Marine areas of nature conservation importance in Ireland

Edited by

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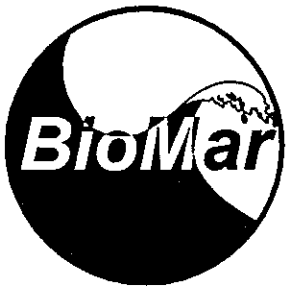
A contribution to the BioMar - LIFE project



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CONTENTS

SUMMARY

Marine ecological and environmental data was collected and analyzed from over 874 sites in Ireland from April 1993 to June 1997. This forms the largest standardized set of marine biological and environmental data in Ireland, and the best available data for nature conservation assessment. The data has been made available on compact disc to interested persons, and would benefit from further more detailed scientific analysis and publication. The database should be regularly built upon to maintain its value as an invaluable resource for coastal management.

This report identifies 20 areas of marine nature conservation importance based on this data; namely, the Saltee Islands and adjacent coastline, Lough Hyne, Roaringwater Bay and islands, Kenmare River, Valentia Island, Magharee Islands and peninsula, Tralee Bay, Kerry Head shoals, Aran Islands, Kilkieran Bay, Mannin Bay, Broadhaven Bay, Mullaghmore Head and adjacent coastline, St John's Point and the north of Donegal Bay, Rathlin O'Birne Island, Rutland Channel area and Aranmore, Tory Island, Mulroy Bay, Finavarra, and Magraths Point. The latter two areas are small species rich rocky seashores. These areas were selected on the basis of their species composition and richness, the presence of rare species, and the richness of biotopes. Additional areas which may be of conservation interest, but which were not adequately surveyed, are Inistrahull on the north coast, Inishbofin area, Killary Harbour, and Salt Lake in Connemara, Tuskar Rock off Carnsore Point, Auchinish and Muckinish in inner Galway Bay, Black Head and sublittoral habitats in north-west Clare, and Blasket Islands in the south-west, and Dalkey Island area and Rockabill.

Some 132 biotopes were identified in Ireland of which 108 are within the proposed 20 areas. About 1,400 species were recorded, of which almost 1,200 occur within the areas. The proposed marine nature conservation areas represent a network of areas encompassing the biogeographic variation considered to occur in Ireland. Their protection is likely to encompass about 80% of the marine biodiversity in Ireland.

1. Criteria for the identification and selection of inshore marine areas for nature conservation

Mark J. Costello

SUMMARY

The aim of biological nature conservation is the prevention of species extinction and protection of ecosystem function. Species and biotope orientated criteria are the most pragmatic approaches to the protection of biodiversity. The selection of marine areas for nature conservation is one of several approaches necessary to provide protection to species from present and future disturbance from mans activities. Wider marine conservation measures complement conservation areas, and are essential because the openness of the sea facilitates the dispersion of pollution and wildlife. Nature conservation areas will not only protect a natural heritage but can provide direct and indirect socio-economic benefits to man. To foster the appreciation of these benefits an essential component of marine conservation is education at all levels, and continuing research to facilitate management.

The selection of marine areas for nature conservation is here divided into two parts, the identification of important areas, and the selection of areas for legal protection. Not all areas of importance may be suitable for legal protection. The aim of this process is to establish a network of areas which will include the variety of biotopes, species and population of species. Thus biodiversity at the community, species, population and genetic levels should be protected. This paper does not consider the protection of large mobile species such as cetaceans, seals, birds and some fish, for which larger areas and population level criteria are more appropriate.

The main criteria proposed for identifying areas of nature conservation importance are (1) species composition, (2) the presence of species rare geographically, (3) species richness, and (4) biotope composition and richness. With adequate data, this approach is likely to indicate a suite of areas which encompass biogeographic variation and form a network of marine protected areas. With the knowledge of what areas would include a wide range of species, the selection of marine areas for legal designation (e.g. as nature reserves) must consider the management feasibility of each area. The latter would include consideration of existing uses, naturalness, alternative boundaries, size, and proximity to terrestrial conservation areas, in relation to management resources. The use of concepts such as representativeness, typicality, vulnerability, sensitivity, fragility, restorability, and numerical scoring of criteria are not felt necessary. Having identified and selected a suite of potential marine conservation areas, additional criteria may attract support for legal designation from other sectors. For example, designation may enhance tourism value, may protect fish breeding and nursery areas, and be an educational resource.

INTRODUCTION

Marine nature conservation

Historically, nature conservation has concentrated on protecting certain species or areas of land so as to prevent species from extinction due to human activity. It has only recently begun to be applied to the marine environment as there is growing recognition of the impacts of man on the sea, particularly through pollution and over-fishing (GESAMP 1990, Kelleher and Kenchington 1992). In comparison to the terrestrial environment, the marine environment is less readily observed, less understood, and water movements inter-connect marine areas more than air movements connect land areas.

The openness of the marine environment presents a particular problem to conservation management. It is not possible for management to intervene in marine nature management in the same manner as on land (e.g. erection of fences, control of grazing). Almost all marine species disperse through the water (whether swimming, floating or rafting), and many have planktonic stages in their life-cycle. For example, all common marine fish in Irish waters with the exception of elasmobranchs (shark family) have planktonic larvae. Pollutants are diluted and transported by wind and tide driven water currents. Indeed, all human wastes and pollutants discharged to air, freshwater and land, may ultimately enter the sea. Therefore, it must be recognised that wider measures to protect the marine environment are as an essential part of marine conservation as the management of marine nature reserves. These measures include the promotion of measures to (a) limit pollution from air, land and rivers, (b) use and harvest natural resources sustainably, (c) harvest non-renewable resources in a careful manner, and (d) prevent the artificial introduction of species to areas where they may have negative impacts on naturally occuring species. In areas identified as being of particular importance to nature conservation, human activity must be managed so as not to compromise the survival of the fauna and flora, be it directly or through alteration of their environment. The Council of Europe theme for the 1995 European Nature Conservation Year, "nature reserves are not enough", was particularly apt for the sea.

The identification of threatened species in the marine environment is particularly difficult because so little is known about the distribution of the majority of species. Indeed, many species are still undescribed and the least well known groups have the most species (Costello et al. 1996). While present knowledge suggests there are more species on land than sea, there are twice as many animal phyla in marine than in either terrestrial or freshwater systems, and 93 % more phyla unique to the sea (Grassle *et al.* 1991).

Needs and benefits marine nature conservation

In addition to moral obligations to protect natural marine heritage there are sound economic reasons for doing so (Table 1). Firstly, marine fauna and flora are both directly (e.g. for human consumption) and indirectly (e.g. as food for commercial fish) of value. Secondly, they act as an indicator of the healthy functioning of marine ecosystems. Coastal ecosystems are an integral part of regional and global ecosystems, and the larger scale ecosystems are dependant on the health of their parts. In the future, the social and economic value of coastal waters is likely to increase as most people live and spend leisure time on the coast. Nature conservation will preserve natural heritage for future generations to use and enjoy.

Changes in the distribution and abundance of marine species may reflect climatic change or pollution, but whatever the cause it is important to recognise that such changes are occurring so as to react appropriately (e.g. reduce fishing pressure on a stock affected by climatic change or pollution). Species from whales to microbes have important roles in the nutrient flows in marine ecosystems. While some species, particularly rare species, may appear of less functional importance in such ecosystem processes, they may become important under future (perhaps different) environmental conditions. It is thus necessary to protect not only species of direct commercial value, but also species of less obvious importance to man.

Marine nature reserves have been successful in enhancing fisheries, primarily by providing a refuge for broodstock whose young disperse to surrounding areas (Alcala 1988, Russ and Alcala 1994). They can also provide a simpler, unequivocal, and more cost effective management option than other fishery measures, such as closed seasons, selective fishing gear and quotas (Bohnsack 1994). Furthermore, there is no by-catch mortality and the study of unfished populations can aid understanding of fish stock dynamics. The simplicity of the nature reserve concept, and its application to all users of the area, can also prove more acceptable and equitable to the local community. Considering the over-fishing crisis in the Atlantic and Pacific oceans, it is time to give increased consideration to nature reserves as a means of protecting marine biological resources where conventional controls have failed.

Limits of information

While general environmental and fisheries measures may protect marine life and habitats to some extent, they may be insufficient to protect rare species and habitats. The most critical stage in marine nature conservation is identifying areas which are a priority for protection. The identification of such areas is particularly difficult (in comparison to land and freshwater conservation) considering the limited knowledge and understanding of what lives in the sea and how marine ecosystems function. Additionally the

information available is limited by the geographic extent of information, observer expertise, and field survey effort. While recognising these limitations, decisions must still be made as to which areas to nominate as conservation areas. Ideally, all areas would have a comprehensive dataset comprised of information collected by standardised methods and equally trained staff. However, it is only possible to standardise expertise between observers at a general level. Skilled observers will identify more species faster than less skilled, and individual observers will vary in ability over time dependng on their experience and diligence.

There are practical limitations in collecting and interpreting information on the marine environment. Even data available will be compromised by (a) natural variation in species abundance over time, (b) ability of personnel to recognise species in the field, and (c) ability of personnel to identify species when they recognise them. Some species are nocturnal and very few marine surveys are conducted at night. Other species are in cryptic resting phases at certain times of the year, and others show large variations in abundance in a locality between years due to local climatic and biological conditions.

Any scientific study is limited in both spatial, temporal and taxonomic coverage. To optimise this limited data all sources of information must be considered. Thus the marine survey of Ireland as part of the BioMar project (Costello 1995) systematically reviewed literature on Irish marine ecology (e.g. Kelly and Costello 1995, 1996, Kelly et al. 1996, 1997) to complement the results of field surveys. This will result in more information for some areas than others and identify information gaps where further work is necessary. Indeed, in identifying areas of conservation interest it is important to state where further work would be necessary for designation or management (e.g. more detailed mapping).

In terrestrial conservation, area assessment has primarily been based on plant and bird distributions. In contrast, in marine conservation it is proposed to use species from a wide range of phyla, classes and orders (Table 2). As in terrestrial conservation assessment, most of these are visually conspicuous such that they are identifiable in situ. It is assumed that by including as wide a range of species as possible within conservation areas, that populations of unrecorded species will also be protected. It is desirable to test this assumption by specialised studies on the distribution of other taxa.

CRITERIA FOR MARINE NATURE CONSERVATION

Past and current approaches

Many criteria have been proposed for the prioritization of areas for nature conservation (Wright 1977, Kelleher and Kenchington 1992), and some of these have been used in the selection of conservation areas (Table 3). The terminology used in the criteria varies, probably reflecting the trends in conservation management of the time. For example, the term biodiversity has only recently become used in ecology and nature conservation. However, the use of long checklists of criteria can distract from the primary purpose of nature conservation, namely the protection of fauna and flora from human impact.

The use of conservation areas for public recreation, education, and scientific research has the potential to conflict with the goals of nature conservation (Wright 1977). As both of these uses are often compatible they are sometimes used in combination to strengthen the grounds for designation and identify the benefits which will arise from conservation (e.g. rich wildlife may increase amenity value).

The protection of nature may increase the value of the areas for other purposes (e.g. recreation, tourism, education, research), but different purposes require different criteria. As these uses are subordinate to nature conservation they cannot be used as criteria in identifying areas of conservation importance. They may usefully promote the benefits of nature conservation to the wider environment, and can thus find merit as "supporting" criteria and in developing management policy.

Numerical schemes and indices have been developed (e.g. Wright 1977). However, the scores and relative weightings applied to potential conservation areas are dependant on how the assessor values different criteria. Such scores may thus compound two subjective components, the criteria themselves and their individual (and unscaled) numerical values. Furthermore, the resulting scores are not comparable with studies which use different criteria or scoring systems. The provision of numerical values may conceal the underlying basis for site selection. Matrices of parameters of interest have also been used (Mondor 1992), but these are perhaps more useful for management to select conservation areas than in identifying areas of actual interest.

Traditional approaches to nature conservation involve the protection of species threatened with extinction from exploitation, and their habitats from damage and disturbance. The Council of Europe Bern Convention, and the European Union Habitats Directive (European Commission 1992), identify both species and habitats which must be protected in member states. The Convention on Biological Diversity goes a step further. This requires all signatories to protect the variety of life as both biological forms (e.g. genes, populations, species) and their interactions (e.g. communities, ecosystems).

Despite the variety of criteria, the basis for all the designations was the aim to ensure the long term survival of fauna, flora, and ecosystems. It is thus proposed that the primary criteria for the identification of marine nature conservation areas would aim to conserve biodiversity, as indicated by the presence of naturally occurring fauna and flora.

Some approaches to conservation select sites on the basis of their habitats, communities and/or biotopes (e.g. Blab et al. 1995). Habitats are defined as the physical environment a species lives in, a community a recurring assemblage of species living in a defined habitat, and biotopes a combination of habitat and community (see review by Hiscock and Connor 1991 for fuller definitions). Such approaches may be better suited to the terrestrial than marine environment, because in the former the habitat is invariably formed by plants which in themselves are species which warrant conservation. On land, the characterising species of the biotope are also a habitat. However, on the seabed plants are limited in distribution to shallow waters with stable substrata, are not as long-lived as trees on land, and do not modify the habitat to the degree than terrestrial plants do. Marine habitats are usually formed by the substratum and water movements, but some are formed by living organisms (e.g. coral reefs, maerl).

Until the BioMar project, there was no international standardized system for the description of habitats, communities and biotopes. This limited the use of these units in nature conservation assessment as it was difficult to compare like units with like. The development of habitat and biotope classifications have been encouraged by the IUCN (Kelleher and Kenchington 1992), and European Commission. The latter developed the CORINE biotope classification for terrestrial habitats primarily designed on a phyto-sociological basis (European Commission 1991a, b, c, d). Within the BioMar project funded by the EC Life programme, a classification of marine biotopes has been developed by the Marine Nature Conservation Review (MNCR) of the Joint Nature Conservation Committee UK (Hiscock 1995, Connor et al. 1997a, 1997b). The general approach and the upper levels of this classification have been agreed at workshops with representatives from CORINE and the north-east Atlantic countries. To illustrate the physical and biological inter-relationships between biotopes matrices have been extensively used (Connor 1995, Connor et al. 1997a, 1997b). Biotopes are another index of biodiversity, which add environmental (habitat) and inter-species (community) aspects to the species level approach. The BioMar-MNCR marine biotope classification provides a standardized way to identify, characterize and compare marine areas.

The composition of communities and biotopes will vary in space and time (e.g. due to biogeographic or seasonal variation in species abundance). The use of habitats, communities and biotopes may provide a useful means of synopsing, mapping, and describing the elements of an ecosystem. They complement, but cannot substitute for the identification of the actual species present. Habitats are not biological units in themselves

and are thus an indirect way of protecting species. Furthermore, habitats, communities, and biotopes are recognized because of the species they contain so there is some circularity in using them as criteria. Species are the only element of biodiversity at the whole organism level which can provide a practical and universal measure of the conservation value of an area. However, only a small proportion of marine species are ever identified in field surveys. The actual species recorded are thus used as an indicator of the variety of all species present. Biotopes are an indicator of both the species present and of the habitat. Considering that no species list will ever be complete, the use of biotopes complements the species level approach in evaluating the conservation importance of marine areas. Therefore, while the emphasis in conservation assessment should remain at the species level, it should be supplemented by the use of biotopes, and perhaps other indices of biodiversity, where possible.

In evaluating the nature conservation importance of an area, it is critical that the fauna and flora present are the primary criterion. It is desirable that as many species as possible occurring within a national territory are represented within nature conservation areas. It will be easier to accommodate widespread species in conservation areas than species with a more limited distribution. Therefore the limited distribution of one or more (rare) species to a locality is a useful means of identifying areas of potential nature conservation importance.

In this document, it is proposed that the process of selecting marine conservation areas is best divided into two phases. Firstly the identification of places which are of nature conservation value, and secondly the selection of such areas for designation on the basis of management considerations. Subsequently, additional characteristics may be used to support the case for selection (Table 4). The selection of conservation areas for legal protection must consider the feasibility and costs of managing the area in terms of the resources and other areas available. Management authorities may need to prioritise marine areas identified as being of nature conservation importance against their available resources. The importance of an area for nature is independent of whether it can be managed or not. However, the management needs are dependant on what species occur there. Whatever approach is taken it is important that the reasons why areas are being proposed for conservation are clear, justifiable, and transparent. Criteria that are few and simple will be easier to interpret, explain, and for the public to understand. It is also necessary to differentiate between criteria which are based on observations from those based on opinion. In this paper, the identification of areas of nature conservation importance and selection of areas for legal designation are thus dealt with separately.

Identifying areas of conservation importance

Species composition

The inclusion of populations of as many species as possible within the (proposed) network of conservation areas is necessary, as an aim of nature conservation is to protect as many species as possible. The contribution of any defined area to the network can be measured as the percentage the species present contribute to the total species list for the region. While it must be recognized that all areas will not have been surveyed in an identical manner, this calculation can be conducted from selected datasets depending on the comparisons required. For example, the BioMar survey team in Trinity College Dublin have used the same staff and methods to survey many sites in Ireland. Their survey results for an area can be compared to the total list of species they recorded in Ireland. As information accumulates, eventually it may be felt valid to compare the total species list for the area with the list of all species known from Ireland, British Isles, Northern Europe, or some wider region. At present, a checklist of the marine species of Northern Europe is not available, although such lists do exist for certain taxonomic groups. The greater the proportion of the national fauna and flora protected within a single conservation area the higher national priority it would receive.

Geographically rare species

Rarity is defined here in terms of geographic distribution rather than population size in an area. This approach was also adopted by Sanderson (1996a) in developing nature conservation assessment criteria in Britain. From field surveys and scientific literature, it will be possible to identify the occurrence of rarely recorded species in certain areas. While a species may be rarely recorded for many reasons, it would be dangerous to assume it is common elsewhere without compelling evidence. Hence, it is prudent to consider a rarely recorded species as rare until found otherwise.

Species of local distribution are more vulnerable than widespread species to extinction as in the event of local extinction, re-colonization from elsewhere is unlikely. They therefore merit special recognition in conservation. It is worth noting that species rare in distribution do not necessarily occur in areas of high species richness (Kareiva 1993, Prendergast et al. 1993). Although one cannot substitute richness for rarity or vice-versa, areas with more species will tend to have more rare species.

Species richness

Within a defined area a wide variety of habitats and/or species may occur, i.e. the area is notably rich in habitats or species. Richness thus differs from species composition in that it ignores the identity of species and is a reflection of the size of an area. This

criterion is particularly important in defining the marine boundaries of the conservation area so as to maximise the range of species and habitats covered.

Because an area is rich in species for certain taxa does not imply that it will be rich for other taxa. The maximum overlap in (10 km²) species rich "hotspots" for birds, butterflies, dragonflies, aquatic plants and liverworts in Britain was only 34 % (Prendergast et al. 1993). Presumably this pattern reflects the different habitats and spatial scales at which taxa live. However, Prendergast et al. (1993) did find that if all the hotspots were combined for a taxon then 48 - 100 % of species in the other taxa were also included.

Biotope composition and richness

Biotopes are identified from their dominant species and habitat characteristics. Areas with more biotopes will thus have more habitats, and consequently a wider variety of species, than areas with less. The number of biotopes in an area (biotope richness) is an additional and complementary indicator of biodiversity to the use of species.

Other "scientific" criteria

Existing other conservation designations mention the use of criteria such as endangered, typicality, representativity, vulnerability, sensitivity, fragility, and restorability (Table 3). These and other criteria are not felt necessary in identifying marine areas of international conservation importance for the reasons outlined below.

Endangered

This is a very important criterion for prioritizing conservation action in both the protection of nature and commercial biological resources. Such species may be covered by the already proposed criteria because they will be geographically rare. If they are not rare, they may still be endangered by over-harvesting, in which case fishery and other regulations may be applied for protection. In the case of commercially exploited species, there will probably be some population abundance information on which the threat to the species (and IUCN criteria) can be assessed.

Typical and representative

In selecting areas which include (a) populations and records of as many species occurring within the national territory as possible, (b) rare species, and (c) many biotopes, it is anticipated that typical and representative habitats and biotopes will be included. However, the results of such assessments should be cross-checked against the list of habitats and biotopes identified in the BioMar classification to identify possible omissions. The concept of using typical or representative biotopes may have been

intended to protect 'good' examples of biotopes; good being defined in terms of species richness, naturalness and having healthy populations of the dominant species (e.g. a natural regenerating oak woodland). However, these aspects can be individually assessed. The MNCR define typical biotopes as the average, the average being based on the existing recorded biotopes. It is thus dependent on bias's in available data, and can only be calculated for common biotopes. Considering the limited resources available for nature conservation, it would seem easier to defend protecting areas with the 'best' (species and biotope rich, rare species present) rather than the 'average'. For this reason, and the likelihood that typical areas will be encompassed within areas proposed on other criteria, typicality and representativity have not been used as criteria in selecting marine nature conservation areas in Ireland.

Vulnerability, sensitivity, fragility, and restorability

The terms vulnerable, sensitive and fragile are entirely dependent on the type of threat and its likelihood of occurrence. It is difficult to predict the future threats to marine areas and life due to the limited understanding of marine and global ecosystems, and the rapid developments in marine technology. For example, salmon farming was not anticipated 30 years ago. With the limited knowledge of the biology and ecology of marine species it is very difficult to assess a species potential for recovery, and even more difficult to predict the restoration of a community. Regardless of real and hypothetical threats, populations of rare species are more likely to be endangered than species of more widespread distribution because local extinction will have a greater impact on species of more limited distribution.

Type localities

The area from where a species is first discovered, its "type" locality, may produce other species new to science, particularly if the source of the species was a rare habitat. The population of a species in its type locality forms the reference from which the description of the species is based. Protection of this population is thus of value in scientific research. Recently (in past few decades) described species are likely to be known from only a few localities (i.e. they are rare). Type localities tend to be either areas which have received more scientific attention than others such that their fauna is better known, or which include habitats which have been rarely studied. These areas may have attracted attention because of the richness of their biota. Areas which are type localities may already be of conservation interest on grounds of species composition, richness and rarity. Being a type locality may be a criterion for scientific interest, but is not proposed as one for nature conservation.

Species at their geographic limit

At the limit of their geographic range, species may be rare and not living under optimal conditions (e.g. temperature may inhibit regular spawning). They may therefore be genetically distinct from individuals at the centre of their geographic range. Biodiversity includes both biological variety at the species and genetic level. Hence, even if species occur rarely in Ireland because they are at the limit of their range, the fact that they may occur in greater abundance elsewhere should not necessarily downgrade their importance in conservation. Indeed, these species provide an indicator of the limits of biogeographic regions and thus help identify areas of importance as part of a network of conservation areas. The occurrence of isolated populations beyond the usual limits of their range is well know in terrestrial and freshwater systems, and a popular criterion for selecting areas for conservation. Species with a Lusitanian distribution and glacial relics (i.e. survived since last ice age) are of special interest in the natural history of Ireland. Relic populations are also possible in the sea. For example, the warm (relative to open coast) summer temperatures in the Lough Hyne marine nature reserve appear to permit the existence of Mediterranean species otherwise absent from the region (Costello and Myers 1991). Changes in the distribution and abundance of species at the limits of their geographic distribution may also provide first indicators of climatic change in marine ecosystems. The occurrence of species at the limit of their distribution is thus worth noting in selecting areas of national conservation importance, but is less valuable at an international level. Such species will also contribute to species and biotope composition and richness and thus be included in these criteria. It is thus considered that species at their geographic limit are adequately included within the proposed criteria for assessment of areas, and may be of [illegible] value in assessing the national importance of areas and developing environmental monitoring programmes

Rarity in abundance

Another form of rarity is the abundance of individuals in a defined area. In many natural communities, most (e.g. 75%) species occur at less than 1 % of the abundance of the common species. Indeed, one or two species may contribute more than half of the community in terms of numbers of individuals or biomass. Thus in a richer biota more species will be rare in abundance.

Some taxa (e.g. predators, parasites) occur at low densities naturally. Species recorded in very low numbers may or may not maintain populations in the area, and may reflect dispersal from adjacent areas (Costello and Myers 1996). Species may also show great fluctuations (by factor of 10 or more) in abundance not only spatially but during a season and between years. Thus observations on a few sampling occasions can only be considered to provide a crude approximation of actual abundance. For these reasons

rarity in terms of abundance or biomass is not proposed as a criterion in conservation assessment.

Management criteria

Naturalness and existing uses

No area of the coast or sea has not been affected by human activities to some extent. Areas which are polluted, have introduced species, or artificial habitats, may or may not be of conservation interest. The criterion of naturalness has a circularity of approach in that the degree of alteration is determined by the change in the composition of the natural fauna and flora. If human impacts are already considered to have compromised the viability of species of conservation interest, then alternative areas (if available) should be selected for designation and management. It would be more effective and less costly to protect nature in areas less disturbed (polluted) by human activity. Naturalness is thus considered a criterion for conservation management rather than for assessing the importance of an area for nature.

Some estuaries (e.g. Baldoyle estuary, County Dublin) subject to organic enrichment from sewage and other sources are important sites for bird conservation. The occurrence of species of conservation interest in a polluted area may be because they benefit from, tolerate, or are unaffected by pollution. Parts of Cork Harbour are very polluted but have species which do not occur elsewhere in Ireland. At least some of these species have been accidentally introduced to the harbour. Introduced species do not tend to need protection from conservation, and some are considered pests (e.g. *Saragassum muticum,* Boaden 1995). Their presence is thus not considered necessary in conservation assessment here, although it may be recognized that they may have altered the natural species composition.

Species of conservation interest may occur on artificial structures in the sea, such as ship-wrecks or piers. These species may or may not occur on adjacent areas of seabed. For example, a ship-wreck on a sedimentary seabed may provide the only examples of species which occur on hard substrata for the area. However, on a wider spatial scale, these species must occur on natural substrata and the biota of artificial structures are unlikely to contribute to biodiversity at more than a very local (few km^2) level.

Boundaries

In order to designate marine conservation areas, the owners and users need to be consulted, and the boundaries defined (Kelleher and Kenchington 1992). Because of the openness of marine systems, buffer zones and the management of areas beyond the conservation area, are particularly important. For these reasons, the IUCN guidelines

expect that marine protected areas will tend to be larger and less fragmented than terrestrial areas (Kelleher and Kenchington 1992).

The boundary should encompass (rather than border) the habitats of conservation interest, and include a buffer zone where possible. Choosing the narrow entrance to a sea inlet as a boundary may not be suitable if the entrance itself is of conservation interest, so an area of adjacent coast should be included. It is proposed that boundaries follow natural features of the coastline visible from the sea and land, such as headlands. It is important that when a person is within the conservation area it can be recognized in the field. Additionally, the latitude, longitude and depth of all boundaries should be stipulated as most commercial fishing boats and larger yachts have navigational and depth detection equipment. It may be possible to have these boundaries indicated on marine charts, and special marker buoys may be used if necessary. In applying boundaries to a marine site, the proximity of land-based sites of conservation (be it geological, ecological or archaeological) may be considered as it may be easier to delimit and manage an integrated coastal site.

Size of area

There are several benefits in having a larger sized conservation area. Firstly, the full habitat of species with large territories or individual range is likely to be covered. That the range for many marine species is unknown does not mean this principle is weakened. Secondly, the population sizes of particular species will be larger in a greater area of their habitat. The larger a population size the less likely it is that a population will become extinct due to a natural or man-induced catastrophe. There are also management benefits in that the management cost per unit area decreases with increasing area. It is not only widely accepted that bigger reserves are better for conservation, but that several protected areas are desirable for many species to account for local extinction's (e.g. Soule and Simberloff 1986). The protection of different populations promotes genetic diversity, and acts as insurance in case of local extinction's.

Management resources

Last but not least, for a proposed conservation area the management authorities must balance the likelihood of success of conservation against the urgency in relation to threats, the resources required to designate and manage the area, and the presence of alternative areas. In all these factors the understanding and support for conservation will be aided by investment in public education and the availability of information.

Education and research

Marine education must be promoted at primary, secondary and tertiary levels as this will stimulate a public understanding of marine ecosystems and the importance of conservation. Ideally this public education would begin before the designation of marine conservation areas. To some extent this has been taking place through general popular media. However, information of local relevance must also be provided at a local level. To facilitate this, it would be valuable to identify areas of importance for marine education due to the variety of habitats and species representative of those occurring around the coast. Published guides to assist school teachers, and promotion by local wildlife rangers would all have a role in local education. This would also relieve pressure on conservation areas for disturbance due to trampling and collecting.

It would also be advisable to promote marine nature conservation in general, and provide local marine educational information, distinctly from the designation of marine conservation areas. Otherwise it may appear that the information is being used to sell the designation of a particular site. The latter should also be conducted within the context of wider coastal zone management.

Important criteria for assessing the educational value of marine areas include accessibility, public safety, the clarity and simplicity of biological phenomena (e.g. intertidal zonation), and resilience of the area to people pressure (e.g. trampling, collecting, turning over of stones). None of these criteria are important for nature conservation assessment. Scientific research may also prefer areas with ease of access and safe working conditions. However, scientists may give particular importance to the scientific history of the area and its wealth of background data.

From field observations and literature, it may be possible to identify other resources in the proposed conservation area which may immediately or in the future benefit from nature conservation. It may be of value for both management and political reasons to identify these potential benefits at an early stage, and to note whether existing activities (e.g. fish farming, fisheries, angling) may pose a significant threat to the fauna and flora.

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Table 1. Some of the benefits of marine nature conservation areas (e.g. reserves). The degree of benefit will depend on the approach and success of conservation management.

Fisheries
- Refuge for commercial species broodstock and spawning. The young will disperse outside of the reserve
- Nursery for juvenile fish of commercial species from damage as bycatch in fisheries

Aquaculture
- Source of animals for commercial ongrowing
- Less pollution improves water quality

Public amenity, tourism
- Natural scenery (due to development controls) increases value of area for walking, boating, yachting, etc..
- More large fish for angling
- Better water quality due to less pollution
- Nature watching (especially birds, dolphins and whales)

Education
- School and public groups can witness nature relatively undisturbed by human activity
- Researchers can study how life operates under natural conditions
- Fosters appreciation of natural heritage and social value of nature

Ecosystem function
- Maintenance of fauna and flora populations which can disperse to areas more disturbed by human activity
- Absorption and recycling of nutrients from sewage and agricultural waste discharges

Future generations
- Sustained development of natural resources

Table 2. The phyla and classes (in capitals) and orders of taxa identified to species level on field surveys by the BioMar project in Ireland.

