

ICES response to EC request for information and advice about appropriate eco-regions for the implementation of an ecosystem approach in European waters

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1. Summary

1.1. This report provides information and advice on eco-regions for the implementation of an ecosystem approach in European waters. A review of existing biogeographical and management regions against a series of evaluation criteria demonstrated that no existing regions could be adopted as eco-regions. Thus eco-regions are proposed based on biogeographic and oceanographic features, taking account of existing political, social, economic and management divisions.

1.2. Eleven eco-regions are proposed (Figure 1):

Greenland and Iceland Seas
Barents Sea
Faroes
Norwegian Sea
Celtic Seas
North Sea
South European Atlantic Shelf
Western Mediterranean Sea
Adriatic-Ionian Seas
Aegean-Levantine Seas
Oceanic northeast Atlantic

1.3. Although the group were not asked to provide specific advice for the Baltic Sea and Black Sea, it was noted that the Baltic Sea should be treated as one eco-region and the Black Sea as one eco-region, if these eco-regions are to be consistent with others. This would result in a total of 13 eco-regions.

1.4. The group did not decide whether the western Channel (ICES area VIIe) should be placed within the Celtic Seas or North Sea. Biogeographic considerations favour inclusion of the western Channel in the Celtic Seas, while management and policy considerations favour inclusion of the western Channel in the North Sea. Further consultation would be needed to resolve the status of the western Channel.

1.5. It was considered desirable to include (1) areas under the jurisdiction of Spain around the Canary Islands and (2) the area under the jurisdiction of Portugal around Madeira (which overlaps slightly with the OSPAR maritime area) in an eco-region. It is

proposed that these waters should be included in the same eco-region as the Azores (Oceanic northeast Atlantic).

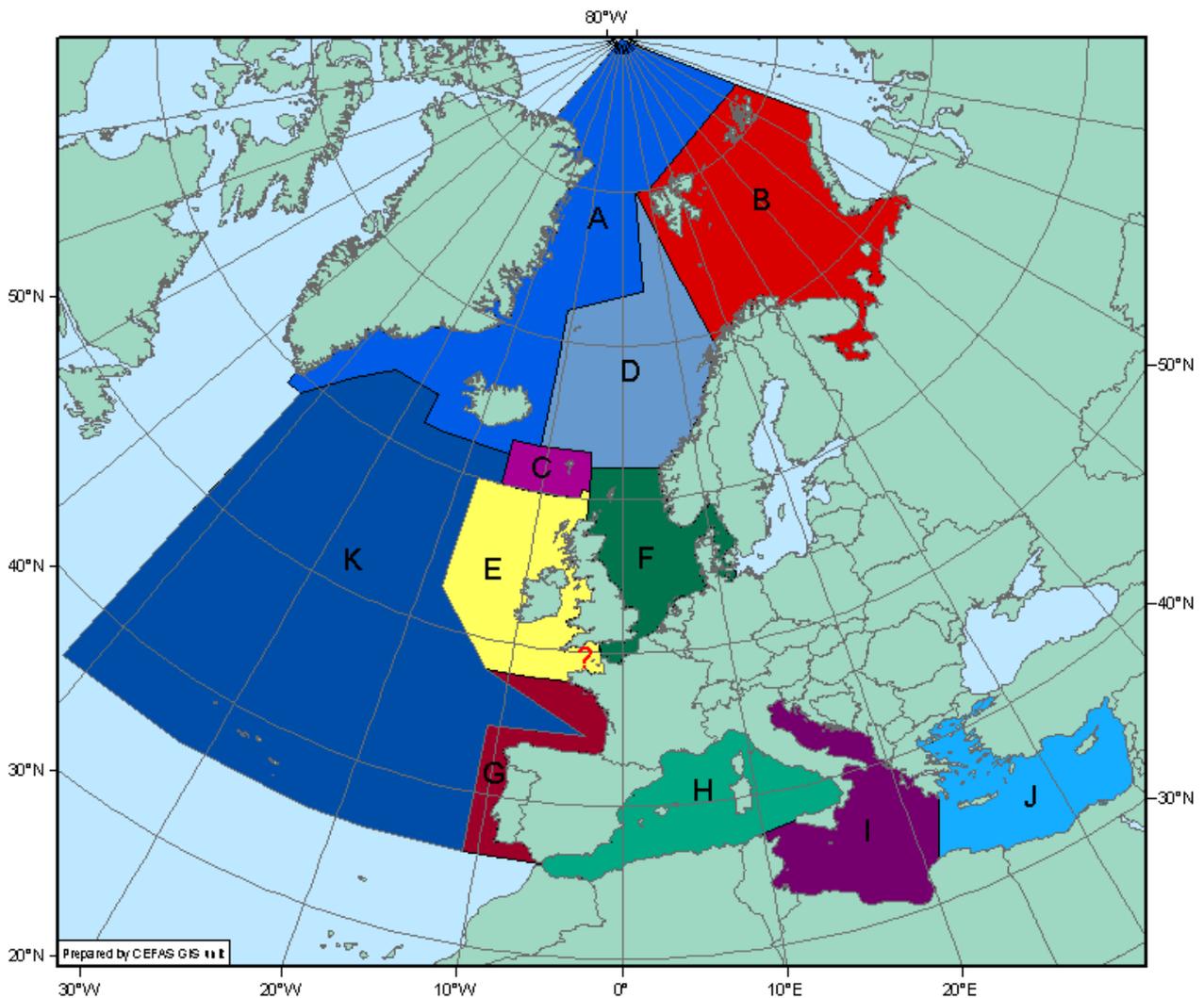


Figure 1. Proposed eco-regions for the implementation of the ecosystem approach in European waters. The eco-regions are Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K). Equidistant azimuthal projection. The question mark denotes the western Channel (ICES Area VIIe), which could be placed in either the Celtic Sea or North Sea eco-region (paragraph 1.4.).

2. Request

2.1. Within the framework of the existing Memorandum of Understanding between the European Commission and ICES, ICES was asked to provide information and advice about appropriate eco-regions for the implementation of an ecosystem approach in European waters, preferably in advance of the Rotterdam Stakeholder Conference 10-12 November 2004 but not later than by the end of 2004. The European Commission submitted the following request (paragraphs 2.2. to 2.7.).

2.2. 'Request of scientific information and advice about appropriate eco-regions for the implementation of an ecosystem approach in European waters'

2.3. 'The Marine strategy will be implemented at many levels, ranging from local to pan-European. This leads to the need to identify individual regional areas for which ecological objectives are to be defined. Ecosystem boundaries are typically based on biological and physical processes. The boundaries of these eco-regions should therefore be based on biogeographic and oceanographic features, taking account of existing political, social, economic and management divisions. By doing so, eco-regions should be characterised by greater similarity in biogeographic and oceanographic characteristics among sites within the same eco-regions. It is envisaged that the eco-regions could be subdivided in sub-regions as appropriate.

2.4. Appropriate biogeographic characteristics may be the composition of faunal communities and patterns of primary production. Appropriate oceanographic characteristics may be depths, basin morphology, tidal and ocean currents, temperature or degree of seasonal stratification. Identification of eco-regions should also take account of the links between the marine and terrestrial environment, including patterns of land use and distribution and density of human populations.

2.5. Boundaries between eco-regions should be defined unambiguously to guide research, objective-setting, assessment, monitoring and enforcement and should take account of the jurisdiction of existing management authorities and areas for sectoral activities, and utilise existing boundaries where they meet the wider criteria for boundary selection.

2.6. There are several existing divisions of the marine areas into regions such as those to be found in the CFP, Marine Conventions, Large Marine Ecosystem, Biogeographical regions used by EEA, WFD etc.

2.7. In the light of the above, we would like to request ICES, within the framework of the existing Memorandum of Understanding between the Commission and ICES, to undertake a scientific review and evaluation of all relevant information concerning the above mentioned classification in regions. The work should focus on the how the above criteria have been applied and which classification offers the best starting point for the identification of eco-regions. In the event that the analysis suggest that a new system are needed ICES is requested to provide recommendation on such or alternatively on how this could be achieved.'

2.8. ICES convened a meeting of experts to provide a response to this request at ICES HQ Copenhagen 19-21 October 2004. Participants are listed in Annex 1.

3. Geographical scope of study

3.1. The documents on the development of the European Marine Strategy draw a distinction between the European seas and the rest of the world's seas, but they have not specified precisely what parts of the sea would be covered as the "European seas".

3.2. In responding to the EC request, it was assumed that the areas to be covered are the maritime areas of the Barcelona, Bucharest, Helsinki and OSPAR Conventions - that is, the Atlantic Ocean west of a line from the south of Greenland, north of a line drawn west from the straits of Gibraltar, and east as far as longitude 51° East, to include the Baltic Sea, the Black Sea and the Mediterranean Sea (Annex 2).

