REPORT OF THE

STUDY GROUP ON MARINE HABITAT MAPPING

The Hague, The Netherlands
10–13 April 2000

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION

At its 86th Statutory Meeting, the ICES Council decided to establish a Study Group on Marine Habitat Mapping (SGMHM) [ICES C.Res. 1998/2:39]. Although habitat mapping and classification are specifically mentioned in the remits of the Marine Habitat Committee (MHC), it was felt that there was not enough expertise in the Committee itself to link this kind of work effectively with initiatives that have already started. SGMHM was established to ensure wider expert participation to help MHC to fulfil its tasks in an efficient way. In order to do this SGMHM convened its first meeting in Oban, Scotland from 6–10 September 1999, in conjunction with a joint OSPAR/ICES/EEA Workshop on Habitat Classification (OSPAR/ICES/EEA, 1999). SGMHM concluded in its report on the outcome of the workshop (ICES CM 1999/E:10) that there was considerable support up to level 3 of the EUNIS classification system under development at the workshop. There was also a need for further elaboration of levels 4 and 5 of this classification, as well as a need for validation of the biotopes already proposed. Furthermore, it was recognised that the proposed classification did not give full coverage of the ICES area, and that a further extension should be aimed for. Finally, it was felt that undertaking joint efforts in habitat mapping would be beneficial to the interests of ICES. Three proposals, designed to advance developments in marine habitat mapping, were brought forward which, in the opinion of SGMHM, could advance developments in marine habitat mapping:

a) produce a detailed habitat map of the North Sea using existing data. This would test data access and cooperation among Contracting Parties.
b) carry out a joint cooperative comparison of deep-sea survey technologies and explore the possible development of standards in this field.
c) carry out a pilot project for habitat mapping to EUNIS level 3 for the entire OSPAR area. This would be an effective test of the EUNIS classification.

On basis of this work, draft Terms of Reference (TORs) were formulated to give guidance to the work of SGMHM in 2000. These TOR were amended and adopted by ICES at its Annual Science Conference in Stockholm, 1999.

2 TERMS OF REFERENCE

ICES C.Res. 1999/2:E:06

The **Study Group on Marine Habitat Mapping** [SGMHM] (Chair: Dr E. Jagtman, Netherlands) will meet in The Hague, Netherlands from 10–13 April 2000 to:

a) review recent developments in marine habitat classification, in particular, review in detail the outcome of the OSPAR/ICES/EEA Workshop on Habitat Classification and Biogeographic Regions (WKCLAS) and the Aquatic Restoration and Conservation (ARC) Workshop on Habitat Classification; this review should be passed to the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT);

b) report on progress made in the joint OSPAR/ICES/EEA proposals on habitat mapping projects (habitat map of the North Sea or Wadden Sea, deep sea map, OSPAR area map to level 3 of the EUNIS classification system) made at WKCLAS, and discuss whether SGMHM can coordinate the proposed projects;

c) work closely with WGEXT to comment on present-day mapping technologies in relation to the requirements of ICES;

d) assess whether further development of (parts of) the standing classification is feasible, provided that there is enough expertise within SGMHM, and if so, take action to build further on this classification;

e) assess whether and how the Benthos Ecology Working Group (BEWG) should be involved in validating the biotopes already proposed;

f) finalise details of a Theme Session at the 2000 Annual Science Conference on Classification and Mapping of Marine Habitats.

3 OVERVIEW

The Study Group on Marine Habitat Mapping (SGMHM) meeting was held in The Hague, and was hosted by the National Institute for Marine and Coastal Management/RIKZ. The meeting was attended by 20 participants from Belgium, Canada, Germany, Ireland, the Netherlands, Norway, Spain, the United Kingdom, and the United States. Of the participants present, seven have been officially appointed as SGMHM members. The list of participants is attached as Annex 1.

On Monday 10 April, the Chair of SGMHM, Eric Jagtman, welcomed the participants to the meeting. He introduced the Terms of Reference for the meeting, and explained the role and position of SGMHM within the ICES framework. By referring to the strategic objectives of the Marine Habitat Committee it was made clear how SGMHM can contribute to the overall strategic plan of ICES.

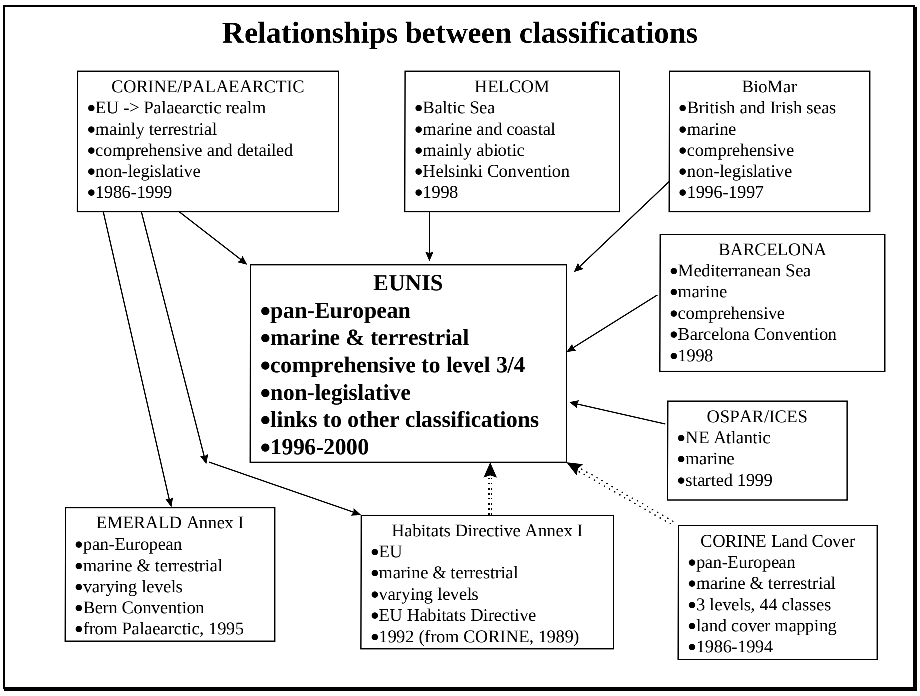
Subsequently, the Agenda for the meeting was discussed and adopted. It is attached as Annex 2.

4 REVIEW OF DEVELOPMENTS IN HABITAT CLASSIFICATION

4.1 EEA's EUNIS Classification (C.E. Davies; Annex 3)

Cynthia Davies, on behalf of the EEA, presented the EUNIS habitat classification (Davies and Moss, 1999). This classification builds upon the CORINE/Palearctic classification, while classification systems developed by HELCOM for the Baltic Sea, the Barcelona Convention for the Mediterranean Sea, BioMar for the British and Irish Sea, and OSPAR for the Northeast Atlantic are slotted in (Figure 4.1.1). A full description of the marine part of this classification system is given in Annex 3. The classification of marine habitats is largely derived from the BioMar project (Connor *et al*., 1997). The development of this classification has continued through a number of successive revisions, expert working groups, and consultations with experts, starting in June 1996. The round of consultations ended with the Oban Workshop (WKCLAS) in September 1999. In November 1999 the EUNIS report was completed and made available for wider consultation. Extracts from this report relating to marine habitats were circulated prior to the meeting in The Hague to receive feedback from SGMHM.

Figure 4.1.1. Diagram showing the relationships between several classification systems.



The aim of the EUNIS classification is to:

- collate information in a consistent manner;
- provide for a common framework and language for a Pan-European habitat classification;
- give the opportunity to slot in detailed classifications (levels 4, 5) in the general framework that EUNIS provides.

The Oban Workshop (WKCLAS) has resulted in some major changes to the EUNIS classification, in particular:

- for deep waters a distinction was made between the abyssal zone (A5) and the bathyal zone (A6);
- a level 3 revision was adopted for sublittoral sediments (A4);
- infralittoral and circalittoral zones are now distinguished at level 4;
- the pelagic zone was not discussed officially in Oban, but informal contact with workshop participants has resulted in a proposed classification for pelagic habitats (A7).

The EUNIS classification has now been made public on the world-wide web (www.mrw.walloniw.be/dgrne/sibw /EUNIS/home.html). For a period of (at least) twelve months the current classification to level 3 will be fixed. Comments and feedback are awaited by Cynthia Davies and Dorian Moss at the UK Centre for Hydrology and Ecology (e-mail addresses: cd@ceh.ac.uk and dor@ceh.ac.uk). During the review period there is opportunity for proposing new units at levels 4 and 5, to be slotted into the existing framework. For the OSPAR/ICES area this will largely be achieved through the Second OSPAR/ICES/EEA marine habitat mapping workshop (see below). New proposals will be accepted, provided that they meet the general criteria used in the current classification, and provided there are no duplicates in the standing classification. To this purpose, SGMHM was invited to suggest new habitat units at levels 4 or 5. It was suggested that, if ICES were to come up with more detailed proposals for a classification, a different numbering from the EUNIS classification should be used. As to the matter of the validation of the EUNIS level 3 classification, it was concluded that mapping of the OSPAR area at the level 3 will be an important test for the consistency of the classification. Furthermore, a field testing programme will be run, starting by the end of April 2000.