ANIMALS		PLANTS	
BRYOZOA		ANGIOSPERMAE	
CHELICERATA	Pycnogonida		
CNIDARIA	Anthozoa	PHAEOPHYCEAE	
	Hydrozoa		
	Scyphozoa	CHLOROPHYCEAE	
CRUSTACEA	Decapoda	RHODOPHYCEAE	
	Amphipoda		Bangiales
	Cirripedia		Ceramiales
	Isopoda		Corallinales
ECHIURA			Cryptonemiales
ECHINODERMATA			Gigartinales
	Asteroidea		Hildenbrandiales
	Crinoidea		Nemaliales
	Echinoidea		Palmariales
	Holothuroidea		Rhodymeniales
	Ophiuroidea		
INSECTA			
MOLLUSCA	Cephalopoda	LICHENS	
	Bivalvia (Pelecypoda)		
	Gastropoda (Prosobranchia)		
	Opisthobranchia		
	Polyplacophora		
NEMERTEA			
PHORONIDA			
PISCES			
PLATYHELMINTHES			
POLYCHAETA			
PORIFERA	Calcarea		
	Demospongiae		
SIPUNCULA			
TUNICATA	Ascidacea		

Table 3. Examples of criteria used for the selection of nature conservation areas.

Organization	IUCN		Council of Europe		European Community (Union)	
Designation	World Heritage Site	Biosphere reserve	Biogenet-ic reserve	European Diploma site	Special Protection Area (birds)	Special Area for Conserv-ation
Unique -						
phenomenon	+					
landscape		+				
habitat			+		+	
Beauty	+			+		
Culture	+			+		
Evolution	+					
Research /science		+		+	+	
Education		+		+	+	
Genetic		+				
Endangered species	+		+		+	+
Restorability						
- habitat		+				+
- species						+
Typical						
- habitats			+		+	+
- species			+		+	
Rare						
- habitats			+		+	+
- species			+		+	
Area					+	+
Population						+
Location						+

Table 4. Proposed criteria for the identification, selection and promotion of marine conservation areas in Ireland.

Scientific criteria for the identification of areas of nature conservation importance

- Species composition
- Geographically rare species
- Species richness
- Biotope richness

Management criteria

- Naturalness and existing uses
- Boundaries and proximity to terrestrial conservation areas
- Size of area
- Management resources

Supporting factors

- Fisheries
- Aquaculture
- Recreation (amenity)
- Cultural heritage
- Tourism
- Education
- Research

2. Selection of marine areas of nature conservation importance based on the BioMar data

M. J. Costello. C. S. Emblow, M. McCrea, P. Tierney and C. Morrow

INTRODUCTION

The increasing threats to the natural resources of coastal marine areas have been widely recognized in initiatives to improve coastal zone management and nature conservation. The protection of marine and coastal areas is now a priority of the Convention on Biological Diversity. The 1992 European Union Directive on the protection of natural habitats, fauna and flora, has further focused attention of regulatory authorities on the marine environment.

In 1992, the BioMar - LIFE project began as a partnership between the National Parks and Wildlife Service (NPWS, administrative co-ordination) and Trinity College Dublin (TCD, scientific co-ordination) in Ireland, the Marine Nature Conservation Review (MNCR) of the Joint Nature conservation Committee and University of Newcastle in Britain, and AID Environment in The Netherlands. The latter completed a report on marine protected areas in Europe in 1994. Methods for the collection and storage of field data developed by the MNCR were further developed by the MNCR, TCD and NPWS during the project (Hiscock 1996).

In the Republic of Ireland, the largest ever survey of marine life and habitats was undertaken by TCD and associated experts. Over four years, 13 ecologists surveyed seashores and underwater habitats (by scuba diving and dredge sampling), and were supported by 5 office staff and several experts on sub-contract. The data collected was entered on standard recording forms and entered into a copy of the MNCR database in TCD. Copies of this database are now with the NPWS, MNCR and Dr M. J. Costello. The data has been published on compact disk to make it available beyond the project.

The Irish data has contributed to the development of the first international classification system for marine biotopes (Connor et al. 1997a, 1997b). This was developed by the MNCR as part of the BioMar project, and provides standard units which can be used in evaluating and comparing the biodiversity of marine areas. The CORINE classifications

and Habitats Directive use both landscape, seascape, habitat and community level units. The marine units in these have been linked to the BioMar-MNCR marine biotope units (Connor et al. 1997a, 1997b).

The Directive does requires certain seascapes to be protected (e.g. 'large shallow inlets and bays'), and these are suitably sized units for birds, seals, cetaceans, and perhaps some fish and other mobile species. A variety of biotopes may occur in any one type of seascape. It would be expected that a wide variety of seascapes would contain a correspondingly wide variety of habitats, biotopes and species. Where biological data is limited, selecting a wide variety of seascapes would be expected to cover the range of habitats and probably biotopes present. A key factor in such an approach is adequately describing seascapes on the basis of the topographical, hydrographic and other characteristics. An analysis of the seascapes of Ireland would complement the use of biotopes and species in conservation assessment, but was beyond the scope of the BioMar project.

The analysis in this report is limited to the BioMar data set, because this is the only standardized data available on a national scale. All available information should be used in selecting areas for nature conservation, so further references are cited. A more complete bibliography of relevant literature has been published (Kelly et al. 1997).

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METHODS

Marine ecological and environmental data was collected and analysed from over 874 sites in Ireland from April 1993 to June 1997 as part of the BioMar project (Figure 1). The species in littoral (intertidal, seashore) and sublittoral (subtidal, underwater) habitats were primarily recorded by marine biologists from direct field observations. Further samples were also collected in cores of sediment from beaches and mudflats, and by dredge from gravel and other sediments in the Irish Sea. The data collected was entered onto standard recording forms in the field, and then into the TCD copy of the MNCR database.

The total data from the BioMar survey could not be analysed together within the database as the dataset was too large. Therefore subsets of the data were analysed separately. Five subsets were selected for analysis; those recorded from littoral rock (Mona McCrea), littoral sediment (Mark J. Costello), infralittoral rock (Chris Emblow), and sublittoral sediments (Paul Tierney). Circalittoral rock data were not analysed due to the premature loss of staff from TCD. The datasets for each analysis were selected from the database on the basis of the biological subzone from which they were recorded. This database field is multi-valued and selecting habitats on the basis of these criteria selected records that could fall into more than one dataset, particularly between infralittoral rock and circalittoral rock and littoral rock and infralittoral rock. These records were analysed in both datasets. Records that were marked as 'incomplete' where excluded from the analysis.

The species data were analysed using TWINSPAN (Hill, 1979) allowing the records to be separated into broad groupings. The groupings formed the basis for each biotope description. However the dataset analysed was very large, particularly for the rocky datasets (1763 habitat records and 1405 species). Records were individually compared with biotopes described for British seas (Connor *et al.*, 1996) and the final groupings (biotopes) were adjusted accordingly. Following Connor *et al.* (1996) a biotope was justified as a single entity if:

1. it could be distinguished from it nearest related community on the basis of a consistent difference in species composition and it occurred in a recognizably different habitat;
2. it is a recognizable association of species in the field;
3. the assemblage of species recurs under similar habitat conditions in different localities;

Species assemblages were distinguished on:

1. a difference in dominant species (most abundant and conspicuous);
2. the co-occurrence of several species characteristic of particular habitat conditions;
3. the presence of taxa unique or primarily found in the community (faithful species). These species may occur at low abundance;
4. both the presence and abundance of species. Some species will only occur at low abundance's but be characteristic of a particular biotope.

Species data was collected from each sampling station in the field. However with the TWINSPAN analysis of the data and comparison with the biotope manual sometimes it was possible to identify more than one biotope in each station, or that the station was representative of a transition zone between two or more biotopes. In these cases the station was assigned more than one biotope, and then labeled with either a (a) P (part of habitat matches this record), (b) T (transitional between biotopes), (c) ? (possible match to the biotope), (d) I (incomplete record), or (e) combinations of ?P or ?T (possible part records and possible transitional records).

The data was analyzed for the presence of rare species, the number of biotopes recorded within each area (biotope richness), the numbers of species recorded within each area (species richness), and contribution of the species composition of the areas to all the species recorded in the survey.

Rare species were identified as species which had never previously or had not recently been recorded in Ireland. These species may be rare beyond Ireland or within Ireland. Species which would not have been consistently sampled in the survey (e.g. some smaller invertebrates) and thus appear rare in the samples were excluded from this category. Species which were recorded in 5 or more localities (there may be one or more sites in a locality) were not considered rare, even where they were recorded for the first time in Ireland during the BioMar survey.

Species which are of conservation value because they create the habitat, e.g. maerl beds, are noted in Appendix 1. However, these species form particular biotopes and to include them as a separate criterion in the nature conservation assessment would be duplication. In addition, some species which are of commercial value but were not considered in evaluating the nature conservation importance of areas are noted in Appendix 1.

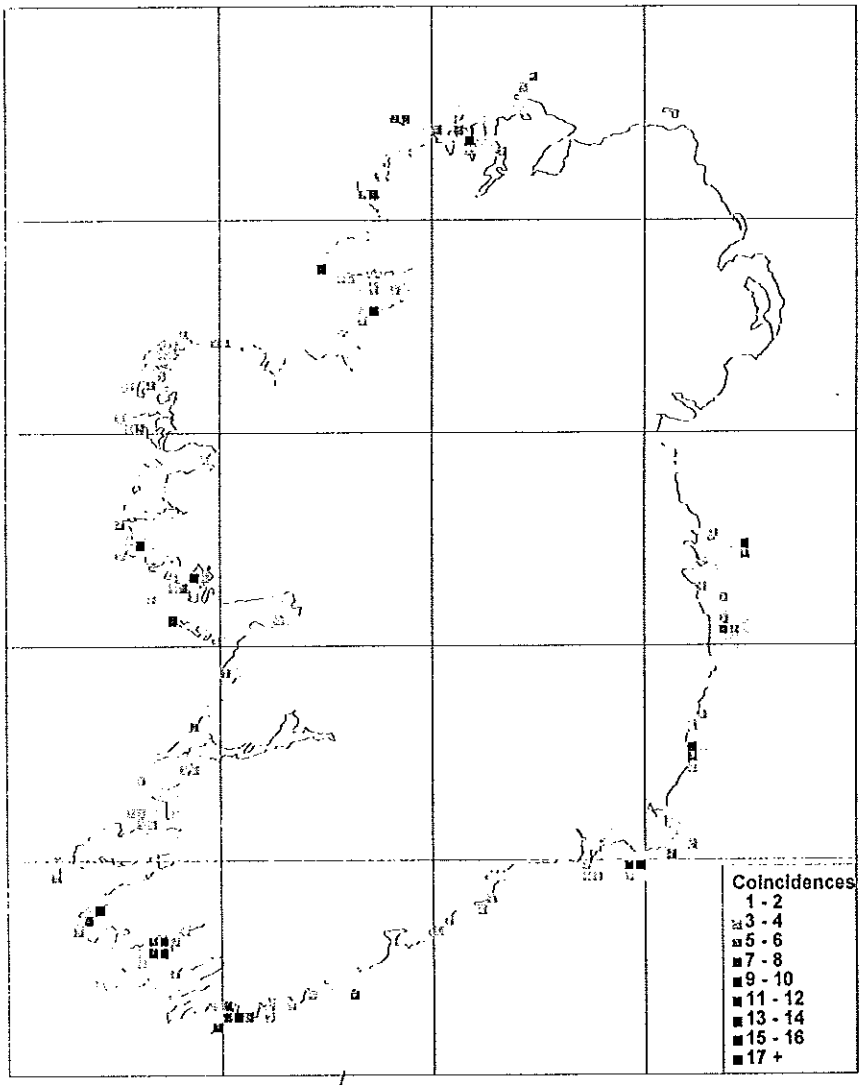


Figure 1. The number of sampling stations (coincidences) per 5 km² sampled in the BioMar project.

RESULTS

RARE SPECIES

The rare species are listed below with notes on their significance, with location details in Table 2.1. Also listed are some species which are defined as rare by Sanderson (1996b) (indicated by [1]) and Erwin *et al.* (1990) (indicated by [2]) for Great Britain and Northern Ireland respectively. Rare species were widely distributed (Figure 2). That more occurred in Kenmare River, Roaringwater, Kilkieran, Donegal and Mulroy Bays than elsewhere partly reflects the survey effort.

Rare in and beyond Ireland

Sponges

Hexadella racovitzai Topsent, 1896

This species was recorded for the first time for Ireland from south of East Brannock Island and west of Bentlevemore, Inishmore, Aran Islands, Co. Galway during the BioMar survey (Morrow and Picton, 1996). It is unrecorded from Britain.

Anemones

Edwardsia delapiae Carlgren and Stephenson, 1928

This burrowing sea anemone has not been recorded since it was originally described from *Zostera* spp. beds on the shore at Valencia Island, Co. Kerry. A small population growing in shallow mud (approximately 5m BCD) in Portmagee Channel, Valencia Island was observed. It would be sensitive to dredging activities.

Fish

Gobius couchi Miller and El-Tawil 1974

The BioMar survey also recorded this goby from Mulroy Bay and Lough Hyne, its only two localities in Ireland (Minchin, 1988). Its only other locality is Helford, Cornwall in England.

Rare in Ireland

Sponges

Tetilla cranium (O F Müller, 1776)

A rarely recorded deep water species.

Quasillina brevis (Bowerbank, 1866)

A rarely recorded deep water species which was recorded from two sites at Kerry Head Shoals.

Halicnemia verticillata (Bowerbank, 1862)

Recorded from Skird Rocks, Co. Galway, Achill Island and the Bills, Co. Mayo.

Tricheurypon sp. Topsent, 1928

Stephens (1915) reported three specimens, all from deep water, the respective depths being 388 fathoms, 468 fathoms and 37 fathoms. Specimens were collected from Salt Lake, Connemara at a depth of 6m below chart datum (BCD) (C.C. Morrow, pers. com) and from Roskeada Bay, Kilkieran Bay, Co. Galway at a depth of 10m BCD. It is likely that *Tricheurypon* sp. is a deep water sponge. It is possible that the sheltered conditions in these two areas resemble those normally found at much greater depths enabling species more typical of deep water to survive.

Lissodendoryx sp. Topsent, 1892[2]

Recorded near Clark's Rock, Slynne Head.

Acervochalina limbata (Montagu, 1818) synonymous with *Haliclona loosanoffi* (Hartman, 1958)

Recorded from four sites.

Hydroids

Halecium plumosum Hincks, 1868[2]

This uncommon hydroid was first described from an Irish specimen. It was recorded at one site in Donegal Bay.

Laomedea angulata Hincks, 1861[1]

This little known hydroid has six records from Britain, and four from the west and south coasts of Ireland. It is restricted to the fronds of *Zostera* spp. plants. It is regarded as a Lusitanian species (Connor *et al.*, 1996). It was found in Tralee Bay, Aranmore, and Kinsale Harbour.

Anemones

Sarcodictyon roseum (Philippi, 1842)

This species has a south-western distribution in Europe, occurs around the west coast of Britain and occasionally in the North Sea (Manuel, 1980). This study recorded it from Mulroy Bay, near Mine Head and Donegal Bay.

Swiftia pallida Madsen, 1970

This sea fan has been recorded in several localities on the west coast of Scotland (Manuel, 1980) and in Kilmakilloge Harbour, Kenmare River, Co. Kerry (Picton, 1985a). This study also found it in Kenmare River, were it occurs in high numbers.

Actinia fragacea Tugwell 1856

The known distribution of this anemone was the English Channel and southwest England (Manuel, 1980). This study recorded it from one site in Donegal.

Aureliania heterocera (Thompson, 1853)

This anemone has previously been recorded in Galway and off the north coast (Picton, 1985a). It occurred in Kilkieran Bay, in the maerl *Lithothamnion corallioides*, as also did *Mesacmaea mitchellii* (see below).

Cataphellia brodricii (Gosse, 1859)[1]

This anemone is known from the coasts of Devon and Cornwall and from the north coast of France (Manuel, 1981). There was only one previous Irish record from Gascanane Sound, West Cork (Picton, 1985a). This study found it to be frequent at the Saltee Islands and common at one site on the east coast, south of Rosslare, Co. Wexford.

Halcampoides elongatus Carlgren, 1912[1]

The only previous record of this anemone in Britain and Ireland is from NE of Mweenish Is., Ard Bay, Co. Galway (Picton, 1985a). This study recorded it nearby in Kilkieran Bay. The species is likely to be under recorded, as it is nocturnal.

Mesacmaea mitchellii (Gosse, 1853)

This burrowing anemone has been previously recorded from Galway (Picton, 1985a). The present study has recorded this species from Kilkieran Bay, where it occurs in association with other burrowing anemones in *L. corallioides* habitats.

Crustaceans

Talorchestia brito Stebbing, 1891

This is the first and only Irish record (Costello et al. 1990). This is remarkable because talitrids were collected from over 90 sites and it is widespread in the north east Atlantic (Lincoln 1979).

Alpheus macrocheles (Hailstone, 1835)

The snapping prawn was only found at McGrath's Point, Co. Clare. Its distribution is southerly and it is considered very scarce (Hayward and Ryland, 1995).

Molluscs

Pholas dactylus Linnaeus, 1758

Piddocks are widely distributed around southern England, but were only found at Aughinish Co. Clare by BioMar.

Tritonia lineata Alder and Hancock, 1848

This nudibranch is rare in Irish waters, but known from Salt Lake, Co. Galway (Picton and Morrow, 1994). It was found in three localities by BioMar.

Hero formosa (Loven, 1841)[1]

The most recent records of this nudibranch are from the west coast of Scotland, near Oban and from the continental slope of the Rockall Trough (Picton and Morrow, 1994). This study found it in one site in the Kenmare River.

Cuthona pustulata (Alder and Hancock, 1854)

This northern species has been recorded as far south as Lundy and Skomer Island in the Bristol Channel and in the English Channel (Picton and Morrow, 1994). This study found it at Rathlin O'Birne.

Calma glaucoides (Alder and Hancock, 1854)

There are a few records of this species in Britain, mostly from the south and west coasts but also recorded from Norway and the Mediterranean Sea (Picton and Morrow, 1994). This study found it in Donegal Bay.

Aeolidiella sanguinea (Norman, 1877)

This nudibranch has been reported from Lough Hyne, Galway Bay (Picton and Morrow, 1994) and Murles Point, Donegal Bay (Nunn, 1990). It is considered rare in Britain (Sanderson, 1996b).

Bryozoans

Schizomavella sarniensis

A recently described and thus little known species of bryozoan (Hayward, pers. comm.), recorded at five sites in the Carnsore area by BioMar.

Celleporina tubulosa (Hincks, 1880)

Recorded for the first time from Ireland (Hayward, pers. com.) by BioMar.

Tunicates

Sidnyum elegans (Giard, 1872)

This is the first time this species has been recorded in Ireland. The tunicate was found at several sites during the BioMar survey off the Saltee Islands.

Phallusia mammillata (Cuvier, 1815)[1]

This species has an unusual distribution, it is common in Bantry Bay, Co. Cork. It is a large and conspicuous species and it is unlikely that it has been overlooked. It is otherwise known from the south coast of England and the Atlantic coast of France (Picton, 1985b). It is a southern species, occurring in northern France, and Portland and Salcombe Harbours on the south coast of England. It has also been recorded from Bardsey Island, North Wales (Hiscock 1984) and from Shetland (Moss and Ackers 1987). The latter record in almost certainly a misidentification and the Bardsey record should be considered doubtful. In Ireland *Phallusia mamillata* is only known from Bantry Bay especially on sheltered rocky habitats. As this represents the northern limit of its known distribution, and it is common here, its ability to disperse must be limited. Thus its presence in Bantry Bay could indicate an interesting relict distribution or a relatively recent introduction.

Fish

Gobius cruentatus Gmelin, 1789

Recorded from L. Hyne by BioMar, one of three sites (also Bantry and Kenmare Bays) it is known from in Ireland (Minchin, 1995). It is distributed from the Mediterranean Sea to Ireland.

Algae

Lithophyllum fasciculatum (Lamarck) Foslie

This species of maerl has been recorded twice during this survey, from the same location in West Cork. It has a distribution from Scotland to Brittany, although previous records from, Scotland, Wales, and Waterford have not been confirmed (Irvine and Chamberlain, 1994).

Naccaria wiggii (Turner) Endl.[2]

Although this species was recorded only twice on the BioMar survey (one an incomplete record from Sherkin), it has been recorded off all coasts of Ireland in other surveys (Guiry, 1978).

Schizymenia dubyi (Chauv. ex Duby) J. Agardh[2]

Reported from the northern, and western coasts of Ireland (Guiry, 1978), from S and W coasts of Britain (Hiscock, 1986), and from four areas by BioMar.

Schmitzia hiscockiana Maggs et Guiry[1]

Recorded from the south and north-west coast by BioMar. It is a recently described species, which may explain its rarity. Hiscock (1986) reports records from Lundy, Pembrokeshire and Galway.

Phyllophora sicula (Kuetz.) Guiry et L. Irvine

Recorded at four sites but there was only one previous record from Ireland, Cork (Guiry, 1978). Also known from SW Britain (Hiscock, 1986).

Rhodymenia delicatula P. Dang.

Only found in Galway Bay by BioMar (Guiry, M. D. pers. comm., 1997). Hiscock (1986) described it as "probably widespread but very inconspicuous", but gave no distribution.

Spyridia filamentosa (Wulf.) Harvey in Hooker[2]

Recorded from Bantry and Roaringwater Bays in this study. The only one previous record from Ireland was from Galway (Guiry, 1978, pers. comm.). It is described as rare but locally frequent (Hiscock, 1986) and widely distributed in warmer waters (Maggs and Hommersand, 1993).

Polysiphonia denudata (Dillwyn) Grev. ex Harvey in Hook.

This is the first confirmed record from Ireland (Maggs, C. A. pers. comm., 1997). Its known distribution was limited to the south coast of England (Maggs and Hommersand, 1993).

Pterosiphonia pennata (Agardh) Falkenb[1]

Recorded once in this study, and previously from scattered locations in southwest Britain and Ireland; namely Lundy, Glamorgan, Cork, Clare and Galway (Maggs and Hommersand, 1993). Reported widely distributed in Atlantic and Pacific Oceans (Schneider and Searles, 1991), but its distribution is difficult to assess due to confusion between a group of morphologically similar species.

Antithamnion densum (Suhr) Howe

Recorded from North Mayo, and previously in Ireland from three collections made off Clare Is., Co. Mayo (Guiry and Maggs, 1991). It is not known from Britain. Other records are from North France, North Spain, the South Atlantic, North and South Pacific (Athanasiadis,1990; Granja, *et al.*, 1992).

Table 2.1. Details of the survey and site number, site name and national grid reference at which the rare species were recorded during the BioMar survey.

Rare in and beyond Ireland		
Hexadella racovitzai Topsent, 1896		
504 6	S of East Brannock Island, Aran Islands	L 780 110
526 1	Reef W of Kerry Head, Kerry Head to Beal Point	Q 556 304
526 2	SE of Kerry Head shoals	Q 593 349
526 5	NW of Kerry Head shoals	Q 601 376
526 7	N of Kerry Head shoals	Q 621 386
Edwardsia delapiae Carlgren and Stephenson, 1928		
517 36	SSE of Knights Town Valencia	V 430 767
Gobius couchi Miller and El-Tawil 1974		
503 14	SE of Deegagh Point, Mulroy Bay.	C 196 340
503 23	Stookan Rocks, Mulroy Bay.	C 187 402
507 2	SE of Castle Island, Lough Hyne	W 099 288
Rare Irish records		
Tetilla cranium (O F Müller, 1776)		
526 3	W of Kerry Head shoals	Q 589 364
526 5	NW of Kerry Head shoals	Q 601 376
526 6	NNW of Kerry Head shoals	Q 612 379
526 7	N of Kerry Head shoals	Q 621 386
Quasillina brevis (Bowerbank, 1866)		
526 6	NNW of Kerry Head shoals	Q 612 379
526 7	N of Kerry Head shoals	Q 621 386
Halicnemia verticillata (Bowerbank, 1862)		
504 44	SW of Doonguddle, Skird Rocks	L 672 241
522 10	E side of Bill's Rocks, The Bills	L 552 938
522 18	S of Dysaghy Rocks, Achill Island	F 575 016
Tricheurypon sp. Topsent, 1928		
504 25	SE of Mussel Rock, Roskeada Bay, Kilkieran Bay.	L 902 342
Lissodendoryx sp. Topsent, 1892		
518 5	NW of Clark's Rock, Slyne Head area.	L 527 437
Acervochalina limbata (Montagu, 1818)		
518 23	Salt Lake rapids, Clifden Bay.	L 659 489
518 27	Opposite Gubbatruffaun, Streamstown Bay.	L 588 545
521 55	S of Nedanone, Outer Kenmare River.	V 605 594
Haliclona loosanoffi (Hartman, 1958)		
519 23	Brinlack Port	B810 312
Halecium plumosum Hincks, 1868		
512 30	NNW of Carricknane, S Donegal Bay.	G 778 593
Laomedea angulata Hincks, 1861		
525 19	NE of Castlegregory Tralee Bay	Q 644 158
525 20	E of Trench Bridge Tralee Bay	Q 636 148
527 43	Aran Road, S of Calf Is. Aranmore	B 685 164
528 1	E of Jarley's Cove Kinsale Harbour	W 649 489
Sarcodictyon roseum (Philippi, 1842)		
503 14	SE of Deegagh Point, Mulroy Bay.	C 195 340
505 1	S of Mine Head (outer), Youghal to Dungarvan.	X 288 803
512 38	Beltra Rock (Bob's Pinnacle), N Donegal Bay.	G 807 696

Table 2.1 continued

Swiftia pallida Madsen, 1970		
501 23	SW of Book Rocks, Kilmakilloge Harbour, Kenmare River	V 738 598
521 14	One mile N of Shamrock Cliff, Mid Kenmare River	V 650 577
521 16	N of Cleanderry Harbour, Mid Kenmare River	V 671 570
521 17	NW of Foilatluggig, Mid Kenmare River	V 678 572
521 20	N of Kidney Rock, Mid Kenmare River	V 694 588
521 28	WSW of Book Rocks, Kilmakilloge Harbour	V 737 597
521 30	SW Laughaun Point, Kilmakilloge Harbour	V 737 599
521 31	Between Laughaun Point and Collorus Point, Kilmakilloge Harbour	V 736 601
521 32	NW Laughaun Point, Mid Kenmare River	V 729 614
521 36	Church Rocks, Inner Kenmare River	V 765 629
521 57	Brigbeg, Outer Kenmare River	V 576 571
Actinia fragacea Tugwell 1856		
512 2	Blue Lough Bay, Ballyconnell Point, S Donegal Bay	G 567 464
Aureliania heterocera (Thompson, 1853)		
504 22	NNE of Leighton Island Kilkieran Bay	L 910 317
504 28	N of Kinnelly Rock Kilkieran Bay	L 864 320
504 32	Lettercallow Spit Kilkieran Bay	L 844 292
Cataphellia brodricii (Gosse, 1859)		
513 7	St Patrick's Bridge, Saltee Islands	S 976 006
513 8	N of Long Bohur, Saltee Islands	X 993 990
513 9	The Bore, Saltee Islands	X 995 965
513 13	Pinnacle SE of Makeston Rock, Saltee Islands	X 967 960
513 22	NW of Molly Hoy, Great Saltee, Saltee Islands	X 940 961
513 27	NW of Goose Rock, Saltee Islands	X 960 990
514 37	SE of Splaugh Rock, Greenore Point to Carnsore Point	T 166 100
514 44	S of Fundale Rock, Greenore Point to Carnsore Point	T 133 045
514 45	S of Carnsore Point, Greenore Point to Carnsore Point	T 121 031
514 47	NE of Terchen, Carnsore Point to Forlorn Point	T 094 030
528 8	E of Old Head of Kinsale Lighthouse, Kinsale Harbour	W 635 391
Halicampoides elongatus Carlgren, 1912		
504 32	Lettercallow Spit Kilkieran Bay	L 844 292
Mesacmaea mitchellii (Gosse, 1853)		
504 22	NNE of Leighton Island Kilkieran Bay	L 910 317
504 26	N of Kinnelly Rock Kilkieran Bay	L 864 320
504 27	N of Kinnelly Rock Kilkieran Bay	L 864 320
504 32	Lettercallow Spit Kilkieran Bay	L 844 292
Talorchestia brito Stebbing, 1891		
513 1	NE of Raven Point, Wexford Harbour	T 122 233
Alpheus macrocheles (Hailstone, 1835)		
516 23	Magraths Point, Doughmore Bay.	Q 977 673
Pholas dactylus Linnaeus, 1758		
524 17	N of oyster beds Aughinish Bay	M 299 129
Tritonia lineata Alder and Hancock, 1848		
521 18	Cave, SW of Kidney Rock, Mid Kenmare	V 691 576
521 31	Between Laughaun Point and Collorus	V 737 602
531 5	SE of Brecaun Bridge, Hook Head	X 786 993
Hero formosa (Loven, 1841)		
521 50	NW of Sherky Island Kenmare River	V 681 614
Cuthona pustulata (Alder and Hancock, 1854)		
527 22	W of Black Rock, Rathlin O' Birne	G 458 795
Calma glaucoides (Alder and Hancock, 1854)		
527 13	Entrance to Teelin Harbour, N Donegal Bay	G 594 751
Aeolidiella sanguinea (Norman, 1877)		
509 2	E side of the Rapids, Lough Hyne.	W 100 282
Schizomavella sarniensis		
513 21	W of Panstown Rock, Saltee Islands.	X 931 958
513 24	N of Whitty Rock, Saltee Islands.	X 939 974
513 26	NW of Powers Rock, Saltee Islands.	X 933 986
514 38	S of Splaugh Rock, Greenore Point to Carnsore Point.	T 156 091
531 2	SW of Great Saltee, Saltee Islands.	X 915 948

