Chapter 51. Biological Communities on Seamounts and Other Submarine Features Potentially Threatened by Disturbance

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1. Physical, chemical, and ecological characteristics

1.1 Seamounts

Seamounts are predominantly submerged volcanoes, mostly extinct, rising hundreds to thousands of metres above the surrounding seafloor. Some also arise through tectonic uplift. The conventional geological definition includes only features greater than 1000 m in height, with the term "knoll" often used to refer to features 100–1000 m in height (Yesson et al., 2011). However, seamounts and knolls do not appear to differ much ecologically, and human activity, such as fishing, focuses on both. We therefore include here all such features with heights > 100 m.

Only 6.5 per cent of the deep seafloor has been Yesson et al. (2011)
nt and guyot features > 1000 m in height and 138,412 knolls
Harris et al. (2014) identified 10,234 seamount and guyot
ricter definition that restricted seamounts to conical forms.
ght (Smith 1991; Wessel et al., 2010). At least half are in the
ely fewer in the Atlantic, Indian, Southern, and Arctic Oceans.
ver approximately 4.7 per cent of the ocean floor, with
an additional 16.3 per cent, in total an area approximately the
mbined, about three-fold larger than all continental shelf areas
oyer et al., 2010; Yesson et al., 2011).

nce local ocean circulation, amplifying and rectifying flows,
particularly near seamount summits, enhancing vertical mixing,
ells known as Taylor columns or cones over some seamounts.
many factors, including the size (height and diameter) of the

Where flows are sufficiently vigorous, they provide a sufficient flow of organic matter to support suspension feeding organisms, such as corals and sponges. Such currents also winnow away the sediment, providing hard substrate necessary for most such as Antarctic Intermediate Water and North Atlantic Deep Water (Koslow et al., 1994; Clark et al., 2010a and b). Whereas the dominant genera and families of deep-sea demersal and midwater fishes tend to have global distributions, the dominant fish species on seamounts in different ocean basins are often from entirely different genera, families, and even orders. This indicates that seamount-associated fishes in different ocean basins were reproductively isolated and evolved independently. Their similar morphologies and adaptation to the seamount environment is a striking example of convergent evolution (Koslow, 1996).

Seamounts are the source of significant ecosystem services. In addition to their biodiversity, seamounts often host substantial aggregations of fishes, which have been subject to commercial fisheries. These include species for which seamounts are their primary environment as well as a larger number for which seamounts account for a smaller proportion of their global catch. Annual landings of primary seamount species
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Ridges typically contain seamounts and sedimented slopes; not surprisingly, similarities in the abundance, diversity, and species composition of ridge habitats are found

Monterey Bay Aquarium Research Institute (MBARI) in Monterey Canyon have led to a renaissance in canyon studies (e.g. Huvenne and Davies, 2013). Whereas most canyons globally have received little or no scientific attention from any discipline, some individual canyons (e.g., Monterey – western North America, "The Gully" – eastern North America, Kaikura – New Zealand,

1.4 Trenches

Trenches are defined as “long, narrow, characteristically very deep and asymmetrical depressions(s) of the seafloor, with relatively steep sides” (IHO, anemones and their mobile benthic associates (e.g., amphipods); communities near hydrothermal vents and cold seeps are dominated by metazoans dependent on and the Chilean Rise. Catches were large nor were they sustainable (Clark et al., 2007).

In the Southern Ocean, seamounts were fished for nototheniids between 1974 and 1991. In the 1990s, the ridges, plateaus, and seamounts around remote subAntarctic islands came to be heavily fished for Patagonian toothfish with trawls and longlines. Initially much illegal, unreported and unregulated (IUU) fishing occurred but has declined significantly since 1996 (Agnew et al., 2009).