4.2 Canadian Review of EUNIS Level 3 Habitat Classification (P. Boudreau)

The second point of the agenda was a report of a review of the EUNIS habitat classification down to level 3, made by a Canadian group, presented by Paul Boudreau from the Bedford Institute of Oceanography, Dartmouth, NS, Canada.

The classification system was overall very well received and is considered to be a good starting point for further progress in habitat classification. Some difficulties were mentioned:

a) The EUNIS classification uses a mixture of substrate/sediment classifications. SGMHM felt that in order to be more consistent the Wentworth classification (1922) should be incorporated, which is regarded to be a basic tool for geologists.

b) The habitats distinguished up to level 3 should be physical. The biology should only come into the system at level 4.

c) It was felt that processes rather than substrate can be important in distinguishing between habitats.

Following these comments David Connor stated that the BioMar classification is related to the Wentworth classification, but that overall, the classification is led by the biology. However, several participants expressed the view that difficulties will arise on the basis of qualitative definitions (gravel, medium sands) or if the classification were to be tested outside Europe (glacial shelf). They conveyed the message that the geology provides a firm basis for classification and subsequent mapping of habitats. Moreover, the abiotics of the system can be easily mapped. It was noted that these maps may form the basis for the strategic design of benthic surveys.

4.3 Results of the Aquatic Restoration and Conservation Workshop (R. Allee; Annex 4)

Becky Allee presented the results from a workshop held in USA last October with participants from all over the United States, except for Alaska. One of the objectives of the workshop was to develop a framework for a national classification system to be used for monitoring habitats, in order to help managers in protecting and conserving threatened ecosystems. At the workshop the EUNIS classification was presented, but as this classification does not provide for a number of major habitat complexes in the USA (coral reefs, mangroves) it was decided to explore the feasibility of a classification system better adapted to North American conditions.

The system presented by Becky Allee is essentially different from EUNIS. While EUNIS aims to be a generic, hierarchical system, this one is descriptive and area-specific. It distinguished up to 13 levels, which in fact can be compared with parameters from the EUNIS system. In Annex 4 the different criteria (levels) are given. The 12th and 13th levels consider substratum and ecotypes, and modifiers and eco-units, respectively. Eco-types, as defined by the workshop, are descriptions of biological communities and may be named for a dominant biotic element, such as sea-grasses, coral reefs, mangroves, etc., or in cases where a readily visible biotic element is missing, eco-types may be named for the substratum and slope, such as mud flat, sand beach. Eco-units are refinements of the eco-types by local modifiers to describe a particular location or characteristic type. Possible modifiers may be temperature, local energy regimes, salinity, history of extreme events, and many more.

The USA workshop was interested in the EUNIS system, but had some criticism. For example, EUNIS uses the criteria exposed/non-exposed and sediment type right in the beginning, while the ARC Workshop was in favour of using these criteria lower down in the decision tree.

The conclusion of the discussion about the two different systems EUNIS and ARC was that although the systems take a different view on ranking habitats, the systems do not differ essentially. Becky Allee announced that after the ARC Workshop additional comments have been received. It has therefore been decided that the ARC Workshop should reconvene (in October 2000 or earlier) to reconsider the classification under development. This meeting will also attempt to produce a series of habitat maps.

4.4 Discussion

This item on the Agenda was to explore whether there is a common ground for the development of an ICES habitat classification. The EUNIS classification certainly provides a common basis for classification, and it may be very useful to the needs of ICES. Its applicability however is as yet fairly limited, since EUNIS is primarily a European-based classification system. Although it takes into account classifications used under the Barcelona Convention, HELCOM etc. (see Figure 4.1.1) the members of SGMHM expressed the feeling that for large areas data still seemed to be missing or that important characteristics of ecosystems are not dealt with properly in EUNIS (e.g., the dynamics and different features of anoxic sediments in the Baltic Sea). Furthermore, it needs to be assessed whether the EUNIS classification is going to work out well for the Atlantic (US and Canadian) waters. Many of these issues can be readily addressed through further development of EUNIS (particular levels 4 and 5) and through practical testing of the system. The Study Group concluded that the EUNIS classification at level 3 could be taken as a template for the development of an ICES classification system.

From the Oban Workshop and the ensuing discussion in SGMHM it appeared that classification of marine habitats on a large-scale area is feasible, if it is based primarily on hydrographic and geological features of the system under consideration. These types of classifications would generally fit into the current EUNIS classification at levels 2 and 3, and will provide a solid basis for habitat classification within the ICES area. Physical habitat description together with biological ground-truth sampling could form the basis for the creation of large area **predicted** biotope maps. Biological data should then be added, overlaying the physical habitats, at the level of functional groups (level 4) or species (level 5). This provides a big challenge to scientists involved, as it is recognised that, especially in the deeper parts of the Atlantic, availability of biological data will be very poor. In collecting (biological) data attention should primarily focus on the shelf seas and the slope, as these are the marine areas that experience the highest pressure from human activities. SGMHM feels that by approaching the classification issue in this way, working from coarse to fine, we can further the development of a classification system that will be of good use to ICES.

4.5 Other Developments: Second OSPAR/ICES/EEA Workshop on Marine Habitat Classification (Annexes 5 and 6)

David Connor introduced the plans for this workshop, that earlier received support from OSPAR as well as ICES. The terms of reference for this workshop, as decided upon by OSPAR, are described in more detail in Annex 5 to provide approved TOR from the ASMO meeting in March. The workshop is to take place at the Southampton Oceanographic Institute (UK) from 18–22 September 2000. Its prime objective is to further the development of the EUNIS classification, in particular by defining additional habitat units at levels 4 and 5 of the classification. In addition to this, discussions will focus on how to deal with bio-geographical variations, and will there be room for a first evaluation of the pelagic habitats proposed in EUNIS. The Study Group decided to strongly support the continued participation of ICES representatives in the continued development, testing and implementation of the EUNIS classification for application to all the ICES areas.

The question was raised how EUNIS is going to deal with recommended amendments from the Southampton Workshop. Cynthia Davies indicated that she was open to receive feedback on the system, provided that this feedback is given by a body of ample significance. She therefore urged SGMHM members to take part in the Southampton Workshop. After that, SGMHM discussed how this workshop could be as well tailored to the needs of ICES, in order to enhance participation in the workshop. To this end, recommendations were drafted by Paul Boudreau and subsequently approved by SGMHM. These recommendations were handed over to David Connor who ensured SGMHM that he would fit in the recommendations into the final programme of the workshop. The recommendations formulated by SGMHM are given in Annex 6.

4.6 Validation of Biotopes already Proposed

At the Oban Workshop it was suggested that the ICES Benthos Ecology Working Group (BEWG) might be able to help in validating the EUNIS classification. Four members of BEWG were present at the meeting (Karel Essink, Heye Rumohr, David Connor, Jan Helge Fosså). They offered that BEWG will carry out a preliminary evaluation of the EUNIS classification. In particular they offered an exploration of functional biological groups to be distinguished at level 4 of the classification. These functional groups should be defined in a such a way that they are able to cover a broader range of geographical areas. On top of this, recognising that members of BEWG are frequently involved in sampling of benthic communities, BEWG was asked to encourage its members to use field data for testing the validity of the EUNIS classification. It was decided that BEWG will discuss these topics at their upcoming meeting in Maine, USA in April 2000. BEWG will report back to SGMHM as well as directly to EEA (Cynthia Davies).

5 PROGRESS IN HABITAT MAPPING

5.1 Short Presentations on Mapping Projects (Annex 7)

Craig Brown: Development of sub-tidal biotope mapping techniques in UK waters, with emphasis on gravel substrates

A research project from CEFAS was presented. It is a 3-year R&D project to characterise the seabed using various physical and geophysical techniques. Based on the results of different techniques (sidescan sonar and the seabed discrimination systems, RoxAnn and QCT View) the seabed of several areas could be divided into acoustically distinct regions. The acoustic outputs from each region were “translated” into sediment types from cobbles and gravels to sand and mud. Biological samples were taken in each of the acoustically distinct regions. Although statistical analysis of the data showed a high degree of variation between replicate samples from each of the acoustically distinct regions, within most of these regions there is evidence of statistically distinct biological assemblages.

Comments from the audience: this is an excellent piece of work. There was a question whether the biological data modified the interpretation of the acoustic data. The answer was that that was not yet done, with the remark that the seabed areas investigated were homogeneous areas. Furthermore it was noted that in case of veneers, a biotope may reflect the layer underneath instead of the surface layer. This is something one should be well aware of.

Karel Essink: Monitoring of some general habitat features in the Trilateral Monitoring and Assessment Programme (TMAP) for the Wadden Sea

Within the framework of the Trilateral Cooperation on the Protection of the Wadden Sea (Denmark, Germany, The Netherlands) a Trilateral Monitoring and Assessment Programme (TMAP) was developed. The TMAP comprises a wide set of specific parameters providing information on the chemical and biological status and developments of the Wadden Sea. In addition, human activities are monitored. Presently under development is a set of so-called general parameters. These comprise among other properties aspects of the geomorphology (extent of high/low tidal flats, extent of sediment types) and hydrology (salt marsh, inundation frequency, wave climate) of the area, climate and weather conditions.

