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Marine nature conservation and sustainable development: The Irish Sea Pilot

A summary report of conclusions for the European Commission and Member States

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Executive summary

This report summarises work undertaken in the United Kingdom to develop a strategy for marine nature conservation within the wider context of sustainable development and the developing *European Marine Strategy*. The marine environment presents many challenges. It is very extensive and contains areas of deep water. Biological information away from coastal areas is often sparse. Parts of the sea are subject to human pressures, some of which are environmentally damaging.

Action in relation to marine nature conservation is often focussed on threatened and declining habitats and species. However, a strategy based only on the conservation of rare and declining habitats and species is likely to leave these features open to wider, long term environmental threat. Not only are the data to identify these available for only a small proportion of the biodiversity resource, but failure to take action to prevent other habitats and species from declining in the wider environment is likely to result in a continued and accelerating loss in biodiversity.

The United Kingdom is considering a strategy for marine nature conservation, linked to a framework based on five spatial scales. These scales are i) the Wider Sea, ii) the Regional Sea, iii) Marine Landscapes, iv) Important Areas, and v) Priority habitats and species. The underlying principle behind this framework is that action to implement the strategy should first be considered at the larger spatial scales, and action taken at the smaller spatial scales only if it is required. In consultation and collaboration with the Governments of the Isle of Man and Ireland, this framework was tested out on the Irish Sea through a Government-funded project, the Irish Sea Pilot.

As part of its work, the Irish Sea Pilot tested out a communications strategy to engage stakeholder participation, a data collation exercise to determine the availability and accessibility of relevant data, and a review of legislation, governance and enforcement relevant to marine nature conservation. The conclusions of these exercises should inform not only new marine policy, but also the future direction of ICZM and the implementation of the Water Framework Directive.

The Pilot considered that, because of the scarcity of biological data away from the coast, other data, specifically geophysical and hydrographical data, should be used to develop a series of 'Marine Landscapes' across the whole sea area, and the relative vulnerability of these marine landscapes to human impacts used to guide the management of human activities. The role of spatial planning to implement such an approach was reviewed.

Ways of establishing ecologically-coherent networks of marine protected areas were tested and conclusions drawn. Criteria for identifying habitats and species for which specific action would be needed were tested and consideration given to the role of such features within the overall marine nature conservation strategy.

Finally, the Pilot considered the issue of setting conservation objectives for marine nature conservation within the wider context of sustainable development and the developing *European Marine Strategy*, taking due account of developing ideas on the implementation of the ecosystem approach and on surveillance and monitoring.

Contents

Developing a strategy for marine nature conservation

1. The achievement of effective marine nature conservation is a considerable challenge and one facing all maritime European states. While the character of this challenge will vary from country to country, the issues which are having to be addressed by the United Kingdom will apply also to many other countries.

2. The areas of seabed over which the United Kingdom has jurisdiction is shown in Map 1 and extends to over three times its land area. Much of this seabed lies in fairly shallow water (i.e. less than 200m depth), but to the north and west there are considerably greater depths along the continental slope, reaching a maximum depth of about 3000m in the Iceland Basin west of Scotland.

3. The UK's jurisdiction over the water column differs somewhat from that of the seabed; for example British fishery limits are also shown in Map 1.

4. There is a long history of research and survey into marine biology. It is estimated that more than 8,000 species of vertebrates, invertebrates and seaweeds occur in the UK maritime area. However, most of the marine survey work undertaken to date has been concentrated within a few kilometres of the coast. In offshore areas, biological data are relatively few and the character of the biological communities is very imperfectly known. For the majority of the 8000 known species, any estimate of their conservation status must be considered as tentative.

5. Human activities in the marine environment contribute substantially to the economy and quality of life. It is estimated[1] that the economic contribution of these activities is in the order of €100 billion annually in the UK. Important contributors are oil and gas (€33 billion), tourism and recreation (€24 billion), naval defence (€9.6 billion), and ship and boat building and repairs (€4.5 billion), with significant contributions also being made by ports (€2.4 billion), fisheries (€0.8 billion) and a range of other activities. These activities have the potential to impact marine biodiversity in different ways, but the most substantial impacts are considered to be those which arise from fishing, with the effects of pollution and eutrophication also important in some coastal waters.

6. The UK, in common with many other European countries, has made specific international commitments relating to marine nature conservation, and some of these are listed in Table 1. These obligations are challenging, relating as they do to an environment which is extensive, contains deep water areas, for which biological data are quite limited, and where there is substantial human activity taking place, some of it environmentally damaging.

[1] Pugh and Skinner (2002)

Table 1: International obligations	
1.	To halt the decline of biodiversity across the European Union by 2010 (decision at the European Summit, Gothenburg, 2001; the El Teide Declaration, 2002; EU 6th Environmental Action Programme).
2.	To identify and designate by 2010 relevant areas of the UK's seas as areas of marine protection belonging to a network of well managed sites (5th North Sea Conference, OSPAR ministerial decision at Bremen, June 2003).
3.	To establish marine protected areas consistent with international law and based on scientific information, including representative networks, by 2012 and time/area closures for the protection of nursery grounds. (World Summit on Sustainable Development, 2002).
4.	To adopt the ecosystem-based approach in the management of the marine environment (the North Sea Conference).
5.	To encourage the application of the ecosystem approach by 2010, noting the Reykjavik Declaration on Responsible Fisheries and decision v/6 of the Conference of Parties to the Convention on Biological Diversity (World Summit on Sustainable Development, 2002).
6.	To maintain or restore natural habitats and species of wild fauna and flora to a favourable conservation status (EC Habitats Directive).
7.	To maintain populations of wild birds to a level corresponding to ecological, scientific and cultural requirements (EC Birds Directive).

7. In 1999, the UK Government commenced a fundamental Review of Marine Nature Conservation to define the issues to be resolved and determine the action needed to resolve them. It quickly became apparent that a strategy based only on the conservation of rare and declining habitats and species is likely to leave these features open to wider, long term environmental threat. Not only were the data needed to identify such features available for only a small proportion of the biodiversity resource, but failure to take action to prevent other habitats and species from declining could be expected to overwhelm a feature-specific approach to conservation within a few years. This would result in a continued and accelerating deterioration in habitats and species and, consequently, in a failure to meet commitments to halt biodiversity loss. It was considered that what was needed was a comprehensive strategy based on the principles of sustainable development and which utilised the ecosystem approach.

8. The strategy being considered by the UK Government for marine nature conservation has two main conceptual components. These are:

   i. A **strategic policy framework for sustainable development** in the marine environment, based on the approach currently being developed under the *European Marine Strategy*, and

   ii. a practical **framework for marine nature conservation** which identifies how action, regulation and enforcement can be applied at sea at appropriate scales.

9. The Irish Sea Pilot was set up as part of the Review of Marine Nature Conservation to test the implementation of the framework for marine nature conservation on the Irish Sea. The Pilot was undertaken in collaboration with the Governments of Ireland and of the Isle of Man. The full report of the Pilot has been published[2], and this summary report outlines the overall strategy being considered for implementation in the UK, presents the main findings from the Pilot, and identifies the actions that would assist the implementation of a framework for marine nature conservation. It is hoped that other countries within Europe, and more widely, will find the conclusions of interest and value.

[2] Vincent, M.A., Atkins, S., Lumb, C., Golding, N., Lieberknecht, L.M. and Webster, M. (2004)

The strategic policy framework for marine sustainable development

Strategic Policy Framework

10. The proposed *European Marine Strategy* as currently envisaged, will contain a vision, high level principles and strategic goals. The development of the *Strategy* is now well under way and it is expected to be adopted in 2005. The high level principles are intended to guide sustainable development and management actions in the marine environment. They encompass the principles of the Ecosystem Approach, together with other relevant principles, for example the precautionary principle and the polluter-pays principle.

11. The UK Government is currently considering how the *European Marine Strategy* can be implemented nationally, including in relation to marine nature conservation. The UK Review of Marine Nature Conservation[3] recommended to Government that the approach be further developed in line with the model set out below in Table 2. This shows how the vision can be delivered through a hierarchy of goals, objectives, targets and actions.

Table 2: Strategic policy framework (nature conservation strand)

Overall vision for the marine environment

Strategic goals for the marine environment

Strategic goals for marine nature conservation

Objectives for marine nature conservation

Targets and actions to achieve the objectives for marine nature conservation

12. In 2004[3], the Review of Marine Nature Conservation proposed draft strategic goals for marine nature conservation (the third level of the framework) as follows:

    i. to halt the deterioration in the state of marine biodiversity and to promote recovery where practicable;

    ii. to further the conservation, where practicable, of marine features which have a key role in contributing to biodiversity and providing essential habitats to support the variety of marine life and the benefits derived from it;

    iii. to maintain the water quality of the marine environment, to protect its physical and oceanographic processes, to support biodiversity, and achieve good ecological status;

    iv. to integrate marine nature conservation into human activities and plans affecting the marine environment to effectively deliver an ecosystem approach consistent with the wider goals for the marine environment;

    v. to increase and broaden understanding and the application of knowledge about marine ecosystems to provide the best available information for policy development and decision-making processes, and to promote understanding among stakeholders.

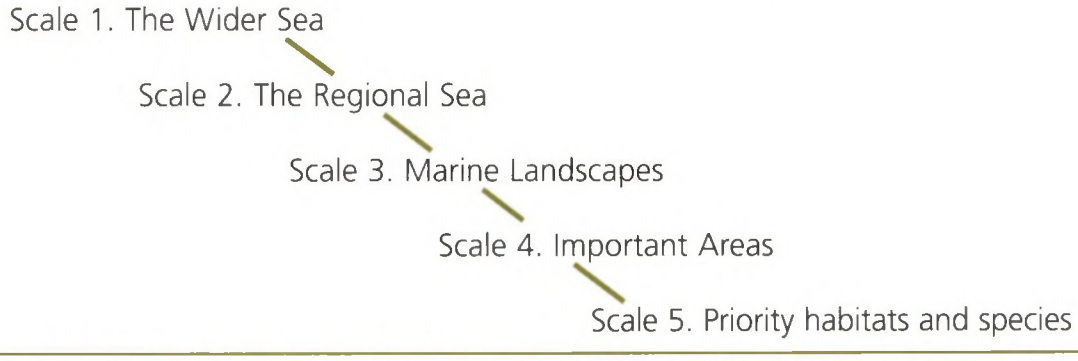
[3] Defra (2004)

The framework for marine nature conservation

13. The framework for marine nature conservation was developed to address the real-life situation of i) extensive sea areas, including deep water areas, ii) large numbers of marine species and habitats, but an insufficiency of data to determine their extent or status, and iii) a multiplicity of human activities, some of which are environmentally damaging.

14. The framework proposed was one which was intended to be capable of implementing, economically and effectively, the overall marine strategy in relation to nature conservation. The framework proposed that action be taken at one or more of a number of the spatial scales shown in Table 3.

Table 3: Framework for marine nature conservation



15. The underlying principle behind this framework is that action to implement the strategy should first be considered at the larger spatial scales, and subsequently at the smaller spatial scales only if further action is required. For example, effective European Union or national legislation to protect whales or dolphins would remove the need for legislation at the regional or local scales. The action needed at the local scale would be enforcement of that legislation. Such use of the framework is potentially resource-efficient. It also enables the major constraints to implementation to be identified and addressed.

16. The five scales of the proposed framework can be summarised as follows:

Scale 1. The Wider Sea

For the Pilot's purposes, the 'Wider Sea' was considered, geographically, as being the North-east Atlantic. However, it also embraced the range of international agreements and mechanisms which influence the way that a country can manage its sea area (for example the UN Convention on the Law of the Sea (UNCLOS), or the EU Common Fisheries Policy (CFP)). Action at this level will normally have to be achieved by agreement in international fora.

Scale 2. The Regional Sea

Regional Seas are identified, mainly using biogeographical factors, as large scale ecosystem sub-divisions of the Wider Sea. The boundaries of regional seas may be adjusted subsequently to take account of socio-economic factors. Functionally, they are considered to be an appropriate scale at which to apply the ecosystem approach for purposes of practical marine management. Action in relation to regional seas would normally be undertaken at the national level or through collaboration between adjacent countries.

Scale 3. Marine Landscapes

Marine landscapes are broad habitat types of the seabed or water column. They vary in scale depending upon the uniformity or complexity of the marine environment, and provide a map of the marine environment equivalent to terrestrial landscapes. Action is likely to be needed to ensure they do not become degraded, or incapable of supporting a satisfactory level of biodiversity at the various levels of the food web. Action might be most appropriate at the national or provincial level.

