HIDDEN DEPTHS AND HIDDEN DANGERS: CONSERVATION OF SEAMOUNT ECOSYSTEMS

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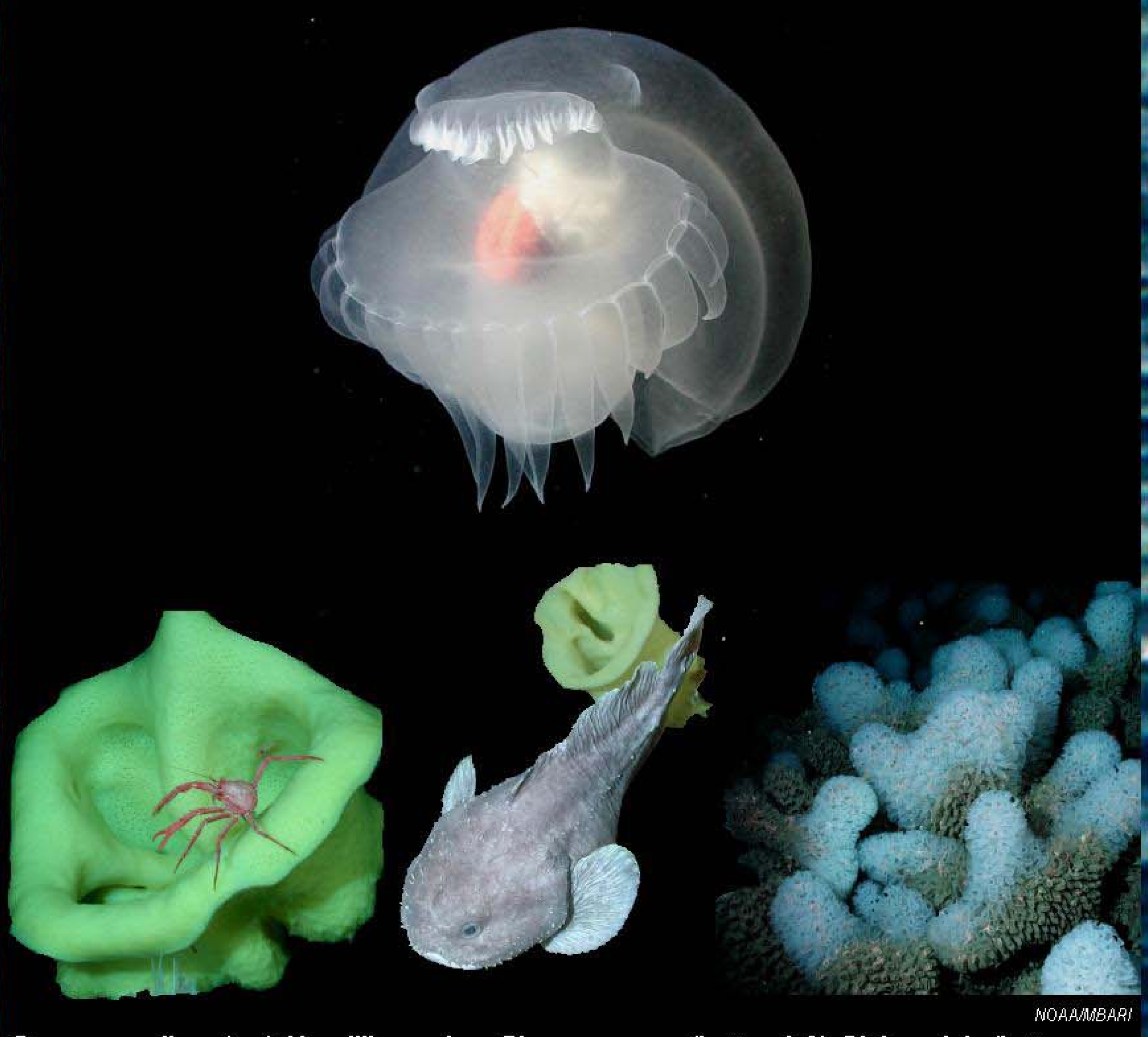
ABSTRACT

