Porcupine Newsletter

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EDITORIAL

The present Newsletter contains outstanding articles from the Cornwall Meeting last August, together with the first crop of articles from presentations at the Peterborough Meeting in March. Sadly, I was unable to attend the Spring Meeting and AGM - and obviously word got out: I gather that over one hundred people came to Peterborough (OK, maybe not just to celebrate my absence), so congratulations to those responsible for the organisation, both for attracting the audience and for catering for it (in every sense of the word).

It would also appear that there was not a flood of volunteers for Office-Bearer posts on Council, so you must suffer my editoring for another year, and I must carry on plaintively requesting material for the Newsletter. Which is to say, all contributions, be they articles, letters, notices, notes or whatever will be gratefully received.

For those of you who were wondering when Summer might start, there is still a reasonable stock of PORCUPINE sweatshirts at the eminently reasonable (and apparently fixed) price of £11.00. Contact myself if you require one.

I have received the latest issue of *De Strandvlo* (Vol.13 No.1) on behalf of PORCUPINE, a special issue containing lots on *Petricola pholadiformis* by Dirk Wouters, in "celebration" (?) of 100 years since its invasion from North America. Interested PORCUPINES should contact myself.

I trust that I am not the only one who has difficulty in keeping up with nomenclatural changes across the numerous marine taxa (for example, I've only just discovered *Necora puber*). Some years ago various itinerant PORCUPINES discussed favourably the idea of an updating service by Members who have some specialization in one or more taxonomic groups - perhaps an annual report of "names that have changed this year", together with new species or new zoogeographic records for that group. Should any such specialist be interested in cooperating on such a service for the esteemed Membership and other readers, perhaps they would like to get in touch with me (name unchanged) - we could get the system working immediately. I hope that we can combine interest, demand and altruism. Incidentally, pycnogonid nomenclature appears comparatively stable.

Finally, the next Newsletter is due in August, for those of you concerned about deadlines (he hoped!).

Roger Bamber, Hon. Editor.

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THE HELFORD VOLUNTARY MARINE CONSERVATION AREA

Pamela E Tompsett

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The Helford River is scenically beautiful and biologically special. Situated on the eastern side of the Lizard Peninsula, this narrow, sheltered arm of the sea stretches inland for nearly six miles from its entrance between the rocky shores of Rosemullion Head and Nare Point. The freshwater influence is low, for this is not a true estuary but a drowned valley, flooded when the water level rose after the last retreat of the ice some 10,000 years ago. Creeks, or pills as they are known in Cornwall, probe the surrounding hills and here, as Rd Olicer Rackham wrote, "ancient woodland meets the sea". On the rising ground above the river banks there is a regular pattern of settlements and farms, some dating back beyond the Iron Age as revealed in their Cornish names.

The high marine biological value of its shores has long been recognised, from the contrasting habitats of the rock pools at Prisk Cove to the stretches of sediment, mud and stones within the river. These sediment shores at Helford Passage, Treath, Helford Point and Gillan have historically supported areas of *Zostera marina* and a unique assemblage of worms, crustaceans, molluscs and echinoderms many of which occur elsewhere only in offshore shallow water.

Of particular interest are the rare Couch's Goby (*Gobius couchii*), for which this is the type locality, and the common sea horse (*Hippocampus ramulosus*) which is found occasionally by local fishermen.

From early times there has been some human impact on the River and its shores. Fishing continues today, as does the collection of shellfish, including the common cockle (*Cerastoderma edule*) and winkles (*Littorina littorea*). Mussels have been overcollected and are no longer present in large numbers, but these and the famous Helford oysters, *Ostrea edulis* and *Crassostrea gigas*, are reared commercially by the Duchy Oyster Farm. Malayan clams (*Tapes philippanarum* = *T. decussatus*) have also been tried experimentally.

River transport is less important today, although the foot-ferry still crosses the river during six months of the year. In ancient times, boats conveyed gabbro pottery from the Lizard to Eastern England. Later, in the heyday of mining, tin was exported from the Wedron mines and, when this industry collapsed, many Cornish emigrants sailed to North America from Gweek.

Activities likely to have an impact on the fauna and flora are on the increase. Wind surfers trample the shellfish beds, whilst bait- and shellfish-collectors turn over the beds of intertidal sediment. On adjacent farmland, the introduction of new crops and practises and the intensification of dairy and grassland regimes increases the risks from pollutant run-off, particularly during periods of alternating drought and torrential rain. Many riverside properties have inadequate septic tanks and control of discharges from visiting yachts is minimal.

The marine fauna, especially the Mollusca, has been studied since the mid-1840s, when naturalists with a national reputation, such as W.P. Cocks and Jonathan Couch, were very active. James Clark brought together all the early Victorian work in the County in his contributions to the Victoria County History (1906). In the 1920s, A.P. Gardiner wrote a short article on the *Zostera* beds of Helford Passage and in the 1940s T.G. Fowler collected quantities of the biggest and best mollusc specimens he could find, distributing them to various collectors: his main collection is now in the Natural History Museum. In 1949, Norman Holme first visited the River with G.M. Spooner and carried out surveys, then and in

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subsequent years, which were to prove very useful in later assessments of changes in the marine fauna. The 1960s and 1970s saw activity by students from the Universities of Reading, Bristol and Exeter, the last represented by Roger Burrows, Paul Chanin and Stella Turk. During the last decade there have been surveys by the Oil Pollution Research Unit (under contract to NCC) and by the NRA.

Between 1970 and 1980, those biologists who had studied the area for many years became increasingly concerned at the decline in the rich fauna and flora, particularly within the intertidal zone. Major factors were thought to be the detrimental effect of TBT-based antifouling paints, disease in the eel-grass beds, physical disturbance (including the practice of trigging - raking for cockles - traditionally and intensively carried out on Good Fridays) and a general increase in the use of the intertidal zone.

Creation of the Helford Voluntary Marine Conservation Area

In 1985, a meeting of individuals and organisations associated with the River agreed to support a 12-month survey of the Helford River to assess the problem and to set nine permanent transect lines for future monitoring. Cornwall County Council sponsored this study, which was funded by Heinz Guardians of the Countryside and WWF UK, with a contribution from the Duchy of Cornwall.

In 1987, Roger Covey and Sue Hocking published their report which pointed to the need for some protective measures. Prolonged discussion led to the designation of the "Helford Voluntary Marine Conservation Area" with the aim of "achieving, by voluntary means, the harmonious use of the river and to monitor the quality of the marine environment."

Development of the organisation continued through the Working Group with a carefully formulated management plan, otherwise known as the "Strategic Guidelines and Five-year Work-programme". Members meet regularly to deal with current issues such as bait-digging, speed-restrictions on boats and planning applications affecting the intertidal zone. WWF UK trustees and Marine Conservation Officers have been staunch supporters, providing basic funding, and the Group is grateful to them and for assistance from local donors.

Current Projects and Special Studies

Transect monitoring at the nine sites, undertaken in 1986, 1988 and 1990 will be repeated in the Autumn of 1993.

Studies of the cockle population at Helford Passage and of the lugworm population with special reference to the effect of bait-digging are in progress.

Dog whelks are being monitored to assess recovery after the population crash in the 1980s at the time when TBT antifouling paints were in widespread use. Following the ban on its use in 1988, juveniles have reappeared at sites at the mouth of the Estuary, particularly on the southern shore at Nare Point. The high populations once seen around the northern site at Prisk Cove have not recovered to the same extent.

The Bar at Helford Passage has become somewhat eroded and bare. By 1988, the once prolific intertidal eel grass (*Zostera marina*) beds had completely disappeared as had the *Z. noltii* from below Calamansack. Factors involved may include:

disturbance by people raking for cockles or bait-digging;

effects of seasons when both unusually high and low temperatures coincided with the spring tides, when the *Zostera* was exposed for relatively long periods in 1984, 1986 and 1987;

increases in nitrate and phosphate levels;

subtle changes in the substrate;

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stress situations make eel-grass particularly susceptible to "wasting disease" in which an organism allied to the slime-moulds is implicated; this is currently the subject of intensive study in Holland by Prof. den Hartog and colleagues.

So far the historic sub-tidal beds in the Helford continue to flourish and, interestingly, the intertidal beds of Mounts Bay remain healthy.

A pilot scheme in "habitat creation" is under way to encourage more intertidal diversity with the longer-term aim of re-introducing intertidal *Zostera*.

Habitat Creation, Phase I:

In April 1990, fresh rock platforms were built on each side of the River, in such a way as to allow plenty of crevices for faunal shelter, and the subsequent colonization was recorded. Within a few weeks there was settlement of juvenile fucoids, the Australian barnacle (*Elminius modestus*), many molluscs, anemones, tunicates, fish, crabs and other fauna. Peacock worms (*Sabella pavonina*), which had recently returned to the shore, settled in close proximity to the platforms.

Habitat Creation, Phase II:

September 1992 saw the completion of a 3 m circle of rocks with additional heaps at each end, deposited on the site of the historic *Zostera* bed, where brief exposure occurs on mid to spring tides.

The crevices were quickly colonized by free-living animals, although the surfaces were not settled quite so quickly as in the pilot schemes. This may be attributed to the more exposed position of the circle. Many *Sabella pavonina* appeared both on and within the rock circle.

At the end of August, eel-grass from the flourishing subtidal beds just off Porthallack at the mouth of the River was collected and replanted within the rock circle. It survived the onslaught of easterly gales to November, as well as the attentions of shellfish collectors and the threat of oil-pollution. Few patches of *Zostera* can have been watched with such concern.