Scale 4. Important Areas

Within regional seas, certain areas are of conservation importance because they contain a high biodiversity of species or biological communities, or because they host important aggregations of mobile species during at least a part of their life cycle, or because they are exceptional for some other reason. These areas have a vital functional role in the ecology and biodiversity of the sea and tend to be vulnerable to damage from development or exploitation. They require special measures for their long term protection. In scale, important areas will vary, (overlapping to some extent with marine landscapes), but many will be modest in size. Action would normally be undertaken at the national and local level, though measures to regulate certain activities might be needed at the European or international level, for example in respect of fisheries and shipping.

Scale 5. Priority habitats and species

The conservation requirements of most habitats and species should be met by effective action at the higher spatial scales, but some will require specific measures to ensure they do not decline or are lost altogether. Action to conserve such priority habitats and species may be taken at a range of scales, but, other than for wide-ranging species, much of the action required will be at the local level.

The Irish Sea Pilot

17. The purpose of the Irish Sea Pilot was to test the proposed framework for marine nature conservation to determine (i) whether it needed to be refined or amended, (ii) the extent to which it could be implemented straight away, and (iii) what additional action or changes would be needed for effective implementation. The Irish Sea was selected for the trial because it is a relatively discrete regional sea which included all the countries of the United Kingdom, the Crown Dependency of the Isle of Man, and another EU Member State, Ireland. It was also an area which had been relatively well studied in the past, and which was subject to a range of economic, social and environmental issues.

18. The Pilot ran for nearly 2 years (May 2002 – March 2004). It was funded primarily by the UK Department for Environment, Food & Rural Affairs (€660,000), with contributions also from other partners, and was undertaken by the Joint Nature Conservation Committee under the supervision of a Steering Group comprising a broad range of stakeholders. The findings and conclusions of the Pilot are set out in fully in its report[2] and are summarised here, primarily, under the five scales of the proposed marine nature conservation framework. However, the Pilot's work was underpinned by three cross-cutting programme elements, and these are summarised below.

The communications strategy

19. A strategy for communicating with Irish Sea stakeholders was prepared at an early stage of the project. Regional sea management depends on collaboration between Governments and stakeholders to build consensus, compare legislation and governance, and to collate data and information. The Pilot established inter-governmental links between the UK, Ireland and the Isle of Man, and all three countries gave policy support and assistance with the provision of data. Each country nominated representatives to sit on the Steering Group and supplied lists of stakeholder contacts for the Pilot's database.

20. Stakeholders included national governments, 56 local governments, economic sectors and non-governmental bodies. It was not considered practical to include local interests in a project of this type and geographical scale.

21. The Pilot undertook most communication by email, an approach which was found to be acceptable to more than 99% of stakeholders. Those who wished to receive postal communications were accommodated. The communications strategy included also stakeholder workshops, a web site, newsletters, presentations, articles in other publications, formal consultations, and bilateral discussions, the latter mainly with economic sectoral interests.

22. The Pilot drew a number of conclusions from its experience with the communications strategy; these included:

    i. email and web-based communication worked well, but, in projects of this nature, stakeholders should be consulted over their preferred means of communication;

[2] Vincent, M.A., Atkins, S., Lumb, C., Golding, N., Lieberknecht, L.M. and Webster, M. (2004)

ii. participating countries should be equal partners in regional sea initiatives of this kind, having equal influence over proposals and equal responsibility for implementation;

iii. engagement of, and consultation with, regional sea stakeholders should be carried out by each Government in its own country.

The data collation exercise

23. Data were collated for the Irish Sea where they were relevant to marine nature conservation and human impacts on the environment. The purposes of acquiring the data were to:

    i. identify, map and characterise the marine landscapes;

    ii. test criteria for areas, habitats and species, and

    iii. examine relationships between the distribution of important nature conservation features and the nature and intensity of human use of the Irish Sea.

24. The main categories of data collated were: hydrography, topography, geophysical structure, natural resources, ecology and human activities relevant to the regional sea. Human activity data were gathered in 16 sectoral groupings, including conservation, oil and gas, renewable energy, fishing, shipping and tourism. The information was managed and analysed using a dedicated GIS (ArcView8).

25. The Pilot found that availability of data varied considerably, both spatially and also across the various human activity sectors. While intertidal and near-coast biological information was found to be satisfactory, data were sparse for most offshore locations. Data in relation to some human activity sectors was found to be good, but, for others it was incomplete or scattered. In major part, this variability was due to the absence of a coherent strategy for data collection and management.

26. The Pilot also found that while most Government Departments and statutory agencies were willing and able to make their data available, this was variable across the whole spectrum of data-holding organisations. The Pilot was aware of further data which the owners were unable or unwilling to make available.

27. It was felt that the limitations referred to above constrained good decision-taking and could lead to duplication of data collection effort. The Pilot drew a number of conclusions in relation to data, including:

    i. there would be considerable benefit in establishing an electronic marine information network to which marine data should be contributed using agreed data standards;

    ii. marine data collected with public funds, and environmental data collected by the private sector for the purpose of complying with a regulatory procedure, should be placed in the public domain within specified timescales;

    iii. improved co-ordination of data collection and research activities needs to be achieved, together with a greater degree of collaboration between survey organisations;

iv. information on the sources, availability, extent and attributes of datasets (comprehensive metadata) needs to be easily and widely accessible;

v. in addition to pursuing improvements at the national level, there could also be benefit in seeking improved co-ordination and collaboration at the Regional Sea and European levels.

The review of legislation, governance and enforcement

28. An important part of the Pilot's remit was to review the existing framework of legal powers, statutory duties, regulatory systems and voluntary mechanisms in force in the UK for delivering marine nature conservation. The aim was to consider if the legislation was adequate to deliver both the international obligations and any conservation objectives which may be set for the Irish Sea. Where gaps or weaknesses were identified, the Pilot made proposals to address them. Similarly, the Pilot looked at enforcement responsibilities, structures and resources with a view to achieving a satisfactory level of effectiveness and efficiency. The review encompassed the relevant European Union, UK and Isle of Man marine nature conservation legislation, regulatory regimes and enforcement mechanisms.

29. The conclusions of the Pilot's work in relation to legislation, governance and enforcement are reported in later sections. However, the Pilot drew a number of general conclusions, and these are summarised below:

i. integrated decision-taking in the UK marine environment is constrained by the sectoral nature of current jurisdictional and management responsibilities. As an alternative to wholesale integration, the establishment of an over-arching multi-disciplinary authority to take overall responsibility for strategic planning in the marine environment would constitute a major step forward;

ii. the responsibility for the enforcement of marine nature conservation should be identified explicitly. Away from the coasts, there would be benefit in those having responsibility for fisheries enforcement taking on this role;

iii. the authority(ies) responsible for enforcing marine nature conservation should have, or have access to, the requisite powers and the necessary vessels and other resources necessary to carry out the enforcement effectively. Effective collaboration and co-ordination arrangements between enforcement agencies operating in the marine environment need to be put in place.

The Wider Sea (Scale 1)

30. The North-east Atlantic is the appropriate scale for implementing nature conservation policies with respect to a number of wide-ranging or migratory aquatic species, including many fish, sea birds and sea mammals. Seabird and seal breeding sites are best addressed through area protection measures (Scale 4), but away from these areas, a range of other measures are required.

31. Cetaceans, seabirds and certain fish species require special protection measures under European Union law, and the UK is currently planning the extension of such measures throughout its jurisdictional area. The main threats to this group of species away from the coasts are considered to be the incidental killing of small cetaceans by capture fisheries, the oiling of seabirds, and the over-exploitation of vulnerable fish stocks.

32. The Wider Sea is the scale at which international agreements regulating the management of a range of human uses of the sea are negotiated. UNCLOS provides a legal framework for the use of the sea, the UN International Maritime Organisation regulates international shipping, and the MARPOL convention controls discharges from ships at sea. Water quality issues in the North-east Atlantic are covered by the OSPAR Convention, which is also addressing the needs of vulnerable marine habitats and species.

33. Within the European Union, the management of fisheries is governed primarily by the EU Common Fisheries Policy, while EC Directives cover a wide range of relevant matters including water quality, Strategic Environmental Assessment, Environmental Impact Assessment, and nature conservation. The key EU legal instruments relating to nature conservation are the EC Birds and Habitats Directives.

34. Agreements reached through the Convention on Biological Diversity, and also through the World Summit on Sustainable Development, have identified the ecosystem approach as a crucial mechanism for the sustainable development of the marine environment. The *European Marine Strategy* is, prospectively, an important mechanism for developing integrated policies with respect to the use made of the seas and its work on implementing the ecosystem approach, and for the co-ordination of monitoring activities, is likely to prove both beneficial and influential.

35. The Pilot reviewed the range of relevant international agreements and EU legislation in the context of the needs of wide-ranging and migratory aquatic species, and marine nature conservation more generally. This work identified a number of areas at the Wider Sea scale where it was felt improvements were needed, including the following:

    i. commercial fishing continues to pose a significant threat to some small cetacean populations as a result of bycatch. Where this is the case, measures to reduce this mortality need to be taken urgently, either through mitigation measures or, where these are unlikely to succeed, formal consideration needs to be given to closure of the fishery.

ii. commercial fishing poses a threat to vulnerable fish species, such as sharks, skates and rays, and deep water fish, both through directed fisheries and as a consequence of bycatch. Mobile fishing gear also has the potential to damage sensitive seabed habitats. Over-exploitation of fish stocks can impact the food web detrimentally and affect the whole ecosystem. For these reasons, there is likely to be significant benefit in applying Strategic Environmental Assessment to commercial fishing activities.

iii. there is uncertainty over whether jurisdictional responsibility for nature conservation legislation affecting fishing lies exclusively with the European Community or is shared with Member States under Article 175 of the EC Treaty. This issue is particularly important with respect to implementing nature conservation policies beyond 6 nautical miles, and requires clarification.

iv. there is a need to continue to support reductions in the incidence of oil and chemical spills resulting from shipping accidents through a range of safety measures. These would include measures to implement the proposals for Marine Environment High Risk Areas, incorporated within the prospective wider MARPOL Particularly Sensitive Sea Area for Western Europe.

v. a principle of the Ecosystem Approach is the avoidance of financial incentives and subsidies which have an adverse impact on ecosystems. There would be benefit in re-directing adverse marine incentives to support good stewardship of the marine environment, promoting the restoration of fish stocks, and encouraging the diversification of excess fishing capacity into other, more sustainable uses of the marine environment.

vi. the *European Marine Strategy* has the potential to provide a strategic framework for decision-taking and an integrated approach to the management of the marine environment such as by means of Regional Sea action plans. The Pilot agreed that further consideration needs to be given to the means of integrating economic, social and environmental objectives, including through a process of spatial planning (considered further in this report under Scale 2, the Regional Sea).

vii. current action being undertaken nationally to co-ordinate and rationalise marine environmental monitoring, and the monitoring of human impacts on the environment, in order to support the implementation of the ecosystem approach, needs to be extended and brought to completion. There is likely to be benefit in co-ordinating such monitoring with that of adjacent countries, through the development of agreed international standards and data sharing.

The Regional Sea (Scale 2)

36. The Wider Sea (i.e. the North-east Atlantic) is too large an area for many aspects of practical marine management and needs to be sub-divided at the ecosystem level. However, the boundaries of such marine ecosystems are seldom clear-cut. The scale at which human activity management is most practical is also an important consideration and this can depend upon its context. For example, a Regional Sea set at the scale of the North Sea might be suitable for handling decisions taken at the OSPAR or European Union level, but, in terms of much practical management, including effective engagement with stakeholders, such a scale is likely to be too large.

37. Work undertaken to identify Regional Seas using biogeographical factors such as water temperature, depth and currents, identified 11 distinct marine ecosystems in the UK jurisdictional area. These are shown in Map 2. Since they encroach on the seas of other countries, discussion with those countries will be needed before such boundaries could be fully defined, but they can serve as an illustration of the approach. This scale of Regional Sea is likely to be an appropriate scale at which to apply the ecosystem approach for the purposes of practical marine management. One of these Regional Seas, the Irish Sea, was used to test and illustrate this.

The Irish 'Regional' Sea

38. The Irish Sea covers an area of about 58,000 sq km. In character, it has the form of a shallow basin, with depths ranging mainly from 20-100m, but with a deeper channel, running north-south, which reaches a maximum depth of 315m in Beauforts Dyke. This channel connects with the Celtic Sea via St George's Channel in the south, and with the Malin Shelf through the North Channel.

39. The total human population residing in coastal localities within 10km of the Irish Sea coastline is estimated at about 6 million. The Pilot investigated the relative economic and employment importance of the various types of human activity undertaken in, and adjacent to, the Irish Sea. Data and statistics on this were not always available at the Regional Sea scale and often had to be compiled or estimated from other data. However, the findings indicated the importance of tourism, oil and gas, defence and shipping-related activities as the dominant sectors.

