

7. MARINE LANDSCAPES

142. The concept of marine landscapes was developed from work undertaken by Roff and Taylor (2000) for Canadian waters. The purpose of the approach was to enable action to be taken to benefit nature conservation in circumstances where marine biological data are limited. Solving this problem is a significant issue for Canada because of its very extensive coastline and marine territory, and the relative scarcity of biological information. This same situation applies to the offshore waters of north-west Europe, including the UK and Ireland.
143. The central assumption of the marine landscapes concept is that geophysical and hydrographical information (for which there is generally better broadscale coverage than biological information) can be used in lieu of biological information to classify medium scale marine habitats and to set marine nature conservation priorities. The justification for this assumption is the very strong ecological relationship which exists between geophysical and hydrographic factors and the character of biological communities. There is an extensive scientific literature describing this ecological relationship, (e.g. Hiscock 1998 for the UK), and the relationship is used as the basis of both the UK (Connor *et al.*, 2003) and the European EUNIS marine habitat classifications (<http://mrs.wallonie.be/dgrne/sibw/EUNIS/EUNISHabitatslnk.xls>).
144. Roff and Taylor developed their classification using, in relation to the seabed, factors such as water temperature, depth/light, substratum type, exposure and slope, and, in relation to the water column, factors such as water temperature, depth/light and the stratification/mixing regime. The intention was that this classification would then be used to inform management action, including the taking of nature conservation measures.
145. In the UK, past practice has been to base nature conservation advice directly on biological data. In practice, however, the absence of good biological data for many offshore areas has meant that (except for advice in relation to seabirds where the data are more extensive) the development of such advice has, in many cases, either not been possible or has been precautionary. This is not a satisfactory basis on which to implement sustainable development. Nonetheless, while the scientific rationale for using geophysical and hydrographical information in lieu of biological information is strong, the approach does need validation to confirm that what was predicted when using a restricted set of data is a sufficiently accurate representation of what actually occurs.
146. Once the marine landscapes have been identified, consideration would need to be given to their relative value for nature conservation, and their susceptibility to harm from human activities.
147. Bearing the above points in mind, the work carried out under the Pilot had the following main components:
- i. the identification of marine landscape types for the Irish Sea using geophysical and hydrographical data;
 - ii. the biological characterisation of these marine landscapes using available data;
 - iii. the validation of the assumption that the marine landscapes identified reflect accurately the real-life situation and the biological character expected;
 - iv. an estimation of the value to nature conservation of the various marine landscapes, and their susceptibility to harm from the kinds of human activity most likely to affect them.

Methods

148. Following the data collation exercise reported in Chapter 4, bathymetry and seabed sediment data were converted from polyline to polygon format and merged with derived slope data in the GIS

using a process called 'union'. This process combines the attributes of each dataset into one, allowing easier querying with the GIS. Other datasets, including generalised bedforms, maximum bed stress (bottom current) and gas seeps, were overlaid on this 'union' layer.