Interest in the whole concept of Voluntary Marine Conservation Area management has become widespread and, rather to our surprise, we have found ourselves to be a focus of attention. Hopefully this means that the protection of the marine environment will be taken more seriously and belated support given to halt decline wherever possible.

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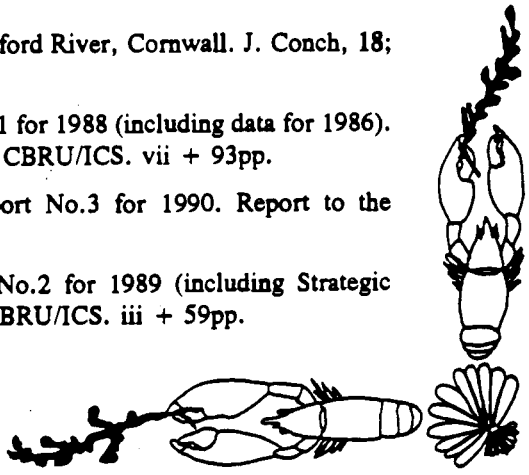

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SOUTHERN MARINE FAUNA AND FLORA FROM SW IRELAND

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Historical Review

As if by some quirk of nature, the little fishing village of Dingle would appear to be situated at the very epicentre of marine faunal diversity in Ireland. The broad expanse of shallow continental water that fans outward from Dingle Bay in SW Ireland supports some of the most interesting marine species and ecosystems in Northern Europe. Indeed, there is probably nowhere else in Europe where both Mediterranean and Arctic species can be found sharing the same habitats. Exposed to the full fetch of the wild Atlantic Ocean, Dingle Bay acts like a biological funnel, concentrating warm-, cold-, shallow- and deep-water species into a colourful kaleidoscope of exotic marine life.

The rich diversity of marine fauna that characterizes the Dingle area was first recognized During the mid-1800s by William Andrews (1802-1880). A native of Chichester, Andrews came to Ireland and became a founder and leading member, and ultimately President, of the Natural History Society of Dublin. He was interested in both zoology and botany and, although he was especially interested in fishes and ferns, his most notable discovery was the now famous "spotted slug of Kerry", *Geomalacus maculosus*, which is found only on the Dingle Peninsula and elsewhere on the Iberian Peninsula. He also recorded several interesting species of the marine fauna, many of them new to Ireland, including what would appear to have been the first record of the trigger fish. *Balistes capriscus* (= *B. carolinensis*), in 1853.

In 1885, Dr E. Perceval Wright formed a committee to investigate the fauna off the south coast of Ireland inside the 100 fathom line and a grant was obtained from the Royal Irish Academy. The committee hired the steamer *Lord Brandon* and, with the help of the Rev. William Spotswood Green (1847-1919), Prof. Alfred Cort Haddon (1855-1940), Joseph Wright (1834-1923), Samuel M. Malcomson (1857-1886), William Swanston (1841-1932) and others, they carried out dredging operations in early August of that year. A second cruise was organised in July 1886, involving additional scientists including Albert Russell Nichols (1859-1933). In May 1888, a deep-water exploration was carried out aboard the *Flying Falcon*. The participants included, amongst others, William F. de Vismes Kane (1840-1918) and Robert Lloyd Praeger (b. 1865). Although many marine species were taken during these three expeditions the total number of fish captured was small. However, our knowledge of the fauna in the waters off the south west coast was greatly enriched as a result of these activities.

As it was felt that there was a lack of accurate information concerning the development of Irish fisheries, particularly on the south and west coasts, the Royal Dublin Society entrusted Prof. A.C. Haddon in early 1889 to carry out a scientific survey of the fishing grounds off the west coast of Ireland. From May to August 1890 the S.S. *Fingal* was engaged, and from March to June 1891 the S.S. *Harlequin*.

Further exlploratory cruises were carried out between 1901 and 1914 by the Fisheries Branch, Department of Agriculture and Technical Instruction, with the Rev. W.S. Green as Chief Inspector of Fisheries. The cruiser *Helga* was employed extensively during these surveys. Among the many contributors were Constance Delap (1868-1935) and her sister Maud Jane Delap (b. 1866), Edward W. Lyons Holt (1864-1922), Stanley Wells Kemp (1882-1945), Anne L. Massy (d. 1931), Colin M. Selbie (1890-1916), Rowland Southern (1882-1935), Jane Stephens (b. 1879) and Walter M. Tattersall

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(1882-1943). Although these investigations greatly extended our knowledge of Ireland's marine fauna, a change in Government policy in the early 1920s appears to have been responsible for the lack of any further significant research in this area for nearly 50 years.

In the absence of adequate funding for marine research, much of our knowledge about the more unusual and non-commercial marine species off our coast has come to light as a result of the cooperation between amateur naturalists and the commercial fishing industry. More recently, the contribution of SCUBA divers and anglers has also been recognized as they tend to be active in areas where the commercial boats do not, or cannot, operate.

A useful piece of teamwork was carried out by an English party in 1895-96, when Valentia Harbour was chosen on the recommendation of Prof. A.C. Haddon for a careful study of its marine fauna. The personnel consisted of E.T. Browne, J.T. Cunningham, F.W. Gamble, W.A. Herdman, M.D. Hill, I.C. Thompson, A.O. Walker and F.E. Weiss, and the Delap sisters of Valentia, who cooperated, extended the collecting period to 1898.

Michael Long - His Contributions to the Fauna of Dingle

It was not until the late 1950s that our knowledge about the rich diversity of marine fauna in the waters of the south-west coast was again brought to notice. For a period of almost 30 years, Michael Long (d. 1980) displayed a keen interest in the fauna and flora of his native Dingle Peninsula. Michael was the proprietor of a well-known public house opposite the harbour, where many of the fishermen brought their unusual catches for identification.

By 1960, Michael Long had assembled the nucleus of a mollusc collection for the Dingle Bay area and in August 1966 he presented a selection from his collection to the National Museum in Dublin. Among these was a specimen of the "rugose bonnet-shell", *Cassidaria tyrrhena* (= *Galeodea rugosa* L.), a Mediterranean species which had only once previously been recorded from Irish coastal waters within the 100-fathom line. This discovery aroused his enthusiasm for collecting rare and unusual species.

With thecooperation of the fishermen of Dingle, Michael collected and presented many marine invertebrate species to the National Museum, not only molluscs but also crustaceans, bryozoans, brachiopods, coelenterates, echinoderms and sponges. He was responsible for the discovery of 12 invertebrate species which until that time were unknown within Irish coastal waters.

He was also responsible for extending the known limits of distribution of several marine species. For example, he discovered the coral *Lophohelia prolifera* within the 100-fathom line near the mouth of Dingle Bay. He extended the northern limit of the sub-tropical conch, the "knobbed triton" (*Charonia lampas*) to the western extremity of Dingle Peninsula (6 records) from the Bay of Biscay (and subsequently earlier doubtful records from the Channel Islands were confirmed by its rediscovery there). His record of another sub-tropical, the "little frog triton" (*Ranella olearium*) extended its known northern limit from deep waters of the St George's Channel and off south-west Ireland.

Michael's discovery of an Arctic species, the northern stone crab, *Lithodes maja*, was the first reliable Irish record (to be followed by several more in the Dingle area) and the southernmost occurrence of this species. The discovery within his collection of otter clam shells of the thicker-shelled *Lutraria angustior*, the first record for Ireland, prompted a search through the collection of the National Museum which revealed further examples, mostly from the west and south-west coasts, which had been erroneaously identified as the European *L. lutraria*.

Drift objects were also of interest: he discovered the unusual barnacle *Stromatolepas elegans* on the neck of a leatherback turtle (*Dermochelys coriacea*), and a cluster of the North American mussel *Brachidontes exustus* on a buoy stranded at Dingle.

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Michael was responsible for bringing to notice over 82% of all the rare fish species recorded in Irish waters, including the first records within the 100 fathom line of sharp-back shark (*Oxynotus paradoxus*), blackmouth dogfish (*Galeus melastomus*), rabbit fish (*Chimaera monstrosa*), deal fish (*Trachipterus arcticus*), comber (*Serranus cabrilla*), grenadier fish (*Malacocephalus laevis*), Mediterranean ling (*Molva dipterygia macrophthalma*), bogue (*Boops boops*), Spanish mackerel (*Scomber colias*), red fish or Norway haddock (*Sebastes marinus marinus*) and puffer fish (*Lagocephalus lagocephalus*).

At the same time Michael was an able botanist, adding a number of species to the list for South Kerry and his *ca* 300 specimen collection in the National Herbarium.

At its AGM on 27 January 1978, the Institute of Biology of Ireland elected Michael as an Honorary Life Member, a singular honour in recognition of his outstanding contribution to the study of natural history in Ireland. Michael Long epitomised the old-time naturalists of wide-ranging interests, following in a long Irish tradition. Sadly, he died on March 10th 1980, and is buried in Miltown Cemetery overlooking Dingle Harbour.

Undoubtedly inspired by Michael Long's enthusiasm, Dingle's reputation as an area of major scientific interest has been maintained owing to the continued interest shown by the local fishermen in bringing to notice any unusual specimens in their catch.

Finally, special mention should also be given to the late Arthur E.J. Went (d. 1980) who, as a senior scientist with the Department of the Marine from the early 1940s to the late 1970s, developed a particular interest in rare fish. Dr Went's numerous articles and scientific papers on the occurrence of exotic fish species in Irish waters, many of them based on specimens discovered by Long, highlighted the important contribution of zoogeography to our understanding of fish biology on both a national and a global scale.