Matthew Service: Habitat mapping in Northern Ireland

In Northern Ireland habitat mapping is being undertaken in the inshore waters and sea loughs. The two principal driving forces are the need to map shellfish resources and special areas of conservation (SACs). The role of habitat mapping as a tool in stock assessment for certain (e.g., *Nephrops*) fisheries was discussed. The need to develop appropriate quality control structures was stressed.

Dick Pickrill: The application of geoscience to marine habitat research in Canada

The SEAMAP proposal was introduced. It is a multi-year, multidisciplinary research proposal, developed by three government departments (Fisheries and Oceans, Natural Resources Canada and the Department of National Defence). SEAMAP will provide basic seabed mapping data for sustainable management of offshore resources. Applications include fisheries management, offshore mineral resource assessment, selection and management of Marine Protected Areas, siting of offshore structures (platforms, pipelines and cables, and national defence). Systematic data acquisition will incorporate multibeam bathymetry, sidescan sonar, high resolution seismic reflection profiling, grab sampling and bottom photography to characterise sediments and biotopes. Data and interpretive maps will be archived in GIS format and output as electronic charts, maps and interpretive reports. Maps for bathymetry, habitats, contaminants, sediment types, mineralogical resources and geological features have many uses, e.g., increasing the efficiency of scallop fisheries.

James Massey: GIS and habitat mapping as a tool for environmental risk assessment in the offshore oil and gas industry in the North Sea

The presentation outlined the problems with environmental risk assessment in the North Sea. There is currently little biology taken into account and this makes assessment of the impact difficult. The project is using a GIS to visually represent existing species, and physical data, categorising these areas into biotopes using the suggested systems and comparing these to statistically analysed groupings. The biotopes are then assessed for sensitivity to physical, chemical and biological factors from the same system as the MarLIN project. The final representation is designed to be accessible to several levels of users to aid its application.

Steven Degraer, Vera van Lancker, and Geert Moerkerke: Mapping the marine benthic habitat: a biogeological approach

The project "Intensive evaluation of the evolution of a protected benthic habitat: HABITAT" was presented. The marine protected area in question is the Western Coastal Banks in the Belgian Coastal Zone. The area is an important overwintering place for the Common Scoter (*Melanitta nigra*). In order to describe the T0 situation of the benthic habitat, data on bathymetry, sedimentology and hydrodynamics are gathered to make a bathymetry map and a geomorphological map. Correlations between digital sidescan sonar recordings and sedimentology and between sedimentology and macrobenthos are established. The project HABITAT will examine which information about macrobenthos can be gathered from sidescan sonar recordings and try to develop a standardised macrobenthos sidescan sonar interpretation and create a generalised "habitat" map of the complete protected area.

Jan Helge Fosså: Presentation of the present status of the mapping of deep water corals and planned MHM project "MAREANO"

The present status of the mapping of deep-water corals and the planned Norwegian MHM project "MAREANO" was presented. The presence/absence of coral reefs along the Norwegian continental shelf was investigated. To keep the costs low, information on the presence of *Lophelia pertusa* was collected from fishermen, literature and reports from Statoil, the Norwegian Directorate of Fisheries and the Institute of Marine Research. Reports of reefs damaged by bottom trawling have been mapped as well. The large reef complex on the Sula ridge was mapped by means of multibeam echosounding. This rapid mapping combined with video recordings of these areas has led directly to the protection of two reef areas. The MHM project MAREANO is planned by five major governmental institutions and will provide information on: bathymetry, marine habitats, biological diversity and natural resources coupled to the seabed, baseline data on contaminants, baseline data on sediments, sediment types, mineralogical resources and geological features. The study area is on the mid-Norwegian shelf and the Vøring Plateau.

Dick de Jong: HABIMAP: a GIS-guided method to make ecotope and habitat maps

After a short explanation of HABIMAP, a demonstration was given of a GIS application on a part of the ICES area. By zooming in on the North Sea and the Wadden Sea, different examples of HABIMAP were shown. For this special occasion, the HABIMAP classification was converted to the EUNIS classification. Is was no problem at all to use level 3 of EUNIS, while for level 4 the HABIMAP types are used. It has to be determined how these classes can fit into EUNIS, whether they are new classes or can be combined with already existing classes. It has to be noted that the definitions of habitat and ecotope are not the same as those used in the EUNIS classification. It was pointed out that this application could be used as a general framework where regional maps can be put in.

5.2 Current Status of Oban Proposals on Habitat Mapping

At the 1999 meeting of SGMHM three proposals were designed to advance developments in marine habitat mapping (see Section 1 of this report). This section reports on SGMHM's discussions about these proposals. Amended versions were circulated prior to the meeting. The first is about the organisation of a workshop on habitat mapping concentrating on survey technologies (see Section 5.2.1). The OSPAR Environmental Assessment and Monitoring Committee (ASMO) reviewed the recommendations for this workshop, but turned it down for reasons of an agenda already heavily loaded with workshops. ACME, being aware that the SGMHM was to deal with these issues in its April 2000 meeting, asked the Study Group to review the plans for the proposed workshop on mapping/survey technologies. The other two are proposals for producing habitat maps for the whole OSPAR area (Section 5.2.2) and the southern North Sea (Section 5.2.3).

5.2.1 ICES Workshop on Deep-Water Survey Technologies and the development of standards for marine habitat mapping (proposal by Norway, supported by ICES ACME; Annex 8)

The proposal was introduced by Jan Helge Fosså. He asked for comments on the proposal. A small subgroup produced a revised version of the proposal that is presented in Annex 8. The following adaptations were made to the proposal:

a) In the title, “Deep Sea” has been changed into “Deep-Water”, while within the text a sentence has been added: “the intention is to cover a range of environments from shelf depths to the deep sea”.

b) Because OSPAR decided not to support this workshop, OSPAR has been deleted from the title. Later this year OSPAR can be asked again.

SGMHM felt that this workshop provides the Study Group with an excellent opportunity to explore issues such as complementarity of survey techniques and common data formats. Because of the cross-disciplinary character of the workshop this will be extremely useful to the needs of the Study Group. Therefore it was decided that SGMHM will give active support. Jan Helge Fosså announced that the IMR is willing to host the workshop, and that IMR will start preparations for the organisation of the workshop shortly. Several members of SGMHM expressed their interest in the workshop and asked for the date of the workshop to be set soon, so that they can make reservations to participate in the workshop.

5.2.2 David Connor: Habitat mapping of the OSPAR area (Annex 9)

This proposal seeks to produce a fairly simple habitat map for the whole of the OSPAR area. This map should use a rapid and easy collation of existing data, at (initially) a coarse level of detail for specified habitats. It was introduced by David Connor, who explained that he is now awaiting official approval by OSPAR to move ahead with this proposal. He announced that this approval for funding is vital; this project will not go through without funding. Connor invited SGMHM to comment on the TOR, which resulted in a modification of the proposal, that is included in this report as Annex 9. On the basis of the modifications adopted, SGMHM decided to give full support to this proposal. It was recognised that this proposal and the proposal on the benthic mapping of the southern North Sea have very much in common. It was therefore stressed that it is important that both projects work in close conjunction with each other.

5.2.3 Proposal for North Sea benthic habitat mapping (D.J. de Jong; Annex 10)

This proposal was introduced by Dick de Jong. He explained that the objective of the proposal is to test the EUNIS classification up to level 3, by producing a habitat map for an international area (southern North Sea). Moreover, this activity will test data availability between countries as well. He demonstrated an application (in Map Objects) showing a simplified depth-class map for the ICES area as a whole. This map could serve as a good starting point to make EUNIS habitat maps at level 3, and to develop level 4 classification, provided that enough data are available on substrate and biota. He showed that, on this basis, a level 4 habitat map could be produced for the Dutch part of the continental shelf. He pointed out that with data from other countries made available, it is worthwhile to undertake an effort to prepare a habitat map for the whole southern part of the North Sea. The Study Group acknowledged this as a worthwhile objective, stating that habitats do not end at national frontiers. Dick de Jong announced that this project will be started on the basis of funding by RIKZ. He cannot, however, work without explicit support from other countries. He asked colleagues to help in providing data, and promises of help were made in regard to this request.

The Study Group welcomed this initiative and suggested that the preliminary results of this effort be presented at both the Southampton Workshop as well as the Annual Science Conference in Bruges.

5.3 Identification of Data Needed

This item was not specifically discussed in plenary. Through the sessions the issue of data format, scale issue, etc., were discussed. The outcome of this discussion was used to revise and strengthen the proposals reported under Section 3.2 of this report.