40. The Pilot's communications strategy enabled the effective engagement of stakeholders at the international, national, regional and local administrative area levels, and with the representative bodies of the main environmental and socio-economic interest groups. The Pilot concluded that effective stakeholder engagement could be achieved with respect to a Regional Sea of this scale.

41. The data collation exercise undertaken by the Pilot confirmed the incomplete coverage of biological data (see Map 3). In contrast, geophysical and hydrographical data were found to be comprehensive. The Pilot concluded that, for the foreseeable future, it would not be possible to base a marine nature conservation strategy solely on biological data, but that recourse would have also to be made to other types of data, particularly geophysical and hydrographical data.

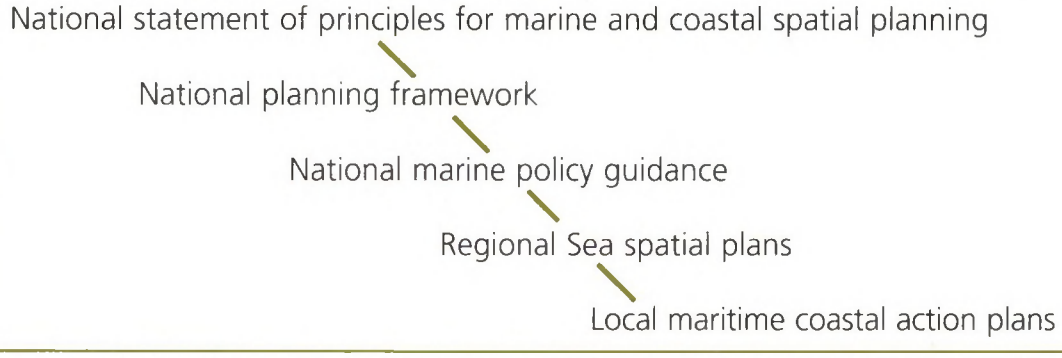
42. Because they are based primarily on biogeographical determinants, the Regional Seas were considered an appropriate scale at which to identify ecologically-coherent networks of marine protected areas as envisaged in the EU Natura 2000 network, and under OSPAR.

43. While the quality and availability of human activity data were variable, it was felt that the data did reflect the nature and relative intensity of human activity pressures on the environment, and could support a strategic planning process. On the basis of the UK's experience with strategic environmental assessment in relation to the marine oil and gas sector, the EC Directive on Strategic Environmental Assessment is likely to be a very important mechanism for the delivery of sustainable development in the marine environment. However, a limitation of this process is that it focuses on the mitigation of environmental harm, and it is not a mechanism for strategic planning across sectors which can take sufficient account of the range of economic, social and environmental objectives which underpin sustainable development.

44. In order to consider how strategic planning could be applied better at the Regional Sea level, the Pilot investigated the contribution that spatial planning could make to this. At present, the UK's land-based planning process does not apply in the marine environment beyond the immediate coast.

45. The Pilot concluded that there would be considerable benefit in introducing a comprehensive system of spatial planning in the marine environment out to the limits of UK jurisdiction, and that such a system should cover all activity sectors. The starting point for such planning should be the vision and strategic goals for the marine environment, and include a presumption that all competent authorities should carry out their functions on the basis of an agreed set of principles which applied the ecosystem approach and the precautionary principle. The Pilot concluded that these principles would be supported in practice by a hierarchy of plans, as summarised in Table 4.

Table 4: Strategic spatial planning framework



46. The Pilot considered that such an integrated, ecosystem-based, marine spatial planning framework would be required to manage the resources of the sea strategically, and that the Regional Sea is an appropriate scale at which to undertake such spatial planning. The Pilot was not able, within the timeframe of the project, to test out the spatial planning process fully on the Irish Sea, and it recommended that such a trial be undertaken.

47. Overall, the Pilot reached a number of conclusions in relation to the Regional Sea, including the following:

i. Regional Seas which act as functioning ecosystems can be identified on the basis of biogeographical factors, but their value for management purposes will be determined partly by practical considerations. The scale and boundaries of such Regional Seas need to be identified in discussion between the relevant countries and international organisations in the light of these considerations.

ii. The Regional Sea, e.g. the Irish Sea, is an appropriate scale at which to involve the range of marine stakeholder interests from international to local level, including engagement with the representative bodies of the main economic and community interest groups. Such involvement is unlikely to be practicable at scales significantly larger than the regional sea.

iii. For the foreseeable future, it will not be possible to base a marine nature conservation strategy solely on biological data because of the patchiness of these data. Other data, particularly geophysical and hydrographical data, will also need to be employed.

iv. The Regional Sea, at the scale of the Irish Sea, is an appropriate scale at which to identify ecologically-coherent networks of marine protected areas.

v. The process of Strategic Environmental Assessment will make a substantial contribution to the avoidance and mitigation of damage to the marine environment but it will not deliver the level of integrated strategic planning needed to achieve the range of economic, social and environmental objectives.

vi. A comprehensive system of spatial planning, covering all human activities in the marine environment, would be capable of delivering integrated strategic planning. Such a system would be set in the context of the need to deliver the vision and strategic goals for the marine environment, would be based on agreed management principles and would be delivered through a hierarchy of a national planning framework, Regional Sea plans and, where appropriate, maritime or coastal action plans. The further definition of such a system would need to determined through a spatial planning trial at the Regional Sea level.

vii. Spatial planning at the Regional Sea level would benefit from being undertaken in collaboration between the various countries bordering the Regional Sea. The provision of spatial planning guidance at the European level could be expected to assist such a process.

Marine Landscapes (Scale 3)

48. As reported in the previous section, it is not practicable to base a marine nature conservation strategy solely on the basis of biological data because of the patchiness of that data. This is particularly true for the more remote areas to the north and west of the United Kingdom, especially the deeper water areas. For this reason, the Pilot considered other approaches, in particular the use of geophysical and hydrographical data to identify marine landscapes.

49. The concept of marine landscapes was developed by Roff and Taylor[4] for Canadian waters. In order to classify the sea into broad ecosystem units related to the topography and ecology, they combined water temperature, depth/light, substratum type, exposure and slope, and the stratification/mixing regime to define units at the landscape scale.

50. The central assumption of the marine landscapes concept is that geophysical and hydrographical information can be used in lieu of biological information to identify broad-scale marine habitats and to set priorities for marine nature conservation. The justification for this assumption is the strong ecological relationship which exists between geophysical and hydrographical factors and the character of biological communities. This relationship is the basis of both the UK and the European EUNIS marine habitat classifications.

51. Irish Sea coastal and seabed marine landscapes were identified using bathymetry and seabed sediment data merged with derived slope data in the GIS. Data on generalised bed form, maximum bed stress (a measure of water currents at the seabed) and gas seeps, were overlaid. Biological characterisation of each landscape type was then carried out by linking available biological data for the Irish Sea and (where appropriate) elsewhere to the relevant marine landscapes.

52. Water column marine landscapes were identified following analysis of water temperature, currents, frontal systems, stratification and salinity datasets. Quarterly datasets were used, producing four seasonal maps, to reflect the seasonal variability in the hydrodynamic water column structure. The biological characterisation of the water column types was based on the distribution of five key features of the plankton community.

53. Two surveys, in the North Channel and Anglesey areas of the Irish Sea, were undertaken to validate whether the data used for the characterisation of seabed marine landscapes provided an accurate representation of the marine landscapes as they actually exist, and also that the marine communities observed reflected those that had been predicted. A variety of data sampling techniques were used, including acoustic ground discrimination, side-scan, multi-beam, video, still-photography and grab sampling. The results of these surveys generally validated the predictions but also demonstrated that there was significant variation in the fine structure of the habitat.

[4] Roff, J.C. and Taylor, M.E. (2000)

Irish Sea marine landscapes identified

54. The marine landscapes identified fell into three main groups:

    i. coastal physiographic marine landscapes where the seabed and overlying water body are closely interlinked;

    ii. seabed marine landscapes in open sea areas where the marine landscapes comprise the seabed and the substrate/water interface;

    iii. water column marine landscapes of open sea areas; frontal systems above the substrate/water interface, were also identified.

55. Eighteen coastal and seabed marine landscape types were identified; these are summarised in Annex 1 and their extent shown in Map 4. The biological characterisation of these types is summarised in Annex 2. Four water column marine landscape types were identified. These are shown in Map 5 and are summarised in Annex 3, together with the abundance of the five plankton community components relating to them.

Further development and use of marine landscapes

56. The Pilot demonstrated that the identification and mapping of a comprehensive series of marine landscape types using geophysical and hydrographical data is practical at the Regional Sea scale. The series identified for the Irish Sea is probably transferable with relatively little modification to adjacent sea areas of broadly similar character such as the eastern Celtic Sea, the English Channel and the North Sea. Additional landscape types would be expected in other regional seas to the south and west of Ireland, west of the Hebrides and north of Scotland. For example, the continental slope, sea mounts, glacial features (e.g. iceberg plough marks), and deep waters might be expected to yield 10-15 new landscape types.

57. The value of the marine landscapes approach is that it uses existing data to enable management strategies for the marine environment to be developed and implemented. As more accurate biological survey data become available, marine landscape maps can be refined.

58. The Water Framework Directive (WFD) requires the achievement of good ecological status in transitional and coastal waters. Links could be made between the marine landscape types defined here and the habitat types used for deriving reference conditions for water bodies for the WFD (which are at a more detailed scale). The WFD also requires water bodies to be risk-assessed in terms of human pressures and sensitivities and the risk of failing to achieve good ecological status.

59. A programme of work to identify marine landscapes in other regional seas around UK is planned for 2004-05. The aim is to create a comprehensive list of characterised marine landscape types and map their distribution. In order to promote common standards and harmonisation of data and policy, a marine landscape approach could be adopted at the European level.

Marine landscapes and sustainable development

60. Identifying marine landscapes represents only part of the action required to ensure that human activities are set within the framework of sustainable development. The different types of marine landscapes differ in their susceptibility to human activities. For example, some seabed types are more likely to suffer long-term damage through abrasion and disturbance than others, while pollution and other water quality effects can be very important in relation to the biological composition of water column types. The Pilot reviewed current knowledge about the vulnerability of coastal and seabed marine landscapes to a range of human activity impacts, and the results of this work are summarised in Annex 4. The Pilot recognised that further work would be needed to refine these vulnerability assessments.

61. A key issue for implementing this element of the marine nature conservation framework is how to manage human activities in a manner which will have due regard to these vulnerabilities. In coastal localities, and more widely in the marine environment where activities involve development (e.g. oil and gas exploration and production, windfarms etc), existing regulatory mechanisms may suffice, especially where these are supported by strategic environmental assessment. For other types of activity, additional measures are likely to prove necessary, for example:

    i. Strategic Environmental Assessment of fishing operations, as concluded in section 4 (paragraph 35ii);

    ii. a system of spatial planning, as concluded in section 5 (paragraph 45).

62. Without these additional measures, managing the range of human activities in accordance with the principles of sustainable development is likely to prove significantly more problematic over the major part of the marine environment.

63. Overall, the Pilot reached a number of conclusions in relation to marine landscapes:

    i. a system of marine landscapes, including coastal, seabed and water column types, is an essential component of a strategy for marine nature conservation and is an effective means of dealing with the relative scarcity of biological data;

    ii. work to complete the mapping, and refine the typology, of marine landscapes is being undertaken for the UK's seas. There would be considerable benefit in the development of European standards to provide the context for this work and to enable its extension to other countries;

    iii. further work is needed to define the vulnerability of the various marine landscape types to human activity impacts, in order to inform the appropriate management of human activities;

    iv. there are currently significant gaps in the UK's ability to manage the full range of human activities across the major part of the nation's sea areas; a problem likely also to be faced by other European countries. The extension of strategic environmental assessment to fisheries operations, together with an effective system of spatial planning, would go a long way towards addressing this problem.

Important Areas (Scale 4)

64. International obligations (Table 1) are driving a policy to establish an ecologically-coherent network of well-managed marine protected areas (MPA). However, the site network established under the Habitats Directive is directed primarily at habitats and species which are threatened and declining. The Habitats Directive lists 8 marine habitats present in UK waters, for protection via site-based mechanisms. By the nature of their selection, such habitats are likely to be very limited in extent. In contrast, the Pilot has identified 18 coastal and seabed marine landscapes (broad habitats) for the Irish Sea, and there are likely to be 20-30 such marine landscapes throughout UK waters.