3.3. In addition to these maritime areas, it was considered desirable to include areas under the jurisdiction of Spain around the Canary Islands and the area under the jurisdiction of Portugal around Madeira (which overlaps slightly with the OSPAR maritime area). The waters surrounding these islands share the same characteristics as the nearest parts of the OSPAR maritime area and form part of the economic and social systems of Europe

3.4. The whole of the island of Greenland has the status of an Overseas Country and Territory under the EC Treaty. However, the waters on its western coast cannot be managed sensibly without taking account of the concerns of Canada. This takes them into a framework different from that for European waters. The waters west of Greenland were therefore not considered further in this study.

3.5. No consideration was given to the waters adjoining non-European constituent parts of EU Member States. The management issues for which eco-regions are being identified would require such waters to be considered in the context of their local global region and not in the context of European waters. On the same basis, no consideration was given to Arctic marine eco-regions east of the Barents Sea (that is, east of 51° East), even though they may adjoin European parts of the Russian Federation.

3.6. In the landward direction, the response is based upon the recognition that the OSPAR Convention includes not only the territorial seas and exclusive economic zones (or equivalent jurisdictions) of the Contracting Parties and the relevant parts of the high seas, but also the internal waters of Contracting Parties as far as the freshwater limit. The situation is less clear in relation to the other regional seas conventions, but it seems sensible that, for the EU and EEA Member States, the definitions of the eco-regions should fit together with the areas delimited for the purposes of the EC Water Framework Directive¹. The response to the request therefore assumes that the landward boundaries of the proposed eco-regions will be those defined as the landward boundaries of coastal waters and intermediate waters under the EC Water Framework Directive

3.7. While the response to the EC request necessarily considers boundaries between various areas, nothing in the response is intended to express any view on the correct boundaries of States, their territorial seas, their exclusive economic zones (or similar jurisdictions) or their continental shelves. Any references to such boundaries are solely for the purpose of putting into context the discussion on eco-regions.

¹ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy Official Journal L 327 , 22/12/2000 P. 0001 - 0073

3.8. The names suggested for the proposed eco-regions (or used to describe other areas) are used solely to simplify discussion by providing a short, descriptive title each of the proposed eco-regions. The names are not intended to have any implications for the naming or status of the eco-regions or of any other areas.

3.9. Claims of Maritime Jurisdictional Zones by Member States of EU and Other States in the North-East Atlantic are summarised in Annex 3.

4. Evaluation of existing biogeographical and management regions

4.1. Consistent with the terms of the request (paragraphs 2.2.- 2.7.), eco-regions were defined as the areas for which ecological objectives would be set when implementing an ecosystem approach in European waters. The request required that the boundaries of eco-regions should be based on biogeographic and oceanographic features, taking account of existing political, social, economic and management divisions. Thus eco-regions should be characterised by greater similarity in biogeographic and oceanographic characteristics within than among regions. Moreover, the European Commission requested that the boundaries between eco-regions should be defined unambiguously to guide research, objective setting, assessment, monitoring and enforcement.

4.2. The evaluation of existing biogeographical and management regions followed a four step process. First, existing biogeographical and management regions that might be used as eco-regions were catalogued. Second, a series of criteria that could be used to assess potential eco-regions (based on oceanographic, biogeographic, ecological, management and policy perspectives) were identified (Table 1). Third, the qualities of existing biogeographical and management regions were evaluated using the criteria. Fourth, changes to existing biogeographical and management regions that would improve their match to the evaluation criteria for eco-regions were identified. Since no existing biogeographical and management regions proved to be suitable for adoption as eco-regions, step four was used to determine the boundaries of the new eco-regions described in Section 5.

4.3. In practice, it was impossible to define a specific scoring system that could be used to balance the often conflicting requirements of the assessment criteria and the relative weighting given to assessment criteria would show regional variation. For example, a proposed eco-region that met the biogeographic, oceanographic and ecological criteria may not have been an optimal eco-region from a management perspective. Accordingly, the expert judgement of the ICES eco-regions group (Annex 1) was used to determine the preferred boundaries for new eco-regions, taking into account the relative strengths and weaknesses of the new eco-region in relation to the criteria in Table 1.

Table 1. Criteria for evaluating existing or proposed eco-regions and the expected qualities of eco-regions that would be appropriate for the implementation of an ecosystem approach in European waters

Category/ Criterion	Expectation in appropriate eco-region
1. Oceanography/ Biogeography/ Ecology	
a. Do the boundaries of existing or proposed eco-regions appropriately demarcate areas with identifiable oceanographic characteristics?	Clear oceanographic justification for demarcation
b. Do the boundaries of existing or proposed eco-regions appropriately demarcate the distribution of	Boundary should demarcate distribution of both pelagic and benthic species and

a range of species or communities that inhabit many different depths?	communities
c. Will oceanographically/ biogeographically defined boundaries of the existing or proposed eco-regions continue to apply over the time-scales used for management (decades or more)?	They would apply for decades or more
d. Would there be significant spatial variation in the response of existing or proposed eco-regions' physical characteristics, species and communities to climate variability and climate change?	Spatial variation should be low so that the rate of management adaptation to climate change can be similar throughout the eco-region
e. Is the level of exchange of materials between existing or proposed eco-regions as low as can reasonably be expected?	Low exchange, eco-region should be a relatively self sustaining system
f. Is the oceanographic and biological variability among sites within the existing or proposed eco-region smaller than variability among eco-regions?	Variability within eco-regions should be smaller than variability among regions
g. If there are sub-regions within the eco-region (oceanographically/ biogeographically identifiable regions that do not meet the criteria for eco-regions), do they nest within eco-regions without gaps or inefficiencies?	Eco-region should divide clearly and completely into a small number (typically ≤ 3) of sub-regions
2. Human impacts and their management	
a. Would management action in one existing or proposed eco-region negatively affect management in another eco-region?	Responses to management action on one eco-region should have a minimal or positive impacts on management actions in other eco-regions
b. Are the existing or proposed eco-regions compatible with the distributions and management of commercially exploited fish populations?	Fish populations should ideally be distributed and managed within the same eco-region
c. Are the boundaries of existing or proposed eco-regions consistent with those of existing or proposed management regions (e.g. WFD, GFCM, MAP, RACs, ICES, OSPAR)?	Consistency should be high
d. Are the boundaries of existing or proposed management and/ or eco-regions consistent with terrestrial management regions?	Boundaries should be consistent to support integration of marine and terrestrial assessment and management
e. Can research, assessment and monitoring of terrestrial and marine impacts be effectively linked at the scale of the existing or proposed eco-region?	It should be possible to link research, assessment and monitoring of terrestrial and marine impacts to effectively support integrated management
f. Are the existing or proposed eco-region boundaries compatible with patterns of land use type and change and the distribution of human populations?	There should be compatibilities between eco-region boundaries and land use type and change and the distribution of human populations since these are key drivers of impacts on the marine environment
g. If there are sub-regions within the eco-region (management regions that do not meet the criteria for eco-regions), do they nest within eco-regions without gaps or inefficiencies?	Eco-region should divide clearly and completely into a small number (typically ≤ 3) of sub-regions
h. Do contiguous shelf areas and the slope to a depth of at least 1000m fall into the same eco-	The shelf and slope to a depth of at least 1000m should fall within the same eco-

region?	region as human activities such as fishing have increasingly spread from shelf to slope regions.
3. Management/ Policy	
a. Do the existing or proposed eco-regions apply to the fullest possible extent to the marine environment including the coastal areas, internal waters, the territorial sea, the exclusive fishery zones and other sea areas under the sovereignty and jurisdiction of the Member States of the European Union and neighbouring countries?	Eco-regions should apply to the fullest possible extent to the marine environment
b. Are the boundaries of the existing or proposed eco-region compatible with the provisions of UNCLOS and other relevant international conventions?	Eco-region boundaries should be compatible with the provisions of UNCLOS and other relevant international conventions
c. In relation to the jurisdiction areas of regional conventions, are there any gaps within the existing or proposed eco-region?	There should be no gaps in jurisdiction
d. If a number of conventions apply in different parts of the existing or proposed eco-regions, then will the management response to any human impact be inconsistent in different parts of the eco-region?	Management responses should be consistent throughout the eco-region
e. Do the boundaries of existing or proposed eco-regions create any known impediments to effective management? (in relation to the management of, for example, aggregate extraction and mining, aquaculture, dredging, engineering and construction, fisheries, land-based impacts, military activities, oil and gas, reclamation, recreation, renewable energy, shipping)	Boundaries should not create impediments to effective management
f. Do the existing or proposed eco-regions facilitate partnerships with neighbouring countries in the Atlantic, Baltic, Mediterranean Sea and Black Sea?	The eco-regions should facilitate partnerships
g. Can the existing or proposed eco-regions be subdivided into political or management regions with as few gaps and inefficiencies as possible?	Eco-region should divide clearly and completely into political and management regions

4.4. The proposed eco-regions met more of the criteria in Table 1 than any of the existing schemes we reviewed, partly because they took account of biogeographic/ oceanographic/ ecological and human impact/ management issues that had often been treated more or less independently.

4.5. There is no universally agreed method for biogeographical classification, but rather, as stated by Dinter (2001), there are as many methods as there are biogeographers. This reflects the fact that nature is continuous and that each part of nature has some uniqueness while it shares some features with other areas. There are no sharp and absolute boundaries but rather more or less clearly expressed transition zones. Biogeographical classification, in common with other classifications such as partitioning into Large Marine Ecosystems (paragraphs 4.11.-4.13.), builds therefore to a high degree of judgements by experts who have a thorough knowledge of the areas to be classified.