5.4 Discussion: Is there a role for SGMHM in coordinating joint mapping-efforts? (Annex 11)

This subject was dealt with after the discussion of the three amended “Oban-proposals” had finished. Heye Rumohr, having earlier noted that Study Groups in ICES have a limited life-span *per definition*, now stated that with the workplan adopted by SGMHM (the 3 proposals mentioned earlier) SGMHM should apply for a full working group status. After some discussion, the Study Group agreed that, in order to be able to coordinate the proposed projects, an appropriate status is required. Paul Boudreau produced a document, specifying detailed objectives for the working group to be established. This document was discussed in SGMHM, and slightly modified on the basis of remarks made. The rationale to apply for working group status is stated below:

> *"to ensure the application of the best science in the collection, compilation and presentation of data towards the development of a habitat classification that can be implemented for all ICES areas. This goal is best reached through a collaborative and cooperative initiative that will draw on available experts within ICES Member Countries.*
>
> *Although the goal is long term (decades), it is the agreement of the committee that immediate steps are required and possible to make progress towards this goal."*

SGMHM recommends that the Marine Habitat Committee and the Advisory Committee on the Marine Environment consider the decision to make SGMHM an official working group within the ICES structure. The proposed name for the working group is the Working Group on Marine Habitat Mapping (WGMHM). A full justification for this proposal is given in Annex 11.

5.5 Comments on Review of Present-day Mapping Technology in relation to the Requirements of ICES

Heye Rumohr and Dick Pickrill gave their comments on the report. It was well received by SGMHM. Their main concern is the under-representation of biological sampling techniques. Their comments were discussed in a plenary session and incorporated in the draft version of the review as received from Jon Side. This annotated version will be sent by e-mail to the WGEXT meeting in Gdansk, Poland together with the written comments received from Vera van Lancken.

5.6 Report to WGEXT

Although several initiatives in habitat classification that are known of were mentioned at the meeting, it appeared that no additional information could be made available. For this reason SGMHM had difficulty in providing WGEXT with a complete review on habitat classification. It was therefore decided to send a message to the WGEXT meeting, which was being held at the same time in Gdansk, Poland, to explain this situation. Together with this message, the concise reports on the EUNIS classification and the ARC Workshop were forwarded to WGEXT for further comments.

6 THEME SESSION ON HABITAT CLASSIFICATION AND MAPPING (BRUGES 2000)

6.1 Programme Outline (D.J. de Jong, R. Allee; Annex 12)

The Study Group decided to recommend to the organising committee a list of potential speakers, which does not imply that contributions from outside SGMHM will be excluded. Becky Allee showed the preliminary list of speakers and asked the audience for comments. The annotated list is showed in Annex 12.

6.2 Further Activities Needed

Hanneke Baretta-Bekker offered to collect the abstracts and to make them ready for submission to the ICES Secretariat. After the meeting, however, it was decided to drop this idea, due to lack of time. Everybody will mail his/her condensed abstract directly to ICES and the Study Group secretariat will send a proposed programme for the Theme Session on Habitat Classification and Mapping.

7 RECOMMENDATIONS

7.1 General Recommendations

SGMHM makes the following recommendations:

a) Work to develop an ICES classification should take the EUNIS classification at level 3 as a template.

b) ICES should support initiatives taken to build on the EUNIS classification at levels 4 and 5.

c) ICES should continue to participate in the evaluation of EUNIS level 3, by mapping and testing, as well as by participating in the Second OSPAR/ICES/EEA workshop on habitat classification.

d) An ICES GIS database with habitat information and maps should be developed.

e) The Study Group should be made a Working Group in order to be able to coordinate projects, with Eric Jagtman as a continuing Chair.

f) The Benthos Ecology Working Group (BEWG) and the Working Group on the Effects Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) are asked to contribute to the verification of the EUNIS classification.

Justifications

a and b) SGMHM considers the EUNIS level 3 classification a good starting point for habitat classification. The classification is, at this level, suitable for use as a template for classification in the ICES area, and enables the production of very simple habitat maps. Further development of the habitat classification at levels 4 and 5 is advised. At this level of detail, regional difficulties in habitat classification may be properly addressed. The Study Group considers this to be a prerequisite to make the use of habitat maps worthwhile to ICES.

c) The marine habitats in the EUNIS classification are based on the MNCR BioMar classification, which was developed for the waters in Britain and Ireland. Testing and mapping in a variety of regions within the ICES area will be used to evaluate to what extent the current classification is suitable for use in other areas, e.g., deep sea water. As the improvement of the EUNIS classification for the Atlantic marine elements is a specific objective of the proposed Second OSPAR/ICES/EEA Workshop on Habitat Classification, it is in the interest of ICES to participate in this activity.

d) Habitat maps combine physical and biological data into integrated ecosystem information. At present there are no ready-to-use and easily accessible habitat maps available for use in ICES. We feel that the production of these maps will prove very helpful for the work of ICES in its Committees, Working Groups, etc.

e) A thorough verification of the EUNIS classification requires a variety of specialties that are only partly represented in SGMHM. The BEWG can contribute to the verification at the community level, making use of the expertise in benthic ecology and the many samples taken. The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) can comment on the current classification on the basis of its expertise in mapping technology and ground truthing of samples.

SGMHM concludes that habitat mapping for the ICES area is feasible and that it will be useful to ICES. However, to achieve this a long-term investment in habitat classification and mapping projects is needed. As a starting point, the Study Group has decided to give support to three proposals which will further development in this field. The Study Group is prepared to coordinate these projects and review developments on a yearly basis. The work at hand will exceed the normal life-span of a Study Group. ICES is therefore asked to express its support for habitat classification and mapping by establishing a Working Group on Marine Habitat Mapping (WGMHM), including the current appointed members of the Study Group.

7.2 Terms of Reference for 2001 Meeting

The SGMHM adopted the following recommendation for its 20001 meeting.

The **Study Group on Marine Habitat Mapping** [SGMHM] (Chair: E. Jagtman, Netherlands) will meet 3–6 April 2001 at the Martin Ryan Institute of the National University of Ireland in Galway, Ireland to review developments in marine habitat classification and habitat mapping, in particular, to:

a) review the outcome of the Second OSPAR/ICES/EEA Workshop on Habitat Classification and Biogeographic Regions (Southampton), the Second Aquatic Restoration and Conservation (ARC) Workshop on Habitat Classification, and the ICES Annual Scientific Conference Theme Session for consideration in the Study Group Workplan;
b) report on progress made in the joint SGMHM plans on habitat mapping projects (habitat map of the North Sea or Wadden Sea, deep sea map, OSPAR area map to level 3 of the EUNIS classification system);
c) review the outcome of the ICES Workshop on Deep-Water Survey Technologies and the Development of Standards for Marine Habitat Mapping;
d) collate comments on the EUNIS classification system, to be submitted to the EEA;
e) prepare a strategy plan for how to deal with pelagic habitats, taking into account the outcome of the Southampton Workshop.

SGMHM will report to the ACME before its June 2001 meeting and to the Marine Habitat Committee at the 2001 Annual Science Conference

8 REFERENCES

Connor *et al*. 1997. The MNCR BioMar marine biotope classification for Britain and Ireland. JNRC Report, No. 229 and No. 230.

Davies, C.E., and Moss, D. 1999. The EUNIS classification. European Environment Agency. ITE project T0809219: 1–124.

OSPAR. 1999. Summary record of the Workshop on Habitat Classification and Biogeographic Regions. OSPAR Convention for the Protection of the Marine Environment of the North-east Atlantic. Oban, 6–10 September 1999.

Wentworth, C.K. 1922. A scale of grade and class terms for elastic sediments. Journal of Geology, 30: 377–392.

ANNEX 1: ANNOTATED AGENDA

Monday April 10
9.30h Coffee
10.00h 1. Introduction

1.1 Welcome to the Meeting (Eric Jagtman)
1.2 Introduction and Terms of Reference (Eric Jagtman)
1.3 Adoption of the Agenda

10.30h 2. Review of developments in habitat classification

A review has to be written (preferable during the meeting) and passed on to WGEXT for comment. We will agree on what the format of this review will be and how we will proceed.

2.1 The EEA's EUNIS classification (Cynthia Davies; Annex 5 and 5a)
2.2 Canadian review of EUNIS level 3 habitat classification (Paul Boudreau)
2.3 Results of the Aquatic Restoration and Conservation Workshop (Becky Allee)
2.4 Discussion: Are there common grounds for an ICES-habitat classification?
2.5 Other developments: Second OSPAR/ICES/EEA Workshop on Marine Habitat Classification (proposed by UK, David Connor; supported by ICES ACME; Annex 6)

2.6 Validation of biotopes already proposed: assess if and how BEWG can be involved

19.00h Diner

Indonesian Restaurant "de Poentjak", Kneuterdijk 16, Den Haag

Tuesday April 11
9.00h 3. Progress in habitat mapping

3.1 Short presentations on mapping projects (Annex 7)

- Craig Brown: Development of sub-tidal biotope mapping techniques in UK waters, with emphasis on gravel substrates
- Karel Essink: Monitoring of some general habitat features in the Trilateral Monitoring and Assessment Programme (TMAP) for the Wadden Sea
- Dick Pickrill: The Application of Geoscience to Marine Habitat Research in Canada
- Matthew Service: Habitat Mapping in Northern Ireland
- James Massey: GIS and habitat mapping as a tool for environmental risk assessment in the offshore oil and gas industry in the North Sea
- Steven Degraer, Vera van Lancker and Geert Moerkerke: Mapping the marine benthic habitat: a bio-geological approach
- Jan Helge Fosså: Presentation of Norwegian MHM planned project "MAREANO"
- Dick de Jong: HABIMAP, a GIS-guided method to make ecotope and habitat maps