Biogeography of Ireland's Marine Fauna

Ireland's marine fauna is composed of a rich amalgum of species derived from several biogeographical zones. Many of our species are typically cool-temperate in range and are found virtually around the whole coast and at most times of the year. However, superimposed on this group are two other elements, the warmer water Lusitanian species and cold water Boreal fauna.

Lusitanian species are those which are at the northern limit of their range in Irish waters, either as residents or as summertime migrants, or both. They are usually abundant south of the Bay of Biscay and in the Mediterranean. Boreal species normally extend anly as far south as North Sea coasts. With the richer southern fauna, there are more Lusitanian than Boreal migrants.

In addition there is the massive North Atlantic Drift current which starts in the western Atlantic as the Gulf Stream. This warm water from the sub-tropics warms the North European coastline and has a major influence on our climate. It brings with it many warmer water species, including rare vagrants, and enables the seasonal migrations of Lusitanian species.

Finally, our marine fauna is also supplemented by a small number of deep-water species from the edge of the continental shelf or deeper further offshore. Some of these species are known to migrate annually from deeper to shallower water.

Representative species from these five marine biogeographical groups are listed in the Appendix. All of these have been recorded from the southwest coast of Ireland, particularly from the Dingle area.

Those species with some economic value are relatively well known, but there remain many others whose biology and status is poorly understood. Without a commercial incentive, many species will

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remain only of interest to the dedicated biologist. Indeed, the difficulty and expense of sampling many marine habitats has resulted in species being regarded as rare when in fact they might be common or abundant; many deep-water species could be considered in this category.

APPENDIX

Resident Warm-Water Species
Undulate ray, *Raja undulata*
White skate, *Raja alba*
Six-gilled shark, *Hexanchus griseus*
Red mullet, *Mullus surmuletus*
Box Crab, *Paramola cuveri*
Deep-water red crab, *Chaceon affinis*

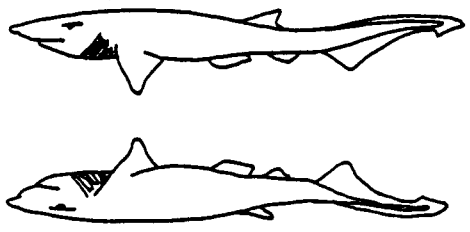
Resident Cold-Water Species
Torsk, *Brosme brosme*
Blue ling, *Molva dypterygia*
Wolf-fish, *Anarhichas lupus*
Jellycat, *Anarhichas denticulatus*
Stone crab, *Lithodes maja*

Regular Warm-Water Migrants
Trigger-fish, *Balistes carolinensis*
Wreckfish, *Polyprion americanus*
Sunfish, *Mola mola*
Bluefin tuna, *Thunnus thynnus*
Albacore, *Thunnus alalunga*
Bonito, *Sarda sarda*
Skipjack tuna, *Katsuwonas pelamis*
Garfish, *Belone belone*
Short-beaked garfish, *Belone svetovidovi*
Skipper, *Scomberesox saurus*
Ray's bream, *Brama brama*
Black bream, *Spondyliosoma centharus*
Mediterranean ling, *Molva macrophthalma*
Swordfish, *Xiphias gladius*
Pilot fish, *Naucrates ductor*
Remora, *Remora remora*
Leatherback turtle, *Dermochelys coriacea*
Loggerhead turtle, *Caretta caretta*
Violet sea-snail, *Ianthina exigua*
By-the-wind-sailor, *Velella velella*

Irregular Warm-Water Species
Tarpon, *Tarpon atlanticus*
Bluefish, *Pomatomus saltarix*
Smooth puffer fish, *Spheroides pachygaster*
American barrel fish, *Hyperoglyphe perciforma*
Long-finned bream, *Taractes longipinnus*
Luvar, *Luvarus imperialis*
Opah, *Lampris guttatus*
White marlin, *Tetrapterus albidus*
Octopus, *Alloposida mollis*
Coconut, *Cocos nucifera*
Sea bean, *Entada gigas*

Irregular Cold-Water Species
Greenland halibut, *Reinhardtius hippoglossoides*
Atlantic football fish, *Himantolophus groenlandicus*

Deep-Water Species
Angler fish, *Cryptosaras couesi*
Sea-toad, *Chaunax suttkusi*
Sharp-backed shark, *Oxynotus paradoxus*
Rabbit fish, *Chimaera monstrosa*
Rat tails (Macrouridae spp)
Spiny eel, *Notocanthus bonaparti*
Greater argentine, *Argentina silus*
Orange roughy, *Hoplostetus mediterraneus*
Beryx, *Beryx decadactylus*
Blue mouth, *Helicolenus dactylopterus*
Boar fish, *Capros aper*
Black fish, *Centrolophus niger*
Cornish blackfish, *Schedophilus medusophagus*



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RANGE EXTENSIONS OF WARM-WATER SPECIES IN THE NORTHERN MEDITERRANEAN: EVIDENCE FOR CLIMATIC FLUCTUATIONS?

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The Mediterranean Sea lies within the warm-temperate marine region which ranges from the north-western coasts of Africa to more or less the entrance of the English Channel (Briggs, 1974; Vermeij, 1980). However, owing to the vastness of the basin, its geological history (Maldonado, 1985) and climatic and hydrological influences, the Mediterranean biota does not show a homogeneous distribution (CIESM, 1981; Pérès, 1985; Tortonese, 1985). Mediterranean workers (Pérès & Picard, 1964; Fredj, 1974) distinguish up to ten different "biogeographical sectors" within this Sea.

The Tyrrhenian Sea, the central sector of the western Mediterranean, is the area inhabited by the most typical Mediterranean flora and fauna, with most endemic species and Atlantico-Mediterranean elements, and a fairly high percentage of species with subtropical affinities.

The Ligurian Sea (northern sector) is colder, and thus characterized by a very diminished subtropical element to the fauna and by the presence of some species from cold-temperate waters generally missing elsewhere. This gives the Ligurian Sea a boreal affinity (Rossi, 1969; Albertelli *et al.*, 1981; Cattaneo-Vietti *et al.*, 1988).

The physical oceanography of the Tyrrhenian and Ligurian Seas is summarized by Tait (1985); the biogeographic boundary between these two seas lies at the Tuscan Archipelago (Castelli *et al.*, 1988; Lardicci *et al.*,1990) (Figure 1).

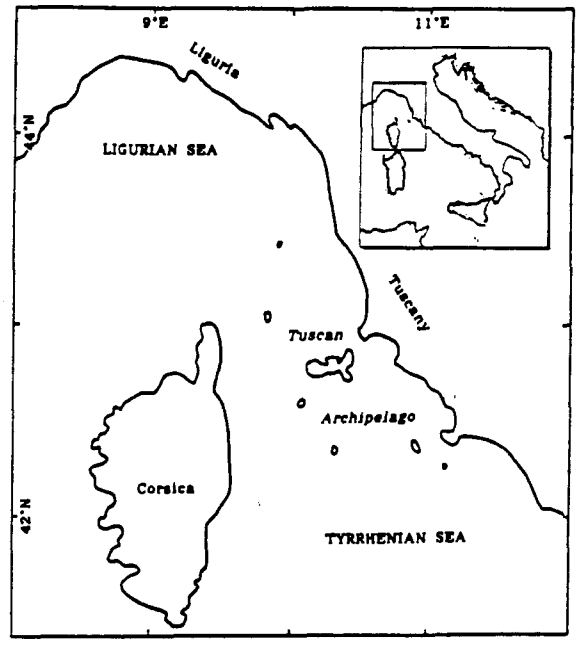

FIGURE 1. The position of the Ligurian and Tyrrhenian Seas in the northwestern corner of the Mediterranean, showing the boundary between these seas at the Tuscan Archipelago.

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Of course, such boundaries are never sharp, and warm-water species have been reported on occasion in the Ligurain Sea. However, over the last few years, some of these species have been found to be more frequent and widespread in the Ligurian Sea than has been known before.

A total of 20 benthic species (Table 1), characteristic of warmer waters, have been recorded by ourselves during routine SCUBA diving for environmental monitoring, or quoted in the recent literature. A number of largely pelagic fishes may be added to this list; in fact, although we were exclusively studying benthic species, *Balistes carolinensis* Gmelin, *Mola mola* (L.), *Pagellus acarne* (Risso) and *Pomatomus saltatrix* (L.) were seen more frequently in the last two years than ever before.

In the past, occurrences of warm-water species in the Ligurian Sea have always been related to the presence of "thermophilic oases" at particular sites (Tortonese, 1958; Sarà, 1985), which were supposed to enjoy warmer local conditions owing to their topography and shelter from cold northern winds. This hypothesis, developed as an analogy to terrestrial situations, has never been supported with actual microclimate data.

TABLE 1: Warm-water Species recently reported from the Ligurian Sea. (* Tuscan Archipelago)

Algae	*Acrothamnion preissii* (Sonder) Wollaston
	Caulerpa prolifera (Forsskal) Lamouroux
	Cystoseira spinosa Sauvageau
	Dasycladus vermicularis (Scopoli) Krasser
	Galaxaura oblongata (Ellis & Solander) Lamouroux
	Penicillis capitatus Lamarck
	Pseudochlorodesmis furcellata (Zanardini) Boergesen
Sponges	*Axinella polypoides* Schmidt
Cnidarians	*Astroides calycularis* (Pallas)
	Halocordyle disticha (Goldfuss)
	Phyllangia mouchezi (Lacaze-Duthiers)
Molluscs	*Charonia lampas lampas* (L.)
	Patella ferruginea Gmelin
Crustaceans	*Calcinus ornatus* (Roux)
Echinoderms	*Centrostephanus longispinus* (Philippi)
	Chaetaster longipes (Retzius)
	Hacelia attenuata (Gray)
	Ophidiaster ophidianus (Lamarck)
Fishes	*Sparisoma (Euscarus) cretense* (L.)
	Thalassoma pavo L.