Table 2.1 continued

Celleporina tubulosa (Hincks, 1880)		
504 7	S of South Island, Inishmore, Aran Islands.	L 766 114
520 7	North of Marnid Point, Tory Island.	B 859 473
527 25	NW tip of Rathlin O' Birne, Rathlin O' Birne Island.	G 462 805
Sidnyum elegans (Giard, 1872)		
513 8	N of Long Bohur, Saltee Islands	X 993 990
513 15	NE of Shoal Rock, Saltee Islands	X 952 960
513 21	W of Panstown Rock, Saltee Islands	X 931 958
513 26	NW of Powers Rock, Saltee Islands	X 933 986
514 43	South Rock, Tuskar Rock	T 216 053
514 44	S of Fundale Rock, Greenore Point to Carnsore Point	T 133 045
531 2	SW of Great Saltee, Saltee Islands	X 915 948
531 8	W of Western Rock, Hook Head	X 783 929
Phallusia mammillata (Cuvier, 1815)		
501 2	W of Glanrooncoosh, Bantry Bay	V 788 393
501 3	SW of Yellow Rocks, Bantry Bay	V 954 534
501 4	E of Slip Island, Glengarriff, Bantry Bay	V 943 552
501 5	Four Heads Point, Bantry Bay	V 931 522
501 9	NE of Lonehort Point, Berehaven, Bantry Bay	V 764 455
501 10	George Rock Buoy, Berehaven, Bantry Bay	V 736 457
501 11	Inner Lawrence's Cove, Berehaven, Bantry Bay	V 737 441
501 13	Walter Scott Rock, Berehaven, Bantry Bay	V 683 451
501 14	W of Sheep Island, Berehaven, Bantry Bay	V 682 446
501 15	S of Foilenaboe Rocks, Berehaven, Bantry Bay	V 677 442
501 17	E of Piper Point, Berehaven, Bantry Bay	V 668 432
Gobius cruentatus Gmelin, 1789		
509 7	Labhra Cliff, Lough Hyne	W 096 283
Naccaria wiggii (Turner) Endl.		
521 46	W of Inishkeragh, Sneem Harbour.	V 691 624
Lithophyllum fasciculatum (Lamarck) Foslie		
508 24	NE of Carrigviglash Rocks Roaringwater Bay	W 022 318
508 25	NNE of Carrigviglash Rocks Roaringwater Bay	W 021 320
508 26	N of Carrigviglash Rocks Roaringwater Bay	W 012 319
Schizymenia dubyi (Chauv. ex Duby) J. Agardh		
525 4	SW of Sound Rock, Inishnabro, Blasket Islands.	V 216 930
528 26	Submarine (U-260) pinnacle, Glandore Bay.	W 235 262
531 7	NW of Three Mile Rock, Hook Head.	X 787 938
531 10	SE of Hook Head.	X 756 962
534 6	Horse Island, The Stags of Broadhaven to Belderrig Harbour.	F 979 426
Schmitzia hiscockiana Maggs et Guiry		
515 18	W entrance to Inishkea channel, Inishkea Islands	F 554 220
527 17	Gloster Rock, Rathlin O' Birne Island	G 488 793
527 24	N of Black Rock, Rathlin O' Birne Island	G 465 795
528 7	SE of Bream Rock, Old Head of Kinsale, Kinsale Harbour	W 635 397
528 9	Coosgorm Bay, Old Head of Kinsale, Courtmacsherry Bay	W 628 391
Phyllophora sicula (Kuetz.) Guiry et L. Irvine		
508 12	Kinnish Narrows, Sherkin Island.	W 017 258
512 36	S of Doorin Point, N Donegal Bay.	G 808 723
516 23	Magrath's Point, Doughmore Bay	Q 977 673
519 23	Brinlack Port, Bloody Foreland.	B 810 312
Rhodymenia delicatula P. Dang.		
516 15	Belacoon Point, Kinvarra Bay, Galway Bay.	M 360 139
Spyridia filamentosa (Wulf.) Harvey in Hooker		
501 13	Walter Scott Rock, Berehaven, Bantry Bay.	V 683 451
508 24	NE of Carrigviglash Rocks, Roaringwater Bay.	W 022 317
508 26	N of Carrigviglash Rocks, Roaringwater Bay.	W 012 319
Polysiphonia denudata (Dillwyn) Grev. ex Harvey in Hook.		
516 17	Ardfry Rapids, Mweelon Bay, North Bay, Galway Bay.	M 351 209
Pterosiphonia pennata (Agardh) Falkenb		
516 23	Magrath's Point, Doughmore Bay.	Q 977 673
Antithamnion densum (Suhr) Howe		
534 11	West of Conaghra Point, Belderg, North Mayo.	G 019 419

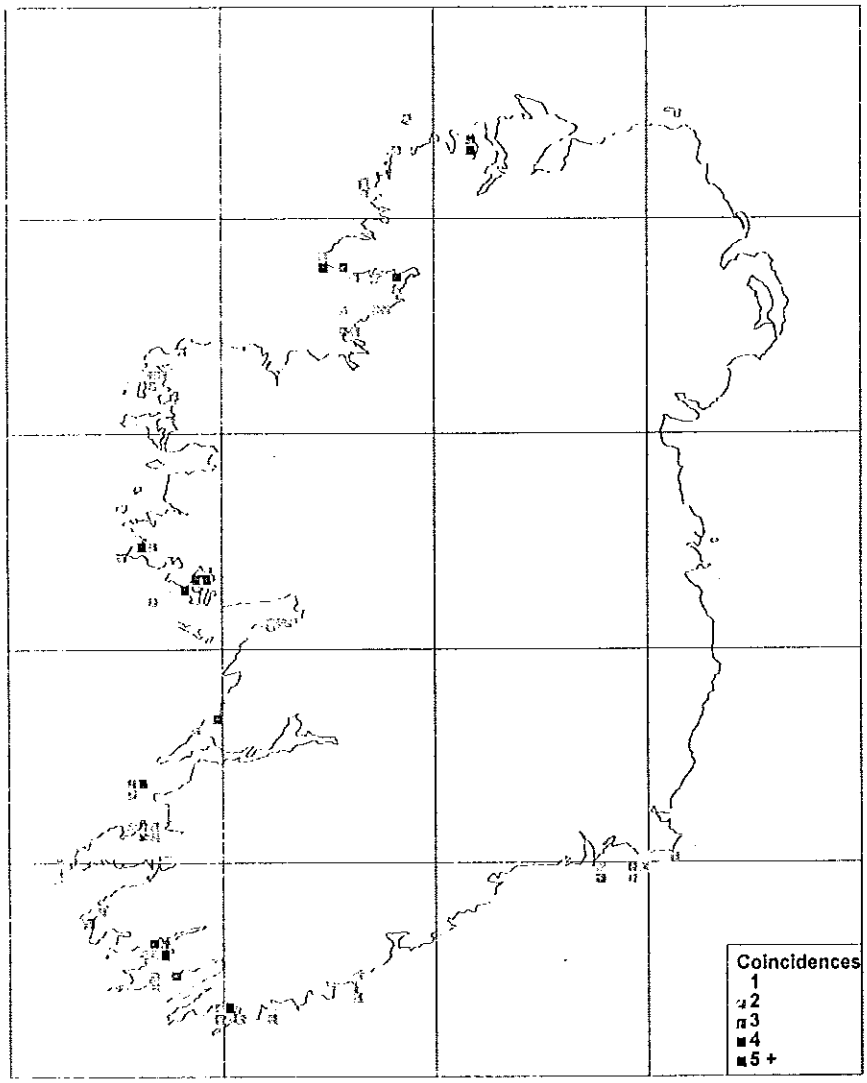


Figure 2. The number of sampling stations (coincidences) per 5 km² in which BioMar recorded notable species (listed in Table 2.1 and Appendix 1).

Biotopes

The survey recorded about 130 biotopes, of which 108 were in the areas of marine nature conservation importance (Table 2.2, Figure 3, Appendix 2). The 108 include 36 rocky shore, 6 beach, 42 rocky sublittoral, and 24 sediment sublittoral biotopes. Further analysis may reveal more biotopes in these areas and the BioMar data, particularly for circalittoral rock. The number of biotopes in the areas sampled will also increase with further sampling.

Species

Maps of the main species groups recorded on the BioMar survey, i.e. sponges, hydroids, anthozoans, bryozoans, echinoderms, tunicates, red algae and brown algae highlight the areas where high numbers of species within each group were recorded (Figure 4). The diversity of brown algae (Chromophycota), recorded on the survey is very much dependent on the number of littoral rocky sites in each 5 km² as the majority of brown algae grow on rocky shores. When all the areas of marine nature conservation importance are considered, they include 78 % to 95 % of each of the more common taxa recorded in the survey (Table 2.3).

Effects of sampling effort and size of area

The assessment of biotope and species composition and richness is unavoidably biased towards areas with more sampling. As would be expected, there was a tendency for there to be more species where there were more biotopes, sampling stations, sites surveyed, and a larger area included in the 'area of conservation importance'. Thus the Kenmare River area is the largest in size, has the most sites, stations, biotopes and species (Table 2.4). The proportions of (a) species per site, (b) species per station, (c) biotopes per station, and (d) species per biotope, are calculated suggest that Lough Hyne, Kerry Head Shoals, and Magheree Islands areas are more diverse (Table 2.5). If these proportions are divided by the number of 5 Km² squares sampled to account for area size (Table 2.6), then the Kerry Head Shoals, Rutland Channel, and some other areas appear more diverse. Two rocky shores, at Finavarra and McGrath's Point in Co. Clare, were very rich in biotopes and species. Because they were isolated from other sites of interest they are shown as single sites of conservation interest and are not directly comparable to the conservation areas.

Table 2.2 List of the codes and titles of the 108 biotopes recorded in the areas of marine nature conservation importance. Biotopes are listed alphabetically.

Littoral rock	
Asc.Asc	*Ascophyllum nodosum* on full salinity mid eulittoral rock
Asc.T	*Ascophyllum nodosum*, sponges and ascidians on tide-swept mid eulittoral rock
AscX	*Ascophyllum nodosum* on mid eulittoral mixed substrata
Aud	*Audouinella floridula* and *Fucus serratus* on sand-scoured lower eulittoral rock
BLlit	Barnacles and *Littorina littorea* on unstable eulittoral mixed substrata
BPat	Barnacles and *Patella* spp. on exposed to moderately exposed, or sheltered vertical, eulittoral rock
BPat.Cht	*Chthamalus* spp. on exposed upper eulittoral rock
BPat.Lpyg	Barnacles and *Lichina pygmaea* on steep exposed upper eulittoral rock
BPat.Sem	*Semibalanus balanoides* on exposed to moderately exposed eulittoral rock
Cor	Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools
Cor.Par	Coralline crusts, *Corallina officinalis* and *Paracentrotus lividus* in shallow eulittoral rockpools
Fcer	*Fucus ceranoides* on low salinity eulittoral rock
FcerX	*Fucus ceranoides* on reduced salinity eulittoral mixed substrata
FK	Fucoids and kelp in deep eulittoral rockpools
FK.Bo	*Fucus serratus*, *Laminaria digitata* and under-boulder fauna in deep boulder-floored eulittoral rockpools
FK.Snd	*Fucus serratus*, *Laminaria digitata* and sand-tolerant algae in sediment-floored eulittoral rockpools
Fser.Bo	*Fucus serratus* and under-boulder fauna on lower eulittoral boulders
Fser.Fser	Dense *Fucus serratus* on moderately exposed to sheltered lower eulittoral rock
Fser.R	*Fucus serratus* and red seaweeds on moderately exposed eulittoral rock
FserX	*Fucus serratus* on lower eulittoral mixed substrata
Fspi	*Fucus spiralis* on moderately exposed to sheltered upper eulittoral rock
Fves	*Fucus vesiculosus* on sheltered mid eulittoral rock
FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
FvesX	*Fucus vesiculosus* on mid eulittoral mixed substrata
G	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in supralittoral rockpools
Him	*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock
MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock
Pel	*Pelvetia canaliculata* on sheltered upper shore rock
PelB	*Pelvetia canaliculata* and barnacles on moderately exposed upper shore rock
R.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on moderately exposed lower eulittoral rock
R.Osm	*Osmundea pinnatifida* and *Gelidium pusillum* on moderately exposed mid to lower eulittoral rock
RamG	*Ramalina* spp. and grey lichens on supralittoral rock
Ver	*Verrucaria maura* on littoral fringe rock
Ver.B	*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock
Ver.Ver	*Verrucaria maura* on moderately exposed to very sheltered upper littoral fringe rock
YG.YG	Yellow and grey lichens on supralittoral rock
Littoral sediments	
AEur	Burrowing amphipods and *Eurydice pulchra* in mobile coarse sand shores
AP	Burrowing amphipods and polychaetes in clean sandy shores
ArelBv	*Arenicola marina* and bivalves in mid to lower shore muddy sand
Lan	Dense *Lanice conchilega* in tide-scoured lower shore sand
PSfol	Polychaetes with *Scolelepis foliosa* in coarse sand shores
Tal	Talitrid amphipods in decomposing seaweed on the strand-line
Infralittoral rock	
Ala.Ldig	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock
Ala.Myt	*Alaria esculenta* and *Mytilus edulis* on very exposed sublittoral fringe bedrock
AlaRAn	*Alaria esculenta* forest with a red seaweed and anemone turf on extremely exposed upper infralittoral bedrock
CorMet	*Corynactis viridis* and *Metridium senile* on vertical exposed infralittoral rock
Die	*Dictyota dichotoma* and *Dictyopteris membranacea* turf on exposed lower infralittoral rock
FoR	Foliose red seaweeds on lower infralittoral rock
HalXK.Ft	*Halidrys siliquosa* and mixed kelp forest with scour-tolerant red seaweeds on scoured upper infralittoral rock
Ldig	*Laminaria digitata* on moderately exposed or tide-swept sublittoral fringe rock
Ldig.Bo	*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders
Ldig.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe rock
Ldig.T	*Laminaria digitata*, ascidians and bryozoans on tide-swept sublittoral fringe rock
Lhyp	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed rock
Lhyp.TPk	*Laminaria hyperborea* park with hydroids, bryozoans and sponges on tide-swept lower infralittoral rock

LhypFa	*Laminaria hyperborea*, a cushion fauna (sponges and polyclinids) and foliose red seaweeds on exposed infralittoral rock
LhypFa.Par	*Laminaria hyperborea* and dense *Paracentrotus lividus* on exposed infralittoral limestone rock
LhypGz.Ft	Grazed *Laminaria hyperborea* forest with coralline algal crusts on upper infralittoral rock
LhypLsac.Ft	*Laminaria hyperborea* and *Laminaria saccharina* forest with red seaweeds on sheltered upper infralittoral rock
Lsac.Ft	*Laminaria saccharina* forest on very sheltered upper infralittoral rock
Lsac.Ldig	*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock
Lsac.T	*Laminaria saccharina*, foliose red seaweeds, sponges and ascidians on tide-swept infralittoral rock
Lsac.X	*Laminaria saccharina*, *Chorda filum* and filamentous red seaweeds on sheltered infralittoral muddy mixed substrata
LsacSpol	*Laminaria saccharina* and/ or *Saccorhiza polyschides* on exposed infralittoral rock
SC	Sponge crusts on wave-surged infralittoral cave walls
SCAn	Sponge crusts and anemones on vertical wave-surged infralittoral rock
SCAs.ByH	Sponge crusts, colonial ascidians and a bryozoan/hydroid turf on wave-surged vertical and steep infralittoral rock
Spol	*Saccorhiza polyschides* and other opportunistic kelps on disturbed sublittoral fringe and upper infralittoral rock
XK	Mixed kelps and scour-tolerant fauna on tide-swept scoured infralittoral rock

Circalittoral rock

AlcC	*Alcyonium digitatum*, *Pomatoceros triqueter*, algal and bryozoan crusts on vertical exposed circalittoral rock
AlcTub	Dense *Alcyonium digitatum*, *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock
Ant	*Antedon bifida* and a bryozoan/hydroid turf on moderately tide-swept circalittoral rock
Axi	Axinellid cup and branching sponges on deep very exposed circalittoral rock
Bra.PlaS	Brachiopods, *Placostegus tridentatus*, *Hydroides* and sponges on sheltered circalittoral rock
CCParCar	Coralline crusts, *Parasmittina trispinosa*, *Caryophyllia smithii*, *Haliclona viscosa* and sparse *Corynactis viridis* on very exposed circalittoral rock
Flu	*Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock
Mus	*Musculus discors* beds on moderately exposed circalittoral rock
Oph	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on slightly tide-swept circalittoral rock
PolCio	*Polymastia* spp. and *Ciocalypta penicillus* on sand-covered circalittoral rock
PomByC	*Pomatoceros triqueter*, *Balanus crenatus* and encrusting bryozoans on mobile circalittoral cobbles and pebbles
SCupPar	Sponges, cup corals and *Parerythropodium coralloides* on shaded/overhanging circalittoral rock
SoAs	Solitary ascidians, including *Ciona intestinalis* and *Ascidia mentula*, on sheltered circalittoral rock
SSoAs	Sponges and solitary ascidians, on sheltered circalittoral rock
SwiErS	*Swiftia pallida* and erect sponges on slightly tide-swept moderately exposed circalittoral rock

Sublittoral sediments

AbraEcor	*Amphiura brachiata* and *Echinocardium cordatum* on circalittoral medium to fine sand.
AfilEcor	*Amphiura filiformis* and *Echinocardium cordatum* in circalittoral clean medium to fine sand
An	burrowing anemones in sublittoral muddy gravel
Beg	*Beggiatoa* spp. on anoxic sublittoral mud
EcorEsil	*Echinocardium cordatum* and *Ensis siliqua* in lower shore to shallow sublittoral muddy sand
Lcor	*Lithothamnion corallioides* maerl beds in infralittoral muddy gravel
Lfas	*Lithophyllum fasciculatum* maerl beds with *Chlamys varia* and algae on infralittoral sandy mud to mud.
Lgla	*Lithothamnion glaciale* maerl beds in tide-swept variable salinity infralittoral gravel
Lhia	*Limaria hians* nests on infralittoral medium to muddy sand.
MacAb	*Macoma balthica* and *Abra alba* in infralittoral muddy sand and mud.
Mob	Sparse epifauna on clean mobile infralittoral sand
NeoBv	*Neopentadactyla mixta* and bivalves in sublittoral shell gravel and coarse sand
Ost	*Ostrea edulis* in shallow sublittoral muddy fine sand and shell
Phy	*Phymatolithon calcareum* maerl beds in infralittoral clean gravels and coarse sands
Sell	*Spisula elliptica* and other bivalves in infralittoral clean sand and shell gravel
Spav	*Sabella pavonina* reefs on infralittoral mud with associated infauna.
SpNep	Sea pens and burrowing megafauna, such as *Nephrops norvegicus*, in stable circalittoral mud
TcomAsAn	*Turritella communis* with ascidians and burrowing anemones in infralittoral muddy sand and mud.
VenBra	Venerid bivalves and *Branchiostoma lanceolatum* in circalittoral coarse sand mixed with shell gravel
VenFabMag	Venerupid bivalve community with *Fabulina fabula* and *Magelona* sp in fine compacted infralittoral sands
VenMya	*Venerupis senegalensis* and *Mya truncata* in lower shore to shallow sublittoral muddy gravel
VmirAn	*Virgularia mirabilis* and burrowing anemones on infralittoral mud
Zmar	*Zostera marina* in infralittoral clean or muddy sand
ZmarBv	*Zostera marina* and bivalves in sheltered infralittoral fine sand and mud

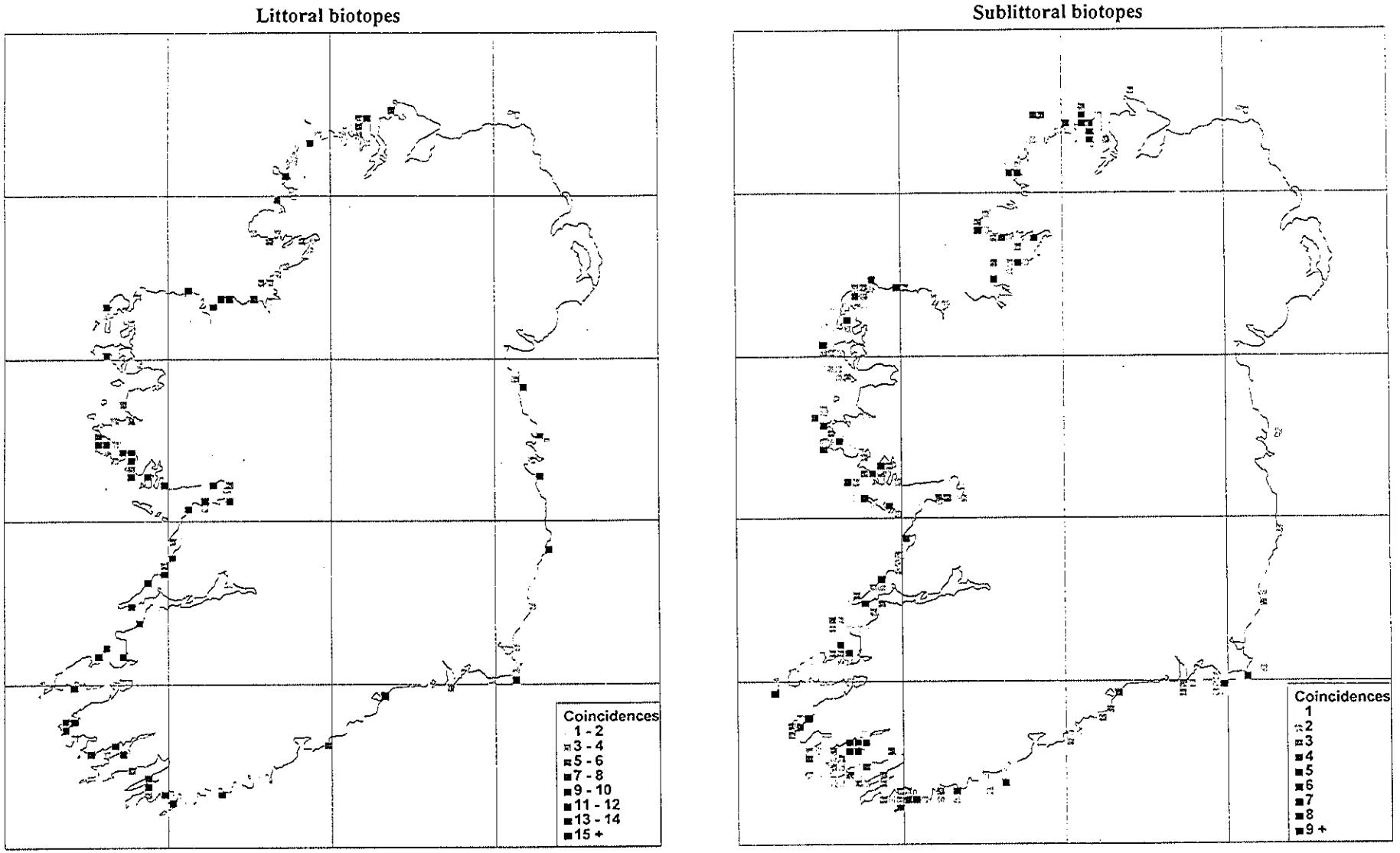


Figure 3. The number of (a) littoral and (b) sublittoral biotopes recorded per 5 km² in the BioMar project.

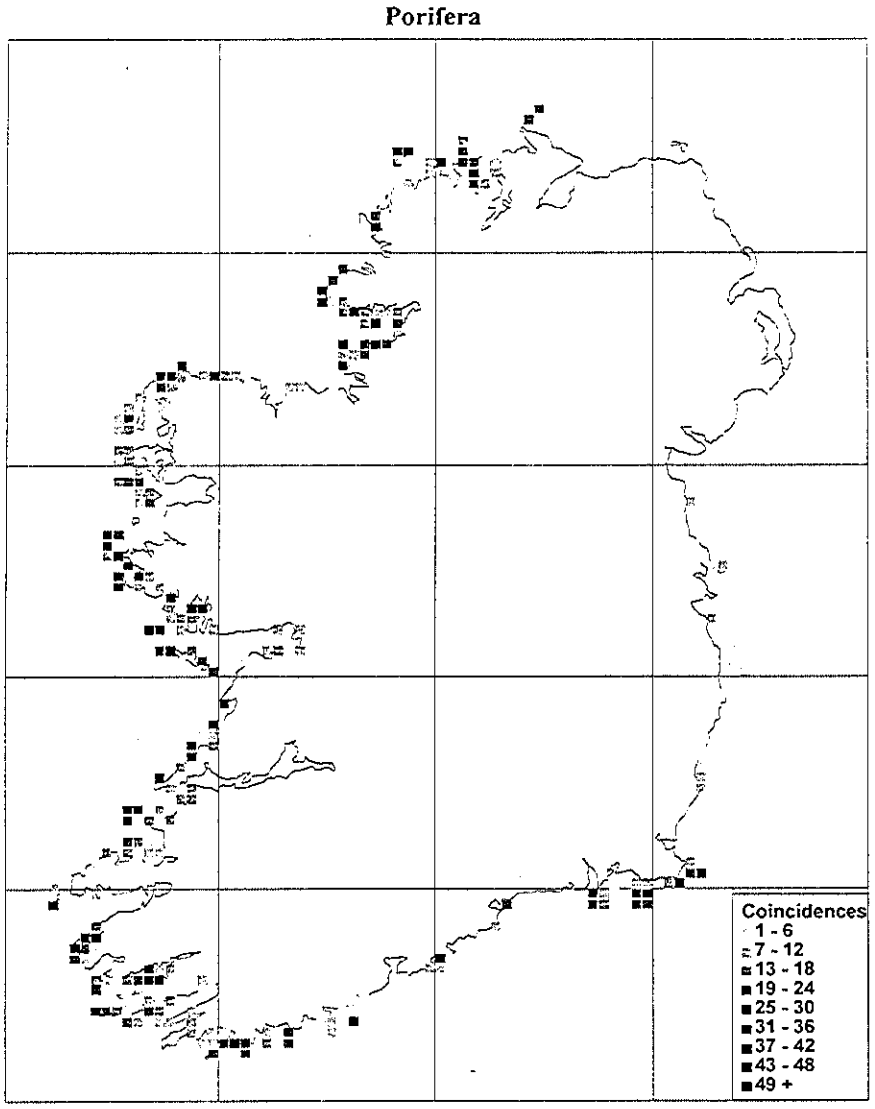


Figure 4(a). The number of species of Porifera recorded per 5 km².

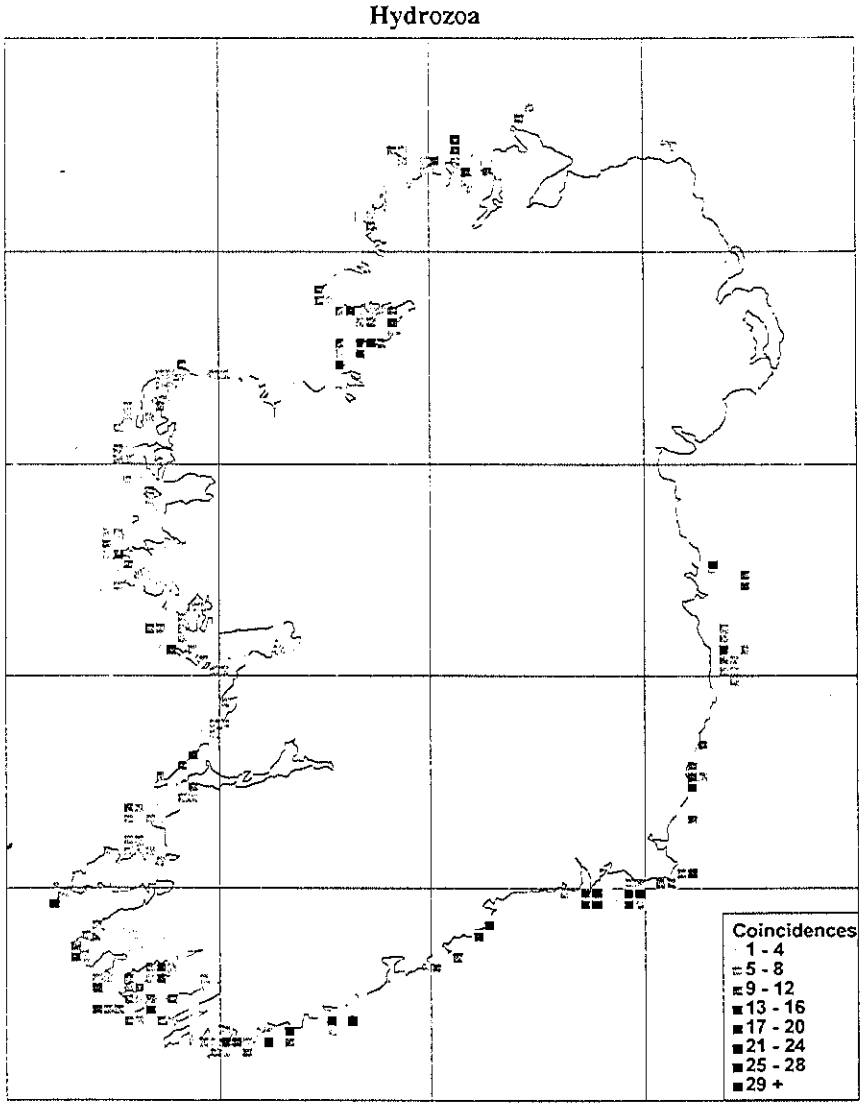


Figure 4(b). The number of species of Hydrozoa recorded per 5 km².

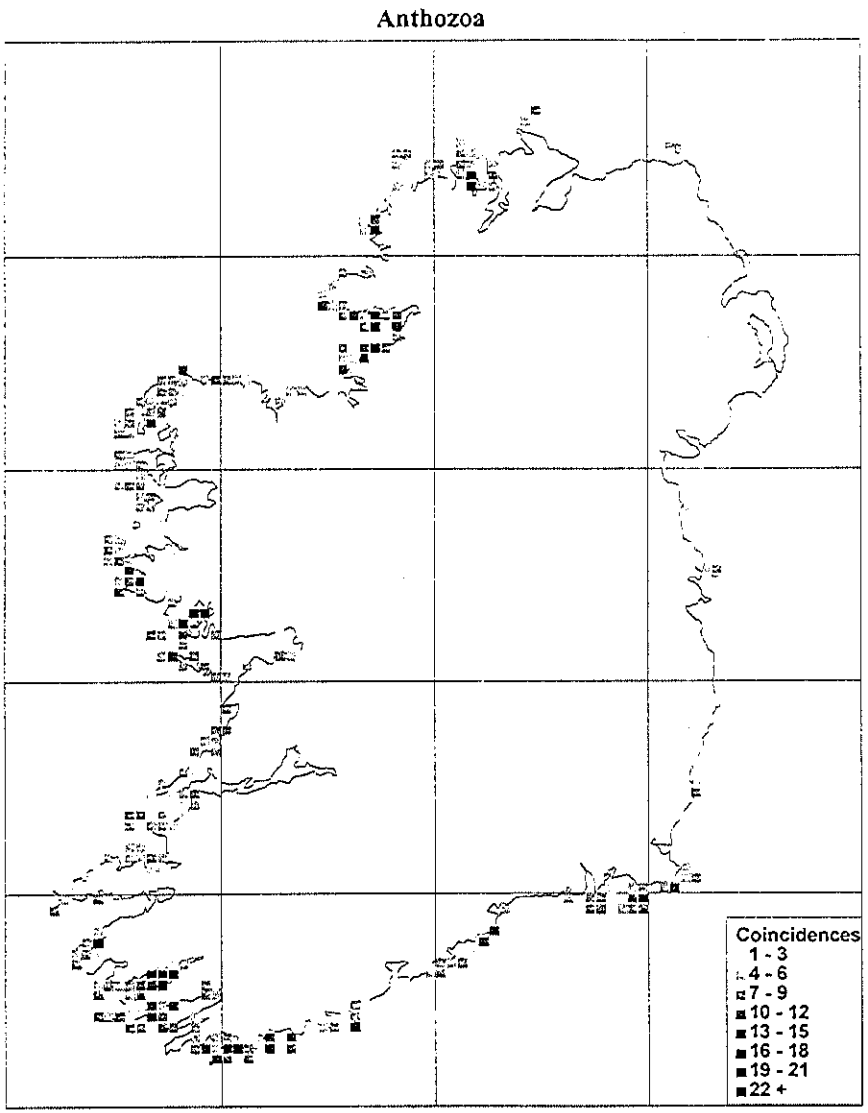


Figure 4(c). The number of species of Anthozoa recorded per 5 km².