149. Practical criteria were developed to enable the separation of marine landscapes into distinct types. Key among these criteria were depth, substratum type, bed-stress/current strength, topography/slope and related factors. Account was taken, with respect to coastal (physiographic) features, of existing definitions (e.g. the definitions applied to Habitats Directive Annex I habitat types). A limitation of the British Geological Survey data was that the sediment datasets did not extend to shallow coastal waters and estuaries. Areas adjacent to the coastline, where British Geological Survey data were unavailable, were considered in the light of the datasets on benthic communities, and allocated to 'photic reef' or 'coastal sediment' marine landscape types on the basis of these communities.
150. Biological characterisation was achieved by linking the available biological data to the relevant marine landscapes by joining the data spatially within the GIS, aggregating data to the biotope complex level of the national habitat classification. Because much of the biological data used were Irish Sea data, this method was to some extent self validating (i.e. it was possible to identify marine landscapes from geophysical and hydrographic data, **and** characterise them with actual biological data for the same areas). However, because biological data were sparse for offshore areas, the biological characterisation of marine landscapes which occur offshore was necessarily predicted by extrapolation from other data, and not confirmed.
151. Two surveys 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. The surveys had the added benefit of providing new data for some types of marine landscape where previous data were particularly sparse. The first survey utilised the RV *Lough Foyle* to survey selected areas of the north-west Irish Sea, targeting a number of (Irish) sea mounds and the deep water channel. The second survey utilised the RV *Prince Madog* and targeted the coarse sediment plains, sand ripple areas and reefs to the north-west of Anglesey. A variety of data sampling techniques were used, including acoustic ground discrimination, sidescan, multibeam, video, still-photography and grab sampling.
152. For the water column types, datasets previously discussed in paragraph 51 were used. An interpolation procedure was carried out on this 'model derived' gridded dataset. Stratification and salinity datasets were combined in a GIS using 'union'. Quarterly datasets were used, producing four seasonal maps, to reflect the seasonal variability in the hydrodynamic water column structure.
153. The biological characterisation of the water column types was carried out using biological data supplied by the Sir Alastair Hardy Foundation for Ocean Science (SAHFOS). The biological data were provided in the form of gridded distribution maps for five key features of the plankton community in the Irish Continuous Plankton Recorder tows. The biological characterisation uses all the data that SAHFOS have available to them (i.e. the data used for this were not seasonal data). The five key features were: i. *Dinophysis spp.*, ii. *Coscinodiscus wailesii*, iii. decapod larvae, iv. fish larvae, v. total adult *Calanus*.
154. *Dinophysis spp.* are a group of dinoflagellates which cause harmful algal blooms, and have been associated with Diarrhetic Shellfish Poisoning. *Coscinodiscus wailesii* is an important member of the phytoplankton assemblage, but is a non-indigenous diatom, originating from the Pacific. Decapod larvae are representative of the benthic component of the plankton assemblage. Fish larvae are representative of a higher trophic component in the plankton. Total adult *Calanus* comprises one of the most important components of the zooplankton community (a principal food source for higher trophic levels).

155. Work was carried out to assess the relative value of the marine landscapes for nature conservation. Some aspects of this are considered later in the chapters on nationally-important features and nationally-important areas, but, in addition, the individual marine landscapes identified for the seabed, were 'scored' for the number of biotope complexes that were found and/or were predicted to occur, to provide a simple measure of relative biological diversity.
156. The Marine Biological Association (MBA) through its *MarLIN* programme has collated information on the sensitivity of marine species and biotopes to the effects of human activities (www.marlin.ac.uk). The Pilot commissioned the MBA to evaluate methodologies for assessing and mapping the sensitivity of the marine landscapes (Tyler-Walters *et al.*, 2003). A sensitivity assessment was made for each of the offshore marine landscapes for which sufficient information on their physical characteristics and biotopes was available. The assessments were made against three main factors: substratum loss, smothering and physical disturbance. Sensitivity was assessed on the basis of whether the biotope groups characteristic of the marine landscape would survive a one-off impact.
157. However, this sensitivity assessment did not take account of actual, likely or potential patterns of exposure to human activities, and the results of the sensitivity work were subjected to a vulnerability assessment which took account of the likely relative exposure of the marine landscape to specific human activities. A matrix of relative vulnerability (following Gilliland, 2001) was used to combine sensitivity and exposure data in order to calculate relative vulnerability.

Results

158. Three main groups of marine landscapes were identified. These are:
- i. **Coastal (physiographic) marine landscapes** such as rias and estuaries where the seabed and water body are closely interlinked. In this group, both the seabed and the overlying water are included within the marine landscape;
 - ii. **Seabed marine landscapes** which occur away from the coast, i.e. the seabed of open sea areas. In this group, the marine landscapes comprise the seabed and water at the substrate/water interface;
 - iii. **Water column marine landscapes** of open sea areas, such as mixed and stratified water bodies and frontal systems. In this group, the marine landscapes comprise the water column above the substrate/water interface.

Coastal and seabed marine landscapes

159. In total, 18 coastal and seabed marine landscape types were identified for the Irish Sea. These are listed in Table 1, which also summarises the distinguishing geophysical and hydrographical characteristics of each type. The distribution of these 18 types is shown in Map 12. Notwithstanding that 'bays' are included on Annex 1 of the Habitats Directive, it was not found useful to identify a marine landscape type for them. Bays were not found to have any inherently distinguishing characteristics beyond that resulting from relative shelter from wave action, and it was considered preferable to define marine landscapes in bay areas on the basis of the seabed, not on that of the physiographic feature.
160. The biological characterisation of each of the coastal and seabed marine landscapes is summarised in Table 2. The biotope complex codes shown in the Table are those found in Connor *et al.* (2003).