65. OSPAR has recognised the need to go beyond threatened and declining habitats and species and to include representative examples of all main habitat types as part of its ecologically-coherent network of MPAs. An ecologically-coherent network is one in which each selected area should be capable of supporting, and being supported by, the areas around them. The science needed to underpin this concept is not currently available and difficult to predict. The Pilot considered this issue and identified some principles which could be used to apply the concept. This issue of ecologically-coherent networks is currently being considered by OSPAR.

66. Important areas are a biological reality. Notwithstanding that the data are necessarily limited by survey effort, Map 6 illustrates the fact that some areas are more biologically diverse than others, and that action taken to conserve these areas would be likely to prove disproportionately beneficial to nature conservation. The Pilot identified four broad categories of important areas, namely:

    i. representative examples of the main marine landscape types;

    ii. areas of exceptional habitat or species diversity;

    iii. important aggregations of mobile species;

    iv. important geological or geomorphological areas.

67. Threatened or declining habitats are included within the first of these categories, and it can be expected that a high proportion of the area of such habitat types would be included within the network.

Important biological areas

68. Criteria for selecting important biodiversity areas were tested and refined by the Pilot (Annex 5). These criteria were effective in identifying important areas for marine landscape types (broad habitats) for which there are sufficient data and which have defined natural boundaries. The criteria were less effective in identifying important areas for habitats where data were limited and boundaries unclear. For this kind of habitat, a better approach was found to be the setting of targets for the level of representation of these habitats within the network, and the identification of areas to meet these targets based on available data.

69. Targets set for the range of different habitat types can take due account of their relative scarcity, extent and value for nature conservation. While representative habitat areas selected without the benefit of detailed biological data are more difficult to justify than those for which such data are available, selection of such areas can be flexible and can take account of human activity pressures and stakeholder preference.

Use of a reserve selection software tool

70. The Pilot found that the identification of a network of important areas was assisted by the use of 'reserve selection' software such as Marxan[5] which can be used to create a network to meet pre-set targets. Map 7 is a network selected by the Marxan software using some possible targets, and preselecting existing Natural sites with some important biodiversity areas and estuaries. Examples of possible targets are that the network should contain records of priority species and a specified percentage of the total area of each marine landscape type. The software can also incorporate existing designated sites within its network or exclude areas from selection such as those of high economic value.

71. The outcome of using the Marxan software tool is dependent on the quality of the data that it is provided with; it cannot solve problems of data quality, coverage and uneven sample distribution. Expert judgement will always be needed to determine why some areas show up as being more important than others. However, a tool such as Marxan can take account of many factors simultaneously and can generate a range of network options independent of any sectoral bias.

Important geological and geomorphological areas

72. The United Kingdom has identified, and, is conserving, a comprehensive suite of terrestrial geological and geomorphological protected areas. The need to preserve our Earth heritage for future generations applies to the marine environment as much as it does terrestrially, and the marine environment contains elements of the Earth heritage that are not expressed on land, such as gas seeps, sand volcanoes, and iceberg plough marks.

73. As part of the Pilot, and in order to test a site selection methodology, an initial list of important geological and geomorphological areas for the Irish Sea was compiled. A conservation option for these could be to incorporate measures within the proposals for the conservation of marine landscapes, and in the networks of important areas.

Other issues

74. The Pilot considered that continued reliance on technical measures, quotas and means of reducing fishing effort under the CFP, are unlikely to be sufficient to protect and recover fish stocks of both quota and non-quota species. Although there are a number of partial MPA under fisheries legislation in UK waters, these do not adequately test the benefits of all types of MPA. The Pilot concluded that, to address this, time-limited, area-based trials could be set up at the regional sea scale with the support and participation of the fishing industry to test the effects of MPA mechanisms.

[5] Ball, I.R. and Possingham, H.P. (2003)

Management of important areas

75. Having identified the individual areas contributing to an ecologically-coherent network, it is necessary to consider the conservation objectives of areas within the network and how to achieve these. Objectives may vary between areas. For example, for representative areas it may be important to enable the habitats and species populations within these areas to develop and maintain their characteristic biodiversity. This will mean that activities which would lead to significant disturbance of these areas, or exploitation of their biological resources, are likely to require strict control. For areas selected to maintain a particular species population or geological feature, the objective may simply be to maintain that feature, and a much wider range of human activities may be acceptable. Within the ecologically-coherent network, therefore, the way that human activities will need to be managed can be expected to differ quite widely from area to area.

76. In order to achieve the objectives for an ecologically-coherent network of MPAs, the Pilot considered it would be necessary to ensure that, i) the areas are formally and officially identified, ii) their objectives are clearly defined, and iii) human activity is managed effectively in order to achieve those objectives.

77. After considering the range of issues summarised above, the Pilot drew a number of conclusions, including the following:

    i. ecologically-coherent networks need to contain representative examples of all the main habitats as well as examples of threatened and declining habitats. The networks would need to include areas of exceptional habitat or species diversity, and important aggregations of mobile species. There may be value in incorporating important geological or geomorphological areas into the network;

    ii. ecologically-coherent networks need to take account of the principle that areas within the network should be mutually supporting;

    iii. criteria such as those set out in Annex 5 can be used to select areas for habitats and species groups for which there are satisfactory data and where the areas are reasonably distinct. For habitats where this is not the case, other methods need to be used, such as targets of the proportion of habitats to be incorporated into a network. The use of selection tools, such as Marxan, is likely to assist in the selection of the most appropriate areas;

    iv. the potential benefits of using long-term MPAs for fisheries management under the Common Fisheries Policy could be considered further. For example, time-limited, area-based, trials could be set up at the Regional Sea scale;

    v. the conservation objectives of MPAs will vary according to the nature of the individual areas and, the degree of regulation of human activity within the areas is also likely to vary;

    vi. in order to achieve the conservation objectives of an area, it will be necessary to ensure that: the areas are formally and officially identified; the objectives are clearly defined; and human activity is managed effectively in order to achieve these objectives.

Priority habitats and species (Scale 5)

78. Action taken to implement Scales 1-4 of the framework for marine conservation can be expected to result in the effective conservation of most marine habitats and species. However, there may be some for which this will not be the case and it may be necessary to take additional, specific, action to conserve them.

79. Also, to ensure that the network of important areas is as effective as possible, it is necessary to determine those habitats and species considered most in need of area conservation measures. For the above reasons, the Pilot considered the issue of how, most cost-effectively, to identify priority habitats and species for which such action might be necessary.

80. As a first step, the Pilot compiled a provisional list of approximately 300 features (marine landscapes, habitats and species) of conservation importance in the Irish Sea from existing OSPAR, IUCN, EU and UK lists. Criteria (Annex 6) derived from existing international models were then tested against a sample of 25 of these to indicate the reliability and value of the use of the criteria and make refinements where necessary. The sample included marine landscapes, habitats and species from a broad range of taxonomic groups. Dossiers for each feature were compiled from existing data to assess each criterion.

81. The Pilot found that the criteria can be used to assess whether marine features should be considered to be of (at least) national importance. The results indicated that in the order of 150 Irish Sea features would be expected to meet the criteria as nationally important and that this figure could be extrapolated to about 300 features in UK seas as a whole.

82. However, it took, on average, two person days to apply the criteria to a feature and to prepare a dossier. This led the Pilot to consider which sequence of action to follow. For example, the distribution of 'provisional list' benthic species could be mapped directly and taken account of in the selection of representative areas under Scale 4 of the framework, without the need for applying further criteria (see Map 8).

83. It was suggested that a cost-effective process might be to screen the 'provisional list' to determine which management measures might be appropriate to the habitats and species on it, and to identify those features whose needs are already being adequately addressed by action recommended under the higher scales of the framework. The criteria could then be applied to the remaining list of features to identify a suite of priority habitats and species for which prescriptive action plans could be developed.

84. The Pilot made the following recommendations in relation to priority features:

    i. there would be benefit in the adoption of a national suite of criteria to be used for the identification of priority habitats and species, standardising these at the European level if possible;

    ii. further work would need to be carried out to determine the most effective means of identifying which priority features would require specific additional, action.

A process for setting conservation objectives and targets

85. To deliver the Marine Nature Conservation Framework the Pilot investigated approaches for the setting of conservation objectives, targets and actions (the fourth and fifth levels of the strategic policy framework set out in Table 2).

86. Initially, the Pilot intended to set conservation objectives for all features at each scale of the marine nature conservation framework but this was found to be repetitive, unnecessarily complex and would have been difficult to implement. The Pilot's analysis, and discussions with stakeholders, indicated that the greatest benefits of setting conservation objectives would be to set them at the wider sea and regional sea levels, with refinement to meet the specific needs of the other levels, if required.

87. The approach adopted by the Pilot was to set aims, derived directly from the strategic goals for the marine environment, for three broad ecosystem components of the regional sea, namely the *physical and chemical properties*, the *productivity* and the *biodiversity*.

88. For each aim, the Pilot developed a series of high level conservation objectives. For example, under the aim of *physical and chemical properties* there might be four high level conservation objectives e.g.:

    i. to protect seabed features so that they can support the processes, habitats and species characteristic of the marine landscapes;

    ii. to protect water column features so that they can support the processes, habitats and species characteristic of the water column;

    iii. to protect the water quality of the component water column features so that they can support the processes, habitats and species characteristic of water column and associated seabed habitats;

    iv. to protect biota quality.

89. Each high level conservation objective could be further refined by the development of one or more 'operational' conservation objectives. The purpose of defining conservation objectives at an operational level is to provide practical guidance for management. The operational conservation objectives could be defined in one of the following ways:

    i. compliance with standards aimed at protecting the marine environment;

    ii. protection or recovery from adverse impacts due to human activity;

    iii. achievement of a particular target state or level.

90. An example of this format is shown at Annex 7. The format was designed so that the operational conservation objectives can be integrated with the Ecological Quality Objectives being developed under OSPAR. Progress towards achieving the operational conservation objectives would be assessed by defining and monitoring indicators and targets set for these objectives. The conservation objectives would apply at the Wider Sea and Regional Sea levels. Once agreed, they would be unlikely to require significant change over time.

91. To implement the conservation objectives, appropriate targets would need to be set at the operational conservation objective level. Collectively, these targets should aim to define the nature conservation requirements for the marine environment. To the extent appropriate, they also need to take account of other sectoral objectives and make appropriate contributions towards achieving sustainable development. The application of the principles of the ecosystem approach will be particularly critical in setting these targets.

92. At other spatial scales (e.g. marine landscapes, important areas and priority features) more detailed and localised conservation objectives could be developed if required. Such work has already been undertaken with respect to European Marine Sites, but it is only envisaged that conservation objectives would be set at the level of priority features where specific action was envisaged, such as within an action plan.

93. Overall, the Pilot concluded that:

    i. conservation objectives could be derived directly from the strategic goals for the marine environment and be defined fairly comprehensively at the scale of the Regional Sea, thus linking the strategic policy framework for sustainable development directly to the framework for marine nature conservation;

    ii. operational conservation objectives to guide the management of human activity can be derived from these high level conservation objectives, and targets set for these;

    iii. a process needs to be established to identify and set appropriate targets for these operational conservation objectives, and the targets then incorporated into the national marine monitoring programme.

94. The above process is considered fully compatible with the work being undertaken on the ecosystem approach and on monitoring being carried out as part of the development of the *European Marine Strategy*.

Conclusions

95. The Irish Sea Pilot was a research project set up to test a number of proposals being considered under the Government-led Review of Marine Nature Conservation. Some of these proposals were found by the Pilot to require amendment; for example the framework for marine nature conservation originally identified four spatial scales, but the Pilot concluded that five spatial scales were required. This summary report has concentrated on setting out the main findings of the Pilot with a view to sharing them with the European Commission and other European countries.

96. The full details of the Pilot are given in the Irish Sea Pilot report[2] and in a range of subsidiary reports available online at www.jncc.gov.uk/irishseapilot. The Irish Sea Pilot report made a total of 64 recommendations; some of these were fairly detailed and this summary has concentrated on the most significant of them.

97. The Pilot has shown that it is possible with existing data to classify the wider marine environment into regional seas and marine landscapes. These geographical scales are suitable for the development and application of planning and management mechanisms to ensure that human activities take place within a strategic framework that will allow the achievement of socio-economic objectives in parallel with the necessary protection and conservation of natural resources and biodiversity.

98. The Pilot demonstrated the importance of ensuring effective and sustainable management of human activities at the higher spatial scales, coupled with the need for the establishment and appropriate management of an ecologically-coherent network of important marine areas. While conservation effort at the level of individual habitats and species will be necessary to complement this wider effort, it is not a replacement for it.