Largescale industrial deep-water fisheries in the North Atlantic date to the development of redfish fisheries in the 1950s using both midwater and demersal trawls over the mid-Atlantic Ridge and on some plateaus. Redfish catches peaked at almost 400,000 tons in the 1950s and have declined considerably but several continue to support some harvest (Koslow et al., 2000; ICES, 2013). Fisheries for roundnose grenadier and Greenland halibut first developed on the upper continental slopes of the Northwest Atlantic in the late 1960s, peaking at over 80,000 tons in 1971 and then rapidly declined and moved to the mid-Atlantic Ridge and Rockall [illegible]

Exploratory trawl fishing on seamounts in the Indian Ocean began in the 1970s targeting shallow-water redbait and rubyfish on the Southwest Indian Ocean Ridge, the Mozambique Ridge and the Madagascar Ridge (Romanov, 2003; Clark et al., 2007) and continued into the mid-1980s. In the late 1990s, trawlers working on the Southwest Indian Ocean Ridge targeted deep-water species, such as orange roughy, black cardinalfish, pelagic armorhead, oreosomatids and alfonsino (Clark et al., 2007), but the fishery rapidly collapsed (Gianni, 2004). Fishing has shifted to the many ridges, seamounts and plateaus targeting a variety of species of deep-sea fish and crustaceans (Clark et al., 2007; Bensch et al., 2009; SWIOFC, 2009).

Overall, deep-water demersal fisheries over the continental slope, ridges, seamounts, and plateaus have landed between 800,000 and 1,000,000 t per annum from the mid-1960s to 1990s (Koslow et al., 2000) and annual landings on the order of 100,000 t since about 1990 (Clark et al., 2007; Watson et al., 2007). The vast majority of seamount-associated demersal fisheries have proven unsustainable, undergoing a boom-

4 Both the North Atlantic Fisheries Organization (NAFO) and North East Atlantic Fisheries Commission (NEAFC) in the North Atlantic set quotas for deep-sea stocks based on scientific assessments, and have identified and closed to fishing areas that meet the Food and Agricultural Organization of the United Nations (FAO) criteria for vulnerable marine ecosystems

4 The Southeast Atlantic Fisheries Organization (SEAFO) has closed selected ridge sections and seamounts to fishing, restricted fisheries to certain subareas, and introduced catch quotas (TACs) for the fishes and deep-water crab targeted on seamounts.

4 States which participated in the negotiations for the establishment of the North P108 708 Tm6.005 Tc 1Tc ,

concern, including mercury and many halogenated hydrocarbons (e.g., DDT, PCBs, and many other pesticides, herbicides, and industrial chemicals) are volatile and enter the ocean predominantly through the atmosphere. These are discussed in Chapter 20. As noted there, concentrations of persistent organic pollutants in deep-dwelling fish loss and declining food availability. Midwater fishes, the primary food of many deepwater squid and fish species, including orange roughy, declined ~60 per cent during recent periods of low-oxygen availability in the California Current (Koslow et al., 2011). Palaeoceanographic studies have pointed to the significance of perturbations in oxygen concentration in controlling deep coral occurrence in the Eastern Mediterranean (Fink servicesare provided b

These characteristics lead to low productivity

5. Integrated assessment of the status of the habitat. Cross-cutting and emergent conclusions.

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diversity and ecological connectivity. The synergistic influence of these factors is unknown at present.

Although it is heartening that some seamounts, ridges and other sensitive marine habitats are being protected by fishing closures, Marine Protected Areas and other actions, little scientific understanding of the efficacy of actions implemented to date and few studies to assess this exist. The connectivity between these habitats remains largely unknown, as are the factors that influence colonization, species succession, resilience and variability. Comparative studies of seamount, canyon, and continental margin habitats seem to indicate that many species are shared (but see Richer de Forges et al., 2000); however, community structure differs markedly and the factors influencing such differences remain unknown (McClain et al., 2009). Our starting point in attempting to unde0 Td [(O)7(ur)4oi arfew stmptingnfs hearniz(ni)4(9(-1.22 Td [(u).i41 h14(ng)2 (ti)4(n)6(d[TJ 0

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