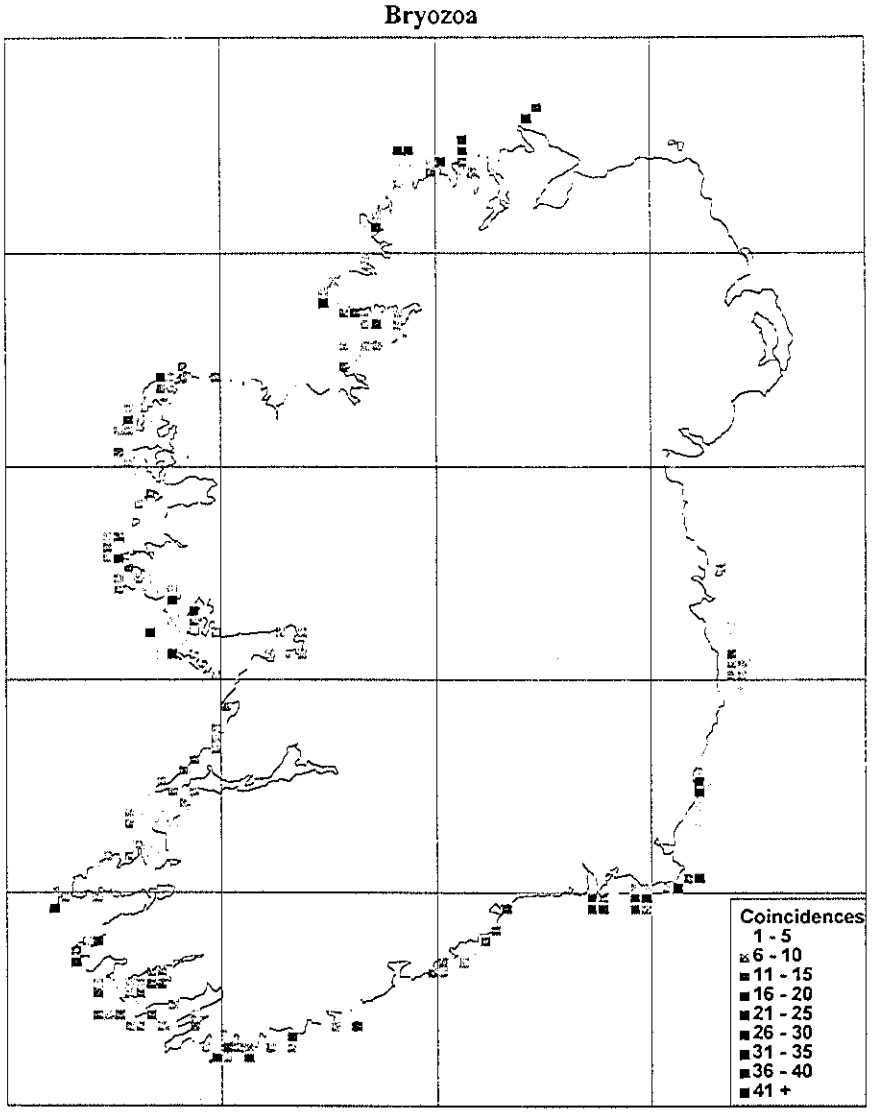


Figure 4(d). The number of species of Bryozoa recorded per 5 km².

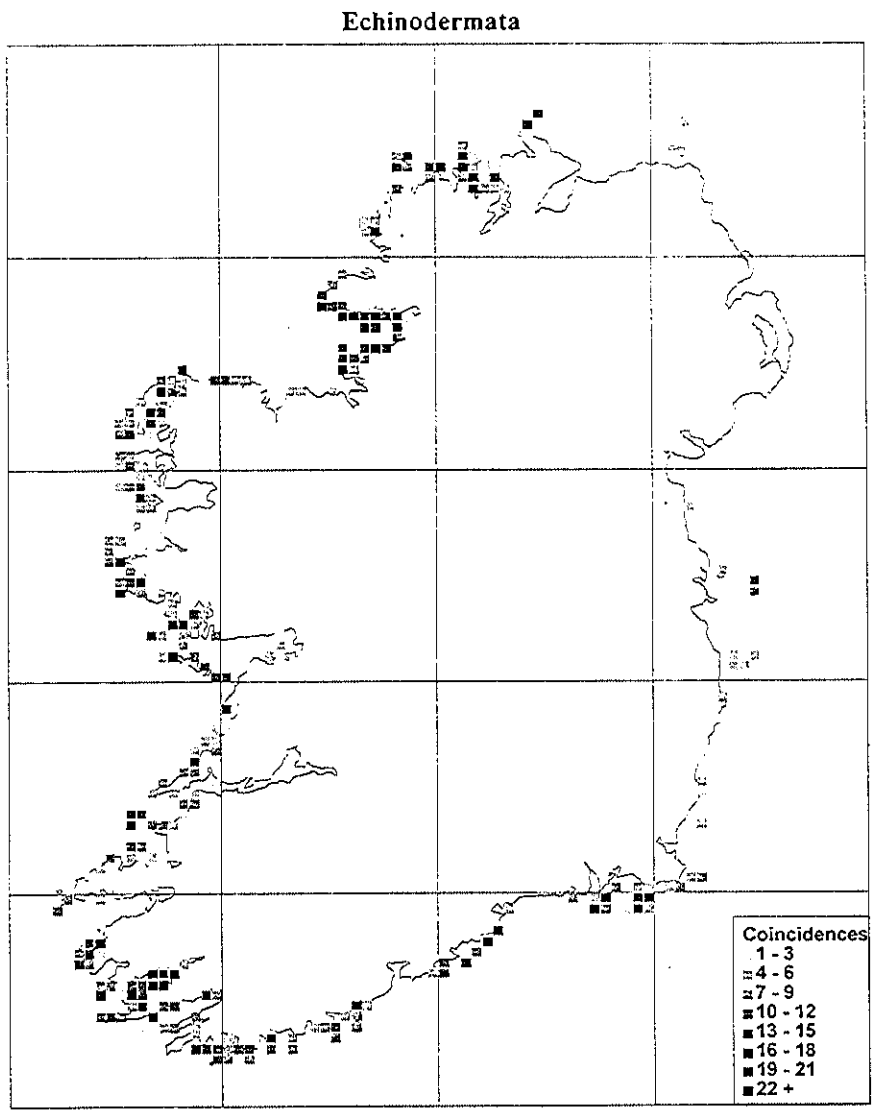


Figure 4(e). The number of species of Echinodermata recorded per 5 km².

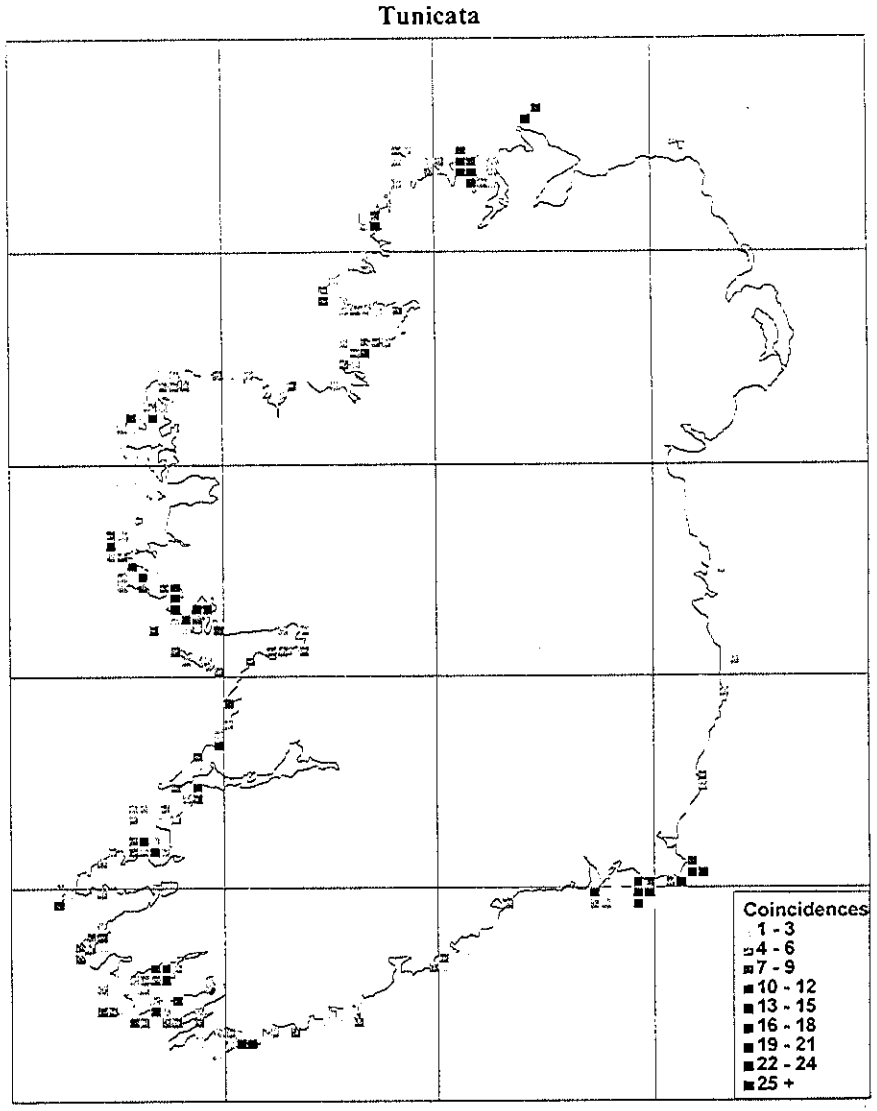


Figure 4(f). The number of species of Tunicata recorded per 5 km².

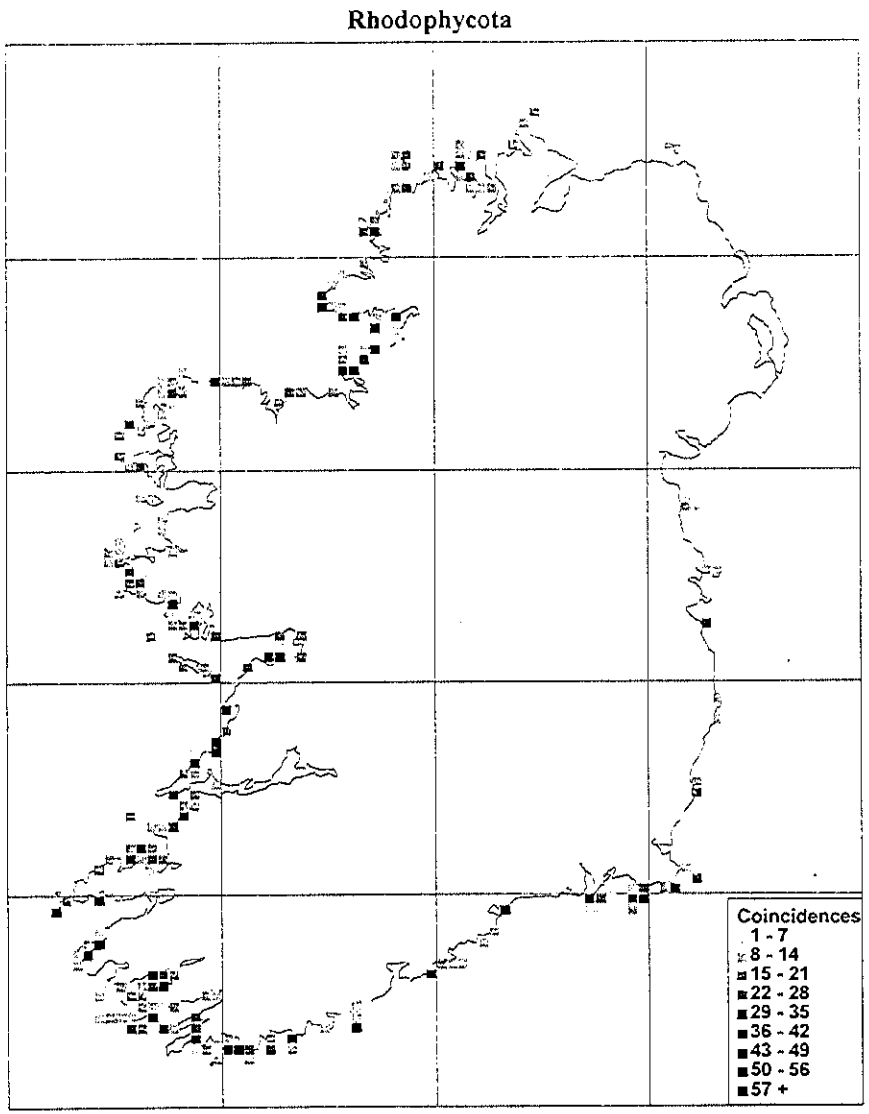


Figure 4(g). The number of species of Rhodophycota recorded per 5 km².

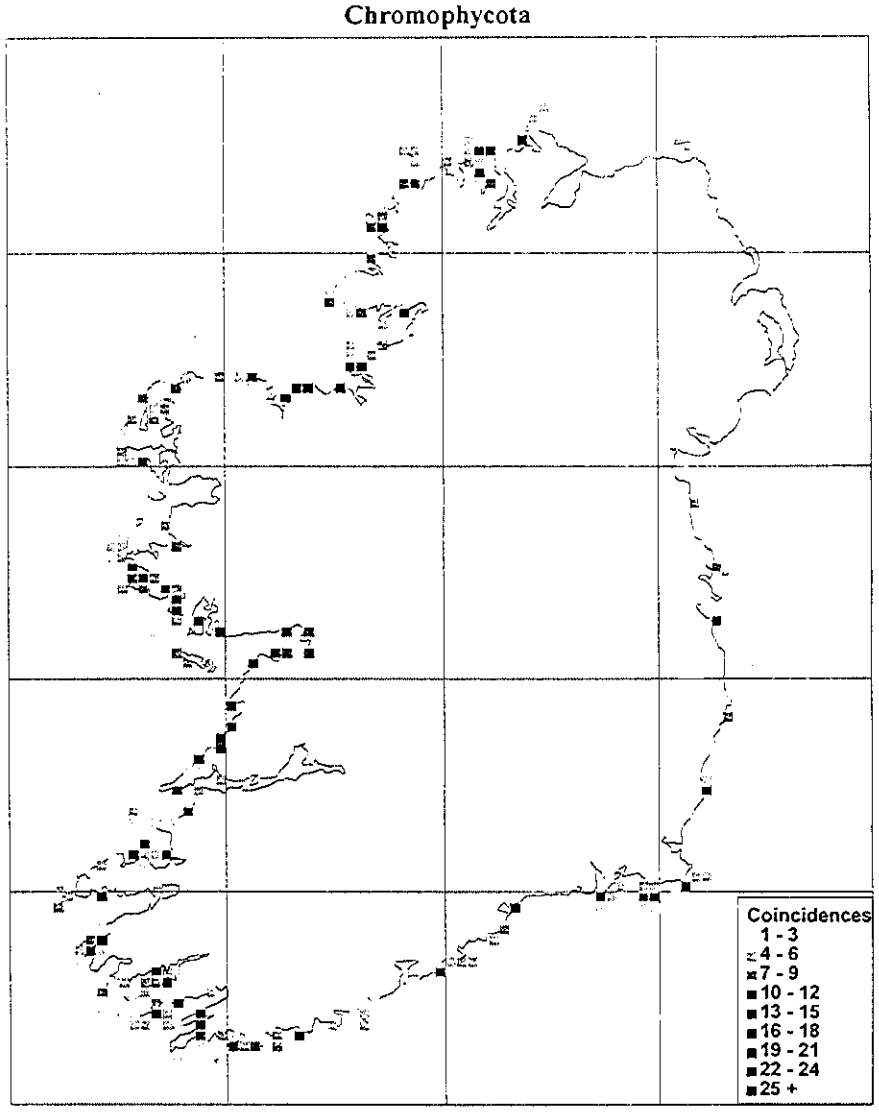


Figure 4(h). The number of species of Chromophycota recorded per 5 km².

Table 2.3. The numbers of species, the proportion of these species which occur in, the proposed areas of nature conservation interest, for the most common taxonomic groups recorded.

Taxon	Number of species present in area of conservation	recorded in whole survey	% species in conservation areas
Porifera	130	146	89.0
Cnidaria	107	132	81.1
Polychaeta	103	128	80.5
Crustacea	106	135	78.5
Mollusca	229	275	83.3
Bryozoa	61	65	93.8
Echinodermata	54	57	94.7
Tunicata	55	64	85.9
Pisces	69	83	83.1
Rhodophycota	161	199	80.9
Chromophycota	61	70	87.1
Chlorophycota	20	23	87.0
Lichens	22	28	78.6
Total	1178	1405	83.8

Table 2.4. The number of sites sampled, stations sampled at sites, biotopes, species, and notable species, recorded in the areas identified as being of nature conservation interest from the BioMar dataset.

Area	5 km^2	sites	stations	biotopes	species	notable species
Saltee Islands	17	43	64	25	507	4
Lough [illegible]	1	15	27	7	287	3
Roaringwater Bay and islands	8	48	96	39	412	6
Kenmare River	21	65	137	44	572	7
Magharee Islands and peninsula	4	10	27	18	288	3
Kerry Head shoals	4	9	9	4	177	4
Tralee Bay	8	15	32	18	292	5
Valentia Island	9	44	57	37	462	4
Aran Islands	8	18	21	12	272	4
Kilkieran Bay	8	32	68	32	545	8
Mannin Bay	6	16	27	25	288	4
St John's Point & N Donegal Bay	11	21	41	24	429	5
Rathlin O'Birne Island	3	14	31	14	240	4
Mullaghmore Head area	9	31	56	25	448	6
Tory Island	4	12	16	8	221	2
Broadhaven Bay	8	22	31	13	333	2
Mulroy Bay	8	31	60	33	493	7
Rutland Channel and Aranmore.	4	14	18	7	287	4
Finavarra	1	1	7	11	156	1
Magraths Point	1	1	8	11	206	4

Table 2.5. The proportion of species per site, species per station, biotopes per station, and species per biotope in each area. * values not comparable as only one site and few stations were sampled.

Area	species / sites	species/ station	biotopes/ station	species/ biotope
Saltee Islands	0.7	0.5	2.30	1.19
Lough Hyne	19.1	10.6	25.93	41.00
Roaringwater Bay and islands	1.1	0.5	5.08	1.32
Kenmare River	0.4	0.2	1.53	0.62
Magharee Islands and peninsula	7.2	2.7	16.67	4.00
Kerry Head shoals	4.9	4.9	11.11	11.06
Tralee Bay	2.4	1.1	7.03	2.03
Valentia Island	1.2	0.9	7.21	1.39
Aran Islands	1.9	1.6	7.14	2.83
Kilkieran Bay	2.1	1.0	5.88	2.13
Mannin Bay	3.0	1.8	15.43	1.92
St John's Point and North Donegal Bay	1.9	1.0	5.32	1.63
Rathlin O'Birne Island	5.7	2.6	15.05	5.71
Mullaghmore Head and adjacent coastline	1.6	0.9	4.96	1.99
Tory Island	4.6	3.5	12.50	6.91
Broadhaven Bay	1.9	1.3	5.24	3.20
Mulroy Bay	2.0	1.0	6.88	1.87
Rutland Channel area, Aranmore.	5.1	4.0	9.72	10.25
Finavarra	*156.0	*22.3	*157.14	14.18
Magraths Point	*206.0	*25.8	*137.50	18.73

Table 2.6. The proportion of species per site, species per station, biotopes per station, and species per biotope relative to (i.e. divide by) the number of 5 Km ^{2} surveyed in each area. * values not comparable as only one site and few stations were sampled.

Area	species/ sites	species/ station	% notable	biotopes/ station	species/ biotope
Saltee Islands	11.8	7.9	0.79	0.39	20.28
Lough Hyne	19.1	10.6	1.05	0.26	41.00
Roaringwater Bay and islands	8.6	4.3	1.46	0.41	10.56
Kenmare River	8.8	4.2	1.22	0.32	13.00
Magharee Islands and peninsula	28.8	10.7	1.04	0.67	16.00
Kerry Head shoals	19.7	19.7	2.26	0.44	44.25
Tralee Bay	19.5	9.1	1.71	0.56	16.22
Valentia Island	10.5	8.1	0.87	0.65	12.49
Aran Islands	15.1	13.0	1.47	0.57	22.67
Kilkieran Bay	17.0	8.0	1.47	0.47	17.03
Mannin Bay	18.0	10.7	1.39	0.93	11.52
St John's Point & North Donegal Bay	20.4	10.5	1.17	0.59	17.88
Rathlin O'Birne Island	17.1	7.7	1.67	0.45	17.14
Mullaghmore Head & adjacent coastline	14.5	8.0	1.34	0.45	17.92
Tory Island	18.4	13.8	0.90	0.50	27.63
Broadhaven Bay	15.1	10.7	0.60	0.42	25.62
Mulroy Bay	15.9	8.2	1.42	0.55	14.94
Rutland Channel area, Aranmore.	20.5	15.9	1.39	0.39	41.00
Finavarra	*156.0	*22.3	0.64	*1.57	14.18
Magraths Point	*206.0	*25.8	1.94	*1.38	18.73

DISCUSSION

The species recorded by BioMar and analyzed here represent about one quarter to a third of those known from Ireland. They provide the only data comparable at a national level and are the best available indicators of marine biodiversity at a national scale. It is especially valuable that the BioMar survey has covered such a wide range of seashore and underwater habitats as this increases the likelihood of a wide range of species' habitats being protected. The purpose of the present analysis was to indicate a suite of areas which together included the range of marine biodiversity likely to occur in Ireland, rather than protect the sampled taxa over any others. No attempt is made to prioritize areas for nature conservation, because each area has its own unique characteristics and will require its own management measures.

The analysis of the data shows its sensitivity to the sampling effort. Considering the large area to be covered within a short period this was unavoidable. However, it demonstrates that further sampling will identify more biotopes and species both in areas not surveyed, and within the surveyed areas.

Other areas of conservation importance

During the BioMar project possible areas of nature conservation importance were discussed with marine biologists familiar with parts of the Irish coast, and the relevant literature. Many of their predictions were supported by the BioMar data and are encompassed within the present areas of nature conservation importance. Others were not supported and have not been included. However, it was not always possible to collect enough information on the variety of marine biotopes during a survey (e.g. due to poor weather conditions). Thus some areas which were suggested as being of possible conservation interest do warrant further surveys. These are Inistrahull on the north coast, Inishbofin area, Killary Harbour, and Salt Lake in Connemara, Tuskar Rock off Carnsore Point, Auchinish and Muckinish in inner Galway Bay, Black Head and sublittoral habitats in north-west Clare, and Blasket Islands in the south-west, and Dalkey Island area and Rockabill off County Dublin. The Irish Sea Study Group report suggested that the latter two areas and Lambay may be of nature conservation importance (Merne et al. 1990). Lambay was surveyed by BioMar and was not considered as of international importance as the other areas proposed in this report. Other small areas, similar in size to Finavarra and Magrath's Point, may also be found to be unusually rich in species and/or biotopes and deserve special protection.

Future studies

It would be useful if future surveys in Irish coastal waters used similar methods, recorded data in a similar manner, and the data was added to the BioMar database. However, this is unlikely to happen in all cases because of differences in study objectives,

personnel, and available methods. It is recommended that the impetus and database established by the BioMar project in Ireland, both field data and bibliography, be maintained and built upon. This database is of value to all aspects of marine and coastal environmental management and not limited to nature conservation.

The limitations of the MNCR-BioMar database must also be recognized. It has been designed for recording marine survey data on a site by site basis, and analyzing this data to identify biotopes. It is a most effective and well designed database for its particular purposes. However, it is limited in the quantity of data that can be analyzed at one time within the database, and the types of analyses which can be conducted. Also errors regularly occur in the database and it is difficult to find persons with the expertise to correct the problems. The exporting of the key elements of the TCD database to a Microsoft Access database, now published on compact disc, makes the data widely available. The BioMar should be further analyzed using other analytical software which may reveal new insights into the patterns of marine biodiversity in Ireland with consequent implications for coastal management. The results, synthesis and interpretation of such analyses should be published in the scientific literature. The database may also provide useful information to develop a marine public education programme.

Complementary approaches to the BioMar survey would include more systematic and detailed mapping of the distribution, and studies of the ecology, of particular taxa by specialists. Mapping of the distribution of marine algae (M. Guiry pers. comm.) and molluscs (J. Nunn pers. comm.) is in progress, and the BioMar data has contributed to this work. The results of these studies may identify new areas of nature conservation importance and significantly improve knowledge of species in currently identified areas. Studies which improve the understanding of the ecology of species which contribute to the wider biodiversity should also be a priority. For example, populations of habitat forming species such as maerl, flame shells, oyster and mussel beds, and large seaweeds create their own biotopes. Another complementary approach would be to analyze the physical features of seascapes (physiographic features) in a standardized manner so as to identify the probable range of marine habitats in Ireland. This could be initially conducted using existing information and analyzed within a Geographical Information System. It should usefully identify what habitats are excluded from currently protected areas (e.g. SPA, SAC, NHA, etc.), and recommend habitats which require consideration and perhaps survey. This approach has been proposed in Canada where it is not feasible to collect standardized biological data for its large coastline within a few years.

3. Inventory of marine areas of nature conservation interest in Ireland

C. S. Emblow, M. McCrea, P. Tierney, C. C. Morrow and M. J. Costello

The areas selected from the BioMar data as areas of nature conservation importance, are listed in a clockwise direction around Ireland. The boundaries drawn in Figure 5 and in the descriptions below do not present definitive boundaries for possible nature conservation areas, but represent areas from which the data has been drawn. The data used was for notable species, biotope richness and species richness collected by BioMar and does not included previous research by other people. Hence the data under estimates the marine ecological resource in each area. In addition to the 18 areas mapped, two rocky shores in Co. Clare are of nature conservation importance, namely Magraths Point, Co. Clare and Finavarra, Co. Galway.

No. of sites
Represents the number of sites surveyed (by BioMar) in each of the areas and the dataset from which the information was drawn.

No. of stations
Represents the number of sampling stations at each site in each of the areas and the dataset from which the information was drawn.

Notable species
The number of notable species recorded by BioMar in each area is given and the species listed. This category includes the rare species (Table 2.1) and species listed in Appendix 1.

Biotope richness
The number of biotopes recorded by BioMar in each area is given and the biotopes listed. Explanations of the codes are given in Table 2.3. Appendix 3 summarizes the distribution of biotopes within each area.

Species richness
The (a) number of species or higher taxa, (b) number of species in each of the main phyla, and (c) the percentage of the total number of species in each phyla, recorded by BioMar in Ireland for the areas are given.

Location Map
Gives the location of the sites surveyed by BioMar considered in the area inventories.
●- Sublittoral sites
■ - Littoral sites

Bibliography
A bibliography for each area is given. These are not exhaustive, and a more complete bibliography has been published (Kelly et al. 1997). References to studies cited in the text are given in section 4 of this report.

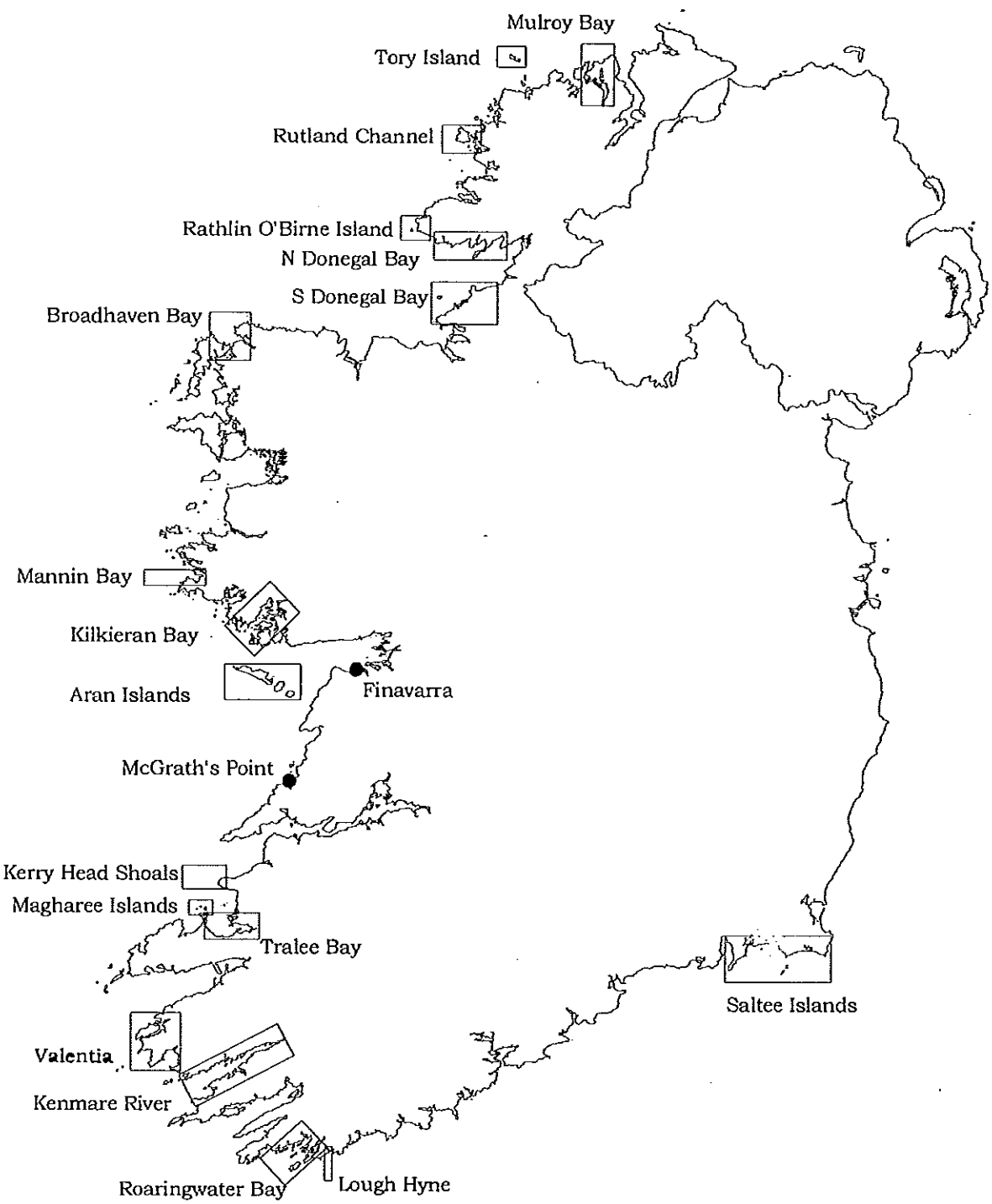


Figure 5. Map showing the distribution of areas of marine nature conservation importance. The boxes are indicative of the areas location and not of any possible boundaries of marine conservation areas.