99. The Irish Sea Pilot made a number of recommendations for further work including:

    i. the application of the marine landscapes classification to all UK waters and, with the collaboration of other countries, more widely;

    ii. a trial of marine spatial planning at the Regional Sea scale to identify likely benefits and test out methods;

    iii. the identification of the range of priority habitats and species requiring specific conservation action;

    iv. further work to identify an ecologically-coherent network of MPAs;

    v. the setting of targets for operational conservation objectives and the incorporation of these into a national marine monitoring programme.

100. Further work on marine landscapes and marine spatial planning is planned to commence during 2004 and it is hoped to make progress on all these areas over the next two years. The UK would warmly welcome the involvement of the European Commission and other Member States in this work.

[2] Vincent, M.A., Atkins, S., Lumb, C., Golding, N., Lieberknecht, L.M. and Webster, M. (2004)

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Physical characteristics of coastal and seabed landscapes

Marine Landscape	Depth (m)	Substratum	Bed-stress/ current	Topography/ slope & additional criteria
Estuary	0-30m	Mixed	Variable	Variable
Ria	Shallow: 0-20m	Typically rocky with sediment	Variable	A drowned river valley; often v-shaped in cross section
Saline Lagoon	V Shallow: 0-5m	Mixed	Weak currents	Parallel to coast, limited water exchange, large surface area: volume ratio
Sea loch	0-200m	Rocky with sediment basins	Variable	Includes fjords (have shallow sill & deep basins) & fjards (generally shallower)
Sound	0-30m	Gravels & sands	Strong currents	Narrow channel, open at both ends
Gas structures	Variable	Mixed	Very weak currents	Pockmarks/ depressions (hard structures)
Photic Reefs	Within photic zone (i.e. generally <10-20m for the Irish Sea)	Bedrock, boulders & cobbles	Variable	Rough/uneven topography Contains Littoral Rock and Infralittoral Rock
Aphotic Reefs	In aphotic zone (i.e. generally >10-20m for the Irish Sea)	Rock/biogenic	Variable	Rough topography (not as pronounced as Sea Mounds)
(Irish) Sea Mounds	Rising >20m above surrounding seabed	Rock, often with sediment veneer	Variable	Sea Mound slope > 1-8%
Sand/ gravel banks	Variable	Sands & gravels	Strong currents	Bank slope >1-8%
Coastal sediment	Intertidal -50m (& no BGS sediment data)	Muds, sands & gravels	Variable	Adjacent to coastline N.B. 'Bucket' category, where no BGS data were available.
Shallow-water mud basin	0-50m	Muds	Very weak currents	Depression
Deep-water mud basin	Deeper than 50m	Muds	Very weak currents	Depression
Fine sediment plain	Variable	Sands & muddy sands	Weak currents	Negligible slope
Sediment wave/ megaripple field	Variable	Sands	Moderate/strong currents	Waves/ripples
Low bed-stress coarse sediment plain	Variable	Cobbles, pebbles & muddy gravels	Low bed-stress	Negligible slope Evidence of fines in sediment
High bed-stress coarse sediment plain	Variable	Boulders, cobbles, pebbles & gravels	High bed-stress	Negligible slope No fines within sediment
Deep-water channel	Deeper than 150m	Cobbles, gravels & mixed sediments	Variable	Channel slope > 1-8%

Marine Landscape	Biology and biotopes identified (> 5% contribution)
Estuary	Fucoids on sheltered rocky shores; Fucoids in variable salinity conditions; Upper estuarine mud shores; mid estuarine mud shores; Mobile sandy shores; Muddy sandy shores LR.LLR.F; LR.LLR.FVS; LS.LMu.UEst; LS.LMu.MEst; LS.LSa.MoSa; LS.LSa.MuSa
Ria	Fucoids on sheltered rocky shores; Barnacles/fucoids on moderately exposed rocky shores; Mussels and barnacles on exposed rocky shores; Lichens; Tideswept kelp; Upper estuarine mud shores LR.LLR.F; LR.MLR.BF; LR.HLR.MusB; LR.FLR.Lic; IR.MIR.KT; LS.LMu.UEst
Saline lagoon	Upper estuarine mud shores; mid estuarine mud shores; muddy sand shores; Infralittoral sandy mud; Sublittoral seagrass beds l.S.l.Mu, UEst; L.S.L.Mu.MEst; L.S.LSa.MuSa; SS.SMu.IFiMu; SS.SMp.SSgr (characteristic biology for a typical saline lagoon from Bamber et al., 2001)
Sea loch	Fucoids on sheltered rocky shores; Silted kelp; Brachiopod & ascidian communities; Circalittoral fine muds; circalittoral sandy muds; Circalittoral muddy mixed sediments; Sublittoral mussel beds LR.LLR.F; IR.LIR.K; CR.LCR.BrAs; SS.SMu.CFiMu; SS.CSaMu; SS.SMx.CMuMx; SS.SBR.SMus
Sound	Fucoids on sheltered rocky shores; Tideswept kelp; Circalittoral mixed faunal turf; Echinoderm and crustose communities; Infralittoral fine sands; Circalittoral coarse sediments; Infralittoral muddy mixed sediments LR.LLR.F; IR.MIR.KT; CR.HCR.XFa; CR.MCR.EcCr; SS.SSa.IFiSa; SS.SCS.CGvSa; SS.SMx.IMuMx
Gas structures	Offshore mud SS.SMu.OMu
Photic reef	Mussels and barnacles on exposed rocky shores; Barnacles/fucoids on moderately exposed rocky shores; Fucoids on sheltered rocky shores; Lichens; Rockpools; Kelp with cushion fauna/foliose red seaweeds/coralline crusts; Sand/gravel affected kelp communities; Kelp with red seaweeds LR.HLR.MusB; LR.MLR.BF; LR.LLR.F; LR.FLR.Lic; LR.FLR.Rkp; IR.HIR.KFaR; IR.HIR.KSed; IR.MIR.KR
Aphotic reef	Circalittoral tideswept fauna; Circalittoral mixed faunal turf; Echinoderm and crustose communities; Circalittoral vertical rock communities CR.HCR.FaT; CR.HCR.XFa; CR.MCR.EcCr; CR.FCR.FaV
(Irish) Sea Mounds	Rock structures with sediment veneer Offshore coarse sediments; Circalittoral sandy mud; Offshore mud; Sublittoral polychaete reefs; Circalittoral mixed faunal turf; Echinoderm and crustose communities SS.SCS.OCS; SS.SMu.CSaMu; SS.SMu.OMu; SS.SBR.PoR; CR.HCR.XFa; CR.MCR.EcCr
Sand/ gravel banks	Infralittoral fine sands; Infralittoral muddy sands; Infralittoral coarse sediments; Circalittoral muddy mixed sediment; Offshore mixed sediment; Sublittoral mussel beds. SS.SSa.IFiSa; SS.SSa.IMuSa; SS.SCS.CCS; SS.SCS.ics; SS.SMx.CMuMx; SS.SMx.OMx; SS.SBR.SMus

Marine Landscape	Biology and biotopes identified (> 5% contribution)
Coastal sediment	Fine sandy shores; Mobile sand shores; Muddy sand shores; Sublittoral estuarine mud; Infralittoral sandy mud LSLSa.FiSa; LS.LSa.MoSa; LS.LSa.MuSa; SS.SMu.EstMu; SS.SMu.ISaMu
Shallow-water mud basin	Circalittoral sandy mud SS.SMu.CSaMu
Deep-water mud basin	Offshore mud; Circalittoral sandy mud SS.SMu.OMu; SS.SMu.CSaMu
Fine sediment plain	Circalittoral sandy mud; Infralittoral sandy mud; Circalittoral muddy sand; Infralittoral fine sands; Infralittoral muddy sands; Infralittoral coarse sediments SS.SMu.CSaMu; SS.SMu.ISaMu; SS.SSa.CMuSa; SS.SSa.IFiSa; SS.SSa.IMuSa; SS.SCS.ICS
Sediment wave/	Circalittoral sandy mud; Circalittoral muddy sand; Infralittoral fine sands; Circalittoral fine sands Infralittoral coarse megaripple field sediments; Circalittoral coarse sediments S.SMu.CSaMu; SS.SSa.CMuSa; SS.SSa.IFiSa; SS.SCS.CCS; SS.SCS.ICS
Low bed-stress coarse	Circalittoral mixed faunal turf; Infralittoral fine sands; Infralittoral muddy sands; Circalittoral gravels & sands; Infralittoral sediment plain coarse sediments; Circalittoral muddy mixed sediment; Offshore mixed sediment CR.HCR.XFa; SS.SSa.IFiSa; SS.SSa.IMuSa; SS.SCS.CGvSa; SS.SCS.CCS; SS.SMx.CMuMx; SS.SMx.OMx
High bed-stress coarse	Circalittoral mixed faunal turf; Circalittoral gravels & sands, Circalittoral pebbles & gravel; Offshore mixed sediment sediment plain CR.HCR.XFa; SS.SCS.CGvSa; SS.SCS.CPbGv; SS.SMx.OMx
Deep-water channel	Offshore mixed sediment SS.SMx.OMx

Criteria for water column landscape types

Water Column Types	Number of days stratified (annual)	Salinity (Dec-Feb)
Mixed and High Salinity	< 40 days	> 34‰
Mixed and Low Salinity	< 40 days	≤ 34‰
Stratified and High Salinity	≥ 40 days	> 34‰
Stratified and High Salinity	≥ 40 days	≤ 34‰

The table below shows the abundance of the five plankton community components relating to the four water column landscape types identified above.

Mean abundance (per $3m^3$) of key plankton community features in the Irish Sea				
	Water Column Units			
	Mixed & High Salinity	**Mixed & Low Salinity**	**Stratified & High Salinity**	**Stratified & Low Salinity**
Key Plankton Community Features	Mean abundance per $3m^3$			
Fish Larvae	1.19	1.24	1.17	1.23
Dinophysis spp.	1.13	1.38	1.52	1.61
Decapod larvae	1.98	2.80	2.14	3.07
Total adult *Calanus*	1.91	1.44	2.32	1.45
Coscinodiscus wailesii	1.06	1.23	1.08	1.31

Relative vulnerability of marine landscapes to human activities

Categories of activity which may cause deterioration or disturbance	Examples of human activities	Estuary	Ria	Saline Lagoon	Sea loch	Sound	Photic reefs	Aphotic reefs	Shallow water mud basins	Deep water mud basins
Substratum loss	Coastal development	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Offshore development	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Aggregate extraction	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Capital dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Maintenance dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Tractor dredging for shellfish	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
	Suction dredging for shellfish	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
Smothering	Disposal of dredged spoil	●●●	●●●●	●●●●	●●●●	●●●	●●●	●●●	●	●
Physical disturbance or abrasion	Maintenance dredging	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Suction dredging for shellfish	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Tractor dredging for shellfish	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Beam trawling	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Scallop dredging	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Demersal otter trawling	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Anchoring	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Mussel harvesting	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
	Recreational activities	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●

Categories of activity which may cause deterioration or disturbance	Examples of human activities	Coastal sediment	Fine sediment plains	LBS coarse sediment plain	HBS coarse sediment plain	Sediment wave/ megaripple field	Sand/ gravel banks	Sea mounts	Deepwater channel	Gas structures
Substratum loss	Coastal development	●●●	●●●	●●●	●●●	●●	●●●	●●●		
	Offshore development	●●●	●●●	●●●	●●●	●●	●●●	●●●		
	Aggregate extraction	●●●	●●●	●●●	●●●	●●	●●●	●●●		
	Capital/maintenance dredging	●●●	●●●	●●●	●●●	●●	●●●	●●●		
	Tractor dredging for shellfish	●●●	●●●	●●●	●●●	●●	●●●	●●●		
	Suction dredging for shellfish	●●●	●●●	●●●	●●●	●●	●●●	●●●		
Smothering	Disposal of dredged spoil	●●	●●	●●	●●	●	●	●●●		
Physical disturbance or abrasion	Capital/maintenance dredging	●●●	●●●	●●●	●●●	●	●●	●●●		
	Suction dredging for shellfish	●●●	●●●	●●●	●●●	●	●●	●●●		
	Tractor dredging for shellfish	●●●	●●●	●●●	●●●	●	●●	●●●		
	Beam trawling	●●●	●●●	●●●	●●●	●	●●	●●●		
	Scallop dredging	●●●	●●●	●●●	●●●	●	●●	●●●		
	Demersal otter trawling	●●●	●●●	●●●	●●●	●	●●	●●●		
	Anchoring	●●●	●●●	●●●	●●●	●	●●	●●●		
	Mussel harvesting	●●●	●●●	●●●	●●●	●	●●	●●●		
	Recreational activities	●●●	●●●	●●●	●●●	●	●●	●●●		

Relative vulnerability of the marine landscape

- High vulnerability
- Moderate vulnerability
- Low vulnerability
- No detectable vulnerability
- Insufficient data to assess sensitivity
- Unlikely to be exposed to the activity

Relative sensitivity of the marine landscape

- ●●●● High sensitivity
- ●●● Moderate sensitivity
- ●● Low sensitivity
- ● No detectable sensitivity

Annex 5

Criteria for the identification of important marine areas

1. **Typicalness**: the area contains examples of marine landscapes, habitats and ecological processes or other natural characteristics that are typical of their type in their natural state.

