2 Offshore habitats, communities and species

2.1 SEAMOUNTS

Seamounts are undersea mountains which are typically cone shaped, rising steeply from the sea-bed but which do not emerge above sea level. In some studies the definition is limited to circular or elliptical features of volcanic origin (Epp & Smoot, 1989) while in other cases height is the defining factor. Only those features that are more than 1,000m high with a limited extent across the summit, for example, have been defined as seamounts by the US Board of Geographic Names (quoted in Rogers, 1994). Seamounts can be very large features not only in terms of their height but also in area as some may be several kilometres across the base. Those which have flat summits, due to wave erosion when they were above sea level, are known as guyots.

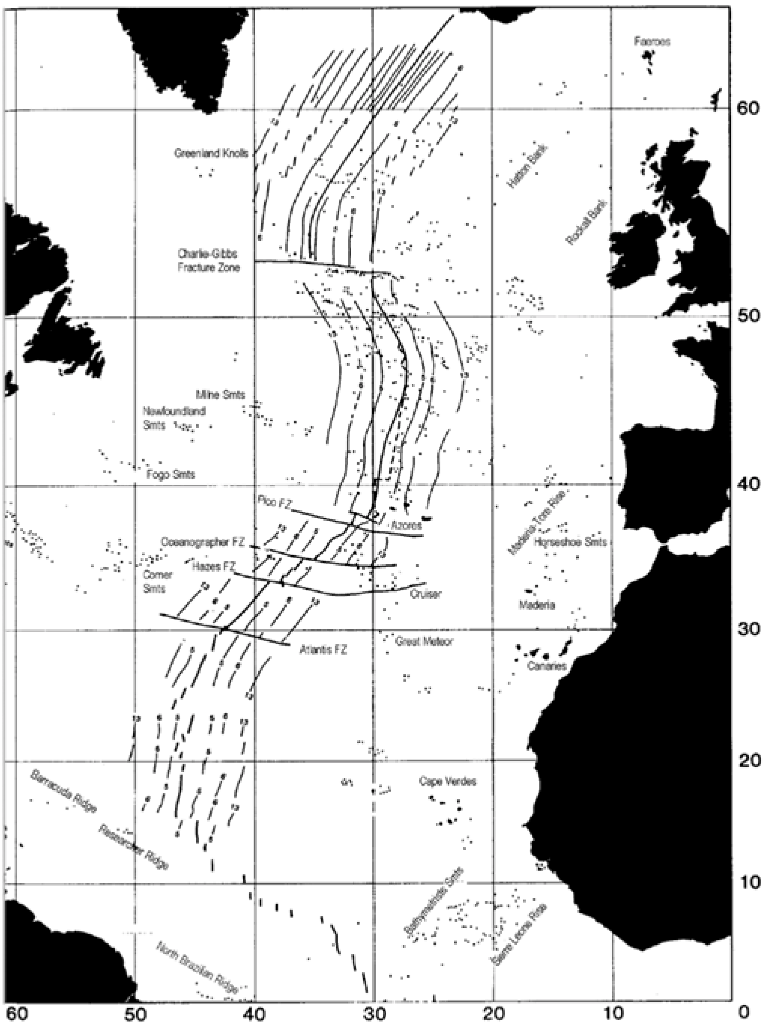
Seamounts often occur in chains or clusters that are probably linked to seafloor hotspots and the associated volcanic activity. Geological studies indicate that they have been generated along the mid-Atlantic Ridge for the past 35 million years although some, such as the seamounts around Rockall Bank and between the south-west corner of Rockall and the Charlie-Gibbs fracture zone, may have formed before then (Epp & Smoot, 1989).

Seamounts are a distinct and different environment to much of the deep sea. Their steep slopes, which are often current-swept, and the predominance of hard exposed rock surfaces provide a marked contrast to the characteristically flat and sediment-covered abyssal plain. Their profile and elevation from the surrounding seafloor also effects the circulation of water in the area for example by deflecting currents as well as leading to the formation of trapped waves, jets and eddies (Rogers, 1994). Some of these eddies are known to become trapped over seamounts to form closed circulations (Taylor columns) which have been observed to persist for several weeks.