Table 1: Summary of physical characteristics of each coastal and seabed Marine Landscape type

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 (not as pronounced as Sea Mounds)	Rough topography
(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%

Table 2: Summary of biological characterisation for each coastal and seabed Marine Landscape type

Marine Landscape	Characteristic biology (> 5% contribution)
Estuary	Furoids on sheltered rocky shores; Furoids 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	Furoids on sheltered rocky shores; Barnacles/furoids 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 I.S.I.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 <i>et al.</i> , 2001)
Sea loch	Furoids 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	Furoids 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/furoids on moderately exposed rocky shores; Furoids 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
Coastal sediment	Fine sandy shores; Mobile sand shores; Muddy sand shores; Sublittoral estuarine mud; Infralittoral sandy mud LS.LSa.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/megaripple field	Circalittoral sandy mud; Circalittoral muddy sand; Infralittoral fine sands; Circalittoral fine sands Infralittoral coarse sediments; Circalittoral coarse sediments SS.SMu.CSaMu; SS.SSa.CMuSa; SS.SSa.IFiSa; SS.SCS.CCS; SS.SCS.ICS
Low bed-stress coarse sediment plain	Circalittoral mixed faunal turf; Infralittoral fine sands; Infralittoral muddy sands; Circalittoral gravels & sands; Infralittoral 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 sediment plain	Circalittoral mixed faunal turf; Circalittoral gravels & sands, Circalittoral pebbles & gravel; Offshore mixed sediment CR.HCR.XFa; SS.SCS.CGvSa; SS.SCS.CPbGv; SS.SMx.OMx
Deep-water channel	Offshore mixed sediment SS.SMx.OMx

161. The results of the two surveys were of considerable interest. The survey undertaken by the RV *Prince Madog* found that there was a good correlation between survey results and the marine landscapes identified from the geophysical and hydrographic data with respect to sediment wave/megaripple fields, and coarse sediment plains. Aphotic reef was validated in general but, in some areas, the actual substrate was more complex than the marine landscapes map indicated, with some admixture and overlay of gravel and finer sediments. The survey undertaken by the RV *Lough Foyle* validated the Irish Sea mounds as substantial rocky outcrops, but indicated that for at least some of the mounds surveyed (two of the four) a veneer of fine sediment of variable thickness composed was present upon the underlying rock in places.
162. In general, the predictions of biotope complexes were validated by the surveys, but, the nature of the communities present often depended on the fine structure of the habitat. For example, gravel areas also contained numbers of protruding boulders, reef areas were partly obscured by sediment veneers, and boulders fields also contained sand and shell in the interstices between the boulders. There is, therefore, a good level of confidence that the marine landscape types are ecologically relevant, although some aspects warrant further investigation.
163. The result of the work to map the biotope complex scores of the individual coastal and marine landscapes is shown in Map 13. It must be emphasised that these scores are a measure of biotope richness, and they also partly reflect survey effort, so should be used cautiously when making judgements with respect to nature conservation value. To give a true picture of the latter, other factors such as the relative rarity of individual marine landscapes, and the conservation value of the species and habitats they support, would also need to be taken into consideration. These are issues which are given further consideration in the two following chapters.

Water column marine landscapes

164. In total, 4 water column marine landscape types were identified. The geographical distribution of these is shown in Map 14, and the hydrographical and physical conditions of each is shown in Table 3.

Table 3: Water column types: physical/hydrographical definitions

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 Low Salinity	≥ 40 days	≤ 34‰

165. The biological characterisation used the same process of spatial joining discussed in paragraph 148. Point values from this grid were spatially joined to the underlying Water Column type, giving a set of abundance values for each water column type. For each dataset, an average abundance was calculated, to give mean abundance per 3m³. The results can be seen in Table 4.