Wednesday April 12

9.00h 3.2 Current status of Oban proposals on habitat mapping

3.2.1 David Connor: Habitat mapping of the OSPAR area (Annex 8)

3.2.2 Jan Helge Fosså: ICES/OSPAR Workshop on the deep sea survey technologies and the development of standards for marine habitat mapping (proposal by Norway, supported by ICES ACME; Annex 9)

3.2.3 Proposal for North Sea benthic habitat mapping (Dick de Jong, NL; Annex 10)

3.3 Identification of data needed, data format, and scale-issues to further the development of joint habitat maps

3.4 Discussion: Role for SGMHM in coordinating joint mapping efforts?

3.5 Comments on review of present-day mapping technology in relation to the requirements of ICES (paper to be passed on to WGEXT)

4. Theme Session on Habitat Classification and Mapping, Bruges 2000

4.1 Outline of programme (Dick de Jong, Becky Allee)

4.2 Further activities needed

5. Recommendations

5.1 Report to WGEXT

5.2 Recommendations on proposed workshops (UK, Norway)

5.3 SGMHM Terms of reference 2001

Thursday April 13

9.00h 6. Adoption of report

7. Close of workshop

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ANNEX 3: EEA EXTRACT FROM DRAFT FINAL REPORT

ITE Project T08092l9

EUROPEAN ENVIRONMENT AGENCY

EUROPEAN TOPIC CENTRE ON NATURE CONSERVATION

1999 Work Programme: Task 4.3

EUNIS HABITAT CLASSIFICATION

Extract from Draft Final Report

November 1999

by

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Dorian Moss

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November 1999

CONTENTS

Abstract

The EUNIS Habitat classification was developed by the European Environment Agency to facilitate description of European habitats through the use of criteria for habitat identification. It is broadly-based and provides an easily understood common language for habitats. It builds on earlier initiatives (CORINE and Palaearctic habitat classifications) and incorporates existing classifications used by European marine Conventions and the EU-funded BioMar project, with cross-references to these and other systems. The classification is linked to a parameter-based database to describe specific habitats.

The EUNIS classification was presented to the EEA/ICES/OSPAR meeting held in Oban in September 1999 and various amendments and additions were proposed. As a result of that meeting revisions were made to the classification by the EUNIS team and a full report made in November 1999. Extracts from the November 1999 report relating to marine habitats have been circulated prior to the meeting in the Hague. The extracts include the criteria diagrams, listing of units to level 3 and the full listing of habitat units.

The revised criteria and decision diagrams used to reach the marine habitats listed at EUNIS level 3 are presented to participants. It is recognised that detailed biotopes from the Atlantic north or south of British and Irish waters, from the Baltic Sea and waters around the Azores are poorly represented. It is likely that EUNIS will need to be expanded to cover this wider geographic area but it is expected that most of the additions will be made at level 5 (where the distinct BioMar and Mediterranean units are now held). Units cannot be deleted if they are not found in the OSPAR area, nor may units be moved within the structure without regard for the principle of criteria-based hierarchy. New units cannot be added without consultation with experts from other areas to determine whether they duplicate existing units and units must follow specified criteria.

It is emphasised that the EUNIS classification cannot be altered except by the project leaders and if the classification does not fully meet the needs of the OSPAR convention, then a separate classification using a different numbering system should be produced, following an hierarchical structure and the criteria-based principles specified for EUNIS. This will enable the more detailed classification to be slotted in appropriately.

The EUNIS classification is expected to remain stable for at least the next year to allow a period of validation and testing. A proposal to map the OSPAR area to EUNIS level 3 was made at the Oban meeting and this project will be an invaluable validation and testing tool for the classification.

The present draft of the EUNIS classification was completed in November 1999 and work is in hand to make it available, through the world wide web, for use, comment and feedback. Comments and feedback should be sent to Dr Dorian Moss or Cynthia Davies at CEH Monks Wood, Abbots Ripton, Huntingdon, Cambs. PE28 2LS UK.

1 INTRODUCTION

1.1 Background

Since the inception of the EEA there has been a continuous work programme towards the following objectives: to develop a common parameter-based European habitat classification frame and to describe a limited number of types, and to work towards a solution of having a full description of European habitat types under the descriptive frame. The habitat classification forms an integral part of the European Topic Centre on Nature Conservation (ETC/NC) nature information system (EUNIS). Two international workshops of experts in nature conservation information and habitat classification were held (Paris, October 1995 and Monks Wood, June 1996). Following the second workshop, the EEA made the decision to base the habitat classification for EUNIS on the Palaearctic habitat classification, developed at the Institut Royal des Sciences Naturelles de Belgique (Devillers & Devillers-Terschuren, 1996) as a successor to the CORINE habitat classification (European Communities, 1991). The classification of marine habitats in the Palaearctic classification would be supplemented (and largely superseded) with information derived from the BioMar project (Connor *et al.*, 1997). The development has continued through a number of successive revisions, experts' working groups, and consultations with experts over the period June 1996 - September 1999.

1.2 Rationale and applications

Amongst the conclusions of the workshops mentioned above was identification of the need for a statement of methodological principles for the habitat classification. This section aims to meet that need and to establish the rationale and applications of the classification as a component of EUNIS, and as a pan-European tool of the European Environment Agency.

1.2.1 Aims and requirements

The habitat classification:

i) should provide a common and easily understood language for the description of all marine, freshwater and terrestrial habitats throughout Europe
ii) should be objective and scientifically based, with clear definitions and principles
iii) information should be held in a relational database allowing interrogation based on a number of parameters
iv) should seek as far as possible to achieve a consensus amongst those concerned with habitat classification as developers or users
v) should be comprehensive, but applicable at a number of hierarchical levels of complexity in recognition of the variety of its applications
vi) should be flexible so as to evolve and allow the admission of new information, but also sufficiently stable to support users of its predecessors.

1.2.2 Geographical coverage

The geographical scope of the classification should be pan-Europe, defined in the same way as in the EEA's Dobris Report (Stanners & Bourdeau, 1995), i.e. the European mainland as far east as the Ural Mountains, including offshore islands (Cyprus; Iceland but not Greenland), and the archipelagos of the European Union Member States (Canary Islands, Madeira and the Azores). Anatolian Turkey and the Caucasus are included in most parts of Dobris and should be included in the classification.

1.2.3 Definitions

Dictionary definitions of "habitat" stress the linking of abiotic and biotic features:

- "the normal abode or locality of an animal or plant" (Chambers Twentieth Century Dictionary, 1977)
- "the natural environment characteristically occupied by a particular organism"; or "an area distinguished by the set of organisms which occupy it" (The New Shorter Oxford English Dictionary, 1993)
- "the living place of an organism or community ("any grouping of populations of different organisms found together in a particular environment") characterised by its physical or biotic properties" (The Concise Oxford Dictionary of Ecology, 1994)

Legislative definitions (Habitats Directive, European Communities, 1992):

- natural habitats: "terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural"
- habitat of a species: "an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle".

These definitions imply that a habitat applies to each individual species or community. In order to classify habitats, it is necessary to seek some generalisation since it is not useful to consider every possible species or community. The scale of organisms and of the environmental units in which they occur is intrinsic to the definition of habitat, which therefore is defined for the purposes of this classification as: "**plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors (soil, climate, water availability and quality, and others), operating together at a particular scale**". The factors included in the definition should therefore all be addressed in the descriptive framework of the habitat classification.

Scale

The scale proposed for the EUNIS habitat classification is that occupied by small vertebrates, large invertebrates and vascular plants. It is the same as that generally adopted by the Palaearctic habitat classification, and is comparable to the scale applied to the classification of syntaxa in traditional phytosociology. Samples of between 1 m^2 and 100 m^2 will generally be adequate to categorise habitats. At the smaller scale, "**microhabitats**" (features generally occupying less than 1 m^2 which are characteristic of certain habitat types and important for some smaller invertebrates and lower plants) can be described. Examples are decaying wood, found in mature forests and required by invertebrates whose function is decomposition, or animal dung in grassland environments. At the larger scale, habitats can be grouped as "**habitat complexes**", which are frequently occurring combinations or mosaics of individual habitat types, usually occupying at least 10 ha, which may be inter-dependent. Estuaries, combining tidal water, mud flats, saltmarshes and other littoral habitats, are a good example.

1.2.4 Applications

A number of applications of a European habitat classification can be identified:

i) to provide broad categories for the assessment of the state and trends of nature for use in the EEA's reporting process

ii) to map habitats at a level appropriate to the scale, whether or not in cross-reference to CORINE Land Cover maps

iii) to obtain an overview of habitat distribution at European level

iv) to enable national nature conservation authorities to place and assess their habitats in a European context

v) to evaluate habitat diversity values in biodiversity assessments

vi) to support the development of the EU Natura 2000 network and the possible revision of Annex I of the Habitats Directive, and also the development of the Council of Europe EMERALD Network

vii) to provide a practical system for the description and monitoring of habitat types for national, regional and local nature inventory, evaluation and management relevant to both site and species information

viii) to identify and document the character and distribution of the most threatened habitat types in Europe e.g., in national or regional red lists.