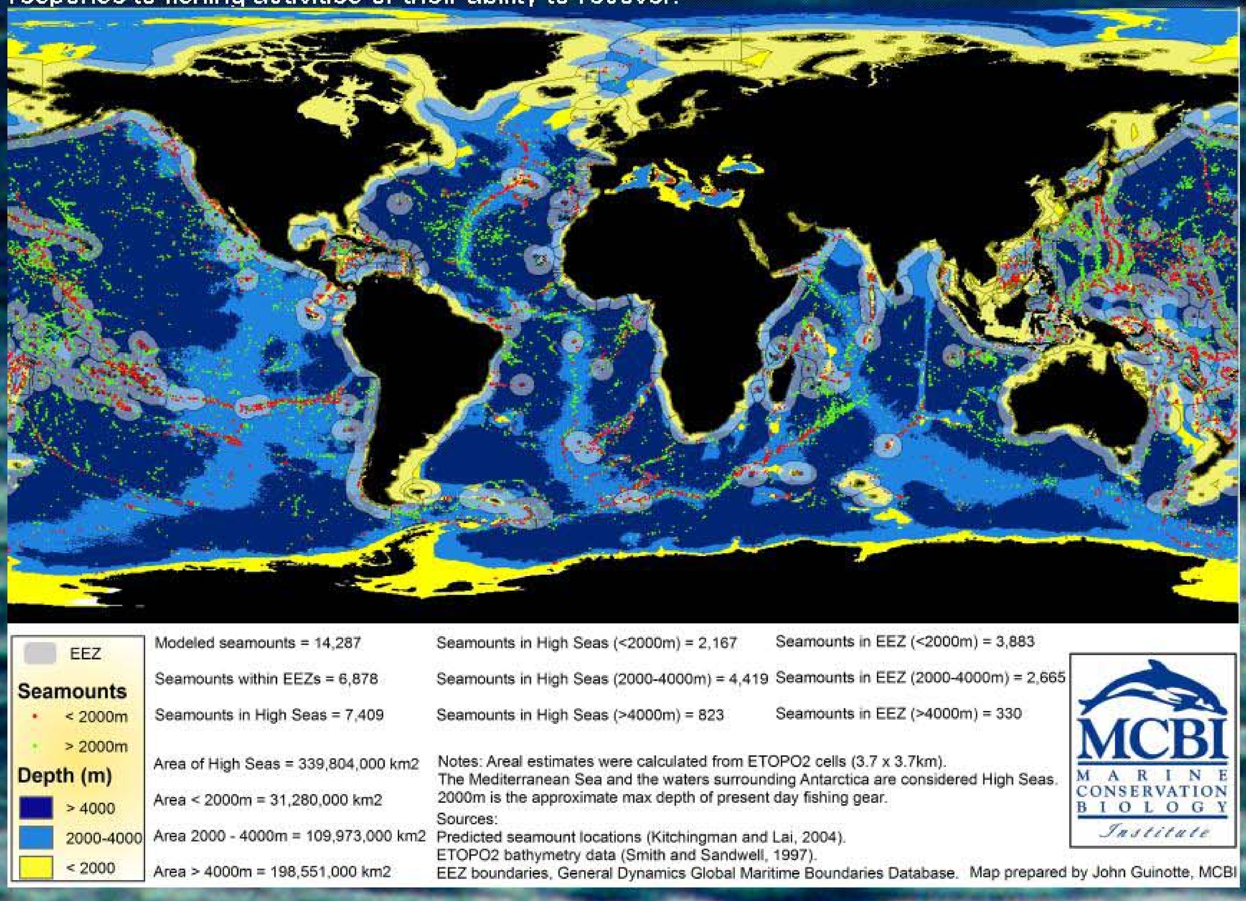
As coastal fish stocks decline worldwide, the commercial fishing industry is increasingly exploiting deep waters, threatening, in particular, diverse and little-studied deep seamount ecosystems. Seamounts are geological structures rising from the sea floor which contrast markedly with the surrounding flat or shallow-sloping sediments in terms of both physical and biological characteristics. Studies of seamounts have found extremely high levels of biodiversity and endemism, with deep sea species often slow-growing and showing low levels of fecundity. This makes them particularly sensitive to disturbance. Commercial fishing vessels harvest deep sea fish by bottom trawling, a practice which can destroy up to 95% of coral and other benthic macrofauna in heavily fished areas. Most bottom trawling is carried out by eleven industrialized countries and, though it comprises less than 1% of the global fishing fleet, its impact on marine biodiversity is disproportionately large. The practice is mainly carried out on the high seas and is largely unregulated. Even where regulation does exist, within EEZs, it has not been sufficient to prevent widespread ecosystem damage. In order to prevent deep seamounts ecosystems being destroyed before their biodiversity has even been properly studied, an international moratorium on bottom trawling over seamounts is urgently required.