2.1.1. Occurrence in the OSPAR maritime area

There are a large number of seamounts in the OSPAR maritime area. An analysis of narrow beam bathymetric data collected by the US Naval Oceanographic Office between 1967 and 1989 identified more than 810 seamounts in the North Atlantic, a number which, even then, was considered to be an underestimate because of incomplete data coverage and the omission of small features from the analysis (Epp & Smoot, 1989). The majority lie along the mid-Atlantic Ridge between Iceland and the Hayes fracture zone hence their abundance in the OSPAR maritime area. There are also groups of seamounts some distance from the mid-Atlantic Ridge to the south-west of the Rockall Bank, west of Portugal on the Maderia-Tore Rise, and the Milne seamounts to the east of the mid-Atlantic Ridge (figure 6). The greatest concentration of seamounts occurs between the Charlie-Gibbs fracture zone and the latitude of the Azores.

Figure 6: Location of seamounts in the North Atlantic (from Epp & Smoot, 1989)



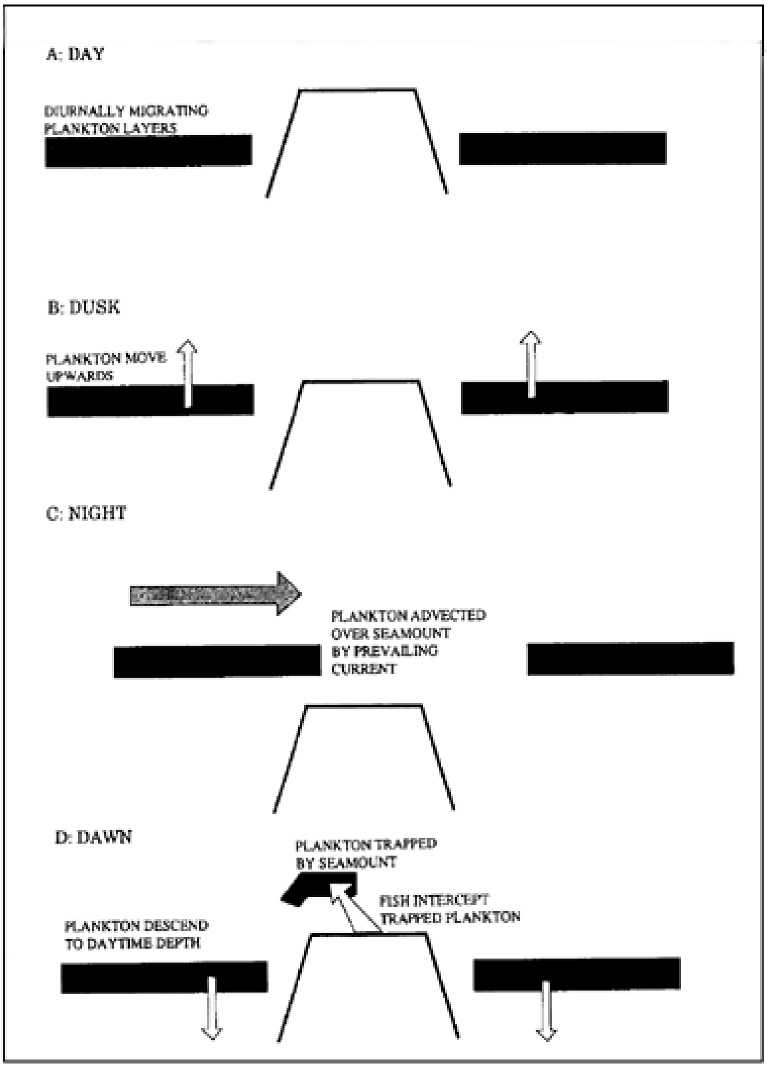
2.1.2 Seamount communities

A review of the biology of seamounts was published in the early 1990s, bringing together what was known about the species and communities found in these areas, the factors that influence the structure of seamount communities, and the effects of commercial exploitation on the associated species (Rogers, 1994). Much of the information presented here is based on that review.

The enhanced currents that sweep around the seamounts and the exposed rock surfaces provide ideal conditions for suspension feeders and it is these that often dominate the benthos. Corals can be particularly abundant on seamounts with gorgonian, scleratinian and antipatharian corals all recorded on these features particularly in areas where the current is greatest, such as on vertical walls and on the crests of seamounts with wide peaks. Other suspension feeders that may be found in abundance are sponges, hydroids and ascidians. Crinoids, holothurians, shrimps and echinoderms may also be present and, in very clear conditions macroalgae and encrusting coralline algae on shallower seamounts.