The experts are helped by there being discontinuities associated with transition zones. These discontinuities may reflect topographical features such as capes, peninsulas, ridges, slopes, and shelf edges that influence the ocean currents and water mass distributions. The discontinuities influence bottom and water characteristics and distribution patterns of flora and fauna. These patterns form the basis for the biogeographical classification.

4.6. The evaluation of existing and proposed eco-regions demonstrated that there is often not a sufficient understanding of biogeographical, oceanographical and ecosystem processes to allow the assessment of issues such as the extent to which eco-regions could be regarded as self-sustaining units. Moreover, it was clear that appropriate boundaries would often be mobile. In setting boundaries for the purposes of responding to this request, we attempted to select boundaries with the highest possible temporal and spatial stability, but acknowledged that the boundaries could never be truly fixed in space and time given climate variation and change.

4.7. The following biogeographical/ oceanographic or management regions that might serve as eco-regions were considered.

OSPAR regions

ICES areas

Large marine ecosystems (LME)

Longhurst provinces

Dinter biogeographical regions

Regional Advisory Council areas

OSPAR regions

4.8. Since 1992 the OSPAR Convention has recognised that there may be the need to divide the OSPAR maritime area into sub-regions. The existing divisions were established for the purposes of the Quality Status Report 2000. Three factors were particularly significant in establishing the boundaries:

- (a) the Greater North Sea region (Region II) reflected the area defined for the purposes of the International Conferences on the Protection of the North Sea, so that the regional report would be directly comparable with the North Sea Quality Status Report produced in 1993;
- (b) the other boundaries were intended to delimit regions that had significantly different ecological circumstances;
- (c) in drawing them, however, account was also taken of the extent to which coastal States facing the Wider Atlantic (Region V) had information on that region, and Region IV (Bay of Biscay/Golfe de Gascogne and Iberian Waters) therefore included some of the deeper waters similar to the rest of Region V

ICES areas

4.9. The system of ICES areas has evolved incrementally since the early 1900s. ICES areas have been based on the requirements for the collection of fisheries statistical data and management, and have some links to regions defined by biogeography/

oceanography and ecology, because the location and timing of fisheries was closely linked to biogeographic and oceanographic factors.

4.10. With the publication of its first fisheries statistics publication (Bulletin Statistique 1904) ICES developed a system of Subareas and Divisions for use in the collection and presentation of fisheries statistics. This system evolved and around 1960 the fisheries statistics system was reviewed by the Continuing Working Party on Fishery Statistics in the North Atlantic Area (CWP). In 1984 ICES compiled a document that brought together the extensive description contained in the appendix to Volume 58 of Bulletin Statistique (published January 1976), the description of Divisions XIVa and b contained in the appendix to Volume 60 of Bulletin Statistique (published April 1978), and the description of the sub divisions of Divisions IIIb d (the waters around Denmark and the Baltic) adopted by the International Baltic Sea Fishery Commission, and the description of all the divisions in Sub areas VII - IX which had not previously been given. The latter Divisions were described because ICES Council Resolution 1986/4:9 requested member countries to begin reporting fishery statistics by divisions for Sub areas VII and VIII in 1987. In 2004 a further refinement to the ICES areas is being introduced to accommodate the statistics needs for deep water fishing, and the NEAFC requirements for reporting by EEZs.

Large marine ecosystems

4.11. Large Marine Ecosystems (LME) were originally proposed by Ken Sherman of the US NOAA. A Large Marine Ecosystem is defined as a relatively large ocean area, typically 200 000 km² or larger, with characteristic bottom topography, hydrography and productivity, and with trophically coupled populations. This definition also provides the criteria for the identification of LMEs. Most LMEs are located on the continental shelves. Here the bottom topography has a strong influence on currents and water mass distribution. The physical conditions again determine the characteristics of plankton production.

4.12. The last criterion for LMEs, having trophically coupled populations, distinguishes LMEs from other classification systems such as biogeographical partitioning. Commercial fish populations are usually important ecological components as prey and predators for other marine biota. Because of their large size, such fish populations require a large living space as they need to feed on the production of prey organisms over a large area. The populations at the same time need to achieve geographical life cycle closure, where spawning areas, larval drift routes, juvenile nursery areas, feeding areas and spawning migrations form a spatial life cycle context in relation to ocean currents and circulation patterns. The distributions of commercial fish populations are therefore an important element to consider when delineating LMEs. Since their distributions reflect circulation and water mass distributions, this criterion is related to the other criteria of characteristic bottom topography, hydrography and productivity

4.13. The current classification (<http://www.edc.uri.edu/lme>) lists 11 LMEs in the Northeastern and northern North Atlantic. These are:

- (a) The Barents Sea LME
- (b) The Norwegian Sea LME
- (c) The Iceland Shelf LME
- (d) The East Greenland Shelf LME
- (e) The Faroe Plateau LME

- (f) The North Sea LME
- (g) The Baltic Sea LME
- (h) The Celtic-Biscay Shelf LME
- (i) The Iberian Coastal LME
- (j) The Mediterranean LME
- (k) The Black Sea LME

Longhurst provinces

4.14. The Longhurst provinces (Longhurst, 1998) provide a scheme for partitioning the water column of the world's oceans into biogeographical units. This scheme includes four primary compartments (*biomes*) that are further subdivided into secondary compartments (*provinces*). In the North Atlantic, Longhurst subdivided the Polar biome into three and the Westerlies biome into four provinces.

- (a) Boreal Polar Province (BPLR)
- (b) Atlantic Arctic Province (ARCT)
- (c) Atlantic Subarctic Province (SARC)
- (d) North Atlantic Drift Province (NADR)
- (e) North Atlantic Subtropical Gyral Province (East and West) (NAST)
- (f) Gulf Stream Province (GFST)
- (g) Mediterranean Sea, Black Sea Province (MEDI)

4.15. Longhurst (1998) also divided the coastal shelves of the northeast Atlantic into two provinces

- (h) Northeast Atlantic Shelves Province (NECS)
- (i) Eastern (Canary) Coastal Province (CNRY)

4.16. The Northeast Atlantic Shelves Province (NECS) is large and diverse, and Longhurst (1998) therefore recognised that a subdivision of the province could be useful for some purposes. He suggested the following subdivisions:

- (i) the North Sea, from the Straits of Dover to the Shetlands;
- (ii) the Channel from Dover west to Ushant;
- (iii) the southern outer shelf from northern Spain to Ushant, including the Aquitaine and Armorican shelves off western France;
- (iv) the northern outer shelf, including the Celtic Sea and the Irish, Malin, and Hebrides shelves off Britain;
- (v) the Irish Sea;
- (vi) the central Baltic (Gottland) Sea
- (vii) the Gulfs of Bothnia and Finland.

Dinter Biogeographical regions

4.17. The Dinter biogeographical classifications were based on a German Federal Agency for Nature Conservation study to identify biogeographical units (provinces) in

the NE Atlantic and Arctic Oceans (Dinter, 2001). This was based on a review of previous oceanographic and biogeographic classifications. The analysis considered (1) pelagic, (2) benthic and neritic of the shelf and upper continental shelf (<1000m depth) (3) benthic and neritic of the shelf and upper continental shelf (<1000m depth) and ice-cover biomes and (4) deep-sea distribution patterns (benthic and pelagic >1000m depth). Dinter (2001) defined a *province* as a geographical unit with either a higher rate of or peculiar endemism, or more often an oceanographic constellation that supports a characteristic biotic association. The *Sub-province* was not specifically defined by Dinter (2001) but is a further subdivision of a province based on examination of species distribution patterns within the province.

Regional Advisory Councils

4.18. For the purposes of the EC Common Fisheries Policy, regional advisory councils are being established. The regions for the purposes of these councils have been defined in two separate ways: geographically and functionally. There are two functional “regions” (pelagic stocks and high seas/long-distance fleet) and five geographical regions:

- a. the Baltic Sea,
- b. the Mediterranean Sea,
- c. the North Sea,
- d. north-western waters,
- e. south-western waters.

4.19. These geographical regions have been defined in terms of the ICES areas and CECAF divisions, except for the Mediterranean, which includes all maritime waters of the Mediterranean Sea east of longitude 5°36′ west². The geographical areas, however, have been chosen in part on the basis of the locations of the fishing fleets which are interested in them. As a result, they do not always reflect biogeographical considerations. For example, the whole of the English Channel (ICES areas VIIId and VIIe) is allocated to the North-Western Waters Regional Advisory Council, while the Kattegat (ICES area IIIb) is allocated wholly to the Baltic Sea Regional Advisory Council.