Saltee Islands and adjacent coastline

County: Wexford
BioMar sector: IR3
Grid reference: T 130 040 - X 700 900
No. of sites: 43 **No of stations:** 64

Description:

This area covers the coastline extending from Carnsore Point to Hook Head including the Saltee Islands out to Coningbeg Rock. Pinnacles of bedrock rise to the surface forming offshore rocks at Coningbeg Rock, the Brandies and Conningmore Rock. The seabed offshore from Carnsore Point consists of large boulders and bedrock subject to strong tidal streams. Around the Saltee Islands the habitat diversity increases with areas of tideswept sand and cobbles with a mixture of bedrock and boulders supporting a rich biota of tunicates, sponges and hydroids.

In addition to the notable species listed below other species of interest were present. *Tethyspira spinosa*, a sponge with a south-western distribution in Britain and Ireland, was previously known in Ireland from Sherkin Island. Sanderson (1996b) classified as scarce *Plocamilla coriacea*, another sponge which has only recently been described from Ireland (Ackers *et al.*, 1992). The hydroid *Halecium muricatum*, has a northern distribution and there have been no Irish or British records in the 20th century, although records do exist for the Isle of Man (Hayward and Ryland, 1995). Another hydroid *Aglaophenia kirchenpaueri*, is scarce along the west coast of Ireland (Picton in Svoboda and Cornelius, 1991) and is classified as scarce by Sanderson (1996b). *Thuiaria articulata* was recorded from the Saltee Islands, and there are few records of this northerly distributed hydroid south of Dublin (Cornelius, 1995). Another hydroid *Sertularella fusiformis*, has no previous Irish records, though Cornelius *et al.* (1995) presume that it may be found all around the British and Irish coasts. The hydroid *Tamarisca tamarisca* is found only patchily throughout Britain and Ireland (Cornelius, 1995) and is classified as scarce by Sanderson (1996b). The brittlestar *Amphiura securigera* was recorded from around the Saltee Islands area although there are a few previous records from Britain and Ireland. Picton (1993) gives it a western and southern distribution. The tunicate *Pycnoclavella aurilucens* has a southwestern distribution in Britain and Ireland and is thought to occur on the west coast of Ireland, extending as far north as Galway Bay (Picton, 1985b). It was classified as scarce by Sanderson (1996b) but was widespread around the Saltee Islands. BioMar recorded *Stolonica socialis*, another tunicate, for the first time in Ireland from several sites at the Saltee Islands.

Littoral rock biotopes were surveyd at Carnsore Point and Hook Head. Biotopes recorded from these sites were typical of rocky shores around Ireland. Littoral sediments recorded from Kilmore Quay beach were also characteristic of many beaches around the coast. Important biotopes within the Saltee Island areas were the rich infralittoral sponge, hydroid and algae communities (FoR, XK and HalXK) which characterised the tide-swept shallower bedrock and boulders. Those circalittoral biotopes recorded were also typical of tide-swept rock particularly the bryozoan characterised *Flustra foliacea* biotope (Flu) and *Alcyonium digitatum* and *Tubularia* spp. biotope (AlcTub). The sublittoral sediment biotope characterised by the sea cucumber *Neopentadactyla mixta* (NeoBv) was recorded around the Saltee Islands. It was only recorded seven times on the BioMar survey.

In addition to the marine fauna and flora of the area Great Saltee Island supports an internationally important breeding population of cormorants, as well as breeding populations of gannet, fulmars, Manx shearwaters, kittiwakes, guillemots, razorbills and puffins.

Notable species: 4 notable species were recorded.

Cataphellia brodricii *Sidnyum elegans*
Schizomavella sarniensis *Schizymenia dubyi* – Hook Hd.

Biotope richness: 25 biotopes were recorded.

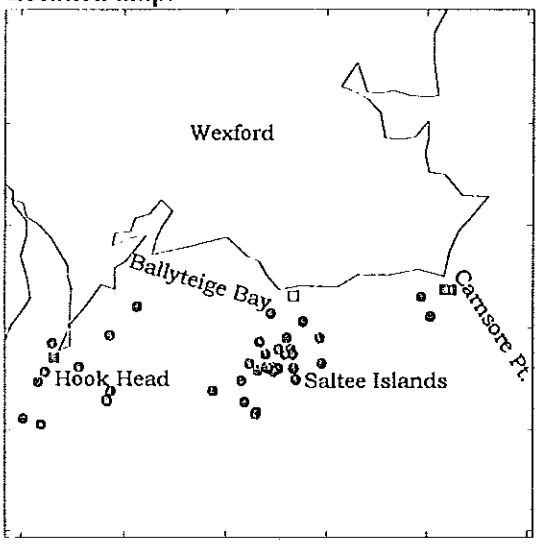
Littoral rock	Aud	**Sublittoral sediment**	**Infralittoral rock**	**Circalittoral rock**
YG.YG		NeoBv	Lhyp.TPk	Axi
Ver.Ver	**Littoral sediment**	Mob	LhypFa	CCParCar
Fser.R	Tal		Ala.Myt	Flu
Asc.Asc	AreBv		HalXK.Ft	AlcTub
BPat.Sem	AP		FoR	Oph
Fves			XK	
BPat			Ldig.Ldig	

Species richness:

507 species or higher taxa were recorded.

Porifera 69 (47.3%) 585pp Saltees	Bryozoa 28 (43.1%)	Chromophycota 26 (37.1%)
Cnidaria 63 (47.7%)	Echinodermata 23 (40.4%)	Chlorophycota 7 (30.4%)
Polychaeta 24 (18.8%)	Tunicata 37 (57.8%)	Lichens 4 (14.3%)
Crustacea 39 (28.9%)	Pisces 35 (42.2%)	Others 8 (17.0%)
Mollusca 78 (28.3%)	Rhodophycota 66 (33.2%)	

Location map:



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Lough Hyne

County:	Cork		
BioMar sector:	IR4		
Grid reference:	W 095 285		
No. of sites:	15	**No of stations:**	27

Description:

Lough Hyne is an enclosed marine 'lake' connected to the sea by a shallow channel. The lough exceeds 40 metres in depth and provides a stable, ultra-sheltered, fully marine environment. The entrance channel to the lough is subject to strong water movement and the seabed here supports a rich fauna and flora. Bedrock cliffs support very rich and varied sponge communities. Towards the head of the lough the seabed is sedimentary with areas of cobbles and mud supporting a range of organisms.

In addition to the notable species, listed below, other interesting species recorded from Lough Hyne include the sponge *Axinella damicornis*, a species was previously recorded from Lough Hyne, Skird Rocks, St John's Point, Rathlin O'Birne Island and Rathlin Island (Ackers *et al.*, 1992). Although recorded from many sites in Ireland it is usually present in very low numbers. Another sponge *Microciona spinarcus*, was recorded by BioMar from a littoral site which is unusual, it is more often encountered on vertical rock faces at exposed sites, where it favours strong water movement (Ackers *et al.*, 1992). The nudibranch *Aeolidiella alderi*, previously been recorded from the south and west of Britain and Ireland (Picton and Morrow, 1994) was recorded from Lough Hyne. The soft coral *Paraerythropodium coralloides*, originally described from Lough Hyne, has only elsewhere been recorded from Clare and south and north Donegal (Picton 1985a).

Biotopes of interest recorded from Lough Hyne include the rich examples of the brown algae dominated biotopes Lsac.Ldig and HalXK.Ft from the tidal rapids. Deeper bedrock cliffs supported biotopes characterised by solitary ascidians (SoAs) and erect axinellid sponges (Axi). Sublittoral sediments in the northern basin of the lough supported beds of the seapen *Virgularia mirabilis* (SpNep).

The fauna and flora of L. Hyne is well documented, is particularly species rich for its area (Costello and Myers 1991), and many species of note have been recorded here. Lough Hyne has been the focus of much previous and current scientific study (e.g. Wilson 1984, Myers *et al.*, 1991). It is currently Ireland's only marine nature reserve.

Notable species:

3 notable species were recorded.

Aeolidiella sanguinea *Gobius couchi* *Gobius cruentatus*

Biotope richness:

7 biotopes were recorded.

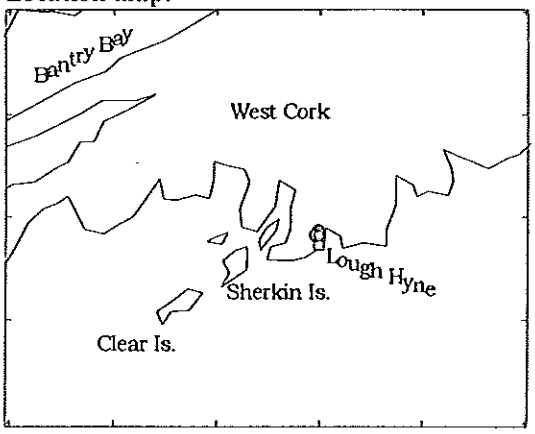
Littoral rock	**Littoral sediment**	**Infralittoral rock**	**Circalittoral rock**	**Sublittoral sediment**
AscX		Lsac.Ldig	SoAs	TcomAsAn
		HalXK.Ft	Axi	SpNep

Species richness:

287 species or higher taxa were recorded.

Porifera 51 (34.9%)	Bryozoa 9 (13.8%)	Chromophycota 14 (20.0%)
Cnidaria 29 (22.0%)	Echinodermata 13 (22.8%)	Chlorophycota 3 (13.0%)
Polychaeta 12 (9.4%)	Tunicata 21 (32.8%)	Others 7 (14.90%)
Crustacea 20 (14.8%)	Pisces 20 (24.1%)	
Mollusca 37 (13.4%)	Rhodophycota 51 (25.6%)	

Location map:



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Roaringwater Bay and islands

County: Cork
BioMar sector: IR4
Grid reference: V 938 205 - V034 342
No. of sites: 48 **No of stations:** 96

Description:

This shallow bay has a wide variety of marine habitats, and is subject to a range of wave exposures. The numerous islands and rocks provide areas of shelter from the prevailing swell, whilst the southern coasts of Clear and Sherkin Islands bear the full brunt of the sea. The sounds and narrows between the islands are subject to increased tidal streams in particular Gascanane Sound. The head of the bay is shallow and sheltered and the seabed is predominantly sedimentary.

In addition to the notable species listed below other interesting species also added to the conservation interest of Roaringwater Bay. The sponges *Hymedesmia jecusculum* and *Microciona strepsitoxa,* recorded from shores in Roaringwater Bay, this is unusual as they are rarely found on shores. The hydroid *Tamarisca tamarisca* recorded thoughout the areas is found only patchily throughout Britain and Ireland (Cornelius, 1995); Sanderson (1996b) classified it as scarce. The inconspicuous burrowing anemone *Halcampa crysanthellum*, was recorded on all coasts, but never in abundance.

Roaringwater Bay has a wide range of biotopes present, due to the range of environmental conditions within the area. Bedrock and boulder shores supported a range of littoral rock biotopes from lichen dominated upper shores (Ver.Ver and RamG) to sheltered sites dominated by *Ascophyllum nodosum* biotopes (Asc.Asc, Asc.T and AscX) and more exposed site characterised by *Fucus serratus* biotopes (Fser.Fser and FserX). In the River Ilen estuary the rock supported a *Fucus ceranoides* biotope (FcerX) typical of variable salinity conditions. Infralittoral rock support a range of kelp biotopes from exposed *Laminaria hyperborea* (LhypFa, LhypLsac.F and LhypGz.Ft) to more sheltered *Laminaria saccharina* (Lsac.Ft) biotopes. An interesting feature of the area is the range of sublittoral sediment biotopes present. A range of sediments supported burrowing sea urchins (EcorEsil, AfilEcor and AbraEcor), whilst shallower sediments where dominated by *Zostera marina* beds (Zmar and ZmarBv). Of particular interest were extensive beds of the maerl *Lithophyllum fasciculatum* biotope (Lfas) recorded only from Roaringwater Bay by BioMar. Two other maerl biotopes were also recorded (Lcor and Phy).

This area is extensively used for commereial fishing and recreation. Several of the offshore island coasts have been proposed as NHAs.

Notable species:

6 notable species were recorded.

Phyllophora sicula	*Lithophyllum fasciculatum*	*Zostera marina*
Lithothamnion corallioides	*Phymatolithon calcareum*	*Spyridia filamentosa*

Biotope richness:

39 biotopes were recorded.

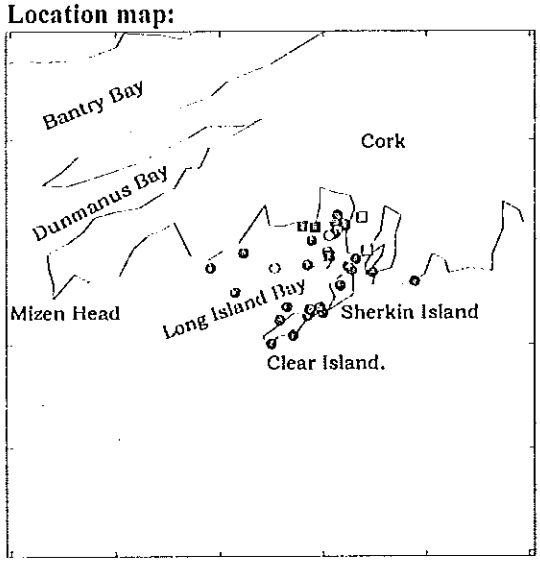
Littoral rock	Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediments
Ver.Ver	Lan	HalXK.Ft	Ant	AbraEcor
RamG		Ldig.Ldig	Axi	AfilEcor
BPat.Sem		LhypFa	CCParCar	EcorEsil
Pel		LhypGz.Ft		Lcor
PelB		LhypLsac.F		Lfas
Asc.Asc		Lsac.Ft		NeoBv
Asc.T				Phy
AscX				Sell
Fves				Spav
FvesB				TcomAsAn
FcerX				VenBra
Fser.Fser				VenMya
FserX				Zmar
R.Mas				ZmarBv
Cor				

Species richness:

412 species or higher taxa were recorded.

Porifera: 48 (33.9%)	Bryozoa: 20 (30.8%)	Chromophycota: 23 (32.9%)
Cnidaria: 49 (37%)	Echinodermata: 25 (43.9%)	Chlorophycota: 7 (30.4%)
Polychaeta: 15 (11.7%)	Tunicata: 18 (28.1%)	Lichens: 11 (39.3%)
Crustacea: 30 (22.2%)	Pisces: 20 (24.1%)	Others: 13 (27.7%)
Mollusca: 70 (25.4%)	Rhodophycota: 63 (31.7%)	

Location map:



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Kenmare River

County:	Kerry		
BioMar sector:	IR5		
Grid reference:	51° 34.00'N 10° 15.00'W - 51° 54.00'N 09° 35.00'W		
No. of sites:	65	**No of stations:**	137

Description:

Kenmare River is a drowned river valley (ria) in which exposure to wave surge gradually decreases from the entrance to the head. Numerous islands and islets along its length break up the coastline providing areas of additonal shelter. Along it's margins are several bays and inlets in which unusual communities occur.

In addition to the notable species recorded from Kenmare River listed below, other species of interest were recorded. The sponge *Dercitus bucklandi* was recorded from shore sites within Kenmare River. This is an unusual location to find this species, as it is found mostly in caves or overhanging rock faces, especiallly at sites exposed to wave action or moderate to strong tidal streams. The sponge *Phakellia ventilabrum* was common in the deeper water and it has recently been recorded in Ireland from Skird Rocks and the Aran Islands (Ackers *et al.*, 1992). Another sponge *Phakellia vermiculata* was also present, and again has only recently been recorded in Ireland from Skird Rocks, the Aran Isles and Kenmare River (Ackers *et al.*, 1992). The sponge *Clathria barleei*, was recorded from Kenmare River, this sponge has a preferred habitat below 40m but was recorded in Kenmare River from relatively shallow water. Previous records are from south and west coasts of Ireland (Ackers *et al.*, 1992). The hydroid *Aglaophenia kirchenpaueri*, is present but scarce along the west coast of Ireland (Picton in Svoboda and Cornelius, 1991) whilst *Tamarisca tamarisca,* is found only patchily throughout Britain and Ireland (Cornelius, 1995). Both were recorded from Kenmare River and are classified as scarce by Sanderson (1996b). The delicate seapen *Virgularia mirabilis* was common in Kenmare River. It often co-occurs with the queen scallop *Aequipecten opercularis* which is commercially fished by dredging. The fireworks anemone *Pachycerianthus multiplicatus*, previously reported from Galway (O'Connor *et al.*, 1977) and then Kenmare (Picton, 1985a), was again found in Kenmare River by BioMar. Two species of brachiopod were recorded from Kenmare River; *Neocrania anomala* on the shores, which is unusual for this species, and *Terebratulina retusa* in relatively shallow water. *Ophiopsila annulosa*, a southern species of brittlestar, has previously been recorded from the south coast of England, the west coast of Ireland and south-west Scotland (Picton, 1993); Sanderson (1996b) classified as scarce. BioMar found it at two sites. The brittlestar *Amphiura securigera* was found in the Kenmare River, and has few records from Britain and Ireland (Picton, 1993). The tunicate *Pycnoclavella aurilucens,* was frequent in Kenmare River and has a southwestern distribution in Britain and Ireland. It is thought to occur on the west coast of Ireland, extending as far north as Galway Bay (Picton, 1985b). It was classified as scarce in Britain by Sanderson (1996b). Another seasquirt *Pyura squamulosa* was recorded; it is described as uncommon by Erwin *et al.* (1990) who recorded the first occurrence in Ireland. However Millar (1970) describes it is common off British coasts. The brown algae *Naccaria wiggii* occurred in Kenmare River, one of only two sites in Ireland from which it was noted by BioMar. The other was an incomplete record from Sherkin Island, Co. Cork.

The range of biotopes recorded from Kenmare River was high. Fifteen littoral rock biotopes were recorded including rockpools with the urchin *Paracentrotus lividus* (Cor.Par). Littoral sediment biotopes were typical of many beaches characterised by polychaetes in particular an *Arenicola marina* and bivalve biotope (AreBv) an amphipod/polychaete midshore biotope (AP) and polychaete/*Scolelepis foliosa* biotope (PSfol). Infralittoral rock biotopes were recorded from a range of wave exposures and depths. Sublittoral fringe rock supported *Laminaria digitata* and *Alaria esculenta* biotopes, Ldig.Ldig and Ala.Myt respectively whilst kelp dominated slightly deeper rock Lhyp, Lhyp.Lsac.Ft, Lhyp and Lsac.Ft.Areas of tideswept shallow rock supported mixed kelp forests (XK). Below the kelp, rock supported red and brown algae dominated biotopes (Dic and FoR). Caves on the south side of Kenmare River had interesting sponge dominated biotopes on their vertical walls (SC) whilst other areas of wave exposed rock were dominated by sponge, hydroid and bryozoans turfs (SCAs.ByH). Those circalittoral biotopes that were recorded included the biotopes characterised by the seafan *Swiftia pallida* (SwiErS), which is only known from Ireland in Kenmare River, and characterised by brachiopods (Bra.PlaS). Offshore exposed rock was characterised by AlcTub with Axi found on deeper rock. The featherstar *Antedon bifida* (Ant) and coralline crusts/bryozoan crust/*Caryphyllia smithi* circalittoral rock biotopes were typical of exposed circalittoral rock within the bay. Sublittoral sediments supported biotopes ranging from waves of mobile sand with little fauna (Mob) to

consolidated sands characterised by burrowing urchins and echinoderms, particularly the cucumber *Neopentadactyla mixta* (AfilEcor and NeoBv). Two maerl biotopes (Lcor and Phy) were recorded from Kilmakilloge Harbour. Towards the head of the bay the seabed was muddy and characterised by the seapen *Virgularia mirabilis* with prawn *Nephrops norvegicus* (SpNep and VmirAn).

Notable species:
7 notable species were recorded.

Acervochalina limbata	*Hero formosa*	Maerl indet.
Swiftia pallida	*Paracentrotus lividus*	
Tritonia lineata	*Lithothamnion corallioides*	

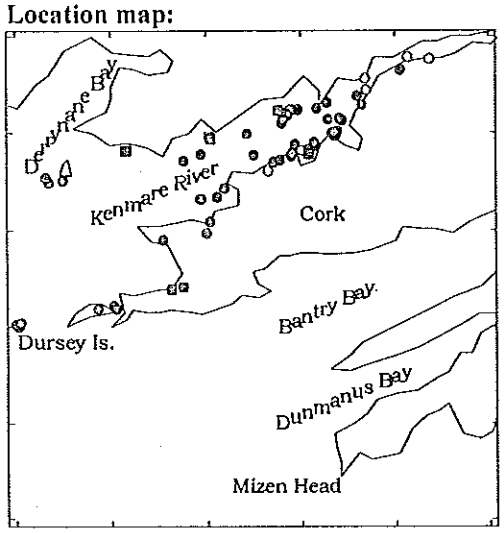
Biotope richness:
44 biotopes were recorded.

Littoral rock	Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediment
BPat.Cht	AreBv	Ala.Myt	Ant	AfilEcor
BPat.Sem	AP	CorMet	AlcTub	Lcor
Cor.Par	PSfol	Dic	Axi	Mob
Cor		FoR	Bra.PlaS	NeoBv
Fser.Fser		Ldig.Ldig	CCParCar	Phy
Fser.R		Lhyp	Oph	SpNep
Fspi		Lhyp.Lsac.Ft	SwiErS	VmirAn
FvesB		Lhyp		
FvesX		Lsac.Ft		
Him		SC		
MytB		SCAs.ByH		
PelB		XK		
Ver.B				
Ver.Ver				
YG.YG				

Species richness:
572 species or higher taxa were recorded.

Porifera 71 (48.6%)	Brachiopoda 2 (100%)	Rhodophycota 99 (49.7%)
Cnidaria 61 (46.2%)	Bryozoa 27 (41.5%)	Chromophycota 29 (41.5%)
Polychaeta 20 (15.6%)	Echinodermata 41 (71.9%)	Chlorophycota 12 (52.2%)
Crustacea 42 (31.1%)	Tunicata 29 (45.3%)	Lichens 12 (42.9%)
Mollusca 77 (27.9%)	Pisces 39 (47.0%)	Others 11 (23.4%)

Location map:



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Valentia Island

County: Kerry
BioMar sector: IR5
Grid reference: V 405 802 - V 463 613
No. of sites: 44 **No of stations:** 57

Description:

This area includes Ballinaskelligs Bay, St Finan's Bay, Puffin Island, Portmagee channel, Valentia Harbour, Doulus Bay and Doulus. It incorporates both hard and soft substrata, with exposed and sheltered sites. Tidal streams vary from strong in the narrows to weak in the harbour.

A number of species were recorded from Valentia Island which are of interest and are noted below. The sponge *Hymedesmia pansa* was recorded from a shore at Portmagee channel, although it is usually found sublittorally. The hydroid *Aglaophenia kirchenpaueri* was found at one site in this area. It is generally present but scarce along west coast of Ireland (Picton in Svoboda and Cornelius, 1991) and has been noted by Sanderson (1996b) as being scarce in Britain. The seapen *Virgularia mirabilis* was recorded at four sites around Valentia Island. This species often co-occurs with the queen scallop, which is commercially fished. The small burrowing anemone, *Halcampa chrysanthellum,* and the worm anemone, *Scolanthus callimorphus* were recorded in this area. Previously it has been recorded from the coast of Dorset (Manuel, 1980) and Roskeada Bay, Co. Galway (Picton, 1985a). The nudibranch, *Haminoea navicula* was recorded from four sites within this area. The only other area it was recorded during the BioMar survey was from Mulroy Bay. The tunicate, *Pycnoclavella aurilucens* has a south-western distribution in Britain and Ireland although it is noted as being scarce in Britain Sanderson (1996b). It was recorded from seven sites within this area.

Thirty-seven biotopes were recorded from the Valentia Island area. A range of rocky shore biotopes included upper shore lichen biotopes (RamG, Ver.Ver and YG.YG) and midshore bedrock and boulders were dominated by a range of fucoid algae including *Fucus vesiculosus* (Fves, FvesB and FvesX) and *Fucus serratus* (FserFser, FserR and FserX) or barnacles and limpets (BPatSem). Sheltered shores were dominated by *Ascophyllum nodosum* (AscX). Littoral sediments were polychaete and crustacean dominated. The strandline was characterised by talitrid amphipods (Tal) whilst the mid to lower shores by *Scolelepis foliosa* (PSfol) and *Euridice pulchra* (Aeur). Infralittoral rock was typically kelp dominated particularly by *Laminaria digitata* in the sublittoral fringe (with Ldig.Ldig and Ldig.T) and on more wave exposed sites *Laminaria hyperborea* (Lhyp, LhypFa and LhypLsac.Ft). Sheltered rock supported a mixed kelp biotope of *Laminaria saccharina* and *Laminaria digitata* (Lsac.Ldig). In the Portmagee Channel tideswept bedrock supported a mixture of kelps and scour tolerant fauna (XK). Foliose red algae dominated below the kelp (FoR). Circalittoral biotopes were recorded from the open coast of Valentia Island. Typically wave exposed rock supported coralline crusts with the bryozoan *Parasmittina trispinosa* and cup coral *Caryophyllia smithii* (CCParCar) with an axinellid sponge dominated community occurring in deeper water (Axi). Mobile rock in Doulus Bay were characterised by the robust polychaete *Pomatoceros triqueter* and barnacle *Balanus crenatus* biotope (PomByC). Interesting sublittoral sediment biotopes occurred within Portmagee Channel including maerl beds (Lcor) and *Zostera marina* beds (ZmarBv). Towards the west of the channel beds a seapen biotope was recorded (VmirAn). Sediment elsewhere in the area was dominated by bivalves (VenMya and MacAb).

Scallop dredging occurs in Portmagee channel periodically, also Valentia and Portmagee are both important centres for sea angling and scuba diving. Puffin Island may be the most important breeding for choughs in Ireland, with flocks of 300 having been recorded.

Notable species: 4 notable species were recorded.

Edwardsia delapiae	*Lithothamnion corallioides*
Paracentrotus lividus	*Zostera marina*

Biotope richness: 37 biotopes were recorded.

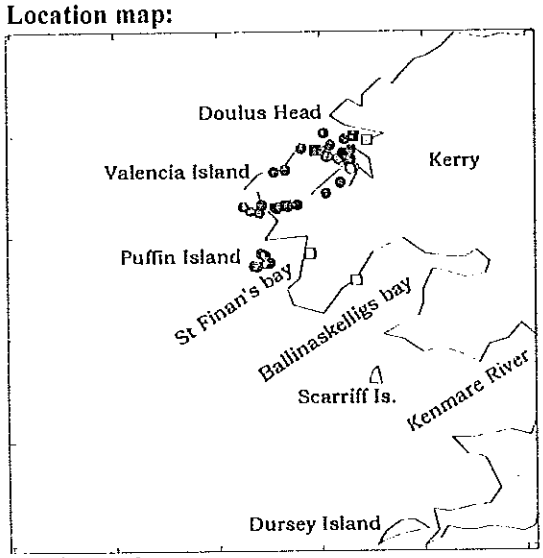
Littoral rock				Littoral sediment
AscX	FserX	MytB	YG.YG	AEur
BPat.Sem	Fspi	PelB		AreBv
FK	Fves	R.Mas		PSfol
FserFser	FvesB	RamG		Tal

Infralittoral rock	LhypFa	Circalittoral sediment	Sublittoral sediment
FoR	LhypLsac.Ft	Ant	VenMya
Ldig.Ldig	Lsac.Ldig	Axi	ZmarBv
Ldig.T	XK	CCParCar	Lcor
Lhyp		PomByC	VmirAn
			MacAb

Species richness: 462 species or higher taxa were recorded.

Porifera: 59 (40.4%)
Cnidaria: 54 (40.9%)
Polychaeta: 34 (26.6%)
Crustacea: 31 (23.0%)
Mollusca: 84 (30.4%)
Bryozoa: 16 (24.6%)
Echinodermata: 25 (43.9%)
Tunicata: 17 (26.6%)
Pisces: 22 (26.5%)
Rhodophycota: 61 (30.7%)
Chromophycota: 23 (32.9%)
Chlorophycota: 7 (30.4%)
Lichens: 8 (28.6%)
Others: 21 (44.7%)

Location map:



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Magharee Islands and peninsula

County: Kerry
BioMar sector: IR5
Grid Reference: Q 580 190 - Q640 230
No. of sites: 10 **No of stations:** 27

Description:

This is a group of offshore islands on the north side of the Dingle peninsula west of Tralee Bay subject to strong tidal streams. The bedrock was limestone and the shores were of particular interest with the urchin *Paracentrotus lividus* in abundance and the rare seaweed *Phyllophora sicula* present. Also of note was the sponge *Myxilla rosacea* which is unusual to find on the shores.

Offshore the seabed was tidal swept bedrock with boulders and cobbles with interesting sponges in particular, including an undescribed species of the genus *Spongosorites*.

Littoral biotopes were well represented from the Magharee Islands and peninsula. The rocky shores of the peninsula supported a range of fucoid dominated biotopes (Fser.Bo, Fser.R and Fves). Away from the algae the rock was characterised by barnacles and limpets (BPat.Cht) with coralline encrusted rockpools (Cor) and lower down the shore deep fucoid and kelp dominated rockpools (FKBo). The infralittoral rock was characterised by mixed kelp biotopes, *Alaria esculenta* (Ala.Ldig) dominating the more exposed sites with *Laminaria hyperborea* (Lhyp.TPk and LhypLsac.Ft), *L. digitata* (Ldig.T) and *Saccorhiza polyschides* biotopes (Spol) in less wave exposed areas. No littoral or sublittoral sediment or circalittoral rock biotopes were surveyed.