2. **Naturalness**: the area has a high degree of naturalness, resulting from the lack of human-induced disturbance or degradation; marine landscapes, habitats and populations of species are in a near-natural state. This is reflected in the structure and function of the features being in a near-natural state to help maintain full ecosystem functioning.

3. **Size**: the area holds large examples of particular marine landscapes and habitats or extensive populations of highly mobile species. The greater the extent the more the integrity of the feature can be maintained and the higher the biodiversity it is likely to support.

4. **Biological diversity**: the area has a naturally high variety of habitats or species (compared to other similar areas).

5. **Critical area**: the area is critical for part of the life cycle (such as breeding, nursery grounds/juveniles, feeding, migration, resting) of a mobile species. The assessment needs to evaluate the relative importance of the area for the species. An area for which a species has no alternative should receive a greater weighting than an area where a species has a range of alternatives for the aspect of its life cycle (e.g. is a given gravel bank the only one for a herring population to spawn on?) This will vary according to species and the part of the life cycle in question.

6. **Area important for a nationally-important marine feature**: features that qualify as special features or which are declined or threatened should contribute to the identification of these areas. The assessment should consider whether such features are present in sufficient numbers (species), extent (habitat) or quality (habitats, marine landscapes) to contribute to the conservation of the feature.

Further guidance is provided in Lieberknecht et al. (2004b) and online at www.jncc.gov.uk/irishseapilot.

Criteria for identification of priority marine features

1. Proportional importance

A high proportion of the marine landscape, habitat, or population of a species (at any time of its life cycle) occurs within the UK. This may be related to either the global or regional extent of the feature.

Features may be categorised as follows:

Globally important: a high proportion of the global extent of a marine landscape or habitat, or a high proportion of the global population of a species (at some stage in its life cycle), occurs within the UK. 'High proportion' is considered to be more that 20%, when known.

Regionally important: a high proportion of the regional extent of a marine landscape or habitat, or a high proportion of the regional population of a species (at some stage in its life cycle), occurs within the UK. 'Regional' refers to the north-east Atlantic (OSPAR) area, 'High proportion' is considered to be more than 30%, when known.

2. Rarity

Marine landscapes, habitats and species that are sessile or of restricted mobility (at any time in their life cycle) are considered nationally rare if their distribution is restricted to a limited number of locations. Rarity can be assessed as a feature which occurs in fewer than 0.5% of the total number of 10km x 10km squares in UK waters.

A mobile species qualifies as nationally rare if the total population size is known, inferred or suspected to be fewer than 250 mature individuals. Vagrant species should not be considered under this criterion.

3. Decline

An observed, estimated, inferred or suspected significant decline (exceeding expected or known natural fluctuations) in numbers, extent or quality of a marine landscape, habitat or a species in the UK (for species, quality refers to life history parameters). The decline at a global or regional level, where there is cause for concern that the proportional importance criterion will be met within the foreseeable future.

Annex 6

Decline in extent and quality of features at different scales should be assessed as shown in the following table:

	Extent	Quality
Marine landscapes and habitats	A seascape or habitat that has declined in extent to 90% or less of its former natural extent in the UK, or its distribution within the UK has become significantly reduced (e.g. lost from several sub-regions).	A seascape or habitat for which quality, based on change from natural conditions caused by human activities, is negatively affected by: i. a change of its typical or natural components over a significant part of its UK distribution, or ii. the loss of its typical or natural components in several sub-regions. Such judgement is likely to include aspects of biodiversity, species composition, age composition, productivity, biomass per area, reproductive ability, non-native species and the abiotic character of the habitat.
Species	Within the UK population of the species: i. there has been a recent significant decline in number of individuals/geographical range; or ii. numbers of individuals/geographical range are presently in marked decline; or iii. the present population is at significantly lower levels than in the past as a result of human activity (evidence for past significant decline).	The species has suffered a significant decline in one or more of the following: • loss of genetic diversity • loss of fecundity • reduction in the number of mature individuals • fragmentation of the population

4. Threat of significant decline

It is estimated, inferred or suspected that the feature may suffer significant decline (as defined under the 'decline' criterion) in the foreseeable future as a result of human activity. This assessment will need to take into account sensitivity, vulnerability and probable exposure to the effects of human activity.

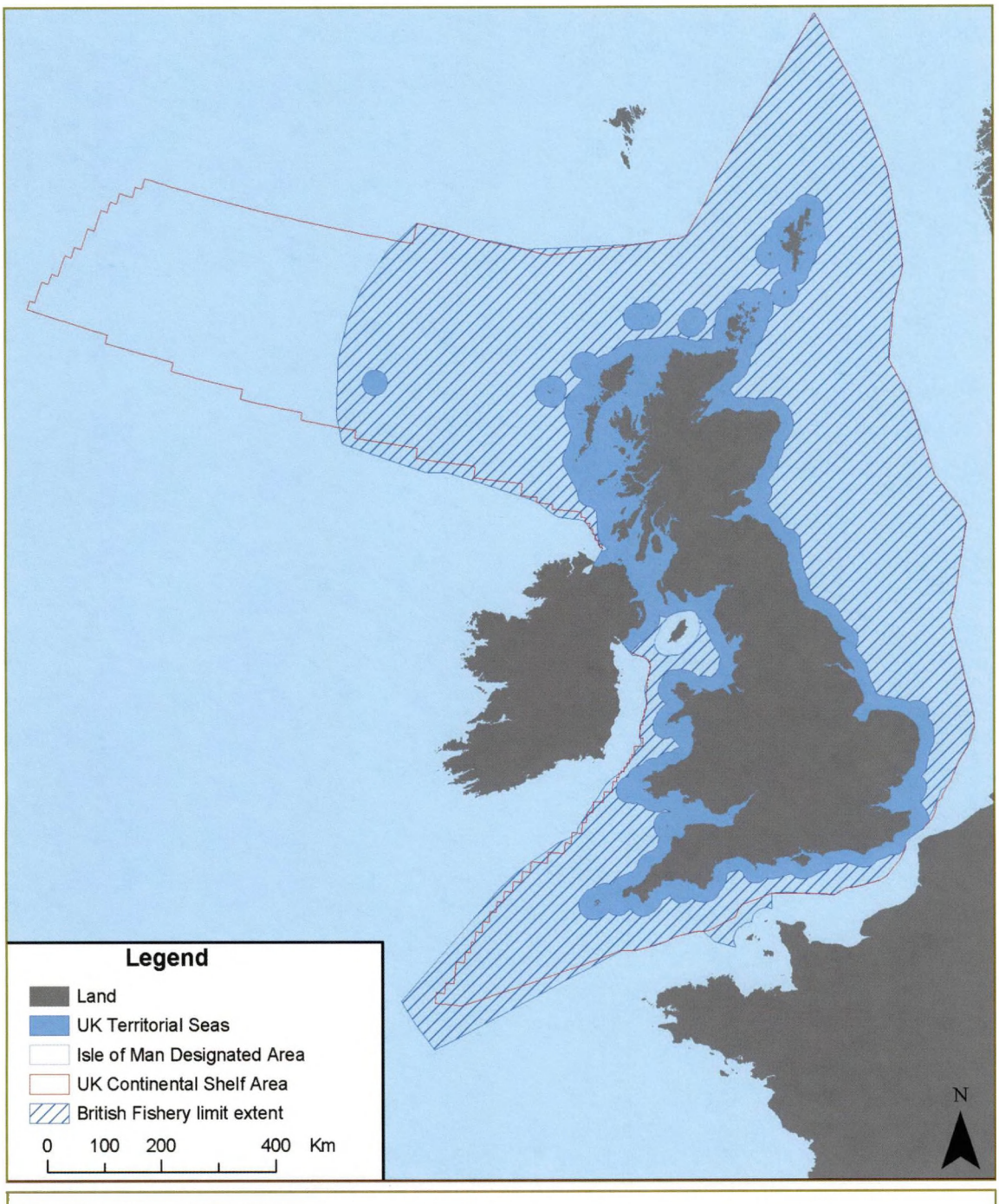
Conservation Objectives

Aim 1: To maintain the water quality, natural processes and structure of the marine environment		
High level objective	**Ecosystem components (illustrative)**	**Operational conservation objectives**
1. Protect seabed features so that they can support the processes, habitats and species characteristic of the marine landscapes.	Coastal morphology • coastal processes	1.1 Protect coastal processes from ecologically-significant change due to human activity, and reverse such change where practicable.
	Seabed habitats • substratum type • particle size composition • topography • substratum structure • siltation • physical processes • chemical processes	1.2 Protect seabed habitats from ecologically-significant change due to human activity, and reverse such change where practicable.
	Biogenic structures • saltmarshes • eelgrass beds • *Sabellaria* spp reefs • *Modiolus* reefs	1.3 Protect biogenic structures from ecologically-significant change due to human activity, and reverse such change where practicable.
2. To protect water column features so that they can support the processes, habitats and species characteristic of the waterbodies.	Water column features • Tides, waves, fetch, currents • Fronts • Stratification • Temporal changes • Freshwater inputs • Salinity • Suspended solids • Turbidity	2.1 Protect the water column features from ecologically-significant change due to human activity, and reverse such change where practicable.

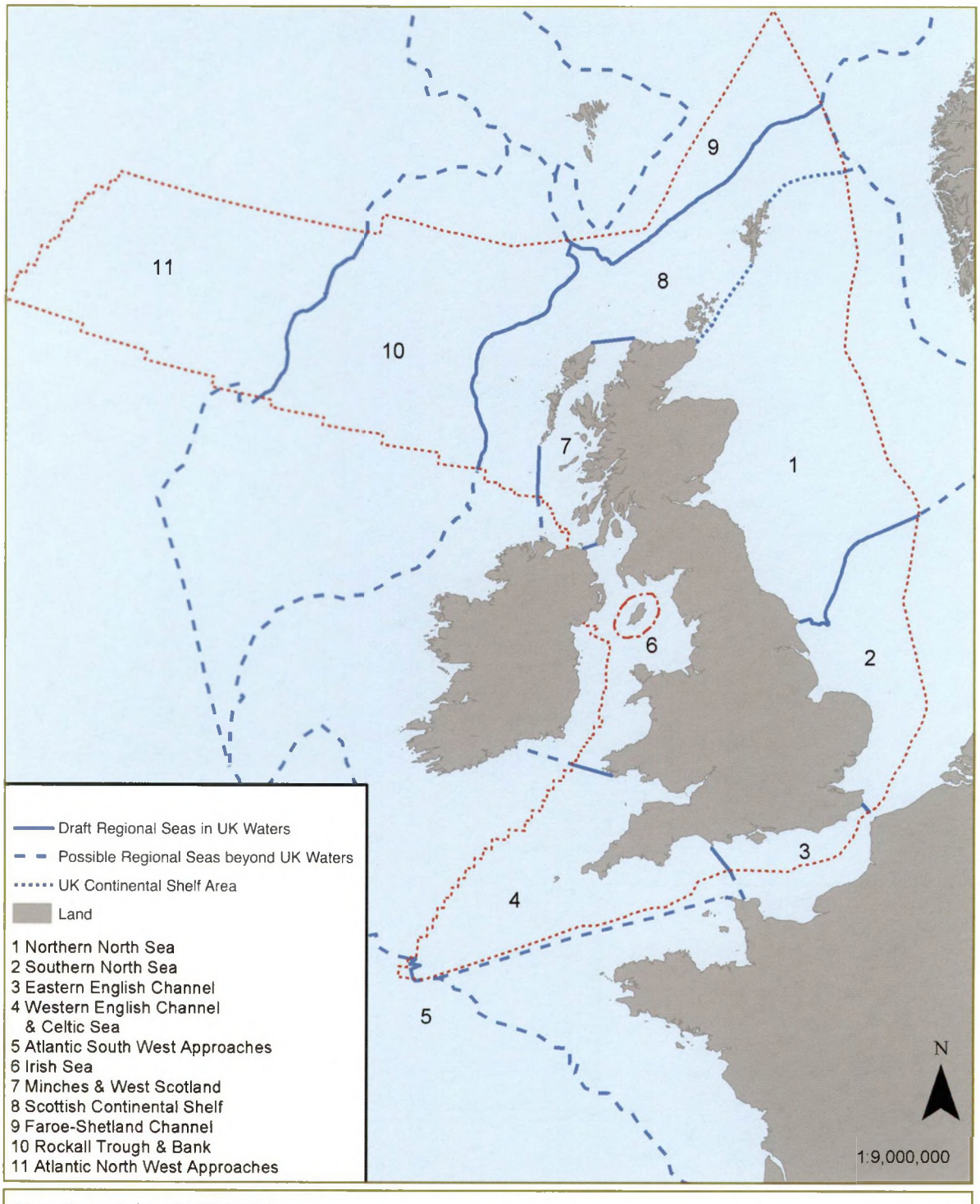
Annex 7

High level objective	Ecosystem components (illustrative)	Operational conservation objectives
3. Protect the water quality of the component water column features so they can support the processes, habitats and species characteristic of the water column and associated seabed habitats.	Water quality • Chemical conditions • Nutrients • Dissolved gases	3.1 Maintain or recover water quality to within defined standards which aim to prevent 'undesirable disturbance' caused by eutrophication.
	Chemical pollutants • Contaminants • Organic compounds • Radioactive elements	3.2 Ensure that environmental standards are not exceeded.
	Oil • Chronic • Acute	3.3 Ensure that environmental standards are not exceeded. 3.4 Reduce the input of oil from accidents, as far as practicable.
	Noise and vibration	3.5 Maintain noise and vibration levels below precautionary standards aimed at protecting vulnerable marine species from disturbance.
	Marine litter	3.6 Reduce input of litter to the marine environment to below levels aimed at protecting vulnerable marine habitats and species.
4. Maintain biota quality	Contaminants • Contaminant loads • Bioaccumulations • Health of animals	4.1 Ensure standards for contaminants in biota are not exceeded.