The late Prof. Enrico Tortonese (1954), working on the expansion into the Ligurian Sea of *Pomatomus saltatrix*, a pelagic warm-water fish more abundant in the southern and eastern Mediterranean, suggested that changes in environmental conditions, chiefly in temperature, favoured the movement of the fish northwards. Tortonese's hypothesis deserves consideration when considering our benthic

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species, since they have pelagic eggs, larvae or propagula (e.g. Tortonese, 1975 for *Sparisoma cretense* and *Thalassoma pavo*; Russo *et al.*, 1990 for *Charonia lampas lampas*; Francour, 1991 for *Centrostephanus longispinus*). We therefore searched the literature on the Ligurian Sea benthos for data on previous occurrences of warm-water species (see Bianchi *et al.*, 1987 for references).

Unfortunately, such data are few, and many of them (especially the older ones) are doubtful. It is often impossible to know exactly the year of occurrence of a certain species as authors of systematic and/or faunistic works may fail to state the date of collection. Moreover, there is no historical series of surveying: data are irregularly scattered and rather random. As usual, the occurrence of a species largely reflects the occurrence of the relevant specialist.

Algae, for instance, have not been studied seriously since the beginning of the present century (see Barberis *et al.*, 1979 for relevant literature). However, in our fifteen-year's experience of scientific diving in the Ligurian Sea we saw none of the warm-water species listed in Table 1 there before 1991, although we regularly saw them in southern Italy over that period.

It must be said that some of the presumed warm-water invertebrate species are rather rare and localized even in the Tyrrhenian Sea: thus new findings may not indicate recent settlements, but may simply be records of previously overlooked populations. This may particularly be the case for the sponge *Axinella polypoides* and the sea-star *Chaetaster longipes*.

However, the records of the ornate wrasse, *Thalassoma pavo*, are unquestionably of great interest. The Ligurian Sea fish fauna has been well studied since the beginning of the 19th century (see Tortonese, 1965). *T. pavo* is a well known fish, easy to recognize: it has been recorded in 1902, 1911, 1985, 1991 and 1992. It is a preferred subject for underwater photography, and many "photographic fish-hunting" competitions have been held every year in Liguria since the 1960s. It is difficult to believe that this species was present but overlooked in the intervening years.

Thus, the evidence of the case of *Thalassoma* would suggest a certain reliability to these data as examples of periodic range extensions of warm-water species into the Ligurian Sea. These migrations are probably related to year-to-year climatic variability and fluctuations, rather than to permanent "thermophilic oases" within the Ligurian Sea.

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AGM Reports

MINUTES OF THE SIXTEENTH ANNUAL GENERAL MEETING OF PORCUPINE, held at Peterborough Central Library on 14th March 1993 at 09.30 am.

Frank Evans was in the chair; twenty-five members were present. Apologies for absence were received from Martin Sheader and Roger Bamber. The Minutes of the Fifteenth Annual General Meeting (Published in PORCUPINE NEWSLETTER, Vol.5 No.4) were approved.

The Hon. Secretary's Report was presented by Ian Killeen and approved. In particular Members were reminded with regret of the death of Vera Fretter.

The Hon. Treasurer's Report was presented by Jon Moore and approved.

The Hon. Editor's Report was presented by Jon Moore (in the absence of Roger Bamber) and approved.

The following Office Bearers were re-elected:

Hon. Secretary	Ian Killeen
Hon. Treasurer	Jon Moore
Hon. Editor	Roger Bamber

Dave Connor was nominated for election to Council. The following Council Members were elected:

Dave Connor		
Mark Davis	Robin Harvey	Ralph Robson
Iain Dixon	Christine Howson	Dennis Seaward
Frank Evans	Antony Jensen	Martin Sheader
Bill Farnham	Jan Light	Shelagh Smith
Willie Fowler	Ivor Rees	Fred Woodward

The auditor was thanked for his work last year, and Nick Light was re-elected as auditor for the coming year.

Future meetings were announced for the Autumn of 1993 at the Port Erin Marine Laboratory on the Isle-of-Man in October; the Spring 1994 and next Annual General Meeting is planned for Edinburgh, and the Autumn 1994 Meeting for Guernsey.

The Meeting closed at 09.56 with the chair proposing thanks to those involved in the organization of the Peterborough Meeting, particularly Dave Connor and the Joint Nature Conservation Committee and English Nature.

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PORCUPINE
RECEIPTS AND PAYMENTS ACCOUNT
for the year ended 31 December 1992

Year to 31.12.91				Year to 31.12.92	
£	£			£	£
		RECEIPTS			
33		Subscriptions -	1990	-	
1145			1991	111	
35			1992	1113	
-			1993	16	
	1213				1240
	17	Sale of P.N. back numbers			43
	184	Bank Interest			115
	55	T Shirt Sales			110
	1469	Total Receipts			1508
		PAYMENTS			
626		Newsletter -	Printing	277	
259			Postage	128	
34			Envelopes	44	
919		Total Newsletter Costs		449	
232		T Shirt Costs		99	
-		Phone & Postage		26	
	1151				574
	318	**SURPLUS BEFORE MEETINGS**			934
		MEETINGS			
100			Dublin	-	
150			Newcastle	-	
-			Oban	52	
-			Cornwall	73	
	250				125
	68	**SURPLUS FOR THE PERIOD**			809
	1516	**BALANCE BROUGHT FORWARD**			1584
		BALANCE CARRIED FORWARD			
233			Current Account	977	
1351			Deposit Account	1416	
	1584				2393

J.J. Moore
Hon. Treasurer

N Hayes
Hon. Auditor
5 March 1993

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HON. SECRETARY'S REPORT FOR 1992

PORCUPINE held two Meetings during the year:

The Fifteenth Annual General Meeting was held at Dunstaffnage on 25 and 26 April and was attended by 38 members and colleagues. The title was "From Loch to Abyss" and several papers were presented on current research into the deep sea environment. PORCUPINE is grateful to Professor Jack Matthews, Director of the Dunstaffnage Marine Laboratory, and his staff for hosting the meeting and especially to Robin Harvey for organizing the event. The station's research vessel *Seol Mara* was made available to **Porcupines** on the 24 and 27 April for dredging in Dunstaffnage Channel and in Loch Etive.

The PORCUPINE Autumn Meeting took place at the Cornish Biological Records Unit at Redruth, Cornwall, on 24 and 25 October. The Meeting's theme "Southern Species" attracted 25 participants from as far afield as Genoa, Italy. On the Sunday and Monday a team of **Porcupines** surveyed the shores at Marazion and Falmouth, adding significantly to the lists of species known. Thanks are due to Stella Turk and her colleagues at the CBRU for hosting and organizing this successful meeting.

Current membership of the Society stands at 196, comprising the following:

180 Full Members
6 Student Members
2 Honorary Life Members
8 Libraries/Institutions (who recieve free publications).

There has been the death of one Member, Dr Vera Fretter of the University of Reading, and 3 resignations; 10 new Members joined last year.

With the production of the new publicity leaflet, PORCUPINE is having a membership drive. We are asking all Members to promote the Society and are sending them a copy of the new leaflet to pass on to friends or colleagues. Council also hopes that PORCUPINE meetings will be advertised on departmental notice boards, etc.

Ian Killeen, Hon. Secretary 14 March 1993

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PRESS RELEASE

The Launch of
THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE - SAMS
formerly Scottish Marine Biological Association - SMBA
on
Tuesday 2 February 1993.

The Launch of The Scottish Association for Marine Science by Professor W.D.P. Stewart, Chief Scientific Adviser to the Cabinet, is the latest stage in the evolution of marine science in Scotland.

The Association has played a key role in the growth and development of Scottish marine science over the past century, through various name changes. The change of name to SAMS reflects the diversity of interests which encompass other sciences, including physics, chemistry and geology.

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The President of the Association, Professor A.D. McIntyre said: "The change is the start of a new phase in the Association's existence. It is also a declaration and a promise that we will promote marine science in Scotland and respond to opportunities and conflicts with determination and commitment. The seas are of paramount importance to Scotland."

The Importance of the Sea

Scottish waters contain the bulk of the UK's marine resources and a significant proportion of the European Community's marine resources, such as oil and gas, fisheries and fish-farming. It is a superb natural environment which sustains a wonderful diversity of wildlife.

Within this range of activities, it is no wonder that different interests often conflict. This necessitates that decisions are taken so that the best use is made of our marine environment. These decisions should be based, among other things, on scientific understanding of ecological balances and assessment of environmental consequences.

SAMS Research

SAMS' research base is at the Dunstaffnage Marine Laboratory near Oban but support for marine research extends throughout Scotland. This is undertaken through research fellowships and bursaries, principally full-time fellowships. The emphasis is on supporting the innovative individual researcher but SAMS also participates in major collaborative research programmes at national and international level.

Communication

SAMS provides a forum for discussion of the best approaches to the future development of marine science in Scotland and aims to represent expert opinion on marine affairs to industry and government.

SAMS organises meetings and conferences on contemporary issues. A major symposium on Water Quality will be held in Napier University, Edinburgh, on 6-7 September of this year.

Education

SAMS promotes marine science education in schools, higher education institutions and to the wider public.

Challenges

Today, the problems that face us and the opportunities ahead are every bit as challenging as those of the early days of the SMBA a century ago. They become ever more so as pressures on the sea and its resources increase.