1.2.5 Principles of the classification

i) a descriptive or parameter frame should be developed to enable users to enter the classification from a number of viewpoints, and so that users might better understand the habitat types through use of a wide range of descriptive and categorised approaches

ii) the classification should be strictly hierarchical, and wherever possible habitats at a given hierarchical level should be of similar importance

iii) there should be clear criteria for each division, but these should not be imposed uniformly across the classification

iv) the most important criteria are physiognomy, dominant plant and/or animal communities and ecological or biogeographical factors determining plant and animal communities, generally in that order

v) habitats within a particular branch of the hierarchy should be ordered following a logical sequence when possible, e.g., depending on levels of a particular abiotic factor such as moisture

vi) nomenclature and description of habitat types should use clearly defined non-technical language and the nomenclature should be systematic and reflect the habitat's location within the classification

vii) ecologically distinct habitat types supporting different plant and animal communities should be differentiated; habitats described from different locations but not differing ecologically should not be separated

viii) any changes in coding should be unambiguously linked to the previous units and should be recorded in the classification history

ix) the coding system used should allow the introduction of new units appropriately placed in the hierarchy with a minimum of perturbation of existing codes

x) habitat units and habitat complexes should be separated in the classification

xi) authorship of habitat types should be established and recorded where possible; literature references should be given when these relate directly to some part of the definition or description of the habitat type

xii) cross-reference to other habitat classifications (e.g., vegetation and marine classifications) and other systems such as land cover should be established explicitly with appropriate notation where correspondences are not precise.

1.3 The October 1999 version of the classification

1.3.1 Process of development

Work completed prior to the end of 1998 was reported by Davies and Moss (1998).

Marine units and criteria were revised in November 1998. Subsequently the whole of the BioMar classification (Connor *et al*, 1997) was incorporated into the EUNIS classification at appropriate points, while consistently conserving the hierarchy found in BioMar. Confirmation of the links between BioMar units and the EUNIS classification was sought through David Connor and amendments made where necessary.

Mediterranean marine habitats units, as defined for the Barcelona Convention marine habitat classification (UNEP, 1998), have been included in consultation with Denise Bellan-Santini and Gérard Bellan. These are additional to Mediterranean marine units from the Palaearctic habitat classification.

Lubos Halada, on behalf of PTL/NC, tested the criteria for the division of EUNIS habitats for habitats occurring in the Phare countries. The focus was on grasslands and shrubs, then woodlands. Comments received have been considered and amendments made where appropriate.

Pierre Devillers and Jean Devillers-Terschuren, the developers of the Palaearctic habitat classification from which the EUNIS classification is derived, were asked to comment and advise on the criteria and definitions of terminology used for the EUNIS habitat classification as prepared by ITE. This was particularly to ensure correct understanding of habitat types drawn from the Palaearctic classification and to verify the correspondence between the Palaearctic habitat classification units and the EUNIS habitat classification. They were asked to suggest amendments, and to identify omissions and awkwardnesses in the EUNIS classification. Following discussions with them and receipt of written comments, parts of the classification have been revised to ensure consistency of criteria between levels and correct linking of Palaearctic units.

Tables of the correspondence between the EUNIS habitat classification (October 1999) and several other habitat classifications are published separately.

An interim report was prepared which incorporated amendments and additions following this process of commenting (Davies & Moss, June 1999) and specific points were discussed at a workshop held at ITE Monks Wood on 14–15 July 1999. Further amendments to the classification and criteria were suggested and where appropriate, incorporated into the classification. A further draft report was prepared and circulated for comment in July 1999 following the July 1999 workshop.

A workshop to discuss marine habitat classification was convened by the Joint Nature Conservation Committee (UK) on behalf of the Oslo and Paris conventions on marine pollution (OSPAR) working group, the International Council for the Exploration of the Sea (ICES), and the European Environment Agency (EEA). The workshop was held in Oban, Scotland, on 6–10 September 1999. The main aim of the workshop was to agree a classification of marine habitats for use in the OSPAR region based on the EUNIS / BioMar classification and expanded where necessary. Significant amendments to the sublittoral parts of the marine part of the EUNIS classification were suggested and have been incorporated where appropriate. The pelagic zone of marine waters was not included on the agenda but was revised following discussions with individuals; the pelagic part of the classification was not validated by that meeting.

A list of reports, working versions, interim reports, etc. produced by ITE on the EUNIS habitat classification is appended (Annex E). A list of all those who have contributed to the development of the classification is appended (Annex F)

1.3.2 The database

The accompanying EUNIS habitat database is held using the framework developed during 1996 and 1997. A table of the EUNIS codes to level 3 is appended (Annex B). So as to clarify the scope of EUNIS level 3, habitat units drawn from the Palaearctic habitat classification (and for marine habitats those developed under the BioMar project and for the Barcelona and the HELCOM Conventions) have been listed at the next hierarchical lower levels (Annex C). These component sub-units are indicated in the database by the use of the third level EUNIS code followed by /, a classification reference letter, and the code of the unit from the other named classification, and not by EUNIS codes of four or more characters. The classification reference letters are P, B, M and H respectively. Additional habitat units suggested by the OSPAR working group are shown by the EUNIS code followed by /O-. **These component subunits are not part of the EUNIS classification, whose scope at present is limited usually to its level 3, but they act as an indication of how EUNIS is a means whereby other classification systems can be combined in a common framework. Generally the names used are those of the parent classification, augmented or edited only where necessary for greater clarity or consistency with other EUNIS names**. In a few cases, where these could not be found in the other classifications, EUNIS habitats have been added at level 4: these are listed in Annex C with 4-character EUNIS codes.

1.3.3 The October 1999 draft final report

The bulk of this document consists of the criteria for separating habitats at each hierarchical level from 1 to 3 (in accordance with principle iii above). Note that criteria have been defined for units at level 4 in the case of saltmarshes. At each level, the criteria are presented on a single page with additional detailed explanatory notes. These notes, which accompany each grey “decision box” on the criteria diagrams, explain how the box is to be applied, and form an **integral and essential** part of the criteria. For Levels 1 and 2, the notes immediately follow the diagram. A description the content of level 1 habitat units is included after the level 1 criteria. For Level 3 criteria, the notes are presented after the diagrams for each set of habitat units at Level 1 and are numbered sequentially within each Level 1 unit with the appropriate lower case letter preceding the number (e.g., a1 is the first note for criteria for Level 3 units of habitat unit A). A new level 2 unit for “Mixed deciduous and coniferous woodland” was agreed at the workshop in July 1999 and the details of the “parent” units are included. A glossary of terms is appended (Annex A) to aid in the interpretation of terminology as used in this report.

1.4 References

Connor, D.W., Brazier, D.P., Hill, T.O., & Northen, K.O. 1997. Marine Nature Conservation Review: Marine biotope classification for Britain and Ireland. Version 97.06. Peterborough, Joint Nature Conservation Committee.

Davies C.E. & Moss, D. 1998. EUNIS Habitat Classification. Final Report to the European Topic Centre on Nature Conservation, European Environment Agency, with further revisions to marine habitats. November 1998. 204 pp.