Areas of soft sediment may also occur on seamounts and in these locations xenophyophores are often the most abundant epifaunal organism (see section 2.11) with polychaetes the most common infauna of sites surveyed. Some seamounts are associated with hydrothermal venting and therefore support the specialised communities found under such conditions (see section 2.7).

Figure 7: Diurnally migrating layers of plankton (from Rogers, 1994)



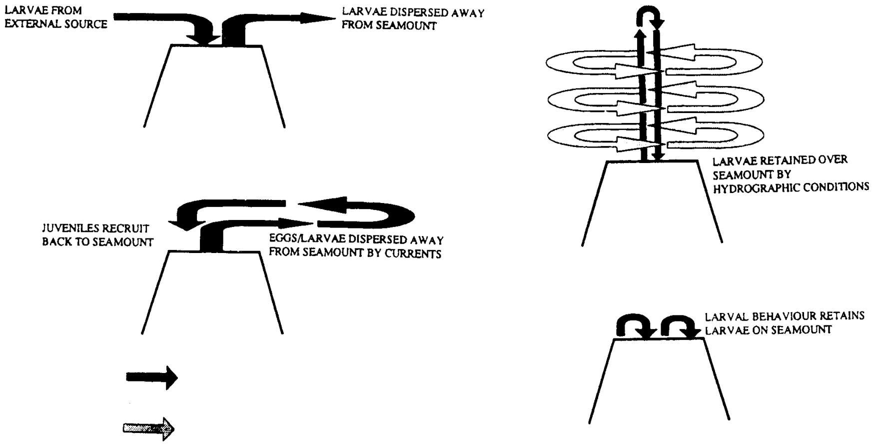
The pelagic communities above seamounts have also been investigated revealing both qualitative and quantitative differences when compared to the pelagic fauna and flora in the surrounding water. One effect is that biomass of planktonic organisms over seamounts is often higher than surrounding areas, possibly as a result of upwelling around the seamount. In other cases the opposite has been observed and it has been suggested that this may be due to intensive grazing by predators or the downward migration and scattering of components such as migrating euphausiids during the day. Acoustic observations and trawls have revealed the movement of nekton over the seamounts which are located at depth during the day (500-600m in the case of *Diaphus suborbitalis* which was studied on the Equator seamount in the Indian Ocean) to between 80-150m at night. This species was revealed to be feeding on diurnally migrating oceanic plankton and was, in turn, an important component of the diet of large fish species including sharks, rays, tuna and swordfish which were much more abundant around the seamount than in the surrounding oceanic waters (Parin & Prut'ko, 1985 in Rogers, 1994).

The concentration of commercially valuable fish species around seamounts is well documented. Aggregations of fish such as the orange roughy are supported in the otherwise food-poor deep sea by the enhanced flow of prey organisms past the seamounts. (Koslow & Gowlett-Holmes, 1998). It has also been suggested that zooplankton undergoing normal diurnal vertical migration are swept onto seamounts or banks by prevailing currents and trapped over the seamount as light levels increase as they are unable to complete their downward migrations (figure 7). One of the studies which has provided evidence of this was in the southern California Bight where redfish (*Sebastes* spp) were seen to be intercepting layers of downwardly vertically migrating plankton around the bank. The concentration of fish species is also likely to be influenced by other factors such as their behavioural ecology, reproduction and life histories but these aspects have still to be studied in any detail (Rogers, 1994).

There is an ongoing debate about whether seamounts support significant numbers of endemic species because of their relative isolation, the different hydrographic conditions compared to the surrounding sea-bed and the life history characteristics of the species which have colonised these areas such as the method of recruitment (Rogers, 1994). The dominant larvae at most seamounts are widespread oceanic species and they are frequently dispersed away from their parent seamount population (Boehlert & Mundy, 1993). In some species, recruitment to seamount populations appears to come from long-lived dispersive larvae that originate from other geographically removed populations (figure 8). It has therefore been suggested that the biota tended to be dominated by species inhabiting the nearest shelf areas and that seamounts might be acting as stepping stones for transoceanic dispersal of species (Wilson & Kaufmann, 1987).

Wilson & Kaufmann (1987) estimated that 15 per cent of the benthic invertebrates on seamounts worldwide were endemic to a particular seamount or local seamount group but only 598 species were reported from seamounts at that time. More than twice as many invertebrate species are now known to occur in such areas. There is morphological and genetic evidence that populations of some organisms on seamounts are distinct from surrounding populations located on other seamounts, the abyssal plain and continental shelf but this is an aspect which will no doubt continue to be subject to review as more is learnt about seamount species.