Notable species:

3 notable species were recorded.

Mycale ovulum *Paracentrotus lividus* *Phyllophora sicula*

Biotope richness:

18 biotopes were recorded.

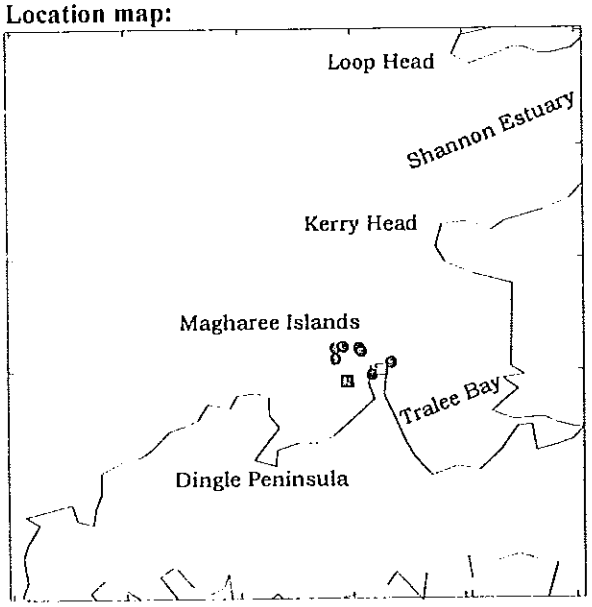
Littoral rock	Infralittoral rock
BPat.Cht	Ala.Ldig
Cor	FoR
FK.Bo	Ldig.T
Fser.Bo	Lhyp.TPk
Fser.R	LhypLsac.Ft
Fves	Spol
G	
Him	
MytB	
Ver.B	
Ver.Ver	
YG.YG	

Species richness:

288 species or higher taxa were recorded.

Porifera 34 (23.3%)	Bryozoa 36 (12.3%)	Chromophycota 25 (35.7%)
Cnidaria 22 (16.7%)	Echinodermata 13 (22.8%)	Chlorophycota 53 (21.7%)
Polychaeta 12 (9.4%0	Tunicata18 (28.1%)	Lichens 12 (42.9%)
Crustacea 25 (18.5%)	Pisces 7 (8.4%)	Others 12 (25.5%)
Mollusca 25 (13.0%)	Rhodophycota 59 (29.6%)	

Location map:



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Tralee Bay

County: Kerry
BioMar sector: IR5
Grid Reference: Q 633 194 - Q712 178
No. of sites: 15 **No of stations:** 32

Description:

This area includes the shallow bay between the Magharee Peninsula to the west and Derrymore and Fenit Islands to the east. The substratum is predominantly sand and protected on all sides except to the north-west. Towards the head of the bay were extensive beds of the native oyster *Ostrea edulis*.

In addition to the notable species listed below several other interesting species were recorded. Throughout the bay the anemone *Calliactis parasitica* was abundant. This anemone is unusual in that it is lives attached to a shell with the hermit crab *Pagurus bernhardus*. *Calliactis parasitica* has been previously recorded in south and west Ireland (Manuel, 1980; Cornelius, *et al.*, 1995), but Tralee Bay was the only site from which it was recorded by BioMar around Ireland. Areas of maerl supported the anemone *Halcampa chrysanthellum*. This small burrowing anemone is reported on all coasts of Britain but is rare in the North Sea (Manuel, 1980). The BioMar survey recorded this species in ten sites at four locations on the south and west coasts of Ireland.

Rocky shores around the bay supported a range of biotopes from lichens dominated zones (Ver.Ver) to the lower shore dominated by *Fucus serratus* on bedrock (Fser.Fser) and boulders (Fser.Bo). Littoral sediments were polychaete dominated (AP and PSfol). The majority of the bay is shallow and sedimentary, only two infralittoral rock biotopes were recorded, a sublittoral fringe mixed forest of *Laminaria saccharina* and *Laminaria digitata* (Lsac.Ldig) and foliose red algae (FoR). No circalittoral biotopes were recorded. Of most interest were the range of sublittoral sediments present in the bay. Sands and gravels were characterised by bivalves and burrowing sea urchins (EcorEsil and Sell), with a dense bed of native oyster *Ostrea edulis* (Ost) towards the centre of the bay. The bed was of significant commercial importance as a fishery, which is closed at present. Seagrass beds occurred in the west of the bay (Zmar and ZmarBv) with maerl occurring in the centre (Lcor and Lgla).

Notable species:

5 notable species were recorded.

Laomedea angulata	*Lithothamnion corallioides*	*Zostera marina*
Ostrea edulis	*Lithothamnion glaciale*	

Biotope richness:

18 biotopes were recorded.

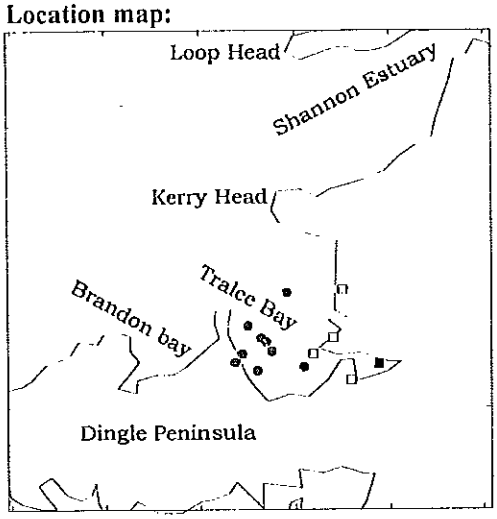
Littoral rock	**Littoral sediment**	**Infralittoral rock**	**Sublittoral sediments**
Asc.Asc	AP	Lsac.Ldig	EcorEsil
BPat.Lpyg	PSfol	FoR	Zmar
Fser.Bo			ZmarBv
Fser.Fser			Ost
Fspi			Sell
Pel			Lcor
Ver.Ver			Lgla

Species richness:

292 species or higher taxa were recorded.

Porifera: 36 (24.7%)	Bryozoa: 9 (13.8%)	Chromophycota: 20 (28.6%)
Cnidaria: 28 (21.2%)	Echinodermata: 28 (49.1%)	Chlorophycota: 4 (17.4%)
Polychaeta: 18 (14.1%)	Tunicata: 16 (25%)	Lichens: 4 (14.3%)
Crustacea: 22 (16.3%)	Pisces: 13 (15.7%)	Others: 21 (44.7%)
Mollusca: 45 (16.3%)	Rhodophycota: 28 (14.1%)	

Location map:



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Kerry Head shoals

County: Kerry
BioMar seetor: IR5
Grid reference: 52 26.87'N 10 04.11'W
No. of sites: 9 **No of stations:** 9

Description:

To the west of Kerry Head is an area of deep (> 40m BCD) bedrock and boulders supporting an interesting and extensive deep water sponge community.

In addition to the notable species listed below several additional species were of interest. The sponges *Tetilla zetlandica* and *T. cranium* occurred in abundance on Kerry Head shoals. Both species were previously only recorded from the Aran Islands and Galway Bay in Ireland (Ackers *et al.*, 1992). The cup sponge *Phakellia ventilabrum* was common in deeper water, it has recently been recorded in Ireland from Skird Rocks and the Aran Islands (Ackers *et al.*, 1992). *Phakellia vermiculata* was also present, and only recently recorded from Ireland from Skird Rocks, the Aran Isles and Kenmare River (Ackers *et al.*, 1992). An undescribed species of the sponge genus *Spongosorites* was also recorded. Also of interest was the hydroid *Abietinaria filicula*; Cornelius (1995) noted a few old records of this hydroid from the north of Ireland but none from the south. It has however been frequently recorded from the Isle of Man and Norfolk, northwards. The rare nudibranch *Aldisa zetlandica* was recorded at one site from Kerry Head shoals and recently from Achill Island and Skird Rocks (Picton and Morrow, 1994). Although it was also recorded from Rathlin O' Birne, and west Galway by BioMar. Recent records of this species were also from sponge rich areas. The brachiopod *Terebratulina retusa* was also in abundance.

Only four biotopes were recorded from Kerry Head shoals. Two infralittoral rock biotopes dominated by *Laminaria hyperborea* (LhypFa) and red foliose seaweeds (FoR). Of particular note were the circalittoral biotopes. The most notable was the species rich deep (>40 m BCD) sponge dominated biotope characterised by the sponges *Tetilla cranium* and *T. zetlandica* with axinellid sponges (Axi). No littoral sites were surveyed and no sublittoral sediment biotopes recorded.

Notable species:

4 notable species were recorded.

Tetilla cranium *Hexadella racovitzae*
Quasillina brevis *Carpomitra costata*

Biotope richness:

4 biotopes were recorded.

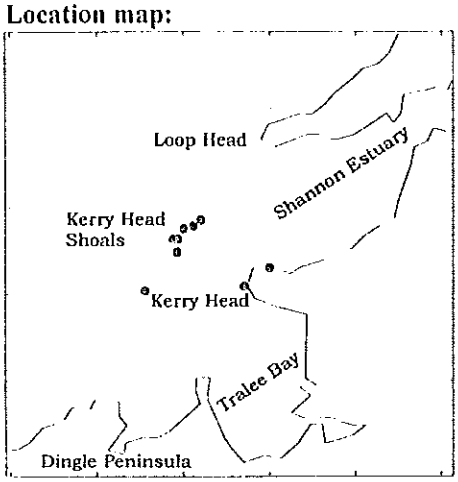
Infralittoral rock	Circalittoral rock
LhypFa	CCParCar
FoR	Axi

Species richness:

177 species or higher taxa were recorded.

Porifera 48 (32.9%)	Brachiopoda 1 (50.0%)	Rhodophycota 23 (11.6%)
Cnidaria 25 (18.9%)	Bryozoa 16 (24.6%)	Chromophycota 5 (7.1%)
Polychaeta 4 (3.1%)	Echinodermata 13 (22.8%)	Others 3 (6.4%)
Crustacea 3 (2.2%0	Tunicata 10 (15.6%)	
Mollusca 15 (5.4%)	Pisces 11 (13.3%)	

Location map:



Bibliography

None.

Aran Islands

County:	Galway		
BioMar sector:	IR6		
Grid reference:	L 750 130 - M 000 000		
No. of sites:	18	**No of stations:**	21

Description:

The Aran Islands form a group of large offshore limestone islands which are very exposed to wave action. Offshore the seabed was steped limestone, and the deeper water supported interesting sponge communities.

In addition to the notable species listed below other interesting species were recorded from the Aran Islands. The sponge *Tetilla zetlandica* was common. It has a limited known distribution in Ireland and has previously been recorded from the Aran Islands and other areas of Galway Bay (Ackers *et al.*, 1992). The cup sponge *Phakellia ventilabrum* was common in the deeper water and it has recently been recorded in Ireland from Skird Rocks and the Aran Islands (Ackers *et al.*, 1992). *Phakellia vermiculata* was only recently recorded from Ireland from Skird Rocks, the Aran Isles and Kenmare River (Ackers *et al.*, 1992). An undescribed species of the sponge genus *Spongosorites* was also recorded. Könnecker (1981) also reported on this assemblage of species from Skird Rocks, Co. Galway. The sponge *Clathria barleei* was recorded from two sites in the Aran Islands. Records of this sponge in Ireland are scarce as its preferred habitat is below 40m. However, there are previous records from the south and west coasts of Ireland (Ackers *et al.*, 1992). The rare nudibranch *Aldisa zetlandica* was recorded from the Aran Islands and recently from Achill Island and Skird Rocks (Picton and Morrow, 1994), although it was also recorded from Rathlin O' Birne, and west Galway by BioMar. Recent records of this species were also from sponge rich areas. The hydroid *Aglaophenia kirchenpaueri* was occasional at two sites from the Aran Islands. It is generally present but scarce along the west coast of Ireland (Picton in Svoboda and Cornelius, 1991). BioMar has also recorded this hydroid from the south coast of Ireland. The brachiopod *Terebratulina retusa* was also in abundance, one of the only two species recorded in Ireland.

No littoral sites were surveyed from the Aran Islands area. Infralittoral and circalittoral rock was typically exposed to wave action and this was reflected in the biotopes recorded. The Aran Islands are limestone and the examples of the biotopes recorded reflected the diversity associated with limestone rock. The sublittoral fringe was characterised by an *Alaria esculenta* biotope (AlaRAn) with dense forests of kelp below (LhypFa). At one site the bedrock in the kelp forest was embedded with the notable purple sea urchin *Paracentrotus lividus*. The mixed *Halidrys siliquosa* and kelp forest biotope (HalXK.Ft) occurred between Inishmore and Inishmaan, an area subject to strong tides and sand scour. Below the kelp zone foliose red algae dominated (FoR). Deep rocky sites supported an interesting axinellid sponge biotope (Axi) with exposed rock habitat characterised by coralline crusts and the bryozoan *Parasmittina trispinosa* (CCParCar). Beds of brittlestars *Ophiothrix fragilis* (Oph) were recorded from bedrock to the north of the Aran Islands. To the south of Inishmore sand covered bedrock ledges had a biotope characterised by *Polymastia* spp. sponges and *Ciocalypta penicillus* (PolCio). Sublittoral sediments from the south of the islands were characterised by burrowing urchins and bivalves (EcorEsil).

Notable species:

4 notable species were recorded.

Hexadella racovitzae	*Celleporina tubulosa*
Erato voluta	*Paracentrotus lividus*

Biotope richness:

12 biotopes were recorded.

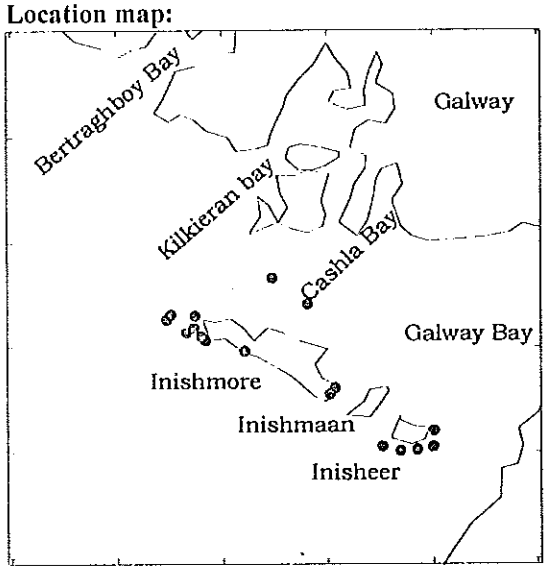
Infralittoral rock	**Circalittoral rock**	**Sublittoral sediment**
HalXK.Ft	CCParCar	EcorEsil
AlaRAn	Axi	
LhypFa	PolCio	
LhypFa.Par	Ant	
SCAs.ByH	Oph	
FoR		

Species richness:

272 species or higher taxa were recorded.

Porifera 58 (39.7%)
Cnidaria 39 (29.5%)
Polychaeta 4 (3.1%)
Crustacea 16 (11.9%)
Mollusca 27 (9.8%)
Brachiopoda 1 (50%)
Bryozoa 20 (30.8%)
Echinodermata 22 (38.6%)
Tunicata 17 (26.6%)
Pisces 16 (19.3%)
Rhodophycota 35 (17.6%)
Chromophycota 11 (15.7%)
Others 6 (11.0%)

Location map:



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Kilkieran Bay

County: Galway
BioMar sector: IR6
Grid reference: L 910 390 - L829 276
No. of sites: 32 **No of stations:** 68

Description:

Kilkieran Bay is a shallow fiardic bay with many islands. The bay is subject to strong tidal streams as the sea funnels between islands and through channels. The bay ranges in depth from very shallow sandy bays to deep tide swept channels and is subject to extreme wave exposure at its mouth to very sheltered sites towards the head and amongst the islands. Subsequently an extensive range of habitats is present.

In addition to the notable species recorded other species of interest were recorded. One of the main features of interest in the bay are extensive beds of maerl, particularly *Lithothamnion corallioides*. The maerl beds were particularly rich for anemone species. The anemone *Halcampa chrysanthellum* was common here although it has been reported on all coasts of Britain (Manuel, 1980). The BioMar survey recorded this species in ten sites at four locations on the south and west coasts of Ireland. Another burrowing anemone *Mesacmaea mitchellii* was previously recorded from Kilkieran Point, Co. Galway (Picton, 1985a) but BioMar recorded this species only from Kilkieran Bay, where it occurs in association with other burrowing anemones in *L. corallioides* habitats. *Aureliania heterocera* was also recorded from similar habitats. Of particular interest in the maerl was *Halicampoides elongatus,* which was also found in a clean gravel habitat in Kilkieran Bay. The only previous record of this anemone in Britain and Ireland was from NE of Mweenish Island, Ard Bay, Co. Galway (Picton, 1985a). This species is likely to be under recorded, as it is nocturnal. The tunicate *Molgula oculata* which is classified as nationally scarce in Britain (Sanderson, 1996b), was recorded in Kilkieran Bay. Towards the head of the bay Gurraig Sound is subject to strong tidal streams and bedrock cliffs here support rich sponge communities including notable species, *Plakortis simplex, Axinella damicornis, Plocamilla coriacea,* and *Raspailia aculeata.* The only previous record of *Plakortis simplex* in Ireland was from 50 miles west-north-west of Eagle Island, Co. Mayo, at a depth of 388 fathoms (236 m) (Stephens, 1915). This species was common in Gurraig Sound, Kilkieran Bay, Co. Galway on tideswept boulders and bedrock at depths between 10 - 30 m BCD. *Axinella damicornis* was previously recorded from Lough Hyne, Skird Rocks, St. John's Point, Rathlin O' Birne Island and Rathlin Island (Ackers *et al.*, 1992). *Plocamilla coriacea* is only recently known from Ireland (Ackers *et al.*, 1992). The sponge *Raspailia aculeata* was recorded from one site in Kilkieran Bay. At the entrance of the bay deep rock sponge communities occurred with the sponges *Phakellia ventilabrum* and *P. vermiculata,* both species have recently been recorded in Ireland from Skird Rocks, Co. Galway and the Aran Islands and Kenmare River (Ackers *et al.*, 1992). Also present in Kilkieran Bay is the fireworks anemone *Pachycerianthus multiplicatus* Carlgren, 1846. This burrowing anemone was first reported in 1977 from Galway Bay (O' Connor *et al.*, 1977) and was later found to be frequent in Kenmare River, Co. Kerry (Picton, 1985a). The BioMar survey also recorded this species from Kenmare River. The seapen *Virgularia mirabilis* grew in abundance on an adjacent muddy seabed and the nudibranch *Armina loveni* that feeds on *Virgularia mirabilis* was recorded here. *Armina loveni* has only previously been recorded in Ireland from Kenmare River and Galway Bay. The nudibranch *Hancockia uncinata* is widely distributed but localised around the coast from Britain, Norway and Brittany although it is scarce in Irish waters and has only recently been recorded from Salt Lake, Galway (Picton and Morrow, 1994). BioMar recorded *Crimora papillata* from 22 sites around Ireland. The rare green starfish *Asterina phylactica* was recorded on the shore from Kilkieran Bay. Because this species has only recently been recognised little is known about its distribution. In Ireland it has been reported from the west coast and from Strangford Lough (Picton, 1993).

Kilkieran Bay has a broad range of littoral and sublittoral biotopes. Rocky shores vary from sheltered *Ascophyllum nodosum* covered shores (Asc.Asc) to more wave exposed *Fucus serratus* (Fser.Bo, Fser.Fser and Fser.R) and barnacle/limpet (BPat.Cht and BPat.Sem) dominated shores. Coralline rockpools had the purple sea urchin *Paracentrotus lividus* (CorPar). Littoral sediment biotopes were typically crustacean/polychaete (Tal, AEur and AP) or bivalve (AreBv) dominated. The sandy beaches of Mweenish Island where particularly interesting with examples of all six littoral sediment biotopes. These were the most species rich examples of these biotopes found by BioMar in Ireland. Infralittoral rock biotopes were dominated by *Laminaria digitata* in the sublittoral fringe (Ldig.Ldig, Ldig.Bo and Ldig.T).

Four circalittoral biotopes were recorded. An axinellid sponge dominated biotope (Axi) was recorded from deeper water in the entrance of the bay whilst from circalittoral sheltered rock in the bay supported sponge and ascidian dominated biotopes (SoAs and SSoAs). Offshore from the entrance of the bay the seabed in the circalittoral was characterised by coralline crusts, bryozoans and *Caryophyllia smithii* (CCParCar). Of particular interest in Kilkieran Bay were the range of sublittoral sediment biotopes. Of note were the rich maerl biotopes recorded from the centre of the bay (Phy and Lcor) and the sand and gravels biotope with numerous species of anemones (An) and the sea cucumber *Neopentadactyla mixta* (NeoBv). Mobile sands and gravels (Mob) were found where tidal streams were strongest in the centre of the bay with the polychaete *Nephtys* typical of sediments towards the entrance of the bay. At the head of Kilkieran Bay sheltered areas of mud supported a dense bed of seapens *Virgularia mirabilis* (VmirAn). Sea grass *Zostera marina* beds (Zmar) were recorded from the north side of the bay.

Kilkieran Bay has a long history of research carried out primarily by researchers from University College, Galway.

Notable species:

8 notable species were recorded.

Halcampoides elongatus	Maerl indet.	*Paracentrotus lividus*
Mesacmaea mitchellii	*Ostrea edulis*	*Lithothamnion corallioides*
Aureliania heterocera	*Zostera marina*	

Biotope richness:

32 biotopes were recorded.

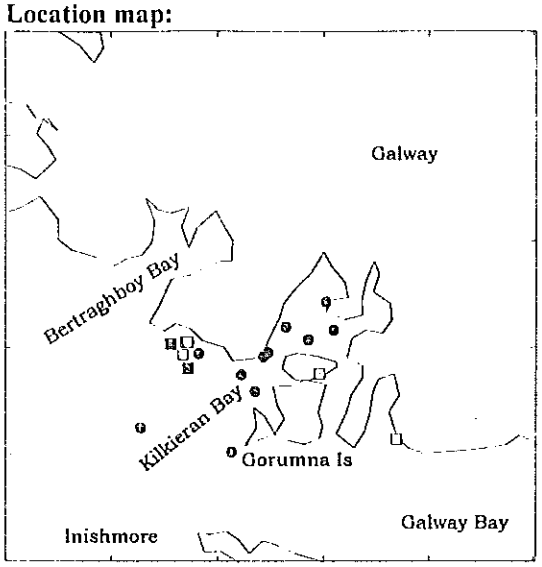
Littoral rock	**Littoral sediment**	**Infralittoral rock**	**Circalittoral rock**	**Sublittoral sediments**
Asc.Asc	Tal	Ldig.Ldig	CCParCar	Mob
BPat.Cht	AEur	Ldig.Bo	Axi	SpNep
BPat.Sem	AP	Ldig.T	SoAs	Zmar
Cor.Par	AreBv		SSoAs	NeoBv
Fser.Bo				An
Fser.Fser				Phy
Fser.R				Lcor
Fspi				VmirAn
FvesB				
Pel				
PelB				
RamG				
YG.YG				

Species richness:

545 species or higher taxa were recorded.

Porifera: 81 (55.5%)	Bryozoa: 28 (43.1%)	Chromophycota: 27 (38.6%)
Cnidaria: 49 (37.1%)	Echinodermata: 26 (45.6%)	Chlorophycota: 5 (21.7%)
Polychaeta: 40 (31.2%)	Tunicata: 28 (43.8%)	Lichens: 14 (50%)
Crustacea: 45 (33.3%)	Pisces: 31 (37.3%)	Others: 41 (87.2%)
Mollusca: 71 (25.7%)	Rhodophycota: 59 (29.6%)	

Location map:



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Mannin Bay

County: Galway
BioMar sector: IR7
Grid reference: L 612 485 - L626 456
No. of sites: 16 **No of stations:** 27

Description:

Mannin Bay is one of a series of northwest facing bays between Slyne Head and Killary Harbour. It is small and shallow and is open to weather from the west and northwest. There are few islets and rocks in it and the substratum is primarily sand and dead maerl. Tidal streams within this bay are weak, but it is exposed to wave surge. The sublittoral communities are dominated by maerl and sea grass, with notable species being given below.

The beaches or 'coral' strands are composed of dead *Lithothamnion corallioides* nodules and are geologically and biologically interesting. Three species were recorded from Coral Strand *Glycera gigantea*, *Gari depressa*, and *Marphysea bellii*, which were only recorded by BioMar a three times. The sponge *Axinella damicornis* was previously recorded from Lough Hyne; Skird Rocks, St John's Point, Rathlin O'Birne Island and Rathlin Island (Ackers *et al.*, 1992). Although recorded from many sites in Ireland it is usually present in very low numbers, and was classified as scarce in Britain by Sanderson (1996b). Two of the sponges recorded were only recently recorded in Ireland, *Phakellia ventilabrum and Phakellia vermiculata* (Ackers *et al.*, 1992). *Terebratulina retusa*, a brachiopod which is found in relatively shallow water, and *Ophiopsila annulosa*, a southern species which has been recorded from the south coast of England, the west coast of Ireland and south-west Scotland (Picton, 1993), were found in only two sites by BioMar. Both were classified as scarce in Britain Sanderson (1996b).

Areas of intertidal rock occur on the south side of Mannin Bay towards Slynne Head and support a range of biotopes. Lichen dominated biotopes occur on the top of the shore (YG.YG, RamG and Ver.Ver) to brown algae and barnacle characterised mid and lower shores (Asc.Asc, Fser.R and Fves and BPat.Sem). Despite the littoral being predominantly sedimentary only three littoral sediment biotopes were recorded. The upper shore strandline was typically characterised by talitrid amphipods (Tal) with the mid and lower shore polychaete dominated. The majority of the seabed in the bay was sedimentary and only one infralittoral and two circalittoral biotopes were recorded in the area. Rocky reefs towards the entrance supported a mixed *Laminaria saccarhina* and *L. digitata* biotope (Lsac.Ldig) and in deeper water axinellid sponge (Axi) and coralline crusts with bryozoan (CCParCar) biotopes. The most notable feature of Manin Bay was the diversity and interest of the sublittoral sediment biotopes. Much of the head of the bay was dense maerl beds (Phy and Lcor) with dense seagrass *Zostera marina* (Zmar and ZmarBv). In deep water towards the entrance of the bay the seabed was sandy with a range of biotopes, in particular a dense bed of the brittlestar *Amphiura filiformis* (AfilEcor) occurred on the southern side of the bay and sand with the sea cucumber *Neopentadactyla mixta* and bivalves (NeoBv). Further offshore the sediment was more mobile (Mob). Towards the head of the bay an oyster *Ostrea edulis* bed was present, (Ost) with areas of seapens and anemones (VmirAn) and burrowing sea urchins *Echinocardium cordatum* and bivalves (EcorEsil and AbraEcor).

Notable species:

4 notable species were recorded.

Ostrea edulis
Lithothamnion corallioides
Phymatolithon calcareum
Zostera marina

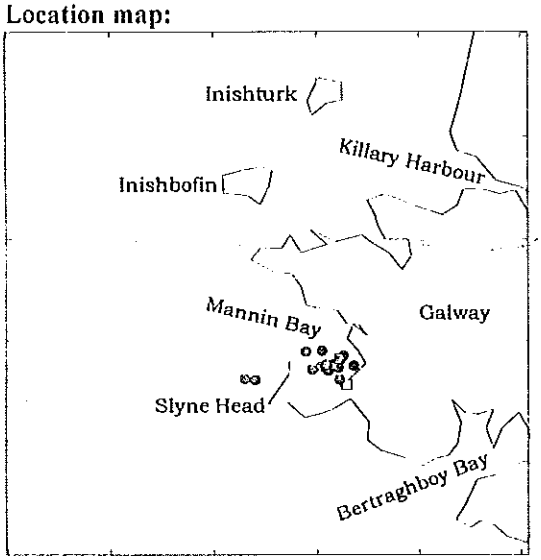
Biotope richness:
25 biotopes were recorded.

Littoral rock	Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediment
YG.YG	Tal	Lsac.Ldig	CCParCar	Mob
Ver.Ver	AP		Axi	AfilEcor
PelB	PSfol			EcorEsil
Asc.Asc				Zmar
Fser.R				ZmarBv
Fves				NeoBv
BPat.Sem				Ost
RamG				Phy
				Lcor
				VmirAn
				AbraEcor

Species richness:
288 species or higher taxa were recorded.

Porifera: 36 (24.7%)	Bryozoa: 9 (13.8%)	Chromophycota: 20 (28.6%)
Cnidaria: 28 (21.2%)	Echinodermata: 28 (49.1%)	Chlorophycota: 4 (17.4%)
Polychaeta: 18 (14.1%)	Tunicata: 16 (25%)	Lichens: 4 (14.3%)
Crustacea: 22 (16.3%)	Pisces: 13 (15.7%)	Others: 17 (36.1%)
Mollusca: 45 (16.3%)	Rhodophycota: 28 (14.1%)	

Location map:



Bibliography
None

Broadhaven Bay

County:	Mayo		
BioMar sector:	IR8		
Grid reference:	54°13.00'N 10°1.00'W - 54°23.00'N 09°46.00'W		
No. of sites:	22	**No of stations:**	31

Description:

This area spans Broadhaven Bay from Erris Head to Benwee Head and ineludes The Stags. The area encompasses a range of habitats from moderately exposed bedrock at Erris Hd to sheltered sediments in the inner Bay and very exposed quartzite bedrock at Benwee Head. The Stags are a cluster of exposed rocky islands with large colonies of breeding seabirds, such as fulmars, numerous storm petrels and possibly the rare Leach's petrels (An Foras Forbartha, 1981).

A number of species were recorded from Broadhaven Bay that are of interest and are noted below. The sponge *Axinella damicornis* has been recorded from a number of sites around the Irish coast, including one site off the Stags. It is usually present in very low numbers, this may be because it is at its most northern limit of distribution. Sanderson (1996b) notes this species as scarce in Britain. The sponge, *Phakellia ventilabrum* was also recorded from the Stags. The hydroids, *Thuiaria articulata* and *Tamarisca tamarisca* were recorded from the Stags and Gubastuckaun respectively. Sanderson (1996b) notes the latter as being scarce in Britain. The anthozoan, *Parazoanthus anguicomus* was recorded from Gubastuckaun. It has been reported from only a few sites in Ireland, Kenmare River, St. John's Point, and from Northern Ireland (Picton, 1985a) and is noted by Sanderson (1996b) as scarce in Britain. All previous Irish records of this species are from deep water off the south-west coast (Manuel, 1980). The sea anemone, *Phellia gausapata* was recorded from the caves, south of Cone Island. This species is considered rare in Britain (Sanderson, 1996b), but has been reported from a number of sites in Ireland (Picton, 1985a). The brachiopod, *Terebratulina retusa* was also recorded from Cone Island. This species was considered a species of particular interest in Northern Ireland (Erwin *et al.*, 1990). The decapod crustacean *Pirimela denticulata* is also considered to be a species of particular interest in Northern Ireland (Erwin *et al.*, 1990). It was only recorded at three sites on the BioMar survey, one of which was Binroe Point.