We are keenly aware of people's enjoyment and dependence on our marine environment - outdoor enthusiasts, fishermen, industrial magnates - and we are conscious of our responsibility for the internationally important wildlife of our coasts and seas. Working together in the interests of marine science, we can ensure responsible use of these resources.

The Scottish Association for Marine Science, P.O.Box 3, Oban, Argyll PA34 4AD. Tel: 0631 62244, Fax 0631 65518.

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NOTICES

BRITISH PHYCOLOGICAL SOCIETY field meeting - phycological field course. Friday 17th to Monday 20th September 1993 on the Isle of Wight. Course Director: Dr Bill Farnham. This field course is intended for professionals, students and amateurs who need or wish to acquire a knowledge of the seaweed flora of British shores.

For further details please contact: Dr Juliet Brodie, Bath College of Higher Education, Newton Park, Newton St. Loe, Bath BA2 9BN.

THE BRITISH MARINE LIFE STUDY SOCIETY has a special offer for **Porcupines:** sample copies of its journal - GLAUCUS - may be obtained by sending a 50p postage stamp to:

B.M.L.S.S., Glaucus House, 14 Corbyn Crescent, Shoreham-by-Sea, Sussex BN43 6PQ.

THE ESTUARINE AND COASTAL SCIENCES ASSOCIATION will be holding its 1994 UK Local Meeting in Durham, UK, next April, on the subject of "Estuaries and Coasts of North East England". Enquiries should be addressed to John Pomfret, AES Ltd., Northumberland Dock Road, Howdon, Wallsend, Tyne & Wear NE28 0QD, UK.

THE FISHERIES SOCIETY OF THE BRITISH ISLES Annual Symposium, on the subject of "Factors Affecting the Distribution of Fish" is being hosted by the Directorate of Fisheries Research, Fisheries Laboratory, Conwy, North Wales from Monday 5th to Friday 9th July 1993.

NATIONAL FEDERATION FOR BIOLOGICAL RECORDING has a Cornish venue for its 1993 Annual Meeting. The NFBR is the parent body for recording in general and for the county Record Centres, in the same way that the Royal Society for Nature Conservation is the umbrella organization for conservation and the county wildlife trusts.

This year the NFBR AGM and Conference will be held in Cornwall, organized by the Institute of Cornish Studies' Cornish Biological Records Unit, on 29 - 30 July. Camborne School of Mines is kindly allowing the use of its lecture theatre together with an area for displays and posters and the Geological Museum as a venue for the buffet lunches. Additionally, there will be an Open Day at the

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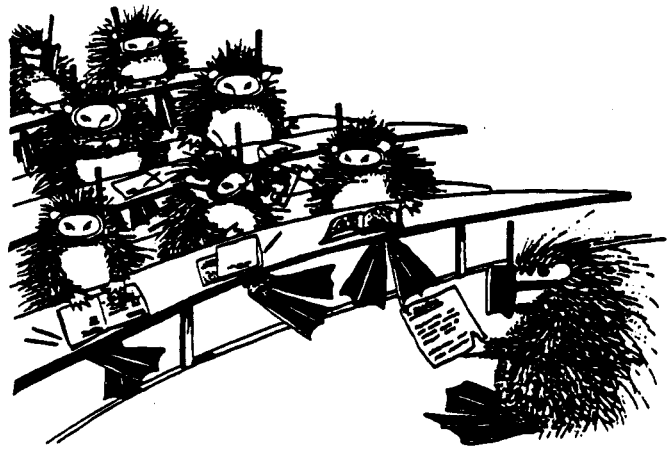
CBRU on the 28th and an outing to the Lizard Peninsula on 31st July to see some of the National Trust's responses to biological crises.

The theme of the indoor meetings will be "Crises and Biological Recording". The first day (0930 to 1700) will include items on oil pollution, dolphin strandings, Lepidoptera habitats and storm damage in the Isles of Scilly as well as an important contribution on the NRA response to the Wheal Jane discharges into the Carrick Roads. The AGM will be held at 1700. The NFBR welcomes new members (subscription is £5.00 per year) and they will be immediately eligible to attend the AGM. The second day (0930 to 1300 only) will include discussions on bats, the biological crises posed by the Channel Tunnel, and drainage of marshland in the London area as well as threats to peatland. A "Recorder" users meeting will be held in the afternoon.

The registration fee is £20 for the Conference (refundable in full if cancellation is received by 15 July). This fee covers a copy of the Proceedings, buffet lunches on Thursday and Friday and coffee/tea/fruit drinks during morning and afternoon breaks. There is no charge for attendance at the "Recorder" users meeting.

There is also the option of a full evening meal in the Cornwall College Refectory at £14 a head excluding drinks. Single student accommodation is offered at Camborne School of Mines at £15 B&B (self-catering).

Those interested should contact The Director, Cornish Biological Records Unit, Institute of Cornish Studies, Trevithick Centre, Trevenson Road, Camborne, Cornwall TR15 3PL, Tel. 0209 710424. Registration with fee should be returned not later than June 30th.



FUTURE MEETINGS

The 1993 Autumn Meeting will be held from 8 to 11 October 1993 at the Port Erin Marine Laboratory, Isle of Man. The theme of the meeting is "Experimental Marine Ecology". The normal weekend sessions are planned for Saturday 9th and the morning of Sunday 10th. Field trips, including both shore and boat work, are planned for Friday 8th (low water 10:40), Sunday (LW 13:15) and Monday 11th (LW 14:40). There will be a conference dinner on the Saturday night. All poster, demonstration, talk or video contributions will be welcome, especially those on the theme of the meeting. The first circular regarding this meeting is enclosed with this Newsletter. Further information may be obtained from Bev Wilson at PEML (Tel: 0624 832027).

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Book review

IRELAND'S MARINE LIFE. A WORLD OF BEAUTY
Matt Murphy and Susan Murphy (Editors)
Sherkin Island Marine Station Publication
IR£20.49, or IR£25.50 boxed in a slipcase,
including postage within Ireland (add a
further £1 for postage outside Ireland)

I thought that it would be relatively easy to review a book full of photographs, but it was surprisingly hard. Being both a marine biologist and a photographer (or at least someone who enjoys taking photographs) this seemed an ideal book. However, as a photographer I was quite impressed, as a marine biologist I found it easy to criticise.

The book is literally a collection of photographs of marine life around Sherkin Island, which have been bound together with no noticeable planning other than that dramatic close-ups have been printed full-page whilst standard shots fill in the gaps. Each photograph is accompanied by the Latin name, common name (where there is one) and the common name in Irish.[A nice touch, you might think, although according to the blurb on the inside cover the book is designed to give people "... a new awareness of Ireland's wonderful natural resource." Presumably people includes those other than the Irish who might find the Irish name superfluous.] There is also, in the majority of cases, a sentence or two of "additional information" on the organism. This is probably the biggest source of criticism, since most of these comments are either annoying or of little use, a prime example being *Actinia equina* described as "... at low tide looking quite like little red blobs of jelly"; the rock goby is "... typically found in pools amongst seaweed", but with no trace of algae in the photograph. I would have preferred no comment at all if it could not be more informative. These comments made me wonder at whom the book was aimed - presumably not informed Porcupine readers!

It is also a little aggravating that the general public will be somewhat misled, as the photographs are displayed for maximum effect but with no indication of scale. For example, *Sertularia* (sea fir) appears to be a coniferous forest well able to conceal the common octopus in an adjacent photograph. Additionally, it is not always made clear to what taxonomic group the organism belongs: Breadcrumb sponge is self-explanatory, but Sea Lemon?. Particularly when it is first encountered in a photograph also containing two anemones; *Velella velella* is described only as a "By-the-Wind-Sailor". I feel that the book is not too successfully treading the middle road between letting the photographs speak for themselves and being an informative picture book.

There are, however, some good points to highlight. The range of taxa portrayed is very good, from plankton and macroalgae to polychaetes and molluscs (but no pycnogonids!). There is perhaps an excess of anemones, but they are, after all, relatively easy to photograph and look good in colour. There are some startling close-ups, noticeably of the Conger eel and of *Cancer pagurus*, and some which show the complexity of so-called simple organisms to good advantage. Some of the pictures are just excellent photographs with lots of intrinsic appeal - I would love the blue-rayed limpets, feeding on kelp with *Membranipora membranacea* in the background, at about six-feet square on my wall.

Overall, this book is good coffee-table material, with the added advantage that the owner will appear very knowledgeable to any friend who glances through it over their Nescafé since you will know more about the organisms than the book will tell them.

Sonia Batten.

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A PRELIMINARY ASSESSMENT OF THE EFFECT OF BEAM TRAWLING ON A BENTHIC COMMUNITY IN THE IRISH SEA[1]

Michel J. Kaiser & Brian E. Spencer

MAFF, Directorate of Fisheries Research, Fisheries Laboratory, Conwy, LL32 8UB, UK.

Introduction

Beam trawls are an extremely effective fishing gear for catching flatfish (e.g. Cruetzenberg *et al.*, 1987) and are used extensively in the North and Irish Seas. The increase in the size and engine power of modern trawlers has required modifications to the gear which increase its weight, for example longer beams and the addition of more chain mat or more tickler chains. Typically, a Dutch 12 m bean trawl weighs 7 to 8 tonnes of which 1 tonne is made up of 19 tickler chains (BEON, 1991). These chains are designed to penetrate the sediment and disturb sole, *Solea solea*, that remain buried by day. The depth to which these chains penetrate depends both on the vessel's towing speed and on the substrate hardness, estimates varying between 3 cm on hard sand and 8 cm in soft mud (Bridger, 1972; BEON, 1991).