Table 4: Mean abundance (per 3m³) of key plankton community features in the Irish Sea

Key Plankton Community Features	Water Column Types			
	Mixed & High Salinity	Mixed & Low Salinity	Stratified & High Salinity	Stratified & Low Salinity
	Mean abundance per 3m ³			
Fish Larvae	1.19	1.24	1.17	1.23
<i>Dinophysis spp.</i>	1.13	1.38	1.52	1.61
Decapod larvae	1.98	2.80	2.14	3.07
Total adult <i>Calanus</i>	1.91	1.44	2.32	1.45
<i>Coscinodiscus wailesii</i>	1.06	1.23	1.08	1.31

166. The 'Mixed and High Salinity' type is characteristic of waters found in the area of the central Irish Sea. Compared to the other types, it has an impoverished plankton community and has the fewest number of phytoplankton taxa. There are no plankton taxa specific to this type.
167. The 'Mixed and Low Salinity' type, in particular around Liverpool Bay, is regularly an area of *Phaeocystis* bloom formation. In addition to *Phaeocystis*, two other species form exceptional blooms in this area: the dinoflagellate *Gyrodinium aureolum* (which produces 'red tides' and occurs in the inshore waters of south-east Liverpool Bay and the Solway Firth) and the luminescent *Noctiluca scintillans*. The 'red tides' caused by *Gyrodinium aureolum* are of particular importance to coastal managers as they have been linked to invertebrate mortalities (Edwards & Johns, 2003).
168. The 'Stratified and High Salinity' type has plankton communities indicative of higher salinity waters and possesses the most diverse zooplankton community of the 4 types. The plankton community contained numerous oceanic species, such as *Calanus helgolandicus* and the area-specific taxon Cocolithaceae, particularly in the south of the Pilot area where the assemblage reflects oceanic inflow from the warmer southern waters.
169. The 'Stratified and Low Salinity' type has the highest mean abundance of *Dinophysis* spp., which is associated with Diarrhetic Shellfish Poisoning.
170. In addition to the 4 water column types, the data indicate a number of areas of water mixing or 'frontal zones', where there is evidence of higher than normal productivity. These include seasonal fronts, resulting from the stratification of the water column in summer, and a salinity front in the Liverpool Bay area which is a permanent feature throughout the year (Edwards and Johns, 2003). The approximate position of these fronts is shown in Map 14.
171. The Liverpool Bay front has the highest phytoplankton biomass and zooplankton abundance of all the 4 water column types (Edwards and Johns, 2003). Its phytoplankton colour index value (an assessment of total phytoplankton biomass), and copepod abundance value (an assessment of secondary biomass), were both about twice those of the other types.
172. The north-east basin of the Irish Sea which incorporates the Liverpool Bay front zone, the 'Mixed and Low Salinity' and the 'Stratified and Low Salinity' water column types, is an area with a high benthic component to the zooplankton assemblage (including Decapod larvae). Another important aspect of the zooplankton assemblage within the three water column types in this area, is that it contains the eggs/larvae of many commercially-exploited species.
173. The Pilot reviewed the distribution data for a range of pelagic vertebrates, including seabirds, cetaceans and basking shark, but was unable to identify clear correlations with the water column marine landscape types or fronts. This may be a result of inadequacies of the data, but may also be due to weak effects of the different water column features on adult vertebrate populations, at least in the Irish Sea. An exception to this general conclusion is that there is some evidence that seabird numbers in summer are concentrated in the vicinity of the seasonal western Irish Sea front. However, full consideration of the correlation between fronts and vertebrate distribution patterns, and indeed between fronts and water column marine landscapes, requires further consideration.

Sensitivity of coastal and seabed marine landscape types

174. Table 5 summarises the results of the exercise referred to in paragraphs 156-157 to assess the sensitivity and vulnerability of coastal and seabed marine landscapes.

Table 5 Assessment of relative vulnerability to different human activities at the marine landscape scale in the Irish Sea

Relative vulnerability of the marine landscape

Relative sensitivity of the marine landscape

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	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Smothering	Disposal of dredged spoil	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
	Maintenance dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Physical disturbance or abrasion	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 mounds	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	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Capital/maintenance dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
Physical disturbance or abrasion	Suction dredging for shellfish	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Tractor dredging for shellfish	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Beam trawling	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Scallop dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Demersal otter trawling	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Anchoring	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Mussel harvesting	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*
	Recreational activities	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	*	*

175. It should be emphasised that Table 5 assesses only the widespread biological components of marine landscapes. While, therefore, it can be used for assessing the likely impacts of human activities at the broad scale, it does not have regard to smaller scale habitats of high conservation value (e.g. eelgrass beds or horse mussel beds), nor to factors relevant to maintaining population biomass or food webs, nor to the needs of nationally-important species. For local spatial planning purposes, therefore, particularly in coastal areas where there is a high degree of habitat complexity, these other aspects of biological importance will also need to be taken into account. Similarly, when taking regulatory decisions, all available information needs to be taken into consideration, including information from environmental impact assessments.