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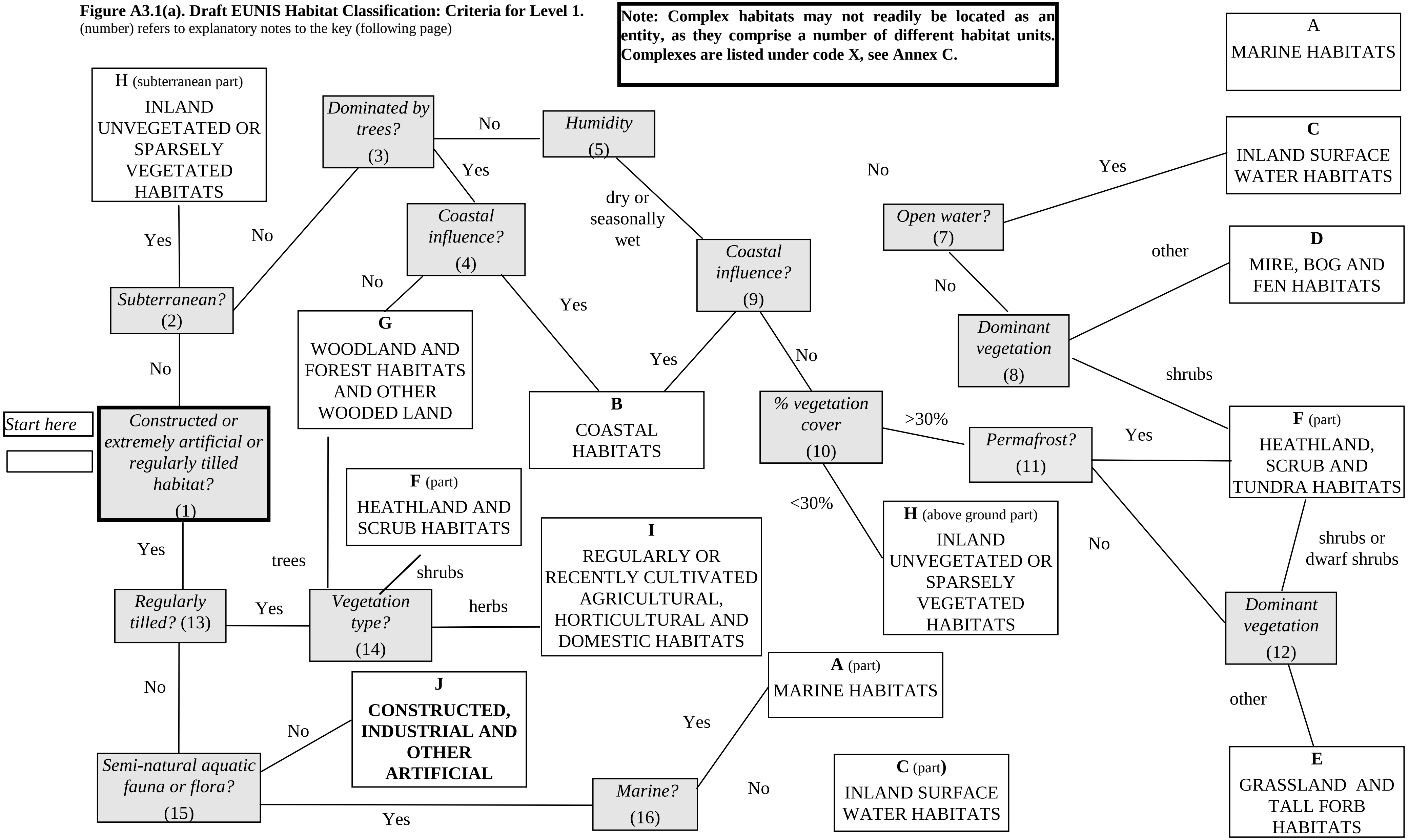
Stanners, D. & Bourdeau, P. 1995. Europe's Environment: The Dobris Assessment. Copenhagen: European Environment Agency.

UNEP. 1998. Annex III. Revised classification of benthic marine habitat types for the Mediterranean region. In: WG. 149/5: Report: Meeting of experts on marine habitat types in the Mediterranean region. SPA/RAC, Tunis.

Figure A3.1(a). Draft EUNIS Habitat Classification: Criteria for Level 1.
(number) refers to explanatory notes to the key (following page)

Note: Complex habitats may not readily be located as an entity, as they comprise a number of different habitat units. Complexes are listed under code X, see Annex C.



Note: Complex habitats may not readily be located as an entity, as they comprise combinations of a number of different habitat units. Complexes are e listed under code X, see Annex C.

1. Is the habitat highly artificial, i.e., either constructed or with a man-made substrate; industrial; maintained sole[illegible]lling; or arising from recent abandonment of previously tilled or constructed habitats (path = *Yes*)? All other habitats follow path = *No*. Note that habitats which originated through extractive industries (quarries, mines etc) but which have been colonised by natural or semi-natural plant and/or animal communities (other than pioneer or ruderal communities) follow path = *No*.

2. The criterion separates subterranean non-marine caves and passages and underground waters (path = *Yes*).

3. Habitats where the dominant vegetation is, or was until very recently, trees, typically single-stemmed, and with a canopy cover of at least 10% are distinguished (path = *Yes*) from habitats dominated by other types of vegetation or without vegetation or dominated by animal communities. Lines of trees, coppices, and very recently clear-felled areas with pre-existing ground cover, not yet re-stocked and with no succession to weedy vegetation follow path = *Yes*. Note that successional weedy communities follow path = *No* and are categorised under E, Grassland and tall forb habitats. Hedges which may have occasional tall trees follow path = *No*, and are categorised under F, Heathland, scrub and tundra. Note also that sparsely wooded areas with canopy less than 10% , including parkland, are included in complexes. Trees are normally able to reach a height of 5m at maturity but this height may be lower at high latitudes or altitudes. Note that dwarf trees and scrub (under 50cm such as occur in extreme alpine conditions) follow path = *No*. Occasionally tall shrubs such as hazel (*Corylus*) and some willows (*Salix*) may have a woodland-type structure and follow path = *Yes*. Canopy cover 10% and height 5m are taken from the FAO TBFRA 2000 definitions (Temperate and Boreal Forest Resource Assessment 2000). It should be noted that in some areas e.g., the Boreal zone, the normal dividing point is 30%. Statistics produced at a regional scale might reflect this divergence.

4. Habitats occupying coastal features and characterised by their proximity to the sea (path = *Yes*), including coastal dunes and wooded coastal dunes, beaches and cliffs, are separated from other terrestrial habitats (path = *No*).

5. The criterion separates habitats which are either *aquatic* or *waterlogged* from those which are always *dry*, or are only *seasonally wet*. Note that the term "*aquatic"* includes: marine and fresh open water habitats; marine littoral habitats which are subject to wet and dry periods on a tidal cycle; marine littoral habitats which are normally water-covered but intermittently exposed due to the action of wind or atmospheric pressure changes; freshly deposited marine strandlines characterised by marine invertebrates; normally wet habitats which may be dry seasonally (rivers and lakes and their littoral zones); freshwater littoral zones include those parts of banks or shores which are sufficiently frequently inundated to prevent the formation of closed terrestrial vegetation. "*Waterlogged"* refers to: habitats which are saturated, with the water table at or above ground level for at least half of the year, e.g., bogs, marshes; those parts of the geolittoral zone (i.e. above the between the mean and high water mark of non-tidal marine waters) which have a high water table. The *dry or seasonally wet* path should be followed in the case of: habitats which are regularly but infrequently flooded or occasionally flooded by extreme weather conditions but which are free-draining; free-draining supralittoral habitats adjacent to marine habitats normally only affected by spray or splash; old strandlines characterised by terrestrial invertebrates; damp heaths and grasslands; moist and wet coastal dune slacks; and permanent snow and surface ice.

6. Marine habitats (path = *Yes*) are distinguished from inland saline, brackish and freshwater aquatic or waterlogged habitats, and inland artificial habitats with semi-natural fauna or flora (path = *No*). Note that marine habitats are directly connected to the oceans, i.e. part of the continuous body of water which covers the greater part of the earth's surface and which surround its land masses. Marine waters may be fully saline, brackish or almost fresh. Marine habitats include those below spring high tide limit (or below mean water level in non-tidal waters), tidal saltmarshes, and also enclosed coastal saline or brackish waters, without a permanent surface connection to the sea but either with intermittent surface or sub-surface connections (as in lagoons). Waterlogged littoral zones above the mean water level in non-tidal waters or above the spring high tide limit in tidal waters are included with marine habitats (path = *Yes*). Note also that rockpools in the supralittoral zone are considered as enclaves of the marine zone and follow the marine path.

7. Habitats with open water (e.g., rivers, streams, lakes and pools), including the littoral zones of the waterbodies (path = *Yes*), are separated from habitats with the water table permanently at or near the surface, but normally without free-standing water. Note that waterlogged habitats with integral pools of open water are considered as complexes.

8. Waterlogged terrestrial habitats are divided according to the type of dominant vegetation: *shrubs;* or *other*. Note that shrubs refers to larger species such as some willows (*Salix* spp.) but dwarf shrub species (for example ericoïd species) follow path = *other*. Note also that habitats dominated by trees (G) are separated earlier (note 3).

9. Habitats occupying coastal features and characterised by their proximity to the sea (path = *Yes*), including coastal dunes, beaches and cliffs, are separated from other terrestrial habitats (path = *No*).

10. Habitats with *less than 30%* vegetation cover are separated from those with *greater than 30%* vegetation cover. Note that chasmophytic, scree and cliff vegetation follow path = *<30%*.

11. Habitats characterised by the presence of permafrost are distinguished (path = *Yes*).

12. Dry terrestrial habitats with greater than 30% vegetation cover are divided according to the type of dominant vegetation: *shrubs or dwarf shrubs;* or *other* grasses and non-woody vegetation. Note that habitats dominated by trees (G) are separated earlier (note 3).

13. Habitats maintained solely by frequent tilling or arising from recent abandonment of previously tilled ground such as arable land and gardens (path = *Yes*) are distinguished from completely artificial habitats (path = *No*), which are primarily human settlements, industrial developments, transport or waste dump sites or highly artificial waters with wholly constructed beds or heavily contaminated water.

14. Regularly tilled habitats are separated according to dominant vegetation type: *shrub* orchards; *tree* nurseries and tree-crop plantations; and habitats dominated by cultivated herbaceous vegetation (path = *herbs*).

15. Constructed habitats which support a semi-natural aquatic fauna and flora are separated from all others. Constructed marine saline habitats below water level (such as in marinas, harbours, etc) which support a semi-natural community of both plants and animals follow path = *Yes*, but highly artificial saline habitats such as industrial lagoons and saltworks which are virtually devoid of plant and animal life follow path = *No*. Constructed inland freshwater, brackish or saline waterbodies (such as canals, ponds, etc) which support a semi-natural community of both plants and animals follow path = *Yes*, but highly artificial waters with heavily contaminated water or which are virtually devoid of plant and animal life follow path = *No*. Constructed terrestrial habitats including buildings and the transport network follow path = *No*.