However, while tickler chains increase the catches of commercial flatfish, they also increase the by-catch of non-commercial fish and epi- and infaunal invertebrates. Fragile animals such as sea urchins and bivalve molluscs tend to be damaged and killed by trawling activity (Bergman & Hup, 1992; Rumohr & Krost, 1992). Conversely, other animals, such as starfish, survive in high numbers (BEON, 1991; present study) and may even benefit by scavenging the dead animnals produced by the passage of the trawl. These effects, coupled with the intensity of the beam-trawling effort in the North Sea, have led to suggestions that such trawling is a possible cause of the long-term changes observed in the North Sea benthic community (Pearson *et al.*, 1985; Lindeboom, 1990).

To date, most research has concentrated on large (6 to 12 m) beam trawls; no information exists on the effect of 4 m beam trawls on the benthic community. When fished in the Irish Sea, 4 m beam trawls are usually fitted with chain mat rather than tickler chains. The mat is designed to prevent rocks from entering the net, as well as to increase the catch of flatfish. The Directorate of Fisheries Research, Conwy, is investigating the effects of the use of this gear on the benthos in the Irish Sea.

In March 1992, a preliminary investigation of an area between Point Lynas, Anglesey, and Great Ormes' Head, North Wales, was carried out to locate a suitable site for a short-term and long-term study of the effects of beam trawling on a benthic community. A suitable site, with a conspicuous filter-feeding community, was found at approximately 4°00'W 53°27'N. The presence of this community, including long-lived species such as *Alcyonium digitatum*, indicated that fishing activity in the area is relatively infrequent. The site is also close to one of the largest sole nursery grounds in the Irish Sea (Rogers, 1992).

In August 1992 we returned to this site to carry out experimental fishing with a commercial 4 m beam trawl fitted with chain mat, to examine the following effects:

1. the immediate effects on the benthic community;
2. the survival capabilities of animals caught in the cod-end;
3. whether animals killed by beam trawling provide food for scavengers;
4. whether beam trawling alters the structure of the sediment.

[1] Not to be cited without prior reference to the authors. Crown Copyright retained.

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In this paper we present preliminary results for objectives 1 to 3. Objective 1 will be discussed in terms of the epibenthic data, as the infaunal samples are currently being processed.

Effects on Epibenthos

Methods

An experimental box, 40 m x 200 m, was marked on the ship's navigation plotter which was linked to a Sercel NR53 DGPS positioning system (accurate to ±2.5 m). Water depth varied between 32 and 34 m. All samples were taken from within this area. Prior to the test-trawling, three ten-minute tows (at a ship speed of 0.4 to 0.9 knots) were made through the box, using a 2 m young flatfish beam trawl fitted with three tickler chains and a net of 2 cm mesh (Rogers & Lockwood, 1989). The positions at the start and end of each tow were recorded, as were the number of individuals and wet weight (±1 g) of each species for each catch. Catch data were standardized by expressing the density as numbers per 1000 m^2 and biomass as g/1000 m^2. After the box had been trawled ten times with the 4 m beam trawl, a further three tows were made with the 2 m beam trawl, the catch being quantified as before.

Many of the animals (for example, *Astropecten irregularis*) occurred too infrequently to determine whether numbers had changed as a result of fishing; therefore, animals were grouped according to their mobility (Table I) on the assumption that mobile animals would recolonize or scavenge on animals killed or exposed by the beam trawl.

Results

The dominant macrofauna by biomass in the community were the anthozoan *Alcyonium digitatum*, bryozoans, echinoderms (*Psammechinus miliaris, Ophiura texturata, Asteria rubens* and *Ophiothrix fragilis*) and crustaceans (*Macropodia tenuirostris, Eupagurus bernhardus* and *Pisa armata*); these were also numerically the most abundant (Fig.1).

The density and biomass of many of the sessile or slow-moving animals (molluscs, echinoderms) was much lower after experimental trawling (Table I). However, the density of mobile invertebrates such as *Eupagurus bernhardus*, *Liocarcinus holsatus*, *Palaemon* spp. and fish increased after trawling. The estimated density of sessile animals fell from 398 to 136/1000 m^2 after trawling, whereas the density of mobile animals increased from 89 to 159/1000 m^2 (χ^2= 107.5; $p<0.0001$). Similarly, the biomass of sessile animals decreased (from 3451 g/1000 m^2 to 689 g/1000 m^2) and that of mobile animals increased (from 613 g/1000 m^2 to 894 g/1000 m^2) after fishing (χ^2= 917.0; $p<0.0001$).

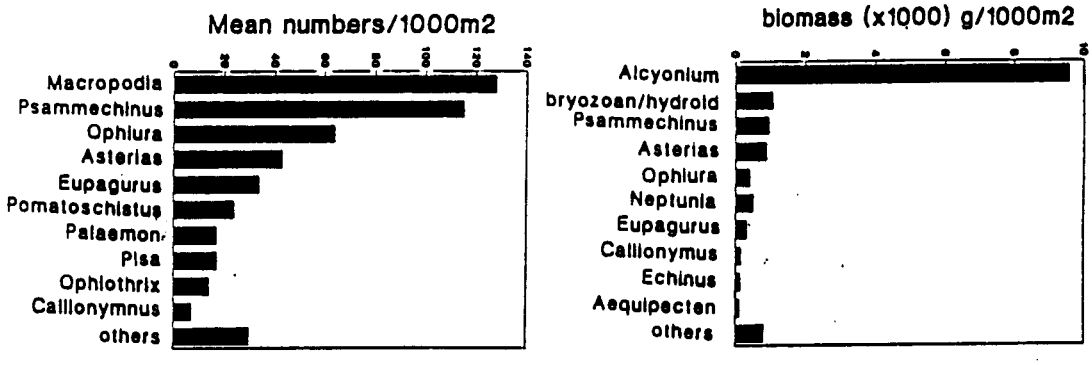

FIGURE 1. The ten dominant species in the benthic community at the experimental site, based on density and biomass. *A. digitatum* and bryozoans/hydroids omitted from density analysis owing to the difficulty in quantifying colonies.

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Table I. The change in density (numbers/1000m²) and biomass (g/1000m²) (mean of 3 samples) of selected dominant species sampled with a 2-m juvenile flatfish beam trawl before and after experimental fishing with a 4-m beam trawl. Motibity of animals is indicated by (S) sessile or (M) mobile.

Species	Density		Biomass		Mobility
	Before	After	Before	After	
Alcyonium digitatum	—	—	9570	4620	S
Bryozoan/hydroids	—	—	1055	670	S
Psammechinus miliaris	115	27	927	89	S
Asterias rubens	43	20	859	247	S
Ophiura texturata	64	25	402	46	S
Palaemon spp.	17	27	2	3	M
Macropodia tenuirostris	128	47	67	12	S
Eupagurus bernhardus	34	47	313	513	M
Callionymus lyra	7	16	161	181	M
Pomatoschistus spp.	23	23	10	6	M

Survival Capabilities

Methods

In a separate experiment, a 4 m beam trawl was towed for 30 minutes. Immediately after hauling, a sub-sample of the catch from the cod-end was placed into a 50 l bin filled with sea-water and then transferred to a survival system with a through-flow of sea-water to waste. The species selected for examination were maintained separately in plastic trays which were covered with plastic mesh and had slits to allow free circulation of water. An assessment was made of the initial mortality (% animals dead in the net) and then live animals were used for the survival experiments. Their subsequent mortality was recorded after 72 h.

Results

The initial (1%) and delayed mortality (3%) of *Asterias rubens* was much lower than that of other species (Figure 2). Up to 20% of *Eupagurus bernhardus* died after 72 h: these tended to be animals which had emerged from their shells, those which remained in their shells being relatively unaffected by the beam trawling. Despite its fragile appearance, *Macropodia tenuirostris* suffered relatively low mortality (32%) after 72 h. Swimming crabs suffered 45% initial mortality which had increased to only 58% after 72 h; *Callionymus lyra* suffered only 10% initial mortality but after 72 hours all had died.

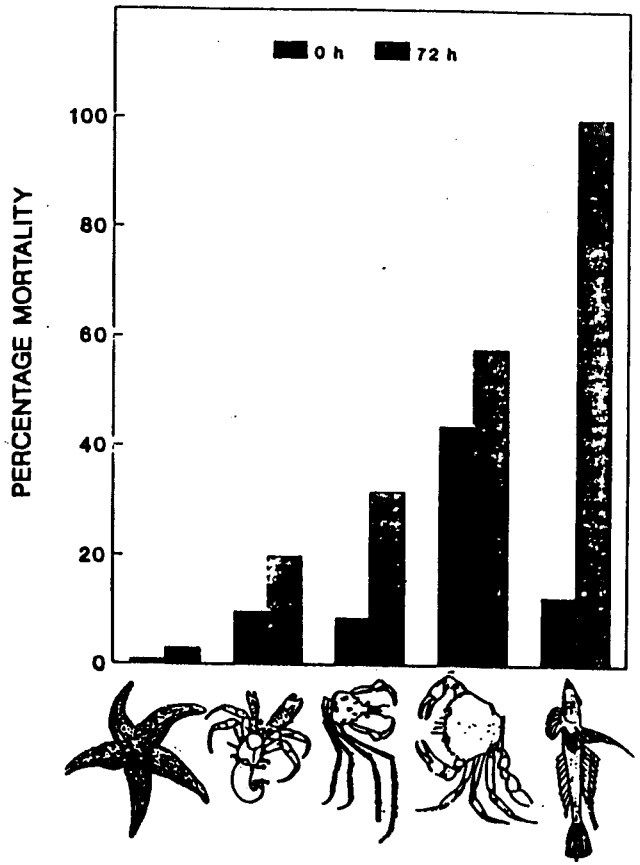

FIGURE 2. Percentage mortality of selected animals from the cod-end of a 4 m beam trawl at the start (0 h) and end (72 h) of the experiment From left to right: *A. rubens; E. bernhardus; M. tenuirostris; L. holsatus; C. lyra.*