5. Proposed new eco-regions

5.1. Following the evaluation process and the redefinition of boundaries, 11 eco-regions are proposed (Figure 2). These eco-regions are:

- Greenland and Iceland Seas (A)
- Barents Sea (B)
- Faroes (C)
- Norwegian Sea (D)
- Celtic Seas (E)
- North Sea (F)
- South European Atlantic Shelf (G)
- Western Mediterranean Sea (H)
- Adriatic-Ionian Seas (I)

² Council Decision 2004/585/EC of 19 July 2004 establishing Regional Advisory Councils under the Common Fisheries Policy, Annex 1.

Aegean-Levantine Seas (J)
 Oceanic northeast Atlantic (K)

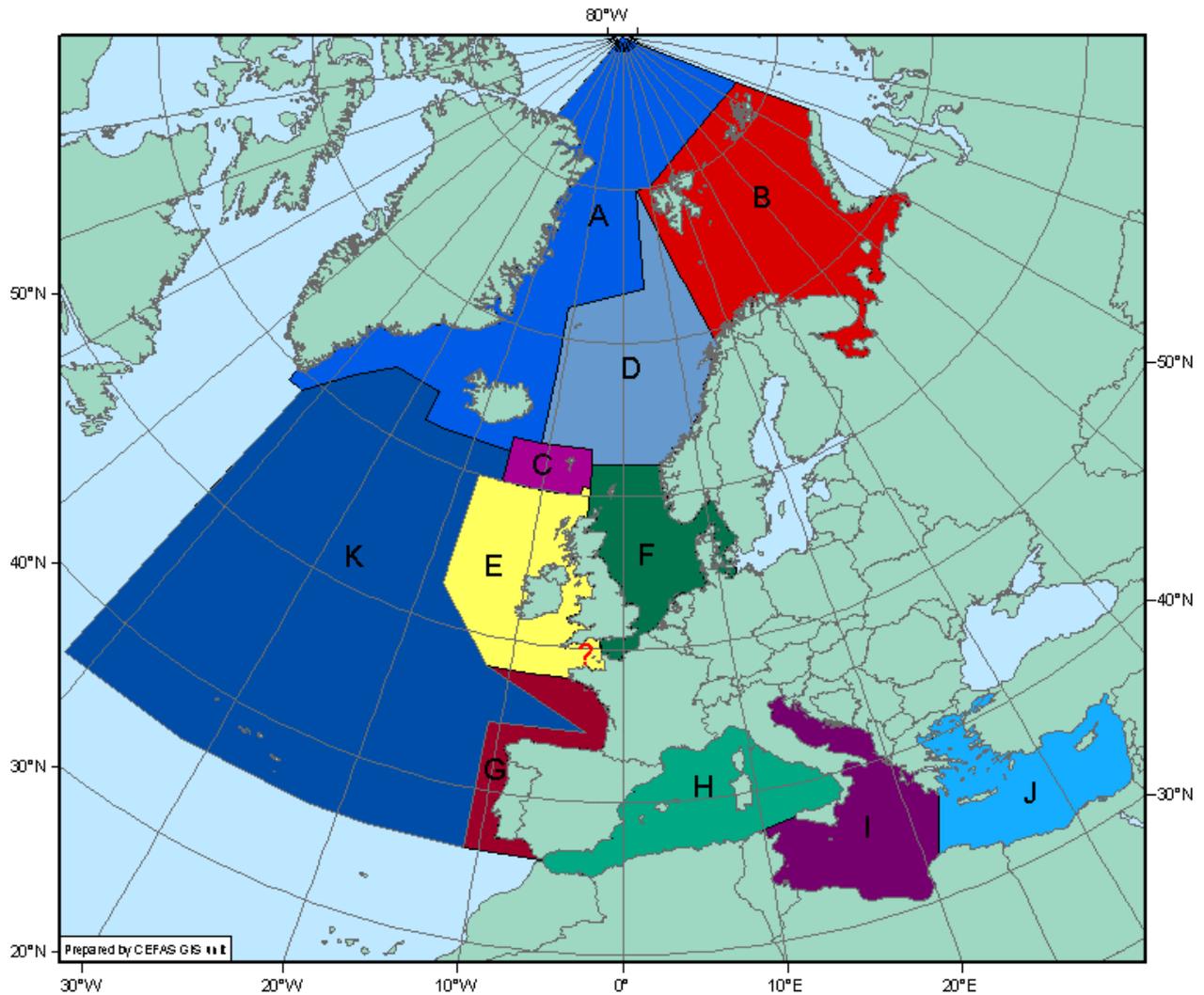


Figure 2. Proposed eco-regions for the implementation of the ecosystem approach in European waters. The eco-regions are Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K). The question mark denotes the western Channel (ICES Area VIIe), which could be placed in either the Celtic Sea or North Sea eco-region (paragraphs 1.4., 6.2. and 6.11.). Equidistant azimuthal projection.

5.2. Although the group was not directly asked to consider the Baltic Sea and Black Sea, the approach adopted to distinguishing what constitutes an eco-region suggests that it would be consistent with the identifications proposed elsewhere to treat the Baltic Sea and Black Sea as a single eco-regions. This would result in a total of 13 eco-regions

5.3. In the Black Sea, there are clearly significant differences between the shallow northern shelf (including the Sea of Azov) and the deep basin and southern rim. These two areas form parts of a whole from a systems perspective, both in terms of ecology and pressures. In line with the proposals for other European seas, a single Black Sea eco-region is therefore suggested, subject to comments from experts on the region, with the two parts being treated as sub-regions.

5.4. The names suggested for the eco-regions are used solely to simplify discussion by providing a short, descriptive title for each of the proposed eco-regions. The names are not intended to have any implications for the naming or status of the eco-regions or of any other areas.

5.5. The Arctic was divided into a number of eco-regions as this is consistent with the biogeographic/ oceanographic weighting given to other eco-regions. However, given the low population density and relatively limited level of human impacts in the Arctic, the eco-regions may need to be federated and treated as a single unit for management purposes.

5.6. It was considered desirable to deal with areas (1) under the jurisdiction of Spain around the Canary Islands and (2) the area under the jurisdiction of Portugal around Madeira (which overlaps slightly with the OSPAR maritime area) in this request. The waters surrounding these islands share the same characteristics as the nearest parts of the OSPAR maritime area and form part of the economic and social systems of Europe. It is therefore proposed that these waters are included in the same eco-region as the waters around, for example, the Azores.

5.7. Boundaries that have been defined for the purpose of responding to this request are fuzzy and the optimal boundary locations will change with climate variation and climate change. It is proposed that boundaries should be re-evaluated at 20 year intervals. It was also noted that according to the Coast Guidelines under the CIS for the WFD, that the recommended interval for examining eco-region borders is every 6 years to account for climate change.

5.8. The relationships between the boundaries of the proposed eco-regions and the boundaries of ICES areas and the OSPAR regions are shown in Figures 3 and 4 respectively. The relationships between proposed eco-regions and depth are shown in Figures 5 and 6.

5.9. In general, eco-region boundaries were set to follow the boundaries of the ICES areas, unless there were strong reasons for making a division within a given ICES area. This is because fisheries management will be a very important component of the European Marine Strategy and will have a significant effect on the ecological and operational objectives that are set for individual eco-regions. Since fisheries are largely managed on the basis of data collected by ICES areas, and since it is important to use historic data collected for ICES areas to support fisheries and environmental management, objective setting and management will be more effective if the eco-regions are aligned with ICES areas.

5.10. The large scales of the maps presented in this report do not allow us to represent small scale boundary information, but this is available from ICES as shape files. These files were used to produce the maps presented in this report. The boundaries that cross

lines of both latitude and longitude may need to be defined in N-S and E-W ‘steps’ for the purposes of the practical implementation and reporting of boundaries and ICES did not attempt to do this.