No littoral rock biotopes and only one littoral sediment biotope were surveyed here by BioMar. The beach at Binroe Point was characterised by burrowing amphipods and polychaetes (AP). Shallow infralittoral rock was characterised by kelp forests (Lhyp) with a faunal turf of hydroids, bryozoans and anemones in more wave exposed areas (LhypFa). Tideswept bedrock and boulders at the entrance to inner Broadwater Bay supported a dense forest of *Saccorhiza polyschides* (Spol). Below the kelp in exposed locations at the entrance of the bay, rock was characterized by the brown algae *Dictyota dichotoma* and a red algae turf (Dic) with steep and vertical rock faces covered with dense *Corynactis viridis* and *Metridium senile* (CorMet). On the south side of Broadhaven east of Erris Head the cliff face had numerous sea caves. The vertical walls within the caves support an interesting an diverse fauna of sponges and bryozoans characteristic of this wave surged habitat (SC). Two circalittoral biotopes were recorded from the area, an axinellid sponges dominated deep circalittoral biotope (Axi) and a coralline algae/bryozoan crust and *Caryophyllia smithii* characterised biotope (CCParCar). Interesting sublittoral sediment biotopes occurred in the bay. Sea grass *Zostera marina* beds (ZmarBv) were found north of Ballyglass Pier with *Ostrea edulis* beds (Ost) occurring further into the bay. Sand within the channel west of Ballyglass were characterised by burrowing sea urchins and bivalves (EcorEsil and Ven.FabMag).

Notable species:

2 notable species were recorded.

Ostrea edulis *Zostera marina*

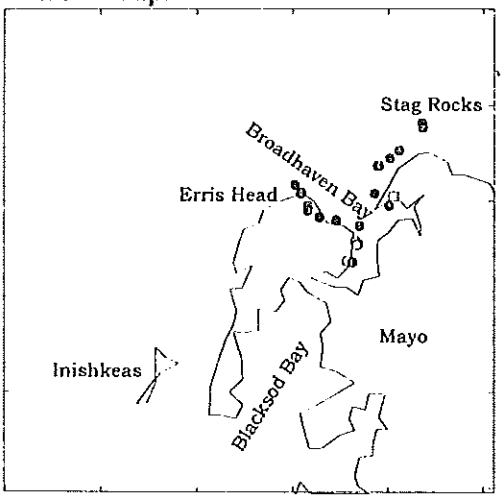
Biotope richness:
13 biotopes were recorded.

Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediment
AP	CorMet	CCParCar	ZmarBv
	Dic	Axi	Ost
	Lhyp		EcorEsil
	LhypFa		Ven.FabMag
	SC		
	Spol		

Species richness:
333 species or higher taxa were recorded.

Porifera 56 (38.4%)	Brachiopoda 1 (50.0%)	Rhodophycota 37 (18.6%)
Cnidaria 36 (27.3%)	Bryozoa 25 (38.5%)	Chromophycota 13 (18.6%)
Polychaeta 21 (16.4%)	Echinodermata 21 (36.8%)	Chlorophycota 2 (8.7%)
Crustacea 26 (19.3%)	Tunicata 16 (25.0%)	Others 8 (17.0%)
Mollusca 48 (17.4%)	Pisces 23 (27.7%)	

Location map:



Bibliography
None

Mullaghmore Head and adjacent coastline

County:	Sligo/Leitrim		
BioMar sector:	IR8		
Grid reference:	54°30.00'N 08°20.00'W - 54°20'00'N 08°43.50'W		
No. of sites:	31	**No of stations:**	56

Description:

This areas includes the south coast of Donegal Bay extending from Tullaghan (Co. Leitrim) to Ballyconnell Point (Co. Sligo) including both Inishmurray and Bomore Island. It consits of carboniferous limestone rock and sandy beaches.

A number of species were recorded from the Mullaghmore Head area that are noted below. The sponge *Dercitus bucklandi* is usually found sublittorally but was unusual in this area as it was found on the shore at Blue Lough Bay. *Axinella damicornis* has been recorded from a number of sites around the Irish coast (including Bomore Island). It is usually present in very low numbers perhaps because it is at its most northern limit of distribution. Sanderson (1996b) notes this species as scarce in Britain. Records of the sponge, *Clathria barleei* were scarce during the BioMar survey as it's preferred habitat is below 40m. Previous records of this species are from south and west coasts of Ireland (Ackers *et al.*, 1992). In addition this sponge is noted by Erwin *et al.* (1990) as a species of particular interest in Northern Ireland. BioMar recorded this sponge at Bomore Island. The sponges, *Phakellia ventilabrum* and *Raspailia aculeata* were recorded off Bomore Island and Thumb Rock, Mullaghmore respectively. Thumb Rock was also noted as an important site for sponges in particular *Polymastia* spp. Several specimens of undescribed species were collected here. The hydroid, *Sertularella gaudichaudi* was recorded at three sites, one of which was Ballyconnell Point, during the BioMar survey. There are no previous Irish records of this hydroid, however Cornelius *et al.* (1995) presume that it may be found all around the British and Irish coasts. The hydroids, *Tamarisca tamarisca* and *Halecium muricatum* were found off Merlin Rocks. The former is considered scarce in Britain (Sanderson, 1996b), and of the latter Hayward and Ryland (1995) note that there have been no Irish or British records in the 20th century. The anemone, *Parazoanthus axinellae* is frequent on southwest coasts of Britain (Manuel, 1980), but is considered rare in Northern Ireland by Erwin *et al.* (1990). The BioMar survey found this species off Bomore Island The rare nudibranch, *Aldisa zetlandica* was also recorded off Bomore Island Sanderson (1996b) notes *Pycnoclavella aurilucens* as scarce in Northern Ireland. However, it has a south-western distribution in Britain and Ireland and was recorded within this area.

Eight littoral rock biotopes were recorded from south Donegal Bay area. The midshore was dominated by brown algae, in particular *Fucus vesiculosus* (Fves and FvesB) and lower down the shore *Fucus serratus* (Fser.Fser). A red algae dominated biotope was also noted (R.Os). On the lower shore a *Himanthalia elongata* biotope was dominant (Him). Three rockpool biotopes were recorded (Cor.Par, FK.Bo and FK.Snd). Littoral sediments were crustacean/polychaete dominated with the strandline characterised by talitrid amphipods (Tal) with the midshore supporting burrowing amphipods and *Eurydice pulchra* (AEur) or polychaetes (AP). Lower shore sediments were characterised by annelids worms, in particular *Scolelepis foliosa* (PSfol).

Infralittoral rock supported a range of biotopes. Shallow wave exposed sublittoral fringe rock was dominated by *Alaria esculenta* and *Laminaria digitata* (Ala.Ldig) whilst more sheltered boulders supported *Laminaria digitata* with a rich underboulder fauna (Ldig.Bo). Shallow bedrock was covered in *Laminaria hyperborea* forest (Lhyp) which had a rich faunal turf at exposed sites (LhypFa). Boulder adjacent to areas of sand where characterised by a forest of *Halidrys siliquosa* and kelps (HalXK.Ft). Steep and vertical bedrock faces in the more wave exposed locations around the Head were covered in *Corynactis viridis* with *Metridium senile* (CorMet).

Circalittoral rock was characterised by coralline crusts and encrusting bryozoans and *Caryophyllia smithi* (CCParCar) with deep rock supporting axinellid sponges (Axi). Vertical rock was covered in dead man's fingers *Alcyonium digitatum*, with bryozoans crusts (AlcC). Much of the subtidal sediments were characterised by burrowing sea urchins and bivalves (EcorEsil and AbraEcor) with *Zostera marina* beds recorded offshore from the west end of Bunduff Strand. Patches of sediment between rocks on Mullaghmore Head were anoxic and had the bacteria *Beggiatoa* present.

There are several Areas of Scientific Interest (ASIs) along the coastline Inishmurry, Bunduff Strand, Mullaghmoe Head, Milk Harbour to Streedagh Point and Ballyconnell Point.

Notable species:
6 notable species were recorded.

Halecium plumosum	*Paracentrotus lividus*	*Zostera marina*
Actinia fragacea	*Carpomitra costata*	*Zostera angustifolia*

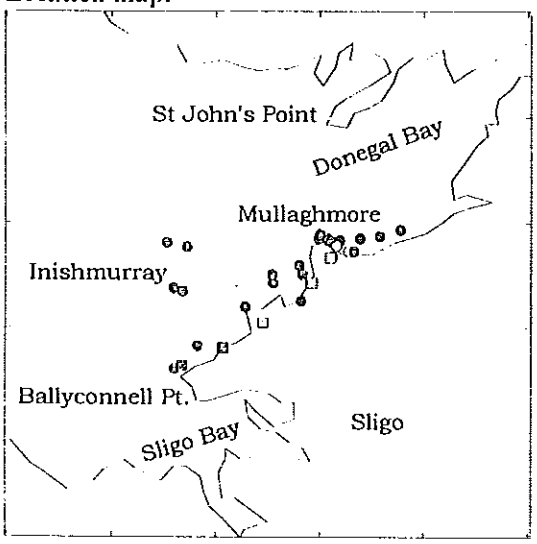
Biotope richness:
25 biotopes were recorded.

Littoral rock	Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediment
Cor.Par	Tal	Ala.Ldig	Axi	ZmarBv
FK.Bo	AP	CorMet	AlcC	Beg
FK.Snd	AEur	HalXK.Ft	CCParCar	EcorEsil
Fser.Fser	PSfol	Ldig.Bo		AbraEcor
Fves		Lhyp		
FvesB		LhypFa		
Him				
R.Osm				

Species richness:
448 species or higher taxa were recorded.

Porifera 64 (43.8%)	Bryozoa 15 (23.1%)	Chromophycota 32 (45.7%)
Cnidaria 55 (41.7%)	Echinodermata 25 (43.9%)	Chlorophycota 8 (34.8%)
Polychaeta 26 (20.3%)	Tunicata 22 (34.4%)	Lichens 1 (3.6%)
Crustacea 38 (28.1%)	Pisces 29 (34.9%)	Others 12 (25.5%)
Mollusca 58 (21.0%)	Rhodophycota 63 (31.7%)	

Location map:



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St John's Point and North Donegal Bay

County:	Donegal		
BioMar sector:	IR8		
Grid reference:	G 600 670 - G 850 800		
No. of sites:	21	**No of stations:**	41

Description:

The extensive limestone bedrock reefs provide a habitat for a diverse fauna and flora. A number of species were recorded from St John's Point and North Donegal Bay are noted below. The sponge *Axinella damicornis* has been recorded from a number of sites around the Irish coast (including three sites in this area). It is usually present in very low numbers which may be because it is at its most northern limit of distribution. Sanderson (1996b) noted this species as scarce in Britain. The sponge *Phakellia vermiculata* was also present, and only recently recorded from Ireland off Skird Rocks, the Aran Isles and Kenmare River (Ackers *et al.*, 1992). The sponge, *Phakellia ventilabrum* was recorded from Beltra Rock, St John's Point and Muckross Head. An undescribed species of the sponge genus *Spongosorites* was also recorded. The hydroid, *Sarsia eximia* was recorded only three times during the BioMar survey, of which Murles Point was one. However, Cornelius *et al.* (1995) suggest that this may be a common species in the lower shore and it is most probably under-recorded. The hydroid, *Abietinaria filicula* was recorded off Muckross Head. Cornelius (1995) noted a few old records of this hydroid from the north of Ireland but none from the south. It has however been frequently recorded from the Isle of Man and Norfolk, northwards. *Thuiaria articulata* was recorded at two sites off Beltra Rock. The sea fan, *Eunicella verrucosa* is rather local on Irish coasts and has been recorded from a number of sites including St. John's Point. In Britain, this species is protected under the Wildlife and Countryside Act (1981). The anemone, *Parazoanthus axinellae* was recorded from two sites in this area, south of Portnagh Rock, St John's Point, and south of Muckross Head. Manuel (1980) has reported this anemone as frequent on southwest coasts of Britain, however the BioMar survey found this species to have a north-westerly distribution in Ireland, with the exception of one record from Kinsale. Erwin *et al.* (1990) noted this anemone as a species of particular interest in Northern Ireland. *Parazoanthus anguicomus* was recorded from Portnagh Rock, St. John's Point. All previous Irish records of this species are from deep water off the south-west coast (Manuel, 1980), with the exception of Kenmare River (Picton, 1985a). Sanderson (1996b) noted this species as scarce in Britain.

Littoral biotopes were recorded from Murles Point a broad platform of limestone bedrock. Ten biotopes were recorded ranging from lichen dominated examples at the top of the shore (YG.YG and Ver.Ver) to brown algal dominated biotopes on the mid and lower shore (Fcer, Fspi and Fves). Areas of midshore bedrock where characterised by barnacles and limpets (BPat and BPat.Cht). Lower shore rock supported barnacles and *Mytilus edulis* (MytB) and the brown algae (Him). Rockpools in the midshore were of particular interest with coralline crusts and the purple sea urchin *Paracentrotus lividus*. Littoral sediments were typically crustacean and polychaete dominated. The strandline was characterised by talitrid amphipods (Tal) whilst the mid and lower shores support burrowing amphipods and the isopod *Eurydice pulchra* (AEur) and polychates (AP). Exposed sublittoral fringe rock supported an *Alaria esculental Laminaria digitata* biotope (Ala.Ldig) with kelp forest dominated by *Laminaria hyperborea* (Lhyp and LhypFa) in the shallow infralittoral. Below that red algae dominated (FoR). A *Corynactis viridis* and *Metridium senile* characterised biotope occurred on steep bedrock off the end of St John's Point. Two circalittoral biotopes were described (CCParCar and Axi) although this does not adequately reflect the diversity of circalittoral biotopes the area.

Notable species:

5 notable species were recorded.

Sarcodictyon roseum	*Lithothamnion corallioides*	*Zostera angustifolia*
Paracentrotus lividus	*Phyllophora sicula*	

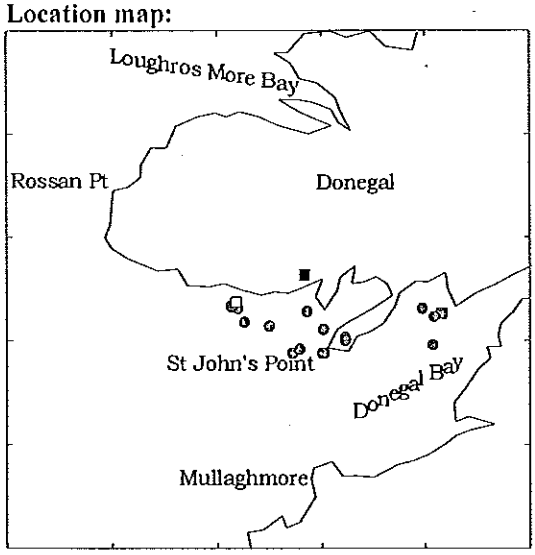
Biotope richness:
24 biotopes were recorded.

Littoral rock	Littoral sediment	Infralittoral rock	Circalittoral rock	Sublittoral sediment
YG.YG	Tal	Ala.Ldig	CCParCar	Zmar
Ver.Ver	AP	CorMet	Axi	NeoBv
Him	AEur	FoR		Lcor
Fcer		Lhyp		TcomAsAn
Fspi		LhypFa		
Fves				
MytB				
BPat				
BPat.Cht				
Cor.Par				

Species richness:
429 species or higher taxa were recorded.

Porifera 60 (41.1%)	Bryozoa 21 (32.3%)	Chromophycota 24 (34.3%)
Cnidaria 51 (38.6%)	Echinodermata 27 (47.4%)	Chlorophycota 7 (30.4%)
Polychaeta 17 (13.3%)	Tunicata 15 (23.4%)	Lichens 6 (21.4%)
Crustacea 36 (26.7%)	Pisces 29 (34.9%)	Others 11 (23.4%)
Mollusca 60 (21.7%)	Rhodophycota 65 (32.7%)	

Location map:



Bibliography
None

Rathlin O'Birne Island

County: Donegal
BioMar sector: IR8
Grid reference: G 620 800
No. of sites: 14 **No of stations:** 31

Description:

Rathlin O' Birne Island lies offshore from north Donegal Bay. The seabed is predominantly rock and supports a rich fauna. The cup sponge *Phakellia ventilabrum,* which was common in the deeper water, has recently been recorded in Ireland from Skird Rocks and the Aran Islands (Ackers *et al.*, 1992). The rare nudibranch *Aldisa zetlandica* was also recorded from Rathlin O' Birne, and west Galway by BioMar, and previously from the Aran Islands, Achill Island and Skird Rocks (Picton and Morrow, 1994). Recent records of this species were also from sponge rich areas. The only BioMar record of the nudibranch *Cuthona pustulosa* was from Rathlin O' Birne Island. It is a northern species that has been recorded as far south as Lundy and Skomer and the English Channel (Picton and Morrow, 1994).

Two interesting species of hydroid where present. The hydroid *Halecium muricatum* occurred at one site around the island. Hayward and Ryland (1995) note there being no Irish or British records in the 20th century., although records do occur from the Isle of Man. The hydroid *Abietinaria filicula* occurred at Rathlin O' Birne. Cornelius (1995) noted a few old records of this hydroid from the north of Ireland but none from the south. It has however been frequently recorded from the Isle of Man and Norfolk, northwards. The sea fan *Eunicella verrucosa* reaches it known northern limit in Europe at Rathlin O' Birne. It does however occur here in large numbers. The sea anemone *Phellia gausapata,* which is characteristic of vertical rock faces in the sublittoral fringe, has been widely recorded in Ireland (Picton, 1985a). The bryozoan *Celleporina tubulosa* has a south-westerly distribution in Britain although this is one of the first Irish records of this species (Hayward, pers. comm.). The recently described red algae *Schmitzia hiscockiana* was recorded here and from from Rathlin O' Birne by BioMar. Hiscock (1986) reports records from Lundy, Pembrokeshire and Galway. The brown algae *Carpomitra costata* was common here despite having a limited distribution in Ireland.

No littoral rock sites were surveyed in the Rathlin O' Birne area. Littoral sediment biotopes were crustacean/polychaete dominated with bivalves present on the lower shore. The strandline was characterised by talitrid amphipods (Tal) with amphipods and the isopod *Eurydice pulchra* characteristic of the midshore biotope (AEur). The lower shore supported an *Arenicola marina* - bivalve (AreBv) biotope. Seven infralittoral biotopes were recorded, reflecting the diversity of habitats around Rathlin O' Birne. Exposed sublittoral fringe rock supported *Alaria esculenta* and *Laminaria digitata* (Ala.Ldig), with kelp forests below (LhypFa, LhypLsac.Ft and LsacSpol). Vertical walls of gullies supported *Corynactis viridis* and *Metridium senile* dominated biotope (CorMet) with turfs of sponges, hydroids, anemones and ascidians (SCAn and SCAs.ByH). Upper circalittoral rock was characterised by coralline crusts, *Parasmittina trispinosa* and *Caryophyllia smitthi* biotope (CCParCar), and areas characterised by the feather star *Antedon bifida* (Ant). Some areas of rock were covered with dense *Musculus dicors* (Mus). In deeper water axinellid sponges were characteristic (Axi).

Notable species:

4 notable species were recorded.

Schmitzia hiscockiana
Celleporina tubulosa
Cuthona pustulata
Carpomitra costata

Biotope richness:

14 biotopes were recorded.

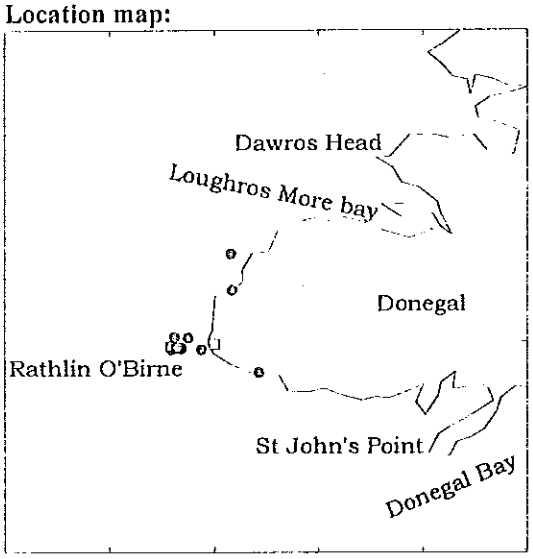
Littoral sediment	Infralittoral rock	Circalittoral rock
Tal	Ala.Ldig	Ant
AEur	CorMet	Mus
AreBv	LhypFa	Axi
	LhypLsac.Ft	CCParCar
	LsacSpol	
	SCAn	
	SCAs.ByH	

Species richness:

240 species or higher taxa were recorded.

Porifera 49(33.6%)	Mollusca 33(12.0%)	Pisces 15(18.1%)
Cnidaria 27(20.5%)	Bryozoa 16(24.6%)	Rhodophycota 39(19.6%)
Polychaeta 7(5.5%)	Echinodermata 17(29.8%)	Chromophycota 10(14.3%)
Crustacea 12(8.9%)	Tunicata 13(20.3%)	Others 2(4.3%)

Location map:



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Rutland Channel area, Aranmore.

County: Donegal
BioMar sector: IR8
Grid reference: C 709 180 - C 597 103
No. of sites: 14 **No of stations:** 18

Description:

This location is a narrow navigable channel connecting Burtonport and Aranmore Island, threading it's way between a series of islets. This channel is strongly tidal with a mixture of soft and hard substrata. These channels gave way to a shallow plain of shelly sand inside Aranmore Island, which featured *Zostera marina/angustifolia* beds. These bore the rare hydroid *Laomedea angulata*. Also notable were low abundances of the calcareous algae *Lithothamnion glaciale* and *Phymatolithon calcareum*. Other species which lend interest to this location include the nudibranch *Aegires punctilucens*, which has a cryptic habit of living in a sponge, and *Stolonica socialis*, which was found also at several sites off the Saltees by BioMar.

No littoral sites were surveyed in the area. Infralittoral rock in Rutland Channel was tidal swept and characterised by *Laminaria hyperborea* with hydroids, sponges and bryozoans (Lhyp.TPk) or a mixed kelp forest of *Laminaria hyperborea* with *Laminaria saccharina* (LhypLsac.Ft). On the more open coast, south of Rutland Island, the seabed was a mixed gravel, cobbles and boulders with sand and the rock supported *Laminaria saccharina* with *Chorda filum* (Lsac.X). Sublittoral sediment biotope included two maerl dominated communities (Lcor and Phy). Maerl was present at the more open coast sites on the south of Rutland Island. In the same area patches of gravel and clean sand supported a *Spisula elliptica* characterised biotope (Sell), patches of seagrass *Zostera marina* were also present (Zmar). No circalittoral biotopes were recorded.

Notable species:

4 notable species were recorded.

Laomedea angulata
Lithothamnion glaciale
Phymatolithon calcareum
Zostera marina

Biotope richness:

7 biotopes were recorded.

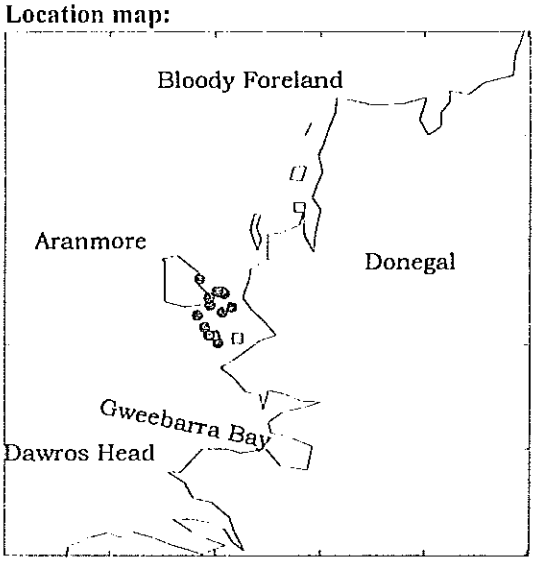
Infralittoral rock
Lhyp.TPk
LhypLsac.Ft
Lsac.X

Sublittoral sediment
Lcor
Phy
Sell
Zmar

Species richness:

287 species or higher taxa were recorded.
Porifera: 27 (18.5%)
Cnidaria: 31 (23.5%)
Polychaeta: 13 (10.2%)
Crustacea: 18 (13.3%)
Mollusca: 35 (12.7%)
Bryozoa: 13 (20%)
Echinodermata: 15 (26.3%)
Tunicata: 18 (28.1%)
Pisces: 23 (27.7%)
Rhodophycota: 53 (26.6%)
Chromophycota: 20 (28.6%)
Chlorophycota: 4 (17.4%)
Others: 17 (36.2%)

Location map:



Bibliography

None

Tory Island

County: Donegal
BioMar sector: IR8
Grid reference: 55°17.00'N 08°10.00'W - 55°14.00'N 08°18.00'W
No. of sites: 12 **No of stations:** 16

Description:

This island is located off the north western corner of Ireland and consists mainly of igneous rock. The southern side of the island is extremely exposed with the dominant sublittoral habitats being bedrock and boulders. The northern side is relatively sheltered and thus only moderately exposed with bedrock and sand being the dominant habitats sublittorally. High cliffs on the eastern side hold large colonies of breeding auks, kittiwakes, common gulls, fulmar and chough (An Foras Forbartha, 1981).

A number of species were recorded from Tory Island that are noted below. The sponge *Axinella damicornis* has been recorded from a number of sites around the Irish coast (including two sites at Tory Island). It is usually present in very low numbers which may be because it is at its most northern limit of distribution. Sanderson (1996b) noted this species as scarce in Britain. The sponge, *Biemna variantia* was recorded from this area. Previous records are from the south-west coast of Ireland and from Strangford Lough (Aekers *et al.*, 1992). Erwin *et al.* (1990) noted this sponge as a species of particular interest in Northern Ireland. *Phakellia ventilabrum* was recorded from three sites around Tory Island. *Raspailia aculeata* was reported from one site. The anthozoan, *Hormathia coronata* is a Mediterranean species that extends up the west coast of Ireland to Scotland. Ten records exist from the BioMar survey, at six locations, widely dispersed on all coasts, of which Tory Island is one. The nudibranch, *Crimora papillata* was found at three sites around Tory Island. The brown algae, *Carpomitra costata* has a restricted distribution in Ireland, but was found at four sites around Tory Island.

No intertidal sampling was carried out on Tory Island. Four infralittoral biotope were recorded, the shallow infralittoral was dominated by *Laminaria hyperborea* kelp forests (Lhyp) with a rich understorey fauna in more exposed locations (LhypFa). Towards the south east end of the island there were strong tidal streams and the rock was characterised by a mixed kelp flora with sand scour tolerant fauna (XK). Steep and vertical exposed bedrock supported jewel anemones *Corynactis viridis* and *Metridium senile* (CorMet). Much of the circalittoral rock was dominated by coralline algae and bryozoans crusts with *Caryophyllia smithii* (CCParCar) with the feather star also abundant with hydroids and bryozoans (Ant). Deeper rock supported axinellid sponges (Axi). To the north and south east of the island the rock was characterised by sand scoured resistant species including the bryozoan *Flustra foliacea* (Flu). Tory Island was also an ASI.

Notable species:
2 notable species were recorded.
Celleporina tubulosa *Carpomitra costata*

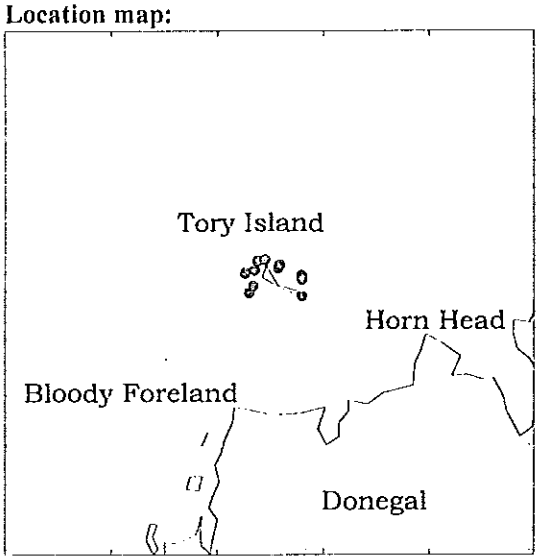
Biotope richness:
8 biotopes were recorded.

Infralittoral rock	Cirealittoral rock
LhypFa	Axi
Lhyp	CCParCar
CorMet	Ant
XK	Flu

Species richness:
221 species or higher taxa were recorded.

Porifera 56 (38.4%)	Bryozoa 21 (32.3%)	Chromophycota 10 (14.3%)
Cnidaria 22 (16.7%)	Echinodermata 17 (29.8%)	Chlorophycota 1 (4.3%)
Polychaeta 7 (5.5%)	Tunicata 11 (17.2%)	Others 3 (6.4%)
Crustacea 8 (5.9%)	Pisces 15 (18.1%)	
Mollusca 19 (6.9%)	Rhodophycota 31 (15.6%)	

Location map:



Bibliography
None

Mulroy Bay

County:	Donegal		
BioMar sector:	IR8		
Grid reference:	C 147 453 - C 280 195		
No. of sites:	31	**No of stations:**	60

Description:

Mulroy Bay is an extremely sheltered inlet on the north coast. This inlet is divided into three distinctive parts by the presence of three sets of narrows, thereby protecting the inner reaches from storm surge. This has facilitated a diversity of habitats being assembled in one area, in particular undisturbed sublittoral mud colonised by scallops. These habitats included several species worth noting, namely: (a) the soft coral *Paraerythropodium coralloides*, also known from recorded this species from L. Hyne, Clare, south and north Donegal (Picton 1985a); (b) the sponge inquiline nudibranch *Aegires punctilucens;* (c) *Stelletta grubii,* a species usually found sublittorally; (d) *Sarsia exima*, a hydroid recorded only three times by BioMar, although it may be more common on the lower shore (Cornelius *et al.*, 1995); (e) the northerly distributed hydroid *Abietinaria filicula* (Cornelius, 1995); (f) the recently described cushion star *Asterina phylactica*, which is known from L. Hyne, Kilkieran Bay (this study), and Strangford Lough (Picton, 1993); (g) the tunicate *Stolonica socialis,* recorded for the first time in Ireland by BioMar; (h) the sponge *Raspailia aculeata* is a deep water species which was found in littorally (BioMar also recorded it in Donegal, Galway and Cork); (i) nudibranch *Haminoea navicula,* about which little is known, although BioMar has found it in Mulroy Bay, Valentia and Clifden; and (j) *Pyura squamulosa,* a tunicate described as uncommon by Erwin *et al.* (1990) who recorded the first occurrence in Ireland, but considered common off British coasts (Millar, 1970).