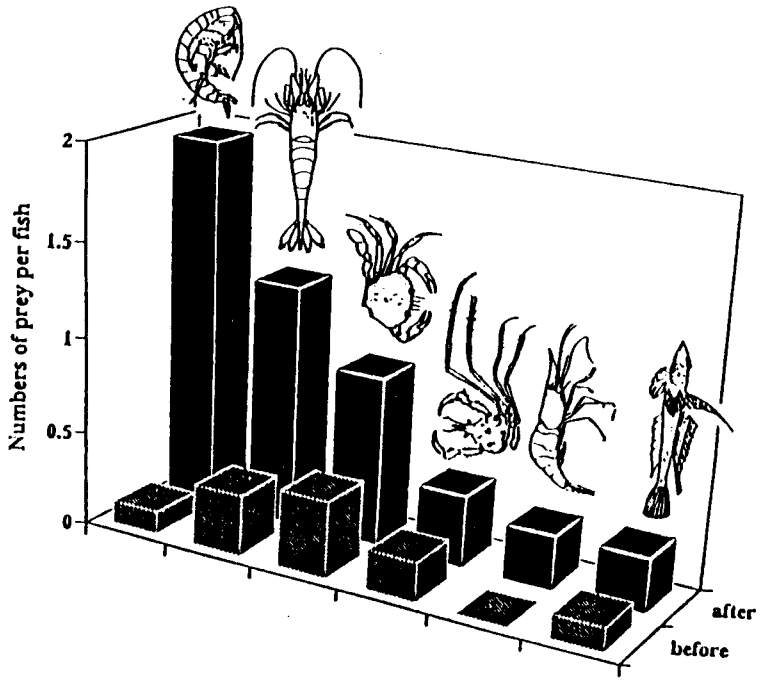

FIGURE 3. Numbers of some prey species in the stomach contents of gurnard before and after passage of a 4 m beam trawl. From left to right: *A. brevicornis; C. crangon; L. holsatus; M. tenuirostris; Palaemon* spp.; *C. lyra.*

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Opportunistic Feeding

Methods

The stomach contents of three species of fish - dogfish (*Scyliorhinus canicula*), grey gurnard (*Eutrigla gurnardus*) and red gurnard (*Aspitrigla cuculus*) - were examined from fish collected from each of three tows of the 4 m beam trawl. After a period of two hours the procedure was repeated. The gape width of each fish was measured with vernier calipers (± 1 mm) and the total length was measured to the nearest 5 mm. In the laboratory, stomachs were assessed for fullness, on a scale from 0 for empty to 10 for full; the contents were then counted, identified to species where possible and weighed (to the nearest g) after blotting on absorbent cloth. The maximum width (cross-sectional) of each prey item was measured by aid of an eye-piece graticule on a dissecting microscope.

Results

There was no significant difference in the relationship between prey width and gape width for either gurnard species (ANCOVA, $F_{1,125} = 2.45$, $p > 0.1$), so these results were pooled. There was a significant relationship between the maximum width of the prey eaten and the maximum gape width both for gurnards ($r^2 = 0.10$, $n = 141$, $p < 0.001$) and for dogfish ($r^2 = 0.07$, $n = 104$, $p < 0.001$). However, the high degree of variability in these relationships suggests opportunistic feeding. The variation could not be explained by inacuracy in the measurement techniques as the relationships between fish length and gape width were highly significant (Table II). Dogfish and gurnard ate the same size-range of prey before and after fishing (ANCOVA: gurnards - $F_{1,125} = 0.12$, $p > 0.7$; dogfish - $F_{1,104} = 0.72$, $p > 0.4$).

Table II. The relationship between fish total length (cm) and fish mouth gape width (cm) for both dogfish and gurnards.

Species	n	Equation	r^2	P
Dogfish	60	gape width = 0.037 fish length +1.74	0.48	0.0001
Gurnards	60	gape width = 0.111 fish length -0.36	0.74	0.0001

Out of a total of 63 species identified to date in the benthic community (28 infauna, 35 epifauna), dogfish fed on ten and gurnards on seven species, The only infaunal prey species from the stomach contents were *Nephtys hombergi, Upogebia deltaura* (dogfish only) and *Ampelisca brevicornis* (dogfish and gurnards). Gurnard stomach contents were composed almost entirely of crustaceans and fish, with occasional gastropods (*Natica alderi*) present. Conversely, dogfish commonly ate *Buccinum undatum, Eupagurus bernhardus* and *Upogebia deltaura*; dragonets (*Callionymus* spp.) occurred in stomachs of both dogfish and gurnards.

The numbers of some prey items per stomach increased significantly in both gurnard and dogfish stomachs after beam trawling (Friedman's ANOVA, $df = 1$, $p < 0.002$) (Fig.3). Gurnards and dogfish significantly increased their intake of *Ampelisca brevicornis* after the passage of the trawl, and gurnard also increased their intake of *Crangon crangon* (Table III). *Palaemon* spp. were only found in gurnard

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stomachs after beam trawling. Neither the mean stomach fullness nor weight of stomach contents of either dogfish or gurnards varied significantly before and after trawling (Table IV).

Table III. The mean±SE number of prey/stomach (for the three numerous important prey in stomach contents) for dogfish and gurnards before and after fishing with a 4-m commercial beam trawl. Significant differences were determined with ANOVA on log (x+1) transformed data.

Species	Before	After	F	P
Dogfish				
Ampelisca	0.53±0.18	1.81±0.39	10.5	0.002
Upogebia	0.50±0.13	0.55±0.16	0.06	0.800
Eupagurus	0.33±0.09	0.42±0.09	0.47	0.496
Gurnards				
Ampelisca	0.15±0.01	2.00±0.92	5.10	0.030
Liocarcinus	0.52±0.30	0.90±0.31	0.76	0.390
Crangon	0.42±0.23	1.28±0.32	4.50	0.040

Discussion

These results show that the 4 m beam trawl lowered the density and biomass of the sessile animals in the experimental box. In particular, the biomass of *Alcyonium digitatum* and hydroids was reduced by approximately 50%. How quickly these animals will recolonize the area is unknown, but natural recruitment may take months to years. The density of some mobile species increased after trawling. Most of these species are scavengers or predators (e.g. *Eupagurus bernhardus*, *Callionymus lyra* and *Palaemon* spp.) and are able to move rapidly (1-3 h) in response to chemical stimuli produced by damaged or killed animals which result from beam trawling activity (Nickell & Moore, 1992). Other scavengers, such as *Buccinum undatum* and *Asterias rubens*, may respond more slowly, arriving after 12 h (Sainte-Marie & Hargrave, 1987; Nickell & Moore, *loc. cit.*). The present results also showed that dogfish and gurnards take advantage of this extra food source, as do dab (*Limanda limanda*) in

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the North Sea (M. Fonds, pers. comm.).

Animals that form the by-catch of a beam trawl can suffer injuries from a variety of sources. The beam shoes, chain mat and abrasive net can inflict wounds of varying degrees of severity. On hauling the net, pressure from the weight of the catch can inflict bruising and internal injuries which may lead to delayed mortality; some species survive this experience better than others (Fig.2). As has been found elsewhere, starfish (*Asterias rubens*) showed a high percentage survival, while swimming crabs (*Liocarcinus holsatus*) are killed when their carapaces are crushed. In a separate study (Kaiser & Rogers, unpubl. data) tickler chains were identified as the part of the beam trawl mainly responsible for crushed carapaces. The 100% mortality of *C. lyra* was unexpected as they appeared superficially undamaged: it is probable that either stress or internal injuries contributed to their high mortality.

Table IV. The mean±SE stomach contents wet weigth (g) and fullness (scale of 0-10, empty-full) for dogfish and gurnards before and after intensive beam trawling (n=60).

Species	mean±SE	F	P
Fullness			
Dogfish	before 4.23±2.80 after 4.63±3.21	0.28	0.50
Gurnards	before 3.36±3.65 after 5.04±3.23	2.38	0.10
Contents weight			
Dogfish	before 7.67±9.15 after 4.06±4.56	2.48	0.10
Gurnards	before 0.98±2.57 after 1.10±1.20	0.04	0.80

Our results demonstrate reductions in density and biomass of, in particular, sessile invertebrates. However, mobile animals quickly migrate into the trawl track and feed on some of the damaged and dead specimens. Not all of the animals caught in the beam trawl are killed. Those able to survive the experience and utilize the additional food source produced by the passage of the trawl may benefit the most, for example *Asterias rubens*. Whether this will lead to long-term changes in the community structure will be investigated in our long-term experiment.

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INDIRECT STUDIES OF SCALE AND COMPLEXITY IN BENTHIC COMMUNITIES: MINDING THE GAP

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When Petersen laid the foundations for the description of benthic communities he made comparisons with the plant communities that are clearly seen to clothe the land. As in the sea one cannot move to a vantage point to "see the wood for the trees", there are risks that myopic impressions are gained from tiny samples or tiny visible patches, and unjustified extrapolations to huge areas are only mediated by topographic information from Admiralty charts. Spatial descriptions for conservation management are most in need of data at just the intermediate spatial scales that can only be imaged using indirect technology. Acoustic methods supported by "ground-truthing" with video and remote still cameras seem to offer the best currently available ways of bridging the spatial gap.