Deep sea mollusc (top), Vermillion crab on Picasso sponge (bottom left), Blob sculpin (bottom centre), Sponge ridge (bottom right)

Introduction

Seamounts are geological structures that rise over 1,000 m above the sea bed, although they may be defined more broadly. They are usually formed by volcanic activity, and they often occur as ridgesor chains (Boehlert & Genin 1987; Wilson & Kaufmann 1987; Rogers 1994). There are estimated to be 810 seamounts in the Atlantic and over 30,000 seamounts in the Pacific ocean (see: Johnston & Santillo 2004). The map below shows the global distribution of seamounts. As fish stocks in shallow waters decline, the fishing industry is increasingly targeting deep water fisheries. Seamounts are associated with aggregations of fish, which have led to their commercial exploitation by the fishing industry. There is a paucity of information about the structure and function of seamount ecosystems, and very little knowledge exists of either their response to fishing activities or their ability to recover.



Seamount Ecosystems and Biodiversity

In contrast to the seafloor, seamounts are often covered by corals, anemones and sponges (Stocks 2004), which may be up to 1,800 years old (Freiwald *et al.* 2004). Seamounts exhibit enhanced productivity at all trophic levels, the reasons for which require further research in order to be fully understood (Johnston & Santillo 2004). One cause is that their physical presence can bring about the upwelling of deep, nutrient-rich waters (Boehlert & Genin 1987). The increased productivity results in a high abundance and diversity of benthic fauna (Rogers 1994; Koslow *et al.* 2000). Seamounts appear to function as ecological islands or chains, as studies of seamount species diversity have found levels of endemism of over 30% (de Forges *et al.* 2000; Koslow *et al.* 2001; Parin *et al.* 1997).

Fish associated with seamounts tend to be very slow growing, slow to mature, long-lived and recruitment can be sporadic (Clark *et al.* 2000, Koslow *et al.* 2000). These factors make such species particularly sensitive to the effects of exploitation, as illustrated by the commercial extinction of the pelagic armourhead (*Pseaudopentaceros wheeleri*) over the Pacific seamounts northwest of Hawaii by excessive harvesting in under twenty years (Johnston & Santillo 2004).

Un-named seamount sea urchin

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Bottom trawling

Deep-sea bottom trawling generally involves one or two vessels dragging a large cone-shaped net at depths of 400m to over 1,800m along deep-sea ridges, seamounts, plateaus and on the continental slope (ICES 2003). The net is weighted by ground gear that consist of rubber or steel rollers or rockhoppers which allow the net to be dragged over a wide range of surfaces. The effects of dragging heavy rockhoppers along seamounts or seabeds can be seen in the visible track-marks they can leave.