Figure 8: Models for recruitment to species on seamounts (from Rogers, 1994)



2.1.3 Conservation issues

The biological resources of seamounts have been the target of intensive exploitation over the years as they support commercially valuable fish, shellfish and corals. This has created serious problems as resources have been fished before there is a reasonable understanding of the biology of the species being targeted, and no formal stock assessment or quotas. The result has been over-exploitation and major crashes in the different stocks. Examples include the crash in populations of the rock lobster, *Jasus tristani* on the Vema seamount due to a combination of overfishing and unpredictable larval recruitment; fishing of the pelagic armourhead *Pseudopentaceros wheeleri* over the southern Emperor seamounts and seamounts in the northern Hawaiian Ridge to commercial extinction within 10 years of their discovery; and the orange roughy *Hoplostethus atlanticus* fishery on seamounts off the coasts of New Zealand and Australia where new discoveries of stocks are typically fished down to 15-30 per cent of their initial biomass within 5-10 years (Koslow *et al.*, in press).

The effects of the fishing pressure is exacerbated by the life history characteristics of some of these species. Orange roughy, for example, form large spawning aggregations near banks, pinnacles and canyons during the winter. When this is considered together with their longevity, low natural rates of mortality, slow growth and variable recruitment of fish species on seamounts, it is clear that they are very vulnerable to exploitation particularly when there is an intense and localised fishing strategy.

Corals are another group of species that have been targeted for exploitation since their discovery on seamounts in the mid-60s and depletion of traditional reserves in the Mediterranean. Red, pink, gold, black and bamboo corals have all been collected from these sites on a substantial scale. In 1983, for example, approximately 70 per cent of the world catch of red coral (about 140,000kg) came from the Emperor-Hawaiian seamounts (Grigg, 1986 in Rogers, 1994).

The effects of these commercial operations go beyond depletion of the target species. Work on seamounts off southern Tasmaina has revealed extensive damage to the benthos as a result of trawling activity (Koslow & Gowlett-Holmes, 1998). Comparisons between heavily fished seamounts and those that were lightly fished showed that the habitat of heavily fished sites was predominantly bare rock with an increasing proportion of coral rubble or coral sand towards the base of the seamount. Fishers reported a large coral bycatch in the early years of the fishery and data suggest that virtually all coral aggregate living or dead has been removed leaving behind bare rock and pulverised coral rubble. Photographic evidence of the impact of fishing included trawl tracks from otter boards on the bare rock (Koslow & Gowlett-Holmes, 1998). The risk of severe depletion and even extinction of elements of the benthic seamount fauna is increased by the combination of their restricted habitat requirements and highly localised distributions that lead to high levels of local endemism.

Because most seamounts lie in international waters there has been little action to try and limit the damaging effects of the various fisheries. There are, however, examples of action when sites lie with exclusive economic zones. In 1995 interim protection was introduced for a group of seamounts south of Tasmania (Koslow & Gowlett-Holmes, 1998). The fishing industry agreed not to trawl in a previously untrawled area covering 370km^2 for three years to allow scientific investigations to take place so that the management options could be assessed. In light of the findings a permanent MPA was established around the seamounts in 1998 not for just the benthic community or the seamount community (which includes seamount associated benthopelagic fish) but the seamount-associated ecosystem which extends throughout the water column. A highly protected zone in which fishing and mineral exploration (including oil) is prohibited extends from 500m to 100m below the sea-bed. The water column above this, up to the surface, has been designated a management resource zone with the aim of ensuring long term protection and maintenance of biological diversity while allowing the tuna longline industry access to the surface waters. The Bowie seamount in the north-east Pacific is another example where an MPA has been established. In this case it is a pilot scheme established by the Fisheries & Oceans Canada in 1998 under Canada's Oceans Act.

2.1.4 Conservation actions

There is very little information about the biological communities of seamounts in the north-east Atlantic. Sites which are known include Anton Dohrn, a flat topped seamount (guyot) which extends from the sea-bed at 2,000m to around 700m in the central part of the Rockall Trough (figure 9), the Josephine and Gettysburg seamounts south of the Tagus Abyssal Plain, and the Milne seamounts on the south-western margins of the OSPAR maritime area. Some examples of seamounts will need to be included in any representative system of MPAs, however site selection is delayed by the fact that there are no biological research programmes focused on these features at the present time and hence little opportunity to assess their status, relative conservation importance or contribution to biodiversity in the OSPAR maritime area.