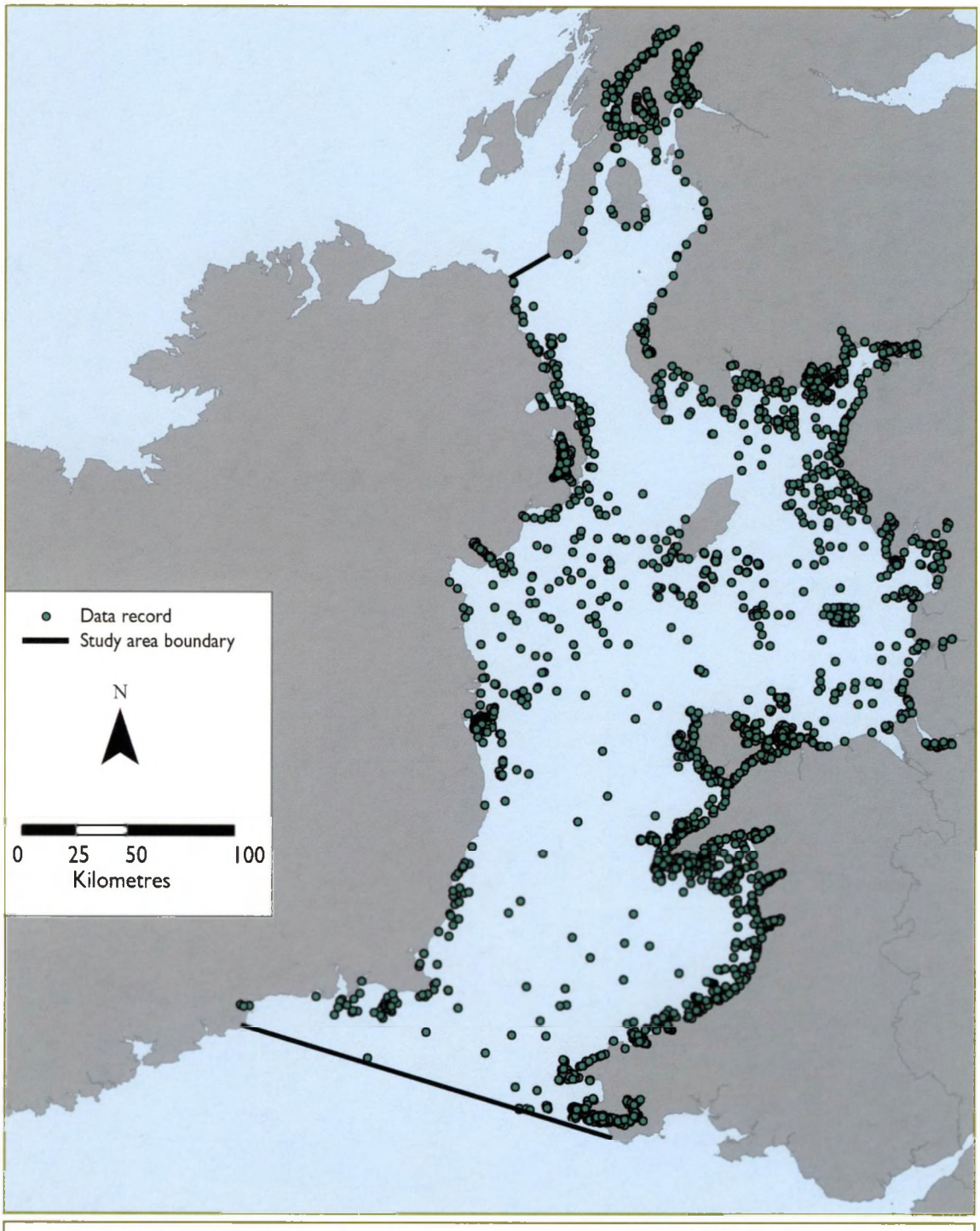
UK marine administrative boundaries



Draft Regional Seas

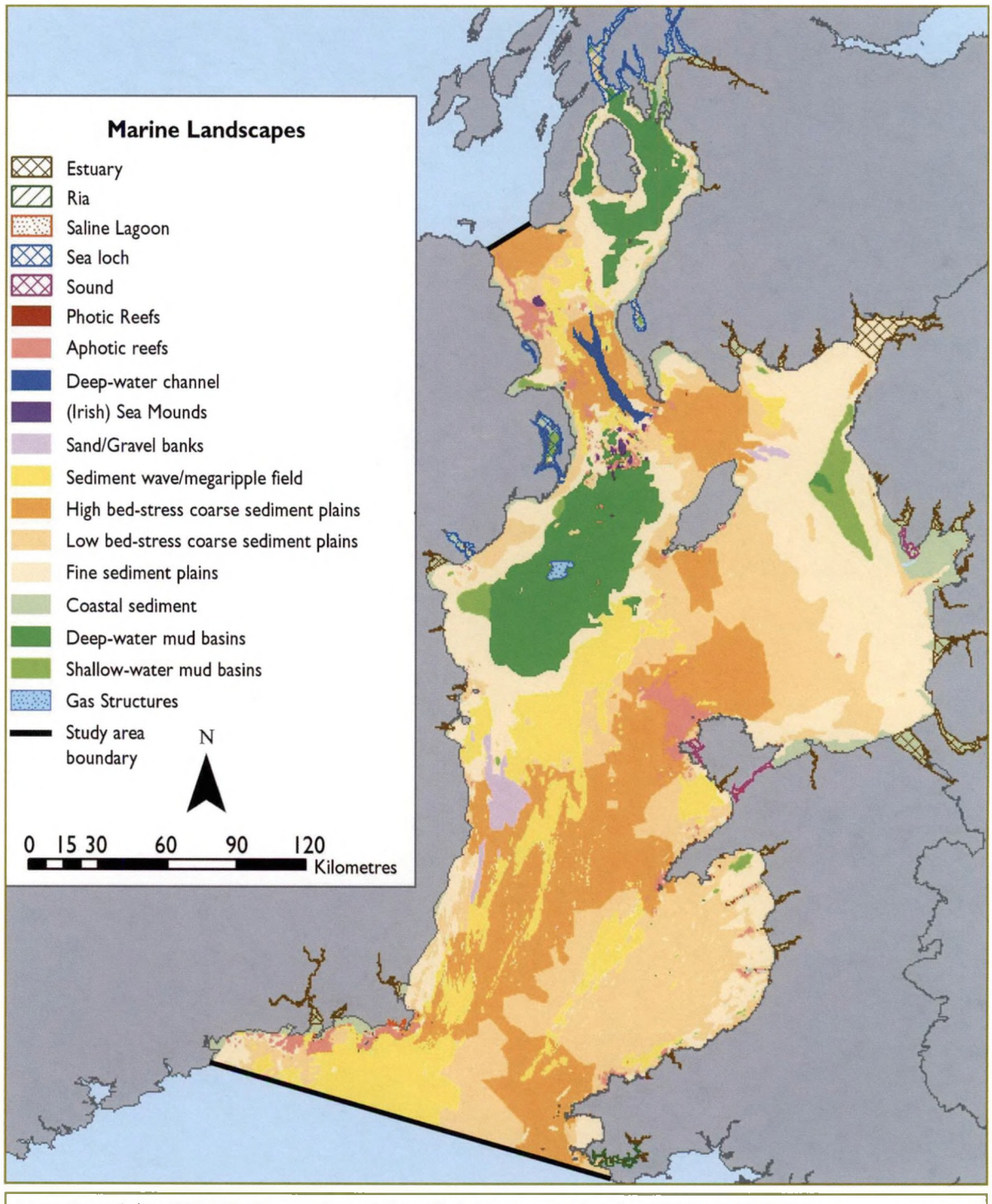


Biological data records



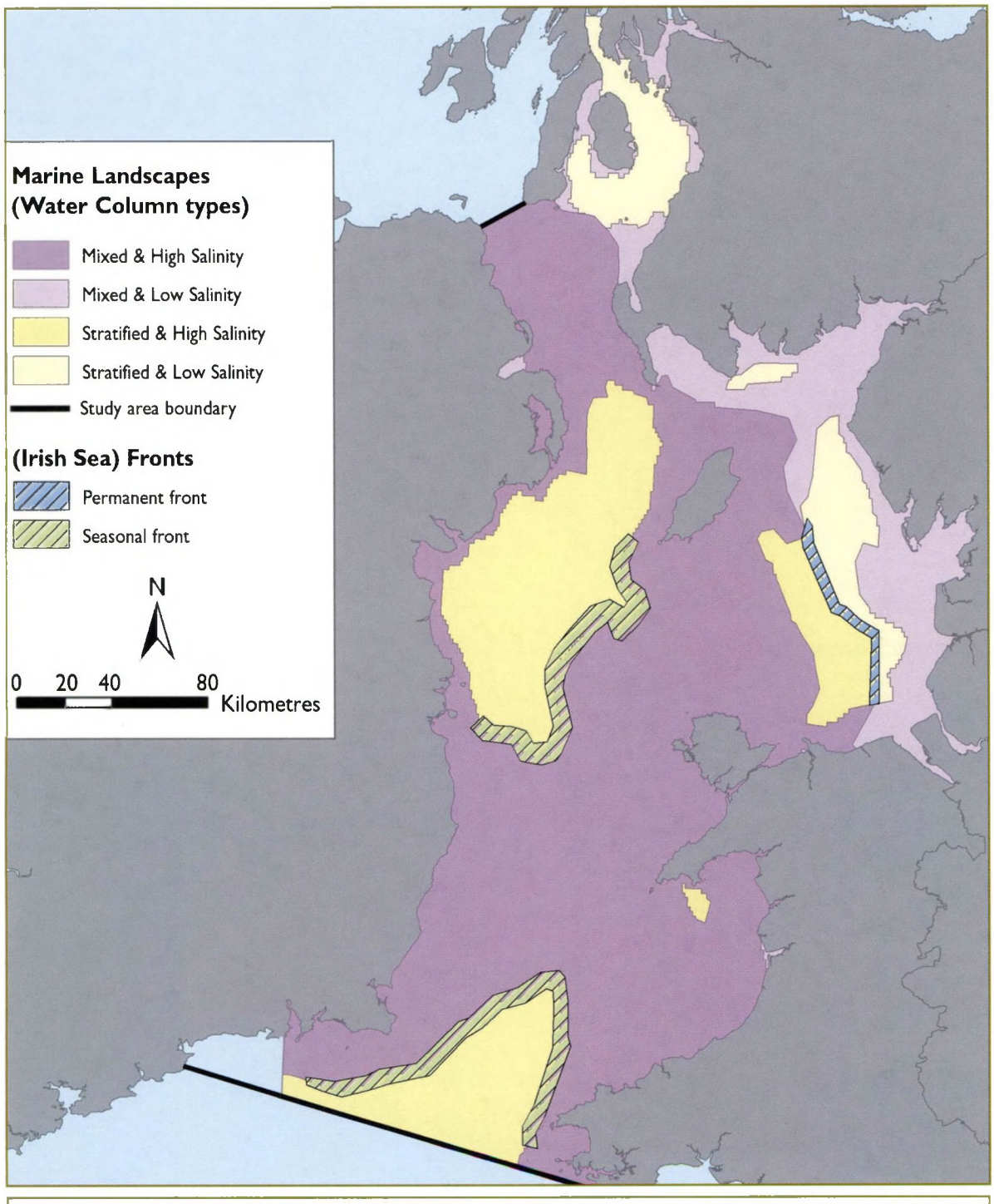
Acknowledgements: Data from various sources.