Bottom trawling is the most efficient method of harvesting deep-sea species and is responsible for over 80% of the deep sea catch (Gianni 2004). Bottom trawling is also one of the most damaging fishing techniques and has been compared with forest clearcutting (Watling & Norse 1998).


Orange roughy caught in a trawl net (left), A bottom trawl net showing rollers (right)

Effects of trawling on marine diversity and ecosystems

A comparison of fished and unfished areas of Tasmanian seamounts found bare rock on 95 % of trawled but only 10% of untrawled bottom substrata and trawling reduced benthic biomass by 83 % (Koslow *et al.* 2000; Koslow *et al.* 2001). A similar study comparing seamounts in New Zealand found heavily-fished seamounts to have just 2-3% coral cover compared with 100% coral cover on unfished seamounts.

The high levels of endemism of the fauna associated with the seamounts makes the possibility of extinctions extremely high (Roberts 2002). There have been very few studies focused to date on community-level impacts of commercial fishing on seamounts and there effects of damage to and the removal of coral and sponges on seamount surfaces is also of great concern.

Coral forests, which form the habitat of Orange roughy (left), but once bottom trawled, coral forests look very different (right).

The bottom trawling industry

Deep- water fisheries comprise less than 1 % of the global fishing and in the high seas, 80% of bottom-species are caught by bottom trawling (Gianni 2004). Gianni (2004) found that in 2001, 95% of bottom trawling in the high seas was carried out by vessels flagged to just eleven countries: Denmark/Faroes Islands; Estonia; Iceland; Japan, Latvia; Lithuania, New Zealand; Norway; Portugal; Russia; Spain.

Countries have jurisdiction over waters 200 nautical miles from their shores in areas known as Exclusive Economic Zones (EEZs). Areas outside of EEZs are deemed international waters and fishing activities are largely unregulated. Even within EEZs, where there are regulations and catch quotas, significant damage to seamounts have occurred.

The impact and intensity of the bottom trawling industry in international waters is particularly difficult to ascertain because of under-reporting and mis-reporting of catches and because of illegal, unreported and unregulated (IUU) fishing (Gianni 2004). Therefore, direct documentation of bottom trawling activities on the high seas is required to determine its effects.

Crewmen on a bottom trawler in the Tasman Sea haul up a 'Paragorgia' coral (top), Greenpeace activists highlighting the damaging impacts of deep sea bottom trawling (bottom).