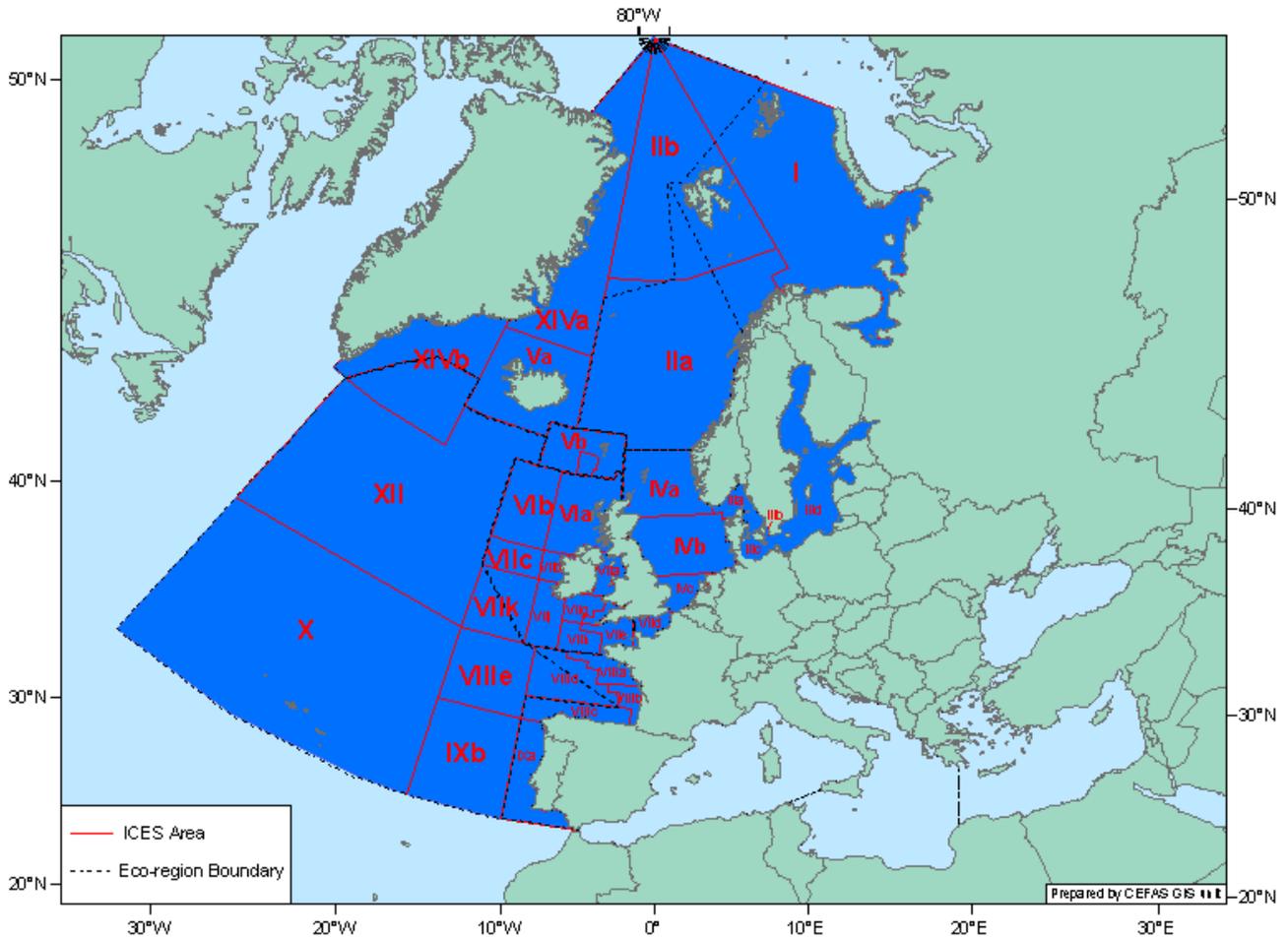


Figure 3. The boundaries of the proposed eco-regions Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K) and the existing ICES areas. Equidistant azimuthal projection.

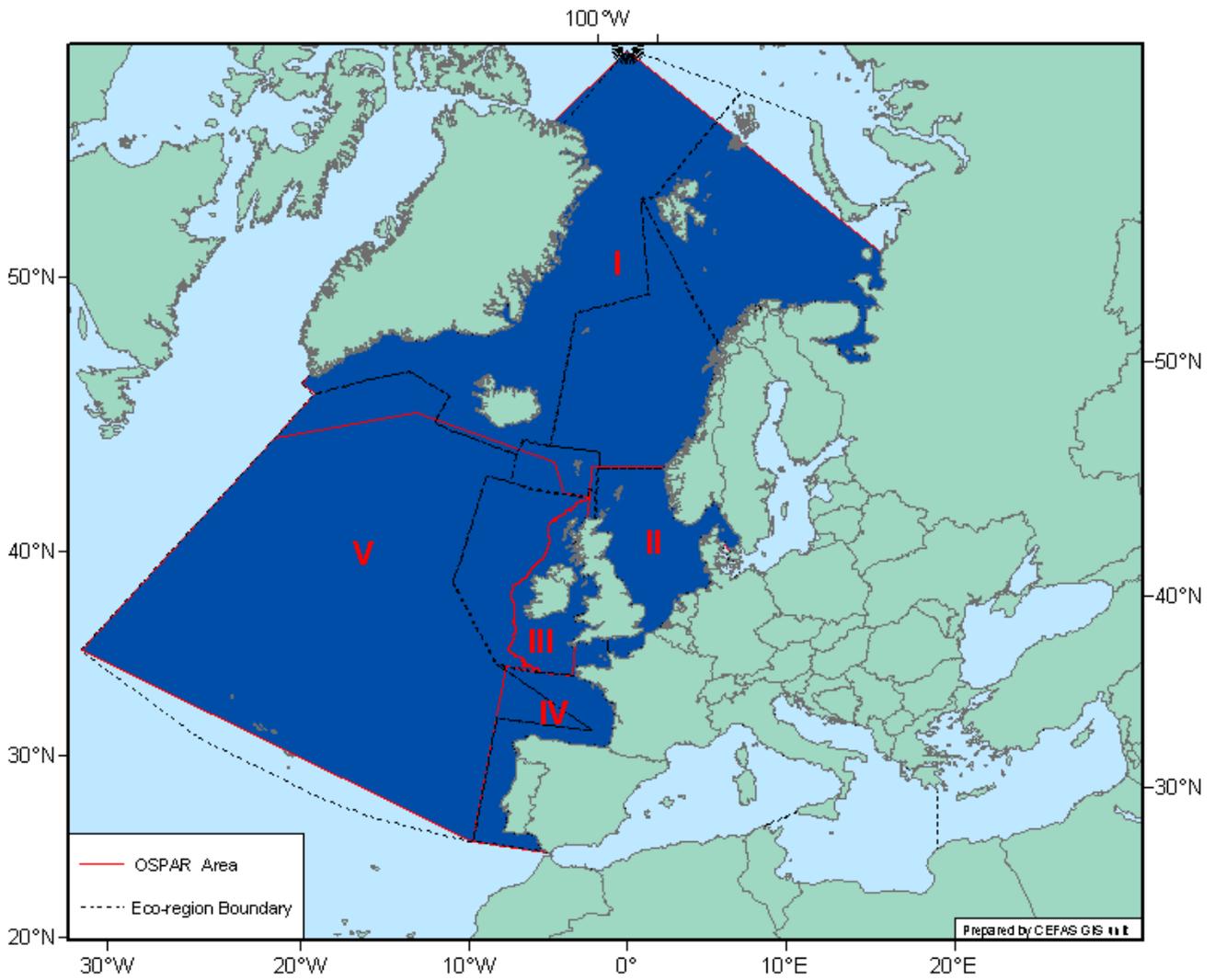


Figure 4. The boundaries of the proposed eco-regions Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K) and the existing OSPAR areas. Equidistant azimuthal projection.

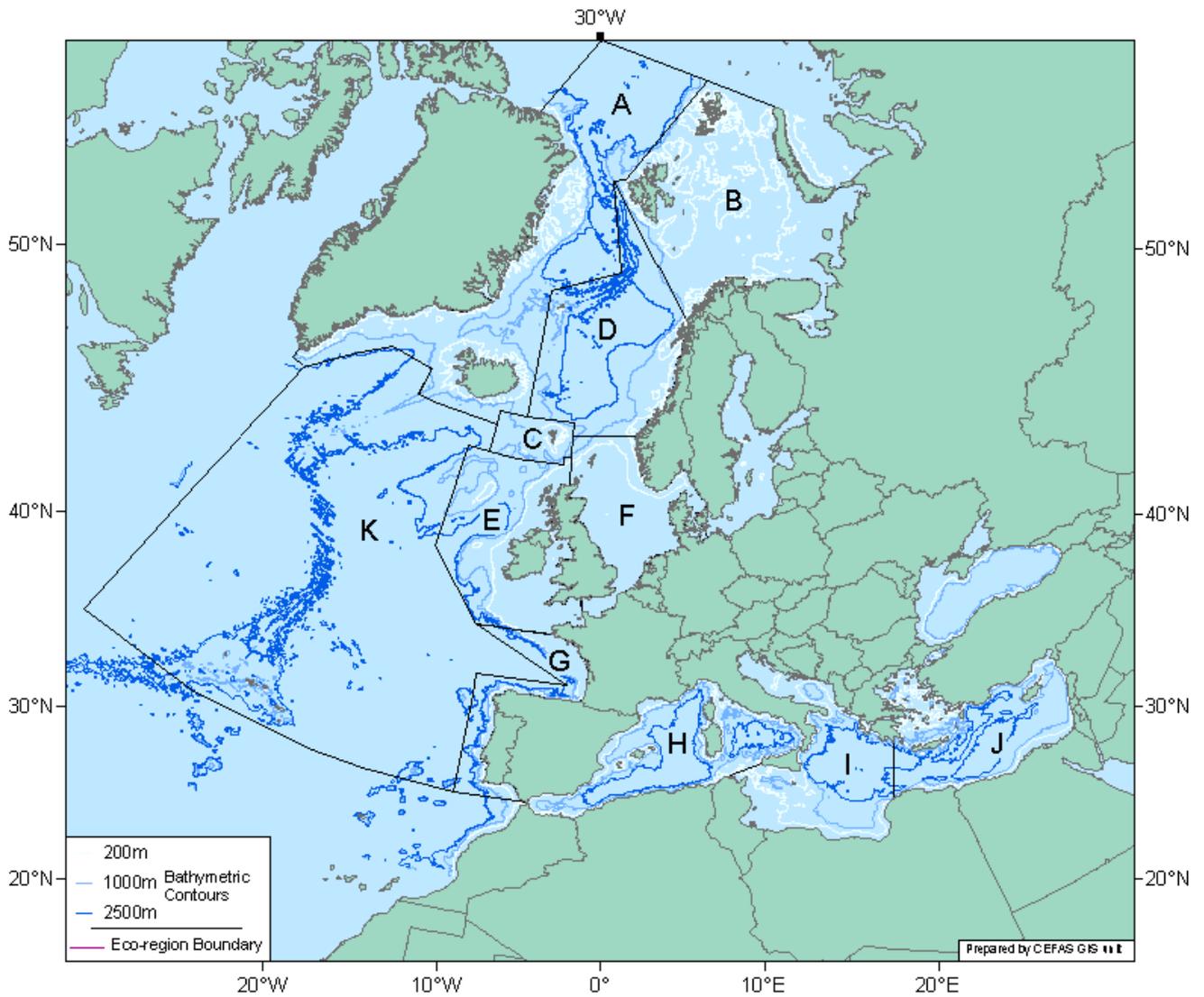


Figure 5. The boundaries of the proposed eco-regions Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K) and the locations of 200m, 1000m and 2500m bathymetric contours.