176. Nonetheless, the application of sensitivity and vulnerability assessments at the marine landscape scale is potentially very useful, particularly in offshore waters, and the further development and refinement of assessment methods is likely to prove very worthwhile.

Discussion

177. The Pilot has demonstrated that the identification and mapping of a comprehensive series of marine landscape types using geophysical and hydrographical data is fully practicable at the Regional Sea scale. The series of 18 coastal and seabed, and 4 water column marine landscapes identified for the Irish Sea by the Pilot may well need some refinement following further work, but 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.
178. For a variety of reasons, including the steepness of the slope of the continental shelf, the presence of sea mounts, a range of glacial features such as iceberg plough marks, and the occurrence of much deeper water than occurs in the Irish Sea, the classification framework developed under the Pilot would need to be extended for use in areas to the south and west of Ireland, west of the Hebrides and north of Scotland. However, the basic concept is sound.
179. There was, generally, a good correlation between the marine landscapes identified and the character of the seabed. But partly because of the inherent simplification which took place in the generation of the marine landscapes, and partly because the substrate data did not always reflect the actual condition of the seabed surface, there was greater variability than a straightforward interpretation of the marine landscape map would have suggested. The same is true of the biological characterisation; in general the relation between marine landscapes and biological communities is very strong, but locally there can be considerable variation and complexity.
180. Marine landscapes can be used to predict the susceptibility of human impacts on their biological communities but there is a need to use some caution in this. Many of the biological communities which presently occur reflect some modification of the natural state as a result of human activity and this could have implications for the conclusions reached. For example, areas of seabed subject to strong currents where sediments are mobile could be expected to support biological communities capable of accommodating a level of physical disturbance. If these communities were considered natural for such an area, human activity causing similar disturbance might, therefore, be assumed to be relatively harmless. However, species-rich biogenic reefs may have developed in these areas but have been destroyed by dredging or trawling activity. Continuation of such activities would ensure that such reefs would not re-establish.
181. The value of the marine landscapes approach is that it uses data which are currently available to enable management strategies for the marine environment to be developed and implemented. It is only to be expected, however, that mapped habitat information derived from future biological survey will be more accurate than marine landscape maps developed largely from geophysical and hydrographical data. As such survey information becomes available over time, marine landscape maps will need to be refined to accommodate it.
182. The Water Framework Directive requires the achievement of good ecological status in transitional and coastal waters. Good ecological status is defined as where the biological quality elements show only low levels of distortion resulting from human activity, deviating only slightly from those normally associated with the surface waterbody type under undisturbed conditions. Links could be made between the marine landscape types defined here and the habitat types defined for deriving reference conditions for water bodies for the Water Framework Directive (which are at a more detailed scale). The Water Framework Directive 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.

Recommendations

183. The following recommendations are made with respect to Marine Landscapes:

R14 The marine landscape approach should be adopted as a key element for marine nature conservation and utilised in the spatial planning and management of the marine environment. The approach should take account of broadscale marine habitat information, as this information becomes available over time. In coastal and estuarine waters the approach should seek to complement that taken under the Water Framework Directive (in relation to typology and reference conditions) at a more detailed level.

R15 A list of internationally-agreed marine landscapes for the north-east Atlantic should be developed. It is suggested that the list identified for the Irish Sea be expanded to include landscapes not found in the Irish Sea and further refined as necessary. Work to complete the mapping of these marine landscapes in the north-east Atlantic should be undertaken in collaboration with other countries.

R16 The methodology for sensitivity and vulnerability of marine landscapes should be further developed and refined, having due regard to relevant standards being developed in relation to the Water Framework Directive. It should be recognised that for purposes of local spatial planning, these assessments should be enhanced using the additional biological information which is available in inshore and coastal environments.

184. A full report of the work carried out on marine landscapes is available (Golding *et al.*, 2004, and online at www.jncc.gov.uk/irishseapilot)