water coral reefs.
	2000	Iverryggen. Cold-water coral reefs.
	2003	Røst Reef, Tisler Reef, and Fiellknausene cold-water coral reefs.
Azores, Madeira & Canary Islands	2004	Deep-water coral reefs (protection made permanent in 2005)
United Kingdom	2004	Darwin Coral Mounds.
Iceland	2006	Three closure areas (Reynisdjup Reef, Hornafjarðardjúp, Skaftárdjúp).
Europe	2006	Capo Santa Maria di Leuca. <i>Lophelia</i> reefs.
	2007	Interim closures of the EU sections of Northwest Rockall Bank and Logachev Mounds.
Mediterranean & Black Seas	2005	General Fisheries Commission for the Mediterranean: All Mediterranean and Black Sea areas deeper than 1000 m closed to bottom trawling.
Canada	2002	Northeast Channel Conservation Area. Deep-water coral.
	2004	Stone Fence Fisheries Closure. Cold-water coral reefs.
	2004	The Gully Marine Protected Area.
United States	1984	<i>Oculina</i> Habitat Area of Particular Concern (expanded in 2000).
	2005	Oceanographer and Lydonia Canyon Habitat Areas of Particular Concern.
North-east Atlantic	2004	Northeast Atlantic Fishery Commission (NEAFC) prohibited bottom trawling and fishing with static gear on an interim basis in 4 seamount areas (Altair, Antiatair, Faraday and Hekate) and a section of the Reykjanes Ridge in the Mid-Atlantic (closures extended in 2008).
	2007	NEAFC: 4 areas on Hatton and Rockall Banks closed to protect cold-water corals (boundaries of 2 areas adjusted in 2008).
North-west Atlantic	2006	Northwest Atlantic Fishery Organization (NAFO) closed 4 seamount chains to all demersal gear for 2007–2010 (Corner, New England and Newfoundland Seamounts and Orphan Knoll). In 2007 a Coral Protection Zone was closed to all demersal gear, and Fogo Seamounts in 2008.

Country/Area	Year designated	Areas Protected to Conserve Cold-water Coral Habitats
South-east Atlantic	2006	Southeast Atlantic Fishery Organization: 10 seamount areas (Africana, Discovery/Junoy/Shannon, Malahit Guyot, Molloy, Panzarini, Schmidt-Ott/Erica, Schwabenland/Herdman, Vema and Wust) closed to all fishing activity for 2007–2010.
PACIFIC		
Canada	2002 2008	Hexactinellid Sponge Reefs in Hecate Strait closed to bottom-trawling (areas expanded and revised in 2006). Bowie Seamount MPA.
United States	1983 1998 2000 2006 2006 2008	Trawl, bottom-set long-line and bottom-set gillnet use prohibited in US Insular Pacific EEZ. Eastern Gulf of Alaska trawl closure. Sitka Pinnacles. Essential fish habitat closures in Aleutian Islands, Gulf of Alaska Slope Habitat, Primnoa Coral Habitat, and Gulf of Alaska Seamounts. Essential fish habitat closures off California, Oregon and Washington. Essential fish habitat closures in the Bering Sea.
Australia	1999 2007	Tasmanian Seamount Reserve (370 km ²) (Commonwealth of Australia, 2002). Southeast Commonwealth Marine Reserve Network.
New Zealand	2001 2007	Seamounts management strategy, seamount fauna including corals (Brodie and Clark, 2004) 40 000 km ² . 17 Benthic Protected Areas (>1,200,000 km ²).
Kiribati	2006	Phoenix Islands Protected Area (expanded in 2008).
North-west Pacific	2007	New RFMO under negotiation. Interim measures adopted in 2007.
South Pacific	2007	South Pacific Regional Fishery Management Organization, new RFMO being developed. Interim measures adopted in 2007.
INDIAN OCEAN		
Eastern Indian Ocean	2006	Southern Indian Ocean Deepwater Fishers' Association voluntary bottom-trawl closures: Agulhas Plateau, Atlantis Bank, Bridle, Coral, Mid-Indian Ridge, South Indian Ridge, Walters Shoal
Western Indian Ocean	2006	Southern Indian Ocean Deepwater Fishers' Association voluntary bottom-trawl closures: East Broken Ridge, Fools Flat, Gulden Draak Seamount, Rusky
SOUTHERN OCEAN		
	2007	Commission for the Conservation of Antarctic Marine Living Resources – Interim measures adopted in 2007.