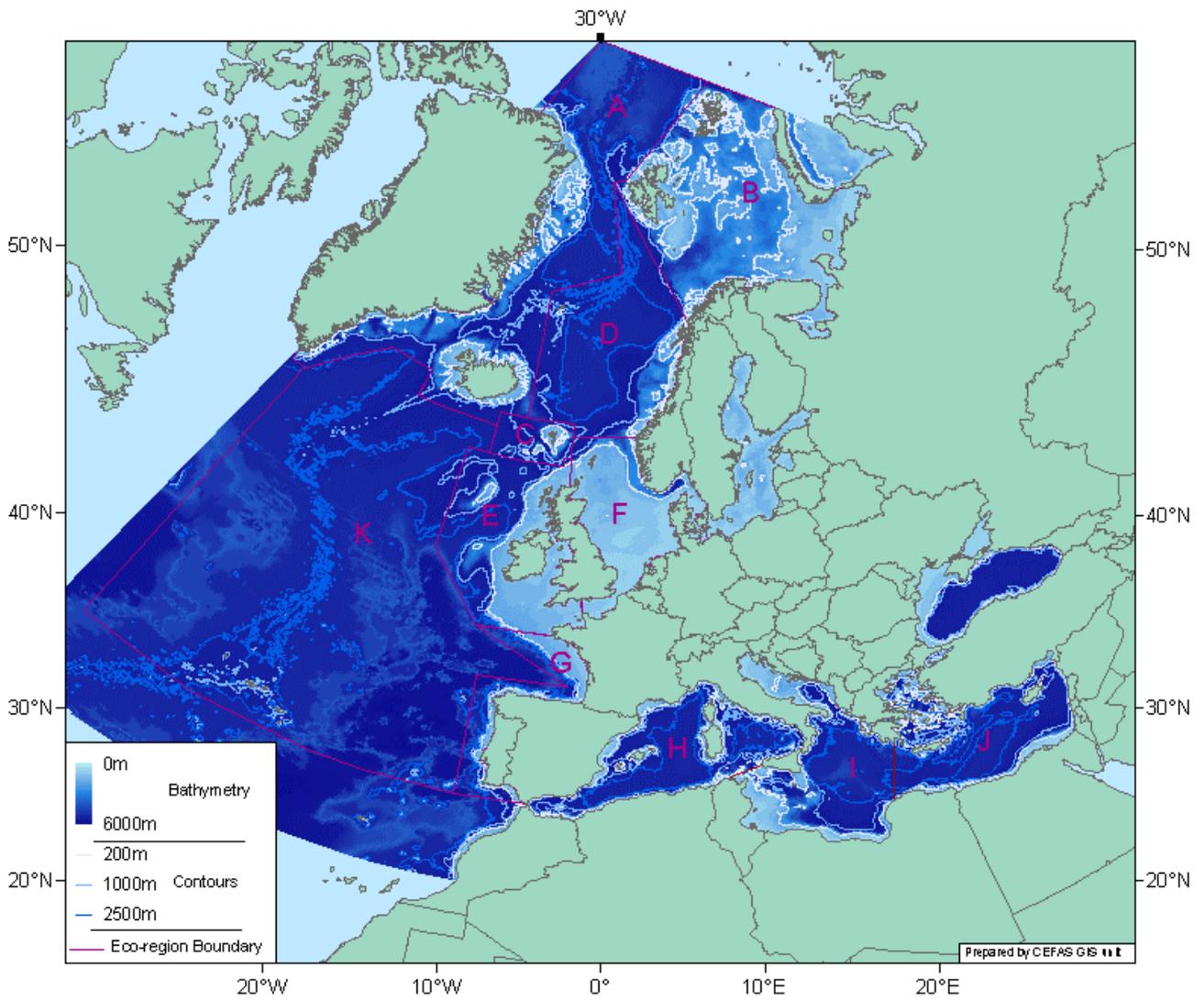


Figure 6. The boundaries of the proposed eco-regions Greenland and Iceland Seas (A), Barents Sea (B), Faroes (C), Norwegian Sea (D), Celtic Seas (E), North Sea (F), South European Atlantic Shelf (G), Western Mediterranean Sea (H), Adriatic-Ionian Seas (I), Aegean-Levantine Seas (J) and Oceanic northeast Atlantic (K) and the locations of 200m, 1000m and 2500m bathymetric contours and additional bathymetric information

6. Comments on the designation of eco-regions and further division into subregions

6.1. The following subsections contain justifications for the locations of eco-region boundaries and suggest some sub-regional boundaries. They are intended to demonstrate why boundaries were selected when such boundaries appear inconsistent with some of the evaluation criteria in Table 1, and to highlight how biogeographic/ oceanographic/ ecological, management/ human impacts and management/ policy constraints were balanced. The texts are not intended to be comprehensive justifications for, or descriptions of, the process of eco-region selection, nor do they consider all possible sub-regions.

6.2. The group did not decide whether the western Channel (ICES area VIIe) should be placed within the Celtic Seas or North Sea. Biogeographic considerations favour inclusion of the western Channel in the Celtic Seas, while management and policy considerations favour inclusion of the western Channel in the North Sea. Further consultation would be needed to resolve the status of the western Channel.

Greenland and Iceland Seas

6.3. There is evidence for a north-south biogeographical split around Iceland, but the management imperative of treating Iceland as a single unit was too great to allow a split on a biogeographical basis. It was also noted that a number of stocks, such as capelin, migrate between the northern and southern areas.

6.4. The Greenland and Iceland Seas eco-region comprises the shelves around Iceland, the Iceland Sea, the East Greenland shelf, and the western and larger part of the Greenland Sea.

6.5. The southwestern border of the Greenland and Iceland Seas eco-region has been drawn to include the shelves and slopes along southeastern Greenland and southwestern Iceland but to exclude the deep northern part of the Irminger Sea (border runs from 59°N 42°W to 62°N 38°W to 64°N 34°W to 64°N 27°W). The southern border includes the shelf and slope south of Iceland bordering the deep Iceland Basin to the east of the Reykjanes Ridge. The southern shelf of Iceland and the waters north of Iceland are ecologically closely connected. The Iceland capelin and cod stocks have spawning areas along the south and southwest coasts of Iceland. The larvae drift with the currents (Coastal and Irminger Currents) to nursery areas west and north of Iceland. The capelin have a seasonal feeding migration north in the Iceland Sea where they exploit the plankton production. They return to spawn by migrating with the southwards flowing East Iceland Current along the eastern side of Iceland.

6.6. In the east, the Greenland and Iceland Seas eco-region borders the Norwegian Sea eco-region. The part of the area that lies to the north of the Iceland Sea includes the northeast Greenland shelf and the western part of the Greenland Sea. This is an ice-covered and mainly high-Arctic area, but Atlantic water that recirculates in the Greenland Sea may give somewhat warmer conditions in the deeper part of the shelf and along the upper slope. There are few fisheries in this part of the eco-region. Arctic zooplankton which are produced in this area are partly advected with the currents (Jan Mayen and East Iceland Currents) into the Iceland and Norwegian Seas where they contribute to the rich feeding conditions for the large stocks of pelagic fish.

Barents Sea

6.7. The Barents Sea eco-region is similar to the Barents Sea Large Marine Ecosystem with the western border following the shelf edge to the deeper Norwegian Sea.

6.8. The shelf along the west coast of Svalbard is considered part of the Barents Sea eco-region. The surface waters of the northwestern Barents Sea flows southwesterwards along the eastern slope of the shallow Svalbard Bank as the cold Arctic Bear Island Current, turns around the Bear Island, and continues north as a cold coastal current along the western Spitsbergen shelf. The deeper shelf areas are also a nursery area for juvenile cod and haddock of the Barents Sea stocks. Ecologically therefore, the shelf is connected to the Barents Sea system. From a practical management point of view, it is advantageous to have the east and west coasts of Spitsbergen within the same ecosystem management unit.