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Experience has been gained over the last three years in using a combination of photography, with a sledge-mounted remote camera, and a ROXANN acoustic seabed discrimination system. The camera system was based on an interval-triggered Photosea 1000 mounted vertically on a sledge with the lens 0.65 m from the bed and giving images of 0.2 m^2. The ROXANN system was used in conjunction with a Koden Chromascope sounder having a 200 cKHz transducer.

Several trials have been undertaken in the Cardigan Bay proposed Marine Consultation Area or relatively close to it. This bay well exemplifies problems of charting habitat mosaics in large MCAs, where there is much ground too stony to reliably grab and too deep for diving.

A 2 x 2 mile box 8 miles NNW of Bardsey was studied using ROXANN and remote photography in anticipation of exploratory drilling by Hamilton Oil. This location has very strong tidal currents and depths are around 60 m. The bed is made up primarily of a veneer of lag cobbles over boulder clay, with relatively small amounts of coarse sand in the interstices. A grid survey with the ROXANN allowed three slightly different types of bottom to be recognized and mapped according to their acoustic reflectivity and roughness. Based on over 250 photographs from ten sledge tows, it was shown that the most acoustically reflective ground comprised a smooth pavement of embedded cobbles and pebbles so scoured as to carry little epifauna. The middle category of ground had the cobbles protruding more, so the micro-relief was rougher. This had slightly more epifauna as well as frequent *Glycimeris*. The third category comprised patches with lower and variable reflectivity. This seemed to be due to accumulations of old *Modiolus* shells that were often wedged together on edge. Mapping of this sort even within such a small box could not have been done without using the two methods in tandem.

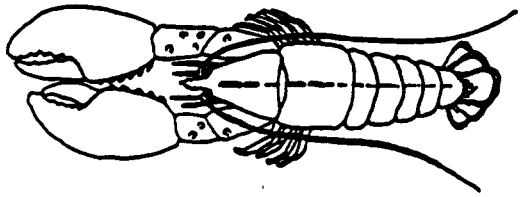
A particularly consistent ROXANN record was collected as a by-product of other work off Pencilan Head. This covered the sharp boundary between the lag gravel and the soft ground of the Muddy Hollow that leads into Tremadoc Bay. Photographic ground-truthing has yet to be done but because this location is also shallow enough for divers it would provide a good location for testing a range of methods under the BIOMAR project.

A third and contrasting location southwest of Aberystwyth was visited in conjunction with the Zoology Department, National Museum of Wales. This is a muddy sand area known as the "Gutter" where some of the earliest grab sampling around Britain was done in 1921 by Laurie and Watkin. Here, as well as the obvious distinction of the surrounding patches of coarse ground, the ROXANN seemed to discriminate slight differences in the nature of the muddy *Amphiura* ground. Although only a few camera sledge tows were run, some of the acoustic variation seemed to be related to the amount of bioturbation by large burrowing decapods.

These and other trials with indirect survey methods suggest that habitat/community mapping of sea areas of conservation importance could benefit from making relatively more use of indirect methods to broaden subsea horizons. Petersen may not have had access to our generation's indirect sensing equipment to multiply the data points, but his choice of characterizing species suggests an appreciation of the "information per unit effort" balance that has always had to be struck.

Acknowledgement

I am grateful to Hamilton Oil Co. Ltd. for permission to use data from a pre-drilling site investigation as an example of sonar and photography used in tandem for benthic studies.



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STRANGFORD LOUGH - THE NEED TO INVOLVE THE LOCAL COMMUNITY

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Strangford Lough is a fully marine lough on the east coast of Co. Down, Northern Ireland. It covers some 150 km^2 and is almost entirely surrounded by land, the entrance being only 1 km wide at its narrowest.

The Lough is situated in the driest, sunniest part of the province, in the rain shadow of the Mourn Mountains, and is largely surrounded by rich glacial soils in the form of drumlins. This has resulted in intensive farming of both crops and livestock, but there are a number of important "natural" habitats surviving, including the second largest area of saltmarsh in Northern Ireland. However, two facts in relation to its shapew and position are largely responsible for its diversity and wealth of marine life.

The narrow entrance to the Lough is responsible for creating the strong currents which gradually dissipate towards the north end of the Lough. This gives rise to a wide diversity of habitats from current-swept bedrock and boulders to deep mud and therefore a great diversity of sub-littoral species in a comparatively small area.

The north-south axis of the Lough results in the mainly westerly or southwesterly winds of this area acting on the two sides of Strangford Lough in completely different ways. The eastern shores are subject to semi-exposure and are therefore mainly sandy or rocky, while the western shores are sheltered and mainly based on mud. However, the presence of islands and headlands providing shelter on eastern shores, the effect of strong currents on shores in the narrows and the presence of stones and boulders from the boulder clay on all types of substrate complicate the picture. The net result is once again a wide diversity of habitats and therefore of species.

In addition to this natural diversity, man has been living in close proximity to the Lough for 6000 to 7000 years. Relics exist recording continuous habitation from stone age times to what is essentially a post-industrial situation today. During this long period there have been very close links to the Lough as a source of food, a trade route and latterly as an area for recreation and tourism. It is impossible to look at Strangford Lough in purely "natural" terms owing to its history and the widely dispersed surrounding population of about 60,000 people.

The process of trying to conserve the environment around Strangford Lough started in 1970 with the designation of the surrounding area as an Area of Outstanding Natural Beauty, and of the Quoile Pondage (an area of flooded land resulting from the building of a barrage for flood protection) as a National Nature Reserve (NNR). In the intervening period up to 1989, another seven NNRs and Nature Researves were designated with few problems, as land was either acquired or management agreements were entered into with the land owners.

In 1987 the process to designate the whole shore line with some of the adjacent land area in places as an A.S.S.I. was started and in 1988 the northern and southern sections of Strangford Lough's shores were designated with minimal concern from the general public. However, in 1989 designation of the central shores of the Lough proceeded and created a major public outcry.

The shore areas at the north and south of the Lough did not generally abut farmland, but the central section was largely directly adjacent to agricultural land. It was perceived that rights of use of the foreshore were about to be severely curtailed and this led to the formation of a new and influential group called the Strangford Lough Nature Conservation Association (S.L.N.C.A.), composed largely of local interests and users.

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The need to conserve Strangford Lough was fully recognized and supported by this group, but the lack of consultation (whether real or perceived is unimportant) with local users and interests was considered autocratic and unacceptable. The need for full involvement of the local community was stressed and supported by a wide cross-section of the local population.

The end result of this high level of discontent about the process of consultation with representative bodies and groups was a willingness within D.O.E. to ensure that a greater degree of consultation took place in future. One of the first signs of this was the production of a 90 page consultation document on the future management of Strangford Lough in 1991. This document outlined the special nature of the Lough and the need for a management plan for the area to ensure both the conservation of its natural habitats and species, and that the needs of the local population were met.

Replies to the consultation document did not generally object to the conservation statements, but concentrated on the management aspect. The suggested way forward for management was a two-tier structure with executive bodies from Government and Local Councils in an Executive Committee, while other groups and users were represented in an Advisory Committee. The Executive Committee was to be chaired by the Minister of State for the Environment for Northern Ireland.

The majority of replies indicated a strong feeling that a single tier structure, with both executive and interest groups on one committee, would be much more likely to ensure that Government Departments listened to the views of user and interest groups. In addition, it was felt that, while the current Minister was committed to the Lough, there was no guarantee that this would remain the case, and the Committee would be best served by a Chairperson elected from within its own ranks.

These two changes were taken on board after the consultation period and the Strangford Lough Management Committee was set up in the spring of 1992. Members were appointed by the Minister of State for the Environment for Northern Ireland from nominees nominated by individual interest and user groups, including local Councils. The composition listed below shows the range of interests represented on the Committee.

Bodies represented on the Committee:

Ards Borough Council
Down District Council
Association of Strangford Lough Yacht Clubs
Royal Yachting Association
Northern Ireland Federation of Sub-Aqua Clubs
Joint Council of Wildfowling Associations for Strangford Lough
Sports Council for Northern Ireland
Northern Ireland Agricultural Producers Association
Shellfish Association of Great Britain
Northern Ireland Fish Producers Organisation Ltd.
Strangford Lough Nature Conservation Association
Ulster Farmers Union
National Trust
Royal Society for the Protection of Birds
Ulster Wildlife Trust
Northern Ireland Environment Link
Council for Nature Conservation & the Countryside

Representatives of Government in the form of senior civil servants sit in attendance at each of the bimonthly meetings.

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The Strangford Lough Management Committee's brief is to advise the D.O.E. on the management of the Strangford Lough area with regard both to the conservation of its wildlife and habitats, and the needs and aspirations of the local population. This work will involve not only advice on the management plan for the forthcoming Marine Nature Reserve but also advice on any aspect of management of the Lough and surrounding area. To date, the Committee has been involved in sewerage, commercial fishing and planning issues on and around Strangford Lough and is currently working closely with the D.O.E. on the production of a management plan for the proposed M.N.R. for the Lough. There is a strong commitment from the D.O.E. that the proposed management plan for the M.N.R. will be agreed with the Strangford Lough Management Committee before the designation proposal goes to other bodies or the general public for consultation prior to implementation.

Gradually, the relationship between local interests and the D.O.E. has improved as government has been seen to listen to local opinion and there is a willingness on both sides to make the system work. Only time will tell if this will prove to be the case, but the signs are good and there is great potential for a long term solution to the thorny problem of combining effective conservation with general public support.

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