Eight littoral rock sites were surveyed in the Mulroy Bay area and this is reflected in the diversity of littoral rock biotopes recorded. Sheltered sites within the bay were characterised by dense *Ascophyllum nodosum* on bedrock (AscAsc) and stable cobbles and gravel (AscX). Mid and lower shore rock was characterised by dense growths of brown algae (Fves, Fspi and Fser.R) with extensive areas of midshore rock at more exposed locations barnacle and limpet dominated (BPat and BPat.Sem). The lower shores at these exposed locations were dominated by mussels *Mytilus edulis* and barnacles (MytB). Elsewhere *Himanthalia elongata* (Him) was the characteristic low shore species. Rockpools in the midshore were deep enough to support fucoids and kelp (FK). No littoral sediment biotopes were recorded on the BioMar survey. Limeburner's Rock, offshore from Mulroy Bay, was very exposed to wave action and the sublittoral fringe was characterised by a dense beds of mussels *Mytilus edulis* with *Alaria esculenta* (Ala.Myt). Within the bay the more sheltered sites were characterised by a forest of *Laminaria digitata* (Ldig and Ldig.Ldig), at Mark's Point this was very tide swept (LdigT). In the exposed upper infralittoral *Laminaria hyperborea* forests were present on bedrock and boulders (Lhyp and LhypFa) whilst in the sheltered and tideswept locations *Laminaria saccharina* was the dominant kelp (Lsac.Ft and Lsac.T). At the entrance to Mulroy Bay scoured infralittoral rock supported a forest of *Halidrys siliquosa* with mixed kelps (HalXK.Ft). Where the bay narrows, tidals streams are accelerated and here bedrock and boulders supported biotope characterised by a mixed kelp flora (XK). Five circalittoral biotopes were recorded, offshore at Limeburner's Rock bedrock was characterised by *Antedon bifida* (Ant) with bedrock in the entrance of the bay dominated by coralline and bryozoans crusts with *Caryophyllia smithii* (CCParCar). Where tidal streams were accelerated around headlands and within the narrows of the bay, scoured bedrock supported the bryozoan *Flustra foliacea* with hydroids and sponges (Flu). Very sheltered circalittoral rock in North Water and Broad Water had solitary ascidians *Ascidiella aspersa* and *Ascidea virginea* with sponges (SSoAs). One site in the east Broad Water had a vertical cliff with cup sponges and the soft coral *Parerythropodium coralliodes*. The range of sublittoral sediment biotopes in Mulroy Bay reflects the range of physical conditons, wave action and tidal stream strength, in the area. Clean gravels and sand in the entrance of the bay were characterised by *Spisula elliptica* (Sell). Four sublittoral sediment biotopes were of particular note at the head of Broad Water. In the entrance of the bay extensive sea grass beds of *Zostera marina* (Zmar) and maerl beds (Lcor and Lgla) occurred. The beds of the flame shell *Limaria hians* (Lhia) observed in Moross Channel were the only such record of this biotope recorded by BioMar. In areas of tidal streams the sand was characterised by bivalves with the sea cucumber *Neopentadactyla mixta* (NeoBv). Much of the sheltered Broad Water consisted of muddy sand with anemones and the turret shell *Turritella communis*. Here, solitary ascidians *Ascidiella aspersa* formed clumps on the sediment

surface (TcomAsAn). South of Moross Channel the sediment was sandier and was characterised by the burrowing sea urchin *Echinocardium cordatum* and brittlestar *Amphiura filiformis* (AfilEcor).

The islands in this bay complex form an important breeding site of sandwich terns. Mulroy Bay is also associated with finfish farming and has an important population of scallops, *Pecten maximus*.

Notable species:

7 notable species were recorded.

Limaria hians	*Gobius couchi*	*Zostera marina*
Paracentrotus lividus	*Lithothamnion corallioides*	
Sarcodictyon roseum	*Lithothamnion glaciale*	

Biotope richness:

33 biotopes were recorded.

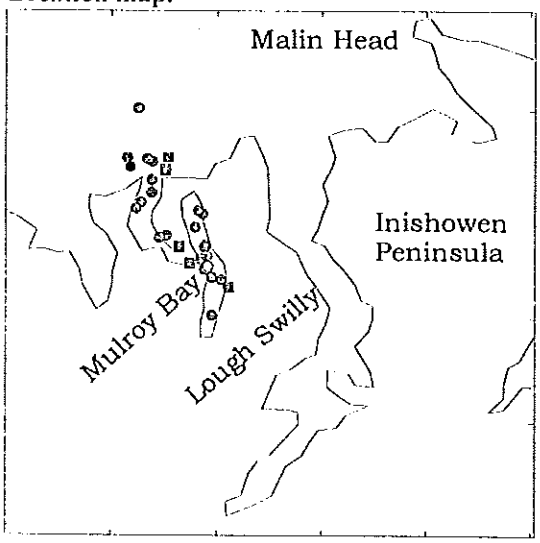
Littoral rock	Infralittoral rock	Circalittoral rock	Sublittoral sediments
Asc.Asc	Ala.Myt	CCParCar	AfilEcor
AscX	HalXK.Ft	SCupPar	Lcor
BPat	Ldig	Ant	Lgla
BPat.Sem	Ldig.Ldig	Flu	Lhia
FK	Ldig.T	SSoAs	NeoBv
Fser.R	Lhyp		Sell
Fspi	LhypFa		TcomAsAn
Fves	Lsac.Ft		Zmar
Him	Lsac.T		
MytB	XK		

Species richness:

493 species or higher taxa were recorded.

Porifera: 59 (40.4%)	Bryozoa: 30 (46.2%)	Chromophycota: 28 (40%)
Cnidaria: 52 (39.4%)	Echinodermata: 33 (57.9%)	Chlorophycota: 6 (26.1%)
Polychaeta: 28 (21.9%)	Tunicata: 28 (43.8%)	Lichens: 1 (3.6%)
Crustacea: 31 (23.0%)	Pisces: 32 (38.6%)	Others: 16 (34.0%)
Mollusca: 80 (29.0%)	Rhodophycota: 69 (34.7%)	

Location map:



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Finavarra

County: Clare
BioMar sector: IR6
Grid reference: 53°09.37'N 09°08.48'W
No. of sites: 1 **No of stations:** 7

Description:

The BioMar survey of Finavarra did not record any unusual species, however there have been many previous surveys of this site, which have revealed interesting species. de Valera *et al.* (1979) made extensive lists of the marine algae, and Ryland and Stebbing (1971) recorded two little known bryozoans, *Callopora rylandi* and *Cribrilina cryptooecium*, from the area. Nearby, extensive banks of the maerl, *Phymatolithon calcareum*, harbours an unusually dense population of the purple sea urchin *Paracentrotus lividus* (Keegan (1974). There has been a field laboratory at Finavarra since April 1973, which allowed for detailed intertidal investigations.

The diversity of biotopes at Finavarra was high, eight littoral and three sublittoral fringe. The supralittoral fringe was characterised by black lichens (Ver.Ver) with an upper shore *Pelvetia canaliculata* zone below (Pel and PelB). A *Fucus spiralis* dominated zone (Fspi) occurred below this and the midshore was dominated by *Fucus serratus* on bedrock (Fser.R) and boulders (Fser.Bo). The underboulders supported rich faunal communities. Areas of midshore rock were dominated by barnacles and limpets (BPat.Cht). Sheltered areas of rock had a dense *Ascophyllum nodosum* biotope (Asc). The sublittoral fringe was dominated by the kelp *Laminaria digitata*. Bedrock had a dense *L. digitata* forest (Ldig.Ldig), with boulders support a rich fauna community underneath (Ldig.Bo). Areas of sublittoral fringe bedrock supported rich faunal crusts of bryozoans and ascidians typical of tide swept locations (Ldig.T).

Notable species:

1 notable species were recorded.
Paracentrotus lividus

Biotope richness:

11 biotopes were recorded.

Littoral rock	Infralittoral rock
Asc.Asc	Ldig.Bo
BPat.Cht	Ldig.Ldig
Fser.Bo	Ldig.T
Fser.R	
Fspi	
Pel	
PelB	
Ver.Ver	

Species richness:

156 species or higher taxa were recorded.

Porifera 10 (6.8%)	Bryozoa 7 (10.8%)	Chromophycota 16 (22.9%)
Cnidaria 5 (3.8%)	Echinodermata 6 (10.5%)	Chlorophycota 3 (13.0%)
Polychaeta 8 (6.3%)	Tunicata 7 (10.9%)	Lichens 8 (28.6%)
Crustacea 21 (15.6%)	Pisces 2 (2.4%)	Others 5 (10.6%)
Mollusca 28 (10.1%)	Rhodophycota 30 (15.1%)	

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Magraths Point

County: Clare
BioMar sector: IR6
Grid reference: 52°45.33'N 09°31.21'W
No. of sites: 1 **No of stations:** 8

Description:

Several rare species were recorded at this rocky seashore. The snapping prawn, *Alpheus macrocheles* was recorded only once on the BioMar survey. It was found at Magraths Point on the lower shore beneath some tightly packed cobbles on bedrock. The distribution of this prawn is southerly and is considered very scarce (Hayward and Ryland, 1995). The red algae, *Phyllophora sicula* was also recorded on the lower shore at this site. This is an extremely rare species with only one previous Irish record, Cork (Guiry, 1978). The BioMar survey recorded this species from four locations on north, west and south coasts of Ireland. The red alga *Pterosiphonia pennata* was recorded from the lower shore. Previous records are from scattered locations in southwest Britain and Ireland (Maggs and Hommersand, 1993), but only at one other BioMar site. Sanderson (1996b) noted this as a scarce species in Britain. The purple sea urchin *Paracentrotus lividus* was recorded in coralline rockpools on the midshore.

No littoral or sublittoral sediment or circalittoral biotopes were recorded from Magrath's Point. However the site had a wide range of littoral rocky biotopes and two sublittoral fringe (infralittoral) biotopes. The upper shore had biotopes dominated by lichens (YG.YG, Ver and Ver.Ver) with a barnacle dominated zone on bedrock (BPat.Cht) and unstables boulders (BLlit). The mid and lower shore was characterised by fucoid algae with zones of *Fucus spiralis* (Fspi), *F. vesiculosus* (Fves and FvesB) and *Fucus serratus* and red algae (Fser.R) on the lower shore. The sublittoral fringe was characterised by *Laminaria digitata* on bedrock (Ldig) and boulders (Ldig.Bo).

Notable species:

4 notable species were recorded.

Paracentrotus lividus
Alpheus macrocheles
Phyllophora sicula
Pterosiphonia pennata

Biotope richness:

11 biotopes were recorded.

Littoral rock	Infralittoral rock
BLlit	Ldig
BPat.Cht	Ldig.Bo
Fser.R	
Fspi	
Fvcs	
FvesB	
Ver	
Ver.Ver	
YG.YG	

Species richness:

206 species or higher taxa were recorded.

Porifera 13 (8.9%)	Bryozoa 6 (9.2%)	Chromophycota 23 (32.9%)
Cnidaria 5 (3.8%)	Echinodermata 8 (14.0%)	Chlorophycota 4 (17.4%)
Polychaeta 16 (12.5%)	Tunicata 12 (18.8%)	Lichens 8 (28.6%)
Crustacea 21 (15.6%)	Pisces 1 (1.2%)	Others 4 (8.5%)
Mollusca 36 (13.0%)	Rhodophycota 49 (24.6%)	

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None.

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APPENDIX 1

Species which were notable because they (a) formed natural habitats, and/or (b) are important commercial resources are listed below. The species of maerl *Lithothamnion corallioides*, *Phymatolithon calcareum*, and *Lithothamnion glaciale* fall into both categories. The native oyster *Ostrea edulis* and purple sea urchin *Paracentrotus lividus* are in places over-exploited commercial resources but have a widespread distribution on the western coasts of Ireland.

Molluscs

Limaria hians (Gmelin, 1791)

Fairly widespread around Britain and Ireland, but was recorded from only four habitats in Ireland by BioMar, all in Mulroy Bay, two littoral and two sublittoral. This species binds gravel with byssal threads into galleries, stabilising it for other fauna and flora to colonize.

Ostrea edulis Linnaeus, 1758

Widely distributed around the south-west, west and north-west of Ireland, but was only found in abundance in Tralee Bay. It is of significant economic value and is important in its habitat-consolidating role. Its abundance has decreased due to exploitation and disease.

Algae

Lithothamnion corallioides P. Crouan et H. Crouan[1]

Occurred frequently on northern, western and southern coasts, and had a unique community associated with it.

Phymatolithon calcareum (Pallas) Adey et McKibbin

This is maerl also has a widespread distribution around the coast, but is locally restricted. It is found from Norway to N. Spain, including W. Baltic and the Mediterranean, (Irvine & Chamberlain, 1994). It is usually associated with *L. corallioides* or *L. glaciale*.

Lithothamnion glaciale Kjellman

This is a species with a largely northerly distribution. It is thought to reach it's southern limit around these islands (Irvine & Chamberlain, 1994).

Maerl indet.

Unidentified live maerl species included for the above reasons.

Sea grass

Zostera marina L.

Widely distributed throughout Ireland, and can form extensive beds in the shallow sublittoral, stabilising sediment and providing a nursery ground for fish. The impact of the removal of *Zostera* may cause the destabilisation of the sediment. The hydroid *Laomedea angulata* (another notable species) appears to be confined to sea grasses in the shallow subtidal (Cornelius, 1995). It is susceptible to direct impacts such as dredging and anchoring of boats and is vulnerable to a decrease in water quality through suspended matter blocking out light.

Zostera angustifolia (Hornem.) Rchb.

Some taxonomists consider the *Zostera angustifolia* to be a narrow leafed intertidal variety of *Zostera marina*. In contrast to *Z. marina*, this is a largely littoral species. The conservation importance of intertidal *Zostera* spp. is however high. Intertidal *Zostera* is an important food source for waders and wildfowl particularly Brent geese (*Branta bernicla hrota*) and widgeon (*Anas penelope*) (Mather & Montgomery, 1996).

Echinoderms

Paracentrotus lividus (Lamarck, 1816) [1]

At present, this sea urchin is found all along the western coast of Ireland. However, many of the locations of greatest abundance have already been heavily harvested.

Locations where species were recorded, including survey and site number, site name, and national grid reference.

Ostrea edulis	504 23	NNE of Leighton Island, Kilkieran Bay.	L 909 316
	504 24	SE of Mussel Rock Roskeada Bay Kilkieran Bay	L 902 342
	504 25	SE of Mussel Rock Roskeeda Bay Kilkieran Bay	L 902 342
	511 34	Horse Ridge (Audley Cove), Sherkin Island	V 989 309
	515 7	SE of Emlybeg Point Blacksod Bay	F 697 301
	515 9	S of Barranagh Island, Blacksod Bay.	F 666 253
	515 11	Elly Bay, Blacksod Bay.	F 634 252
	515 37	SW of Barrett Point Broadhaven	F 757 337
	516 28	E of Canower Point Bertraghboy Bay (N coast)	L 763 398
	518 12	SSE of Mannin Rocks, Mannin Bay.	L 622 461
	518 23	Salt Lake rapids, Clifden Bay.	L 659 489
	524 17	N of oyster beds Aughinish Bay Galway Bay	M 299 128
	525 19	NE of Castlegregory Tralee Bay	Q 644 157
	525 20	E of Trench Bridge Tralee Bay	Q 636 148
	525 21	NE of Aughacasla Point Tralee Bay	Q 661 140
	525 22	SW of Samphire Island, Tralee Bay.	Q 709 143
	525 23	W of Fenit Island causeway Tralee Bay	Q 675 160
	525 24	Middle of Tralee bay	Q 669 170
Paracentrotus lividus	503 32	Ballyhoorisky Point, Mulroy Bay.	C 154 455
	504 6	S of East Brannock Island, Aran Islands.	L 780 110
	504 38	W of Mulroa Point, Kilkieran Bay.	L 772 280
	512 2	Blue Lough Bay, Ballyconnell Point, S Donegal Bay.	G 567 464
	512 4	Lislary Point, Cloonagh Bay, S Donegal Bay.	G 606 481
	512 35.	Murles Point, N Donegal Bay.	G 815 726
	515 6	Channel NW of Claggan Point, Blacksod Bay.	F 701 281
	515 8	SW of Ardmore Point, Blacksod Bay.	F 678 271
	515 24	SE of Carricknaroun, Mullet peninsula.	F 647 333
	516 13	S of Fanore Point, Black Head, Southern Galway Bay.	M 136 098
	516 14	Finavarra Point, Galway Bay.	M 239 116
	516 18	W of Cloghmore Point, Kilkieran Bay.	L 969 214
	516 21	Kilclogher Head, Kilbaha Bay.	Q 765 479
	516 22	Duggerna Rock, Kilkee, Moore Bay.	Q 874 605
	516 23	Magrath's Point, Doughmore Bay.	Q 977 673
	516 25	Spanish Point, Mal Bay.	R 022 786
	517 10	E of Reencaheragh Point, Valencia Island.	V 356 729
	517 25	W of Murreagh Point, Valencia Island.	V 395 785
	518 1	W side outer neck of Inishee Island, Roundstone.	L 734 412
	519 15	Ballynacashlan, Downpatrick Head.	G 117 416
	519 16	Fort Promontory, N of Inishcrone, Killala Bay.	G 289 318
	519 18	Pollnagat, Easky, Sligo Bay	G 384 388
	519 19	Carrickfadda, E. of Aughris Head, Sligo Bay.	G 518 360
	519 20	Muckros Head, North Donegal Bay.	G 618 737
	519 24	Meenclady Bay, W Inishboffin Bay, Bloody Foreland.	B 864 339
	519 25	Carrickabraghy, Doagh Isle, Malin Head.	C 396 521
	521 23	Cus Island, Ardgroom Harbour.	V 709 578
	521 52	Carrigavunig, SW of Garinish Is, Sneem Harbour	V 676 623
	521 55	S of Nedanone, Outer Kenmare River.	V 605 594
	521 59	A NW of Abbey Island, Outer Kenmare River.	V 515 582
	522 16	Rockpools at Dooagh, Achill Island.	F 607 045
	522 17	W side of Dooagh Beach, Achill Island.	F 601 046
	530 7	Coosanea, N, Magharee Islands, Brandon Bay	Q 595 191
	530 11	Carrigaroad, Gerahies, Bantry Bay.	V 899 446
	530 12	S of Ballymore Point, Ventry.	V 405 989

Lithothamnion corallioides	501 3	SW of Yellow Rocks Bantry Bay	V 954 534
	501 15	S of Foilenaboe Rocks Berehaven Bantry Bay	V 677 442
	503 9	E of Knox's Hole Mulroy Bay	C 124 406
	503 13	N of Pan Bay Mulroy Bay	C 188 348
	503 13	N of Pan Bay Mulroy Bay	C 188 348
	503 21	S of Mullaghanhardy Point, Mulroy Bay.	C 189 371
	503 22	Moross Castle Mulroy Bay	C 179 388
	503 25	Outer Millstone Bay, Mulroy Bay.	C 152 380
	503 27	N of Tirloughan Bay, Mulroy Bay	C 145 378
	504 31	NW of Lettercallow Spit Kilkieran Bay.	L 847 295
	504 32	Lettercallow Spit Kilkieran Bay	L 844 292
	504 33	S of Lettercallow Spit Kilkieran Bay.	L 843 291
	504 34	SW of Illaunmaan Kilkieran Bay	L 822 274
	508 27	SW of Carrigviglash Rocks Roaringwater Bay	W 014 312
	508 28	NW of Rincolisky Castle Roaringwater Bay	W 012 309
	508 29	NW of Illaunrahnee Roaringwater Bay	W 006 307
	512 40	N of Black Rock St John's Point	G 724 704
	512 41	Black Rock St John's Point	G 724 701
	517 13	S of Quay Brack Valencia	V 361 731
	517 14	E of Portmagee Valencia Island	V 367 731
	517 15	Portmagee Channel opposite pier Valencia	V 370 731
	517 16	Portmagee Channel E of Bridge Valencia	V 378 733
	518 11	W of Craghnagh Rock Mannin Bay	L 611 470
	518 12	SSE of Mannin Rocks Mannin Bay	L 622 461
	518 13	NW of Katherine Rocks Mannin Bay	L 621 473
	518 16	Entrance to Lough Athola Mannin Bay	L 622 482
	518 17	S of Haggard Rock Mannin Bay	L 620 477
	518 18	SW of Haggard Rock Mannin Bay	L 616 477
	521 22	W of Ship Rock Ardgroom Harbour	V 709 584
	521 46	W of Inishkeragh Sneem Harbour	V 692 624
	523 4	S of Rossbrin Cove Castle Island Sound	V 968 291
	523 16	Lonehort Point Berehaven	V 761 459
	523 23	Llaundrane Kenmare River	V 631 614
Phymatolithon calcareum	511 22	E Binny Island, Sherkin Island.	V 960 283
	511 24	Castle Island Castle Point Sherkin Island,	V 956 300
	511 28	E Middle Calf, Sherkin Island.	V 959 263
	511 35	Rincolisky Castle Sherkin Island	V 989 309
	518 14	E of Mannin Creek Mannin Bay	L 636 475
	518 18	SW of Haggard Rock Mannin Bay	L 616 476
	523 15	SW of Mannin Island	W 020 324
	527 33	Middle Sound Aranmore	B 691 118
Maerl indet.	501 9	NE of Lonehort Point Berehaven	V 764 456
	504 27	N of Kinnelly Rock Kilkieran Bay	L 864 320
	504 30	N of Kinnelly Rock Kilkieran Bay	L 864 320
	515 13	SSW of Ardelly Point Blacksod Bay	F 655 230
	521 25	E of Carravaniheen Is Ardgroom Harbour	V 715 590
Limaria hians	503 11	Back Lough Narrows, Mulroy Bay.	C 174 353
	503 21	S of Mullaghanhardy Point, Mulroy Bay.	C 189 371
	503 22	Moross Castle, Moross Channel, Mulroy Bay.	C 179 388
	503 26	Mark's Point, Broadwater, Mulroy Bay.	C 185 357
Lithothamnion glaciale	503 19	White Mares Bay Mulroy Bay	C 191 361
	525 18	SE of Kilshanig Point Tralee Bay	Q 664 174
	525 23	W of Fenit Island causeway Tralee Bay	Q 675 160
	525 24	Middle of Tralee Bay	Q669 171
	527 39	E of Toninishgun Point Rutland Channel	B 708 149

Zostera marina	503 31	Portnagarribane, Fanad, Lough Swilly.	C 227 478
	503 35	Bay S of Carnsore Point Lough Swilly	C 281 350
	50316	SW of Rough Island Mulroy Bay	C 196 304
	504 30	N of Kinnelly Rock Kilkieran Bay	L 864 320
	508 19	NW of Goose Island Roaringwater Bay	W 004 291
	508 19	NW of Goose Island Roaringwater	W 004 292
	508 28	NW of Rincolisky Castle Roaringwater Bay	W 012 309
	508 29	NW of Illaunrahnee Roaringwater Bay	W 006 307
	511 30	Horseshoe Harbour, Sherkin Island.	V 997 252
	511 32	W Sherkin, Sherkin Island.	W 002 250
	511 34	Horse Ridge (Audley Cove) Sherkin Island	V 989 309
	511 35	Rincolisky Castle, Sherkin Island.	V 989 309
	512 24	Off Bunduff Strand Mullaghmore	G 713 569
	515 5	E of Claggan Point, Blacksod Bay.	F 702 274
	515 10	Outer Elly Bay Blacksod Bay	F 6563 250
	515 13	SSW of Ardelly Point Blacksod Bay	F 655 230
	515 36	Ballyglass Pier Broadhaven	F 767 354
	515 36	Ballyglass Pier Broadhaven	F 767 354
	517 12	E of Reencaheragh Point Valencia Island	V 357 730
	517 33	The Foot Knight's Town Harbour Valencia	V 428 775
	518 11	W of Craghnagh Rock Mannin Bay	L 611 470
	518 12	SSE of Mannin Rocks Mannin Bay	L 622 461
	518 14	E of Mannin Creek Mannin Bay	L 637 476
	523 1	Croagh Bay Long Island Sound	V 899 293
	523 4	S of Rossbrin Cove, Castle Island Sound.	V 968 291
	523 5	S of Castle Island, Castle Island Sound.	V 957 297
	523 13	NE Goose Island Channel, Skeams.	V 999 301
	523 14	Goose Island Channel, Skeams.	V 998 296
	525 19	NE of Castlegregory Tralee Bay	Q 644 158
	525 20	E of Trench Bridge Tralee Bay	Q 636 148
	525 21	NE of Aughacasla Point Tralee Bay	Q 661 140
	527 33	Middle Sound Aranmore	B 691 118
	527 34	NE of Inishkeeragh, Aranmore	B 684 129
	527 43	Aran Road, S of Calf Is., Aranmore	B 685 164
	528 1	E of Jarley's Cove Kinsale Harbour	W 649 489
	529 15	Callinafercy, Castlemaine Harbour.	Q 765 015
	529 17	Back of Derrymore Island, Tralee Bay.	Q 759 129
	529 20	Poulnasherry Bay, Shannon.	Q 942 577
Zostera angustifolia	512 2	Blue Lough Bay Ballyconnell Point S Donegal Bay	G 568 465
	512 4	Lislary Point Cloonagh Bay S Donegal Bay	G 607 481
	512 35	Murles Point N Donegal Bay	G 815 727
	528 23	W of Rabbit Island Glandore Bay	W 217 313

APPENDIX 2

Summary tables of the biotopes recorded from the conservation areas. Site numbers are given in the key below. Biotope codes are in Table 2.2.

List of areas and number.

1	Saltee Islands and adjacent coastline	11	Mannin Bay
2	Lough Hyne (Ine)	12	St John's Point and North Donegal Bay
3	Roaringwater Bay and islands	13	Rathlin O'Birne Island
4	Kenmare River	14	Mullaghmore Head and adjacent coastline
5	Magharees Islands	15	Tory Island
6	Kerry Head shoals	16	Broadhaven Bay
7	Tralee Bay	17	Mulroy Bay
8	Valentia Island	18	Rutland Channel, Aranmore.
9	Aran Islands	19	Finavarra
10	Kilkieran Bay	20	Magraths Point

Littoral rock

	Areas of conservation importance																			
Biotope	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Asc.Asc	•		•				•				•						•		•	
Asc.T			•																	
AscX		•	•					•									•			
Aud	•																			
BLlit																				•
BPat	•											•					•			
BPat.Cht				•	•					•		•							•	•
BPat.Lpyg							•													
BPat.Sem	•		•	•				•		•	•						•			
Cor			•	•	•															
Cor.Par				•						•		•		•						
Fcer												•								
FcerX			•																	
FK								•									•			
FK.Bo					•									•						
FK.Snd														•						
Fser.Bo					•		•			•									•	
Fser.Fser			•	•			•	•		•				•						
Fser.R	•			•	•			•		•	•						•		•	•
FserX			•					•												
Fspi				•			•	•		•		•					•		•	•
Fves	•		•		•			•			•	•		•			•			•
FvesB			•	•				•		•				•						•
FvesX				•				•												
G					•															
Him				•	•							•		•			•			
MytB				•	•			•				•					•			
Pel			•				•			•									•	

PelB			•	•				•		•	•								•	
R.Mas			•					•												
R.Osm														•						
RamG			•					•		•	•									
Ver																				•
Ver.B				•	•															
Ver.Ver	•		•	•	•		•	•			•	•							•	•
YG.YG	•			•	•			•		•	•	•								•

Littoral Sediment

	Areas of conservation importance																			
Biotope	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
AEur								•		•		•	•	•						
AP	•			•			•			•	•	•		•		•				
AreBv	•			•				•		•			•							
Lan			•																	
PSfol				•			•	•			•			•						
Tal	•							•		•	•	•	•	•						

Infralittoral Rock

	Areas of conservation importance																			
Biotopes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ala.Ldig					•							•	•	•						
Ala.Myt	•			•													•			
AlaRAn									•											
CorMet				•								•	•	•	•	•				
Dic				•												•				
FoR	•			•	•	•	•	•	•			•								
HalXK.F	•	•	•						•					•			•			•
Ldig																	•			•
Ldig.Bo										•				•					•	•
Ldig.Ldi	•		•	•				•		•							•		•	
Ldig.T					•			•		•							•		•	
Lhyp				•				•				•		•	○	•	○			
Lhyp.TP	•				•													•		
LhypFa	•		•	•		•		•	•			•	•	•	•	•	•			
LhypFa.P									•											
LhypGz.			•																	
LhypLsa			•	•	•			•					•					•		
Lsac.Ft			•	•													•			
Lsac.Ldi		•					•	•			•									
Lsac.T																	•			
Lsac.X																		•		
LsacSpol													•							
SC				•												•				
SCAn													•							
SCAs.By				•					•				•							
Spol					•											•				
XK	•			•				•							•		•			

Circalittoral Rock

Biotope	Areas of conservation importance 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AlcC														•						
AlcTub	•			•																
Ant			•	•				•	•				•		•		•			
Axi	•	•	•	•		•		•	•	•	•	•	•	•	•	•				
Bra.Pla				•																
CCParC	•		•	•		•		•	•	•	•	•	•	•	•	•	•			
Flu	•														•		•			
Mus													•							
Oph	•			•					•											
PolCio									•											
PomBy								•												
SCupPa																	•			
SoAs		•								•										
SSoAs										•							•			
SwiErS				•																

Sublittoral Sediment

Biotope	Areas of conservation importance 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AbraEco			•								•			•						
AfilEcor			•	•							•						•			
An										•										
Beg														•						
EcorEsil			•				•		•		•			•		•				
Lcor			•	•			•	•		•	•	•					•	•		
Lfas			•																	
Lgla							•										•	•		
Lhia																	•			
MacAb								•												
Mob	•			•						•	•									
NeoBv	•		•	•						•	•	•					•			
Ost							•				•					•				
Phy			•	•						•	•							•		
Sell			•				•										•	•		
Spav			•																	
SpNep				•						•										
TcomAs			•									•					•			
VenBra			•																	
VenFab																•				
VenMya			•					•												
VmirAn				•				•		•	•									
Zmar			•				•			•	•	•					•	•		
ZmarBv			•				•	•			•			•		•				