Faroes

6.9. The Faroes eco-region corresponds to the Faroe Plateau Large Marine Ecosystem but an adjustment of the boundary has been suggested. The shelf around the Faroe Isles and the shallow Faroe Bank to the southwest form a distinct ecological unit with characteristic circulation pattern, plankton production and composition, and self-contained fish populations of cod, haddock and other species. The slopes around the shelf and bank areas are included in the eco-region. For practical purposes, the borders should correspond to those of ICES area Vb.

Norwegian Sea

6.10. The Norwegian Sea eco-region broadly corresponds to the Norwegian Sea LME but with a change in the northern border. The mid-Atlantic ridge continues north from Iceland through the Iceland Sea, then turns north-eastward from Jan Mayen as Mohn Ridge, before it turns north again through the Greenland Sea. The Lofoten Basin in the northern Norwegian Sea continues as a northwards extension to the east of the mid-Atlantic Ridge along Spitsbergen. The border of the Norwegian Sea eco-region is suggested to follow Mohn Ridge northeast from Jan Mayen and then north along 5°E to 80°N. Thus the deep extension from the Lofoten Basin in the eastern Greenland Sea is included in the Norwegian Sea eco-region. Part of the Norwegian Atlantic Current continues north along the Spitsbergen slope and into the Arctic Ocean through the Fram Strait. The northwards extension of the eco-region can be justified ecologically. The Atlantic water is ice-free and phytoplankton production is driven by seasonal warming. Zooplankton production is similar to that of the northern Norwegian Sea and there is an advection of zooplankton with the northwards current. Also the fish community along the slope of Spitsbergen resembles that further south, and commercially important species such as Greenland halibut have a continuous distribution north in this area.

Celtic Seas

6.11. ICES Area VIIe (western Channel) would be included in the Celtic Seas on biogeographic grounds. However, for management purposes there were good reasons to include it with the North Sea, since activities such as shipping and pollution control need to be managed for the Channel as a whole. The group propose that the decision whether to include the western Channel in the Celtic Seas or North Sea requires further consideration.

6.12. In including the entire western Channel in either the Celtic Seas or North Sea, the group ignored an apparently clear biogeographical division at approximately 50° N that was identified by Dinter (2001) and split the western Channel and parts of the Celtic Sea into northern and southern regions. Based on the evidence that Dinter (2001) reviewed and knowledge of water masses, fish and benthic invertebrate distributions in this area, this split was not considered justifiable.

6.13. The main differences between the Celtic Seas sub-region identified for the purposes of the OSPAR Joint Assessment and Monitoring Programme and the proposed Celtic Seas eco-region are that (a) the eco-region is defined by reference to ICES sea areas, rather than by reference to a natural feature, such as an isobath and (b) the eco-region extends substantially further west than the OSPAR sub-region.

6.14. The justification for the greater westwards extension lies in the changes in perception of the slopes of the continental shelf since the OSPAR sub-regions were defined in the mid-1990s. At that time, the emphasis was on defining an area for which consistent data was available, and there was little data for the areas west of the 200-metre isobath. The sub-region was therefore confined to the area shallower than this isobath. Since the mid-1990s, much more has become known about the slopes of the continental shelf. It is now clear that this a very important area for the well-being of the continental shelf, and that it contains important features, such a cold-water coral reefs, which are exposed to significant threats. It is therefore important that it should be managed consistently with the shallower shelf waters. This will be facilitated by including both the shelf and its slopes in the same eco-region. The proposed eco-regions are therefore designed, particularly in the Celtic Seas eco-region, to contain the whole of the slope down to 1 000 metres- the greatest depth to which cold-water coral are usually distributed.

North Sea

6.15. In the Kattegat, both ecological and management arguments can be found for the inclusion of the Kattegat in either the North Sea or the Baltic eco-region. On balance, however, it is recommended that the Kattegat should be included in the North Sea eco-region. The ecological and management arguments depend on the balance between considerations relating to the upper waters (which are heavily influenced by the Baltic) and the deeper waters (which are equally influenced by the Atlantic/North Sea). At present the Kattegat forms part of the maritime areas of both the Helsinki and OSPAR Conventions. There could be a case, in spite of the wish to have unambiguous eco-regions, for preserving this situation. However, inclusion of the Kattegat in the North Sea eco-region is recommended for the reasons given below.

6.16. Kattegat is a fairly shallow area with a two-layered and strongly stratified water mass structure. The brackish water flowing out from the Baltic forms the upper layer, while North Sea water flowing south forms the lower layer. The mean salinity of the brackish water as it flows through the Danish Belts into Kattegat is about 10‰, while the mean salinity as it exits Kattegat in north is about 25‰. This shows that roughly two portions of North Sea water from the deeper layer mixes with one portion of the brackish Baltic water as it flows northwards through Kattegat. In terms of circulation and hydrography, therefore, the North Sea water has a dominant influence in Kattegat. This is reflected also in the biological conditions and the biota shows in general stronger similarity to that in the North Sea than to the Baltic Sea. In terms of eutrophication

assessment, the Kattegat is very much linked to the circulation in the eastern part of the North Sea. Nutrient enriched water from the coastal areas of the southeastern North Sea is likely to affect the water quality (e.g. oxygen conditions) in Kattegat due to the circulation described above.

6.17. In terms of fish stocks, Kattegat form part of the distribution area for several stocks in Skagerrak and also for some stocks in the wider North Sea. Kattegat is, therefore, often included with Skagerrak in assessments of stocks by ICES. This is the case for plaice, sole, whiting, sandeel, and sprat. Kattegat is also part of the distribution area for some stocks in the Baltic. Thus, autumn spawning herring from the western Baltic may migrate out to feed in Kattegat and even in Skagerrak.

6.18. The boundary of OSPAR Area II (Greater North Sea) was formerly at 5° W, but the group could not see an oceanographic, biogeographical, ecological or management justification for this and propose that the boundary is moved to 4°W where it is consistent with the western boundary of ICES Area IVa.

6.19. The benthic fauna of the deep Norwegian trench would be more closely related to that of the Norwegian Sea. On balance, however, the surface waters above the trench are affected by the outflow from the Baltic and so this area is better treated as part of the North Sea.

South European Atlantic Shelf

6.20. In setting the boundary of the South European Atlantic Shelf at 48°N, the group ignored an apparently clear biogeographical division at approximately 50° N that was identified by Dinter (2001) and used by him to split the western Channel and parts of the Celtic Sea into northern and southern regions. Based on the evidence that Dinter (2001) reviewed and knowledge of water masses, fish and benthic invertebrate distributions in this area, this split was not considered justifiable. Moreover, the Dinter (2001) Lusitanian province was differentiated into a Northern and Southern warm subprovince with a cool subprovince in between. This discrimination was not considered sufficiently profound to justify the division of the South European Atlantic Shelf into more than one eco-region.

6.21. Consistent with the requirement to include the shelf and slope to 1000m depth in the same eco-region, the western boundary of the South European Shelf Seas in the vicinity of the ICES areas VIIIa and VIIIb was redefined as a line from 48°N, 12°W to 44°30'N 3°W rather than following the ICES boundary. It was recognised that this change from the boundary of the existing ICES areas would mean that historical data collected in these areas might not easily be compiled and analysed at the scale of the new eco-region, but the management imperative of keeping the slope and shelf in the same eco-region was considered to override this concern.

6.22. If subdivisions of the South European Atlantic Shelf are required, it is recommended that the divisions are based (1) on the main river catchments affecting this eco-region and (2) on topographical and oceanographic features of the shelf.

6.8. Western Mediterranean Sea, Adriatic-Ionian Seas and Aegean-Levantine Seas

6.23. For the Mediterranean, the group concluded that the levels of differentiation between eco-regions used in the Atlantic, when applied to the Mediterranean evidence,

supported a division into three eco-regions. However, it is suggested that each of the three eco-regions in the Mediterranean could be subdivided into two sub-regions (Figure 7). These would be

Western Mediterranean Sea

Sub- region 1A : *Ligurian-Catalan-Algerian Seas*

Sub- region 1B : *Tyrrhenian Sea*

Adriatic-Ionian Seas

Sub- region 2A : *Adriatic Sea*

Sub- region 2B : *Ionian Sea*.