Marine Landscapes – coastal and seabed types



Acknowledgements: Raw data from various sources; processed by Neil Golding & Mike Webster, JNCC

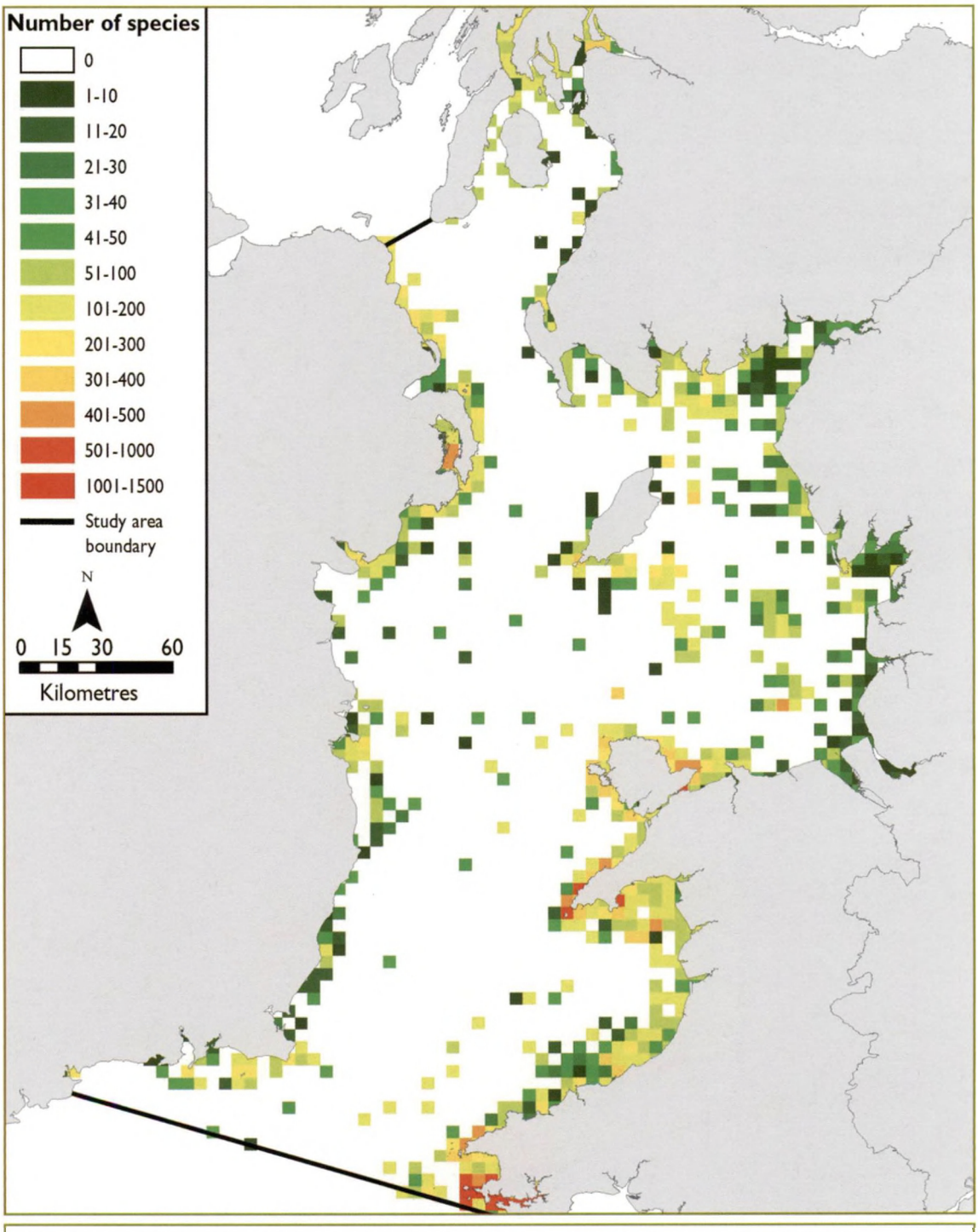
Marine Landscapes – water column types



Acknowledgements: Data supplied by Proudman Oceanographic Laboratory; interpolated and converted by JNCC.

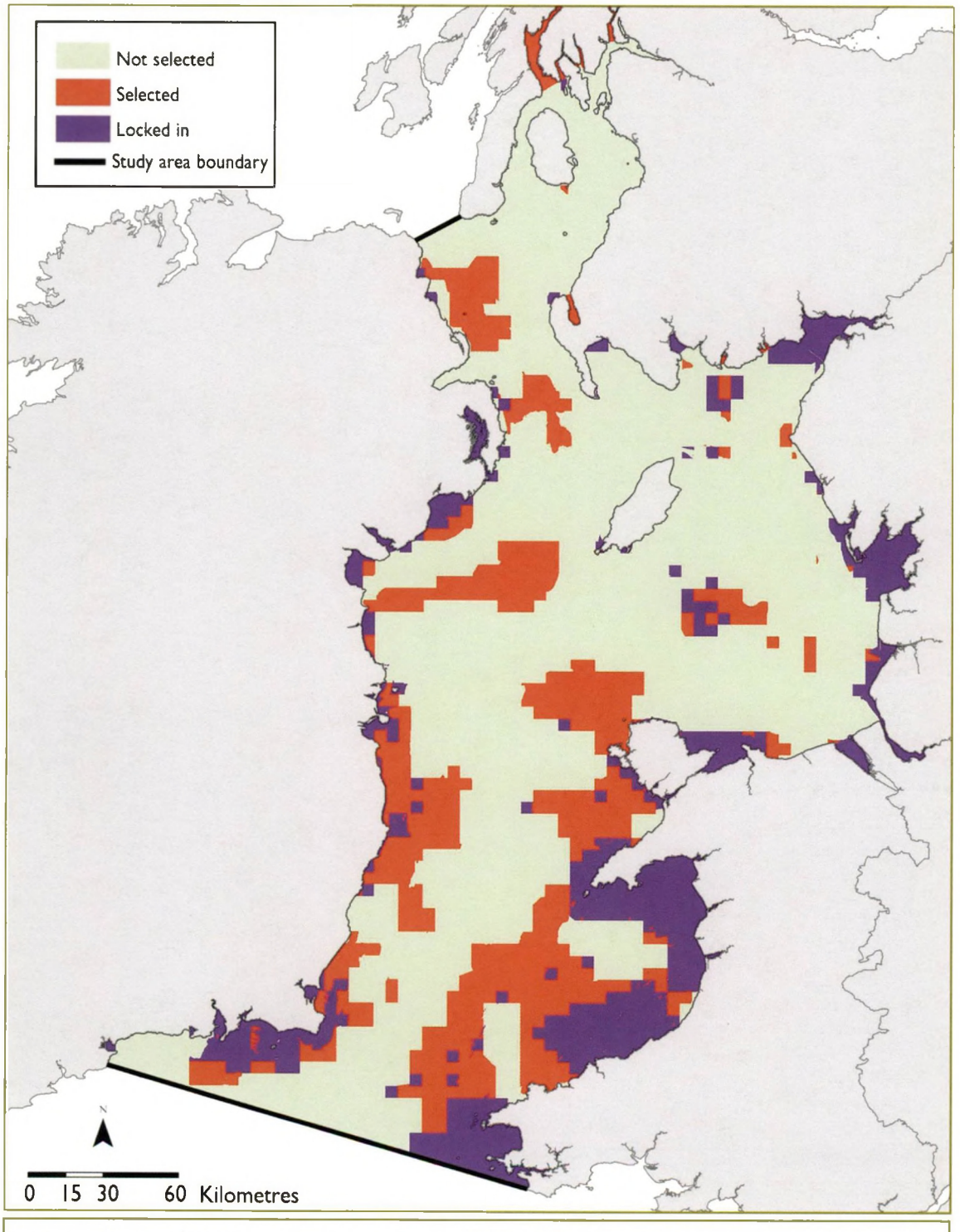
Map 6

Number of benthic species recorded in 5km by 5km grid cells

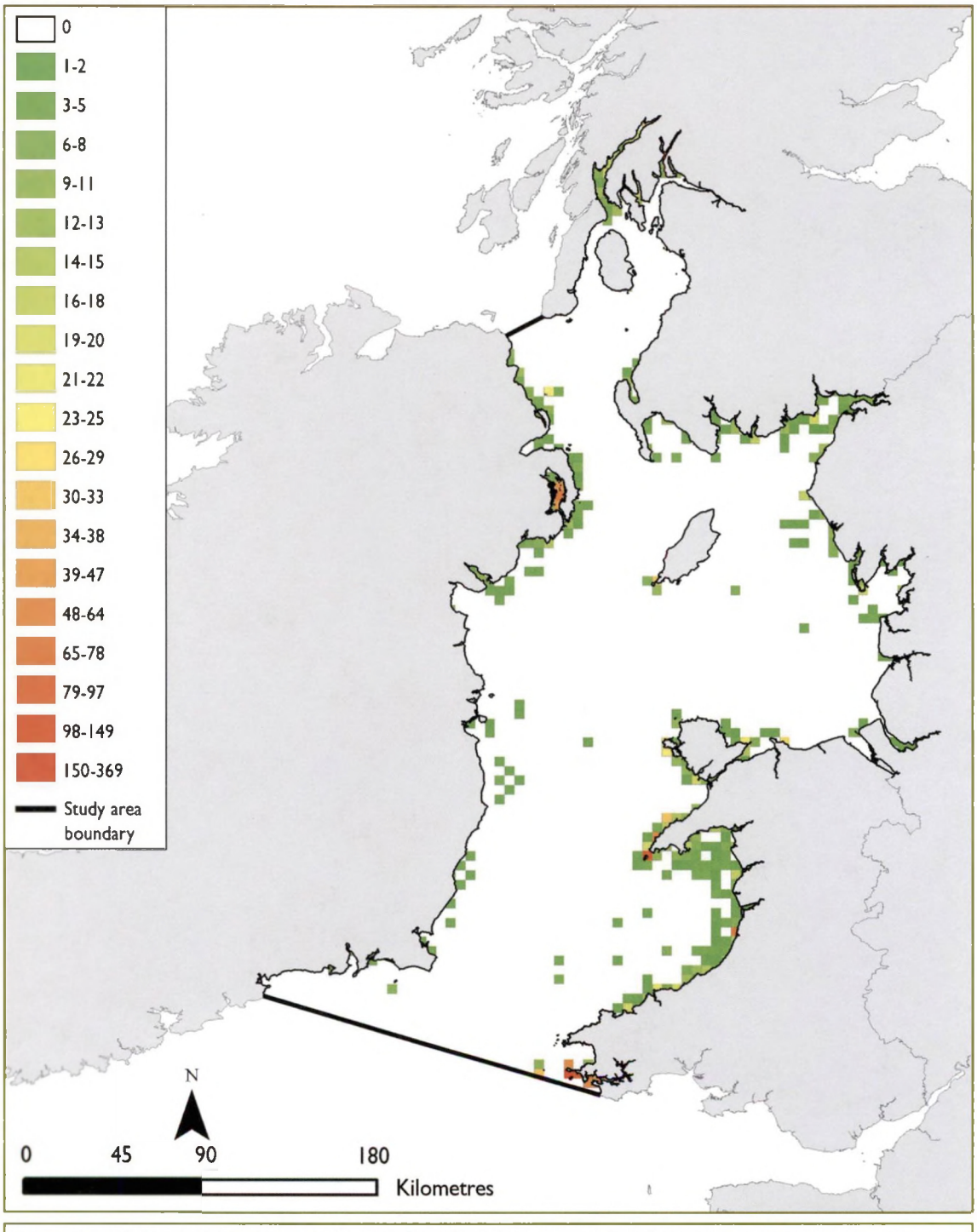


Acknowledgements: Data from various sources.

Results of using 'reserve selection' software to identify a network of possible MPAs in the Irish Sea



Numbers of provisionally nationally important habitats and benthic species recorded in 5km by 5km grid cells



Acknowledgements: Data from various sources.

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