Figure 9: Bathymetry of the Anton Dohrn seamount (from Jones *et al.,* 1994)

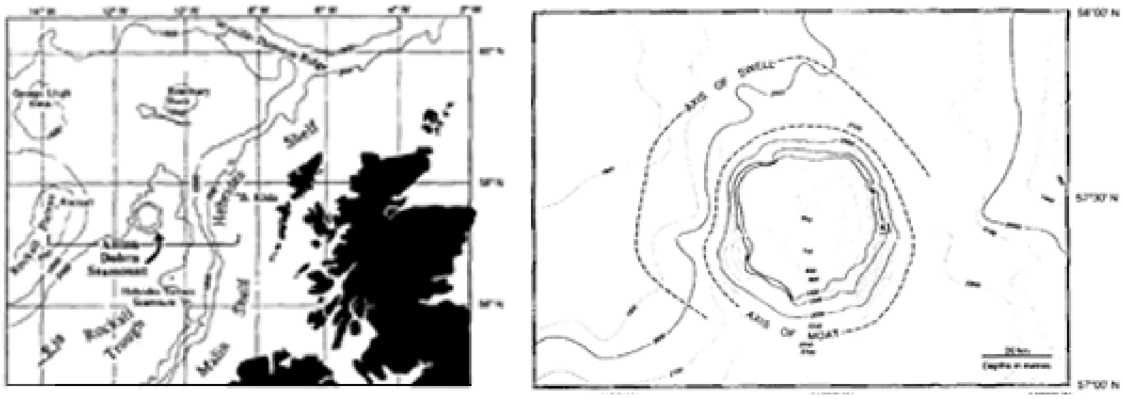
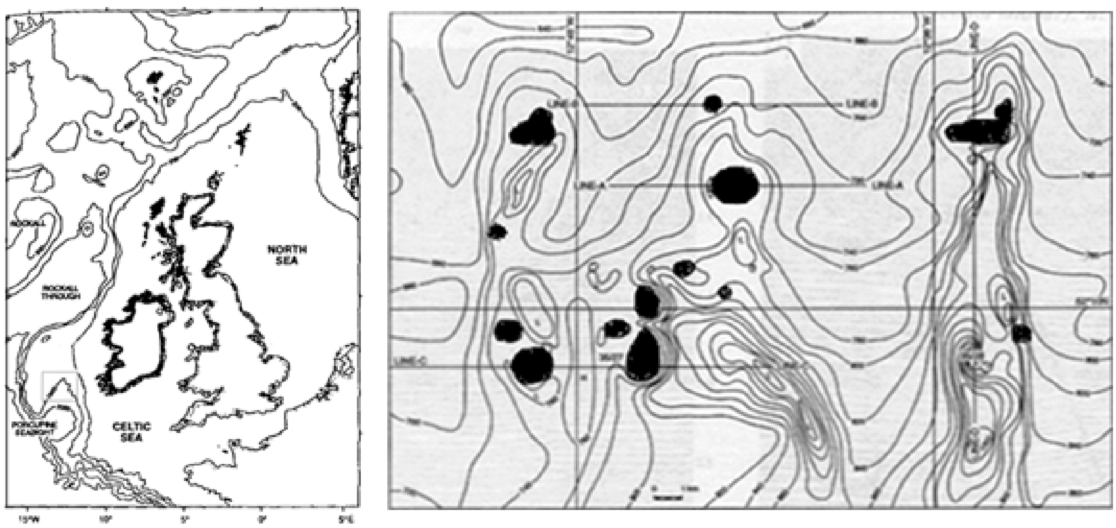


Figure 10: Detailed bathymetry of some carbonate mounds in the Porcupine Basin (from Hovland *et al.,* 1994)



Given the conservation importance of seamount habitats which have been investigated, the pressures on these features and the associated communities and species in other parts of the world, and the lack of information on the resource extraction and impacts on seamount communities in the north-east Atlantic, the identification of sites to focus research and conservation action should be undertaken as soon as possible. Site protection, combined with other measures directed at the specific activities which are a threat to the marine communities or species associated with seamounts such as restrictions or prohibitions on fishing or mineral extraction, can then be directed at these sites.