Investigating Bottom Trawling

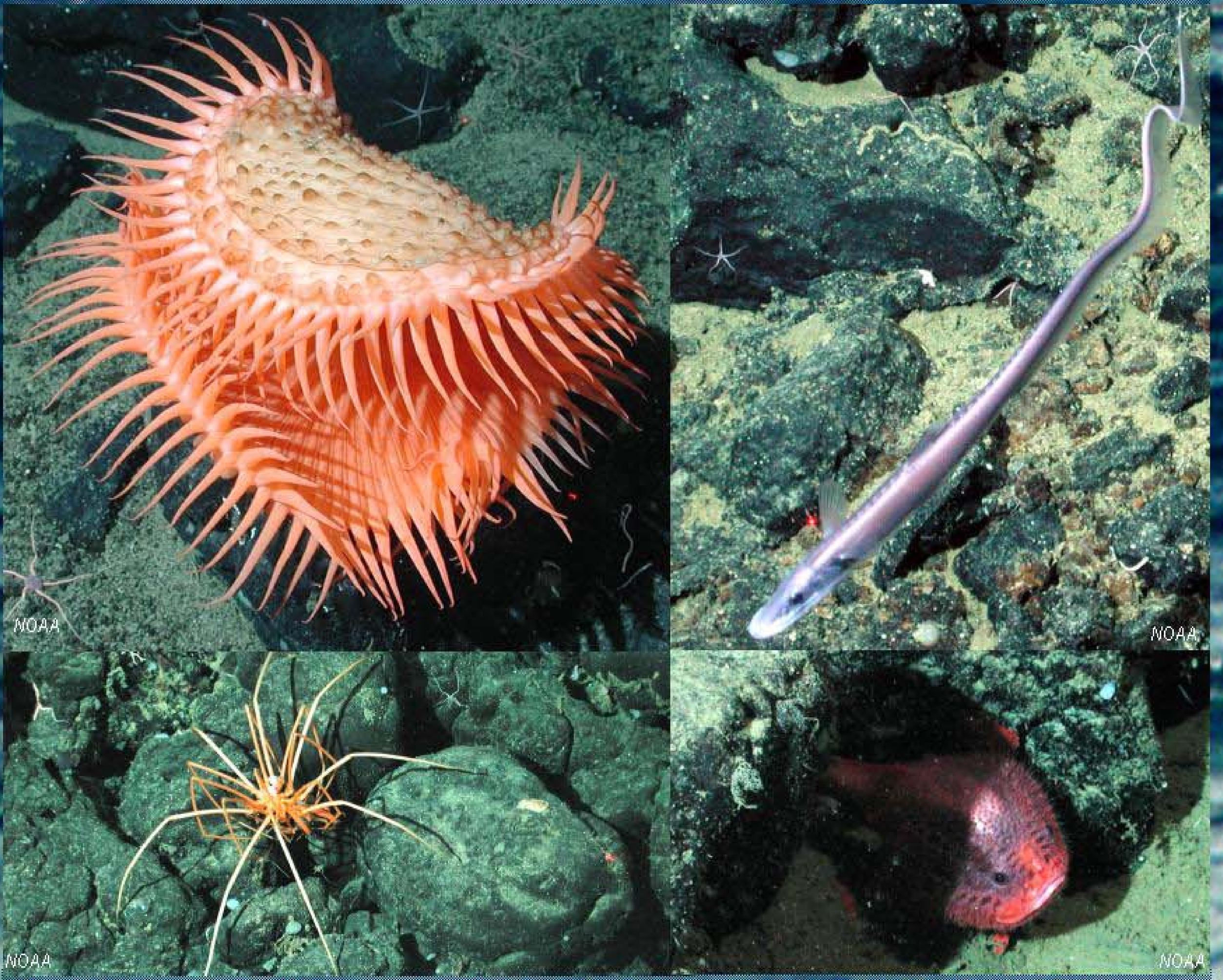
Greenpeace has investigated the impacts of bottom trawling on the high seas by monitoring the activities of fishing vessels with bottom trawling gear in international waters in the northern and southern hemisphere. These investigations have revealed high levels and diversity of by-catch, which included ghost sharks and CITES listed coral species.

The level of damage caused to seamount ecosystems by bottom-trawling is evident from a very large gorgonian coral found in a bottom trawler's net in the Tasman sea in June 2005. Gorgonians play an important role in seamount ecosystems, providing food or shelter for crinoids, brittlestars, seastars, basketstars, anemones, molluscs, fishes, and crabs (Stocks 2004).


Coral by-catch on a bottom trawler in international waters in the Tasman Sea, including Cites listed Leiopathes and Bathypathes corals endemic to seamounts (top), a ghost shark recovered from the discarded by-catch of a deep sea trawler (bottom)

The need for a moratorium on bottom trawling over seamounts

Bottom trawling is the most destructive form of fishing and can result in the destruction of over 95 % of fragile, slow-growing coral. Exploited deep-water species are also very slow growing, slow to mature and have low fecundity. There is very little knowledge of the resilience of seamount ecosystems or of the diversity of seamount species. Only 3-4% of known seamounts have been sampled (Stocks 2004). The extremely high levels of endemism found on sampled seamounts suggests that many species are likely to go extinct unless there is a moratorium on the highly destructive activity of bottom trawling over seamounts.



Deep sea diversity: fly trap anemone (top left); Halosaur (top right); sea spider (bottom left); sea toad (bottom right).

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