Aegean-Levantine Seas

Sub- region 3A : *Aegean Sea*

Sub- region 3B : *Levantine Sea*

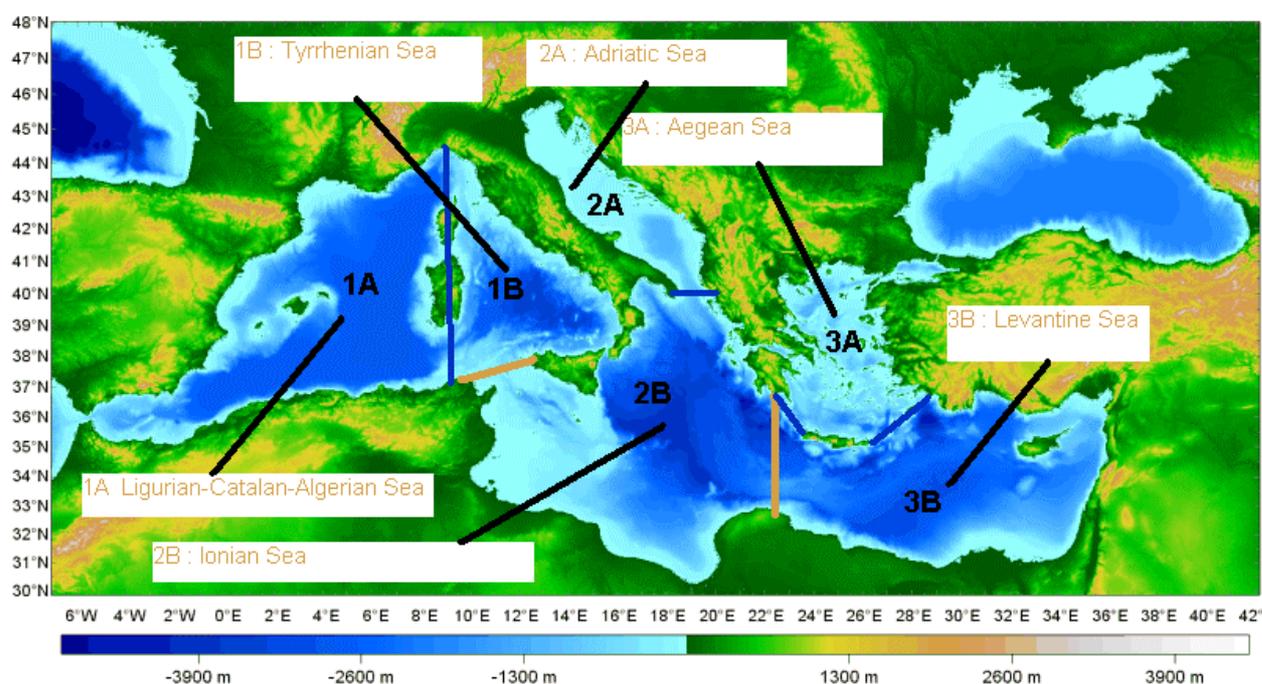


Figure 7. The three eco-Regions for the Mediterranean Sea (bordered by red lines) and the proposed divisions and names of sub-regions (bordered by blue lines).

Oceanic northeast Atlantic

6.24. The Oceanic northeast Atlantic is treated as a single eco-region because the latitude of any division E-W in the Oceanic north-east Atlantic is particularly difficult to define when there is a near continuum in water temperature. An E-W line at around 43° N might be considered as sub-regional division, but would not be sufficiently well defined to be adopted as an eco-region boundary. The location of the E-W line could be guided by the division between the Longhurst (1998) NADR and NAST provinces, which lies at 43° N.

7. References

Dinter, WP (2001) Biogeography of the OSPAR Maritime Area. Federal Agency for Nature Conservation, Bonn.

Longhurst, A. (1998) Ecological geography of the sea. Academic Press, San Diego. 398pp

8. Appendices

Annex 1. Participants at the ICES meeting (ICES HQ Copenhagen 19-21 October 2004) to provide a response to the EC request for information and advice about appropriate eco-regions for the implementation of an ecosystem approach in European waters

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Annex 2. Definitions of areas from Regional sea-conventions

BARCELONA CONVENTION

Article 1 - Geographical Coverage

1. For the purposes of this Convention, the Mediterranean Sea Area shall mean the maritime waters of the Mediterranean Sea proper, including its gulfs and seas, bounded to the west by the meridian passing through Cape Spartel lighthouse, at the entrance of the Straits of Gibraltar, and to the east by the southern limits of the Straits of the Dardanelles between Mehmetcik and Kumkale lighthouses.
2. The application of the Convention may be extended to coastal areas as defined by each Contracting Party within its own territory.
3. Any Protocol to this Convention may extend the geographical coverage to which that particular Protocol applies.

BUCHAREST CONVENTION

Article I - Area of application

1. This Convention shall apply to the Black Sea proper with the southern limit constituted for the purposes of this Convention by the line joining Capes Kelagra and Dalyan.
2. For the purposes of this Convention the reference to the Black Sea shall include the territorial sea and exclusive economic zone of each Contracting Party in the Black Sea. However, any Protocol to this Convention may provide otherwise for the purposes of that Protocol.

HELSINKI CONVENTION

Article 1 - Convention Area

This Convention shall apply to the Baltic Sea Area. For the purposes of this Convention the "Baltic Sea Area" shall be the Baltic Sea and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57 44.43'N. It includes the internal waters, i.e., for the purpose of this Convention waters on the landward side of the base lines from which the breadth of the territorial sea is measured up to the landward limit according to the designation by the Contracting Parties.

A Contracting Party shall, at the time of the deposit of the instrument of ratification, approval or accession inform the Depositary of the designation of its internal waters for the purposes of this Convention.

OSPAR CONVENTION

Article 1 - Definitions

For the purposes of the Convention:

- (a) "Maritime area" means the internal waters and the territorial seas of the Contracting Parties, the sea beyond and adjacent to the territorial sea under the jurisdiction of the coastal state to the extent recognised by international law, and the high seas, including the bed of all those waters and its sub-soil, situated within the following limits:
 - (i) those parts of the Atlantic and Arctic Oceans and their dependent seas which lie north of 36° north latitude and between 42° west longitude and 51° east longitude, but excluding:
 - (1) the Baltic Sea and the Belts lying to the south and east of lines drawn from Hasenore Head to Gniben Point, from Korshage to Spodsbjerg and from Gilbjerg Head to Kullen,

- (2) the Mediterranean Sea and its dependent seas as far as the point of intersection of the parallel of 36° north latitude and the meridian of $5^{\circ} 36'$ west longitude;
- (ii) that part of the Atlantic Ocean north of 59° north latitude and between 44° west longitude and 42° west longitude.

Annex 3. Claims of Maritime Jurisdictional Zones by Member States of EU and Other States in the North-East Atlantic (Breadth in Nautical Miles)

	TS	CZ	EEZ	FZ
Belgium*	12	24	DBC	+ ³
Cyprus*	12	24	200	
Denmark	12		200	200 ⁴
Estonia	12 ⁵		DBC	
Finland*	12	14		DBC
France*	12	24	200 ⁶	
Germany*	12		DBC	
Greece*	6 ⁷			
Iceland*	12		200	
Ireland*	12			200
Italy*	12			
Latvia	12		DLM	
Lithuania*	12		DLM	
Malta*	12	24		25
The Netherlands*	12		DBC	
Norway*	12	24	200	200 ⁸
Poland*	12		DLM	
Portugal*	12	24	200	
Spain*	12	24	200 ⁹	+ ¹⁰
Slovenia*				
Sweden*	12		+ ¹¹	
United Kingdom*	12 ¹²		200 ¹³	200 or 12 ¹⁴

TS: territorial sea CZ: contiguous zone EEZ: exclusive economic zone FZ: fisheries zone
 *: party to the UN Convention on the Law of the Sea DBC: defined by coordinates
 DLM: defined by the delimitation line or an equidistance line in the absence of a maritime delimitation line

*Land-locked States (Austria, Czech Republic, Hungary, Luxemburg, Slovakia) in the EU are excluded from the list. Iceland and Norway are not member States of the EU.

**Denmark, Iceland, Ireland Norway and the United Kingdom have extended continental shelf claims beyond 200 nautical miles in accordance with Article 76 of the United Nations Law of the Sea Convention.

³ Coterminous with the exclusive economic zone

⁴ For Greenland and Foroe Islands

⁵ In some parts of the Gulf of Finland, defined by coordinates

⁶ Applies to the North Sea, the English Channel and the Atlantic Ocean from the Franco-Belgian border to the Franco-Spanish border, Saint Piere and Miquelon, French Guiana, Réunion, New Caledonia, French Polynesia, Franch Southern and Antarctic Lands, Wallis and Futuna, Tromelin, Glorioso, Juan de Nova, Europa and Bassad da India Islands, Clipperton Island, Mayotte, Guadeloupe and Martinique.

⁷ Ten-mile limit applies for the purpose of regulating civil aviation.

⁸ Jan Mayen and Svalbard

⁹ In the Atlantic Ocean

¹⁰ In the Mediterranean Sea

¹¹ To be determined by agreement or up to equidistance line

¹² Also three nautical miles. (Three nautical miles in Anguilla, Guernsey, British Indian Ocean Territory, British Virgin Islands, Gibraltar, Monserrat and Pitcairn; 12 nautical miles in United Kingdom, Jersey, Bermuda, Cayman Islands, Falkland Islands, Isle of Man, St. Helena and Dependencies, South Georgia, South Sandwich Islands, and Turks and Caicos Islands.)

¹³ Bermuda, Pitcairn, South Georgia and South Sandwich Islands.

¹⁴ 12 nautical miles in Guernsey; 200 nautical miles in United Kingdom, Anguilla, British Indian Ocean Territory, British Virgin Islands, Cayman Islands, Falkland Islands, Monserrat, St. Helena and Dependencies, and Turks and Caicos Islands.