16. Constructed marine habitats with semi-natural fauna or flora (path = *Yes*), are separated from inland constructed non-marine surface water habitats with semi-natural fauna or flora (path = *No*).

17. (See note 6 for definition of marine).

Descriptions of Level 1 Habitats

A Marine habitats

Marine habitats are directly connected to the oceans, i.e. part of the continuous body of water which covers the greater part of the earth's surface and which surround its land masses. Marine waters may be fully saline, brackish or almost fresh. Marine habitats include those below spring high tide limit (or below mean water level in non-tidal waters) and enclosed coastal saline or brackish waters, without a permanent surface connection to the sea but either with intermittent surface or sub-surface connections (as in lagoons). Rockpools in the supralittoral zone are considered as enclaves of the marine zone. Includes marine littoral habitats which are subject to wet and dry periods on a tidal cycle including tidal saltmarshes; marine littoral habitats which are normally water-covered but intermittently exposed due to the action of wind or atmospheric pressure changes; freshly deposited marine strandlines characterised by marine invertebrates. Waterlogged littoral zones above the mean water level in non-tidal waters or above the spring high tide limit in tidal waters are included with marine habitats. Includes constructed marine saline habitats below water level as defined above (such as in marinas, harbours, etc) which support a semi-natural community of both plants and animals. The marine water column includes bodies of ice.

B Coastal habitats

Coastal habitats are those above spring high tide limit (or above mean water level in non-tidal waters) occupying coastal features and characterised by their proximity to the sea, including coastal dunes and wooded coastal dunes, beaches and cliffs. Includes free-draining supralittoral habitats adjacent to marine habitats which are normally only affected by spray or splash, strandlines characterised by terrestrial invertebrates and moist and wet coastal dune slacks. Excludes dune slack pools and rockpools.

C Inland surface water habitats

Inland surface water habitats are non-coastal above-ground open fresh or brackish waterbodies (e.g., rivers, streams, lakes and pools, springs), including their littoral zones. Also includes dune slack pools. Includes constructed inland freshwater, brackish or saline waterbodies (such as canals, ponds, etc) which support a semi-natural community of both plants and animals; normally wet habitats which may be dry seasonally (temporary or intermittent rivers and lakes and their littoral zones). Freshwater littoral zones include those parts of banks or shores which are sufficiently frequently inundated to prevent the formation of closed terrestrial vegetation. Excludes permanent snow and ice.

Note that habitats which intimately combine waterlogged habitats with pools of open water are considered as complexes.

D Mire, bog and fen habitats

Habitats which are saturated, with the water table at or above ground level for at least half of the year, dominated by herbaceous or ericoïd vegetation e.g., bogs, marshes. Includes waterlogged habitats where the groundwater is frozen. Excludes waterlogged habitats dominated by trees or large shrubs.

Note that habitats which intimately combine waterlogged habitats with pools of open water are considered as complexes.

E Grassland and tall forb habitats

Non-coastal habitats which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year) with greater than 30% vegetation cover. The dominant vegetation is grasses and other non-woody vegetation (including moss-, lichen-, fern- and sedge-dominated communities). Includes successional weedy communities and managed grasslands such as recreation fields and lawns. Does not include regularly tilled habitats dominated by cultivated herbaceous vegetation such as arable fields.

F Heathland, scrub and tundra habitats

Non-coastal habitats which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year) with greater than 30% vegetation cover. The dominant vegetation is shrubs or dwarf shrubs. Includes regularly tilled shrub orchards, hedges (which may have occasional tall trees) and habitats characterised by the presence of permafrost. Also includes dwarf trees and scrub (under 50cm, such as occur in extreme alpine conditions).

G Woodland and forest habitats and other wooded land

Habitats where the dominant vegetation is, or was until very recently, trees, typically single-stemmed, and with a canopy cover of at least 10%. Includes lines of trees, coppices, and very recently clear-felled areas with pre-existing ground cover, not yet re-stocked and with no succession to weedy vegetation. Trees are normally able to reach a height of 5m at maturity but this height may be lower at high latitudes or altitudes. Tall shrubs such as hazel (*Corylus*) and some willows (*Salix*) with a woodland-type structure are treated as woodland. Includes regularly tilled tree nurseries and tree-crop plantations. Excludes dwarf trees and scrub (under 50cm) such as occur in extreme alpine conditions.

Note sparsely wooded areas with canopy less than 10%, including parkland, are included in complexes.

H Inland unvegetated and sparsely vegetated habitats

Non-coastal habitats with less than 30% vegetation cover (other than where the vegetation is chasmophytic or on scree and or cliff) which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year). Subterranean non-marine caves and passages including underground waters. Habitats characterised by the presence of permanent snow and surface ice other than marine ice bodies.

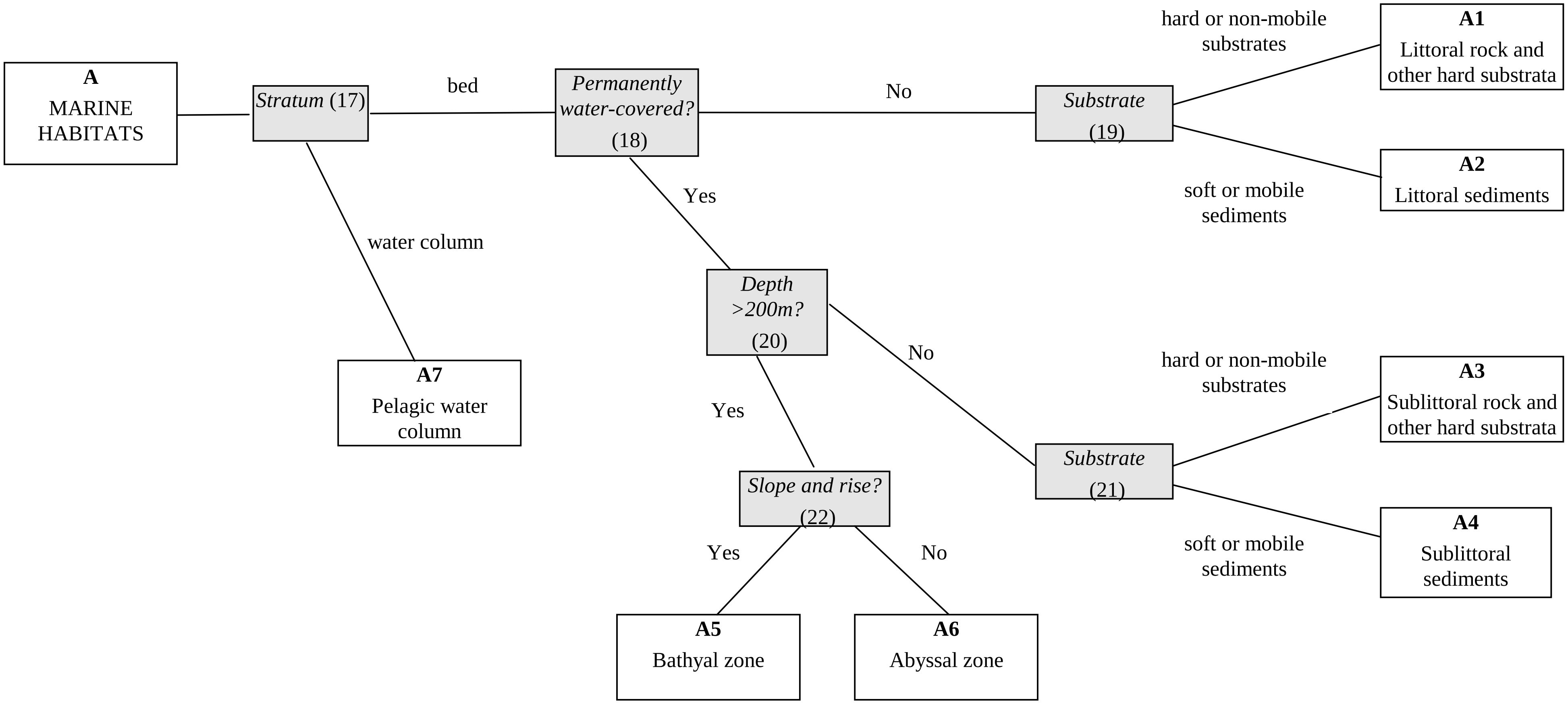
I Regularly or recently cultivated agricultural, horticultural and domestic habitats

Habitats maintained solely by frequent tilling or arising from recent abandonment of previously tilled ground such as arable land and gardens. Includes tilled ground subject to inundation. Excludes shrub orchards, tree nurseries and tree-crop plantations.

J Constructed, industrial and other artificial habitats

Primarily human settlements, buildings, industrial developments, the transport network, waste dump sites. Includes highly artificial saline and non-saline waters with wholly constructed beds or heavily contaminated water (such as industrial lagoons and saltworks) which are virtually devoid of plant and animal life.

Figure A3.1(b). Draft EUNIS Habitat Classification: Criteria for Marine Habitats to Level 2.
Note that the key to Level 1 shows two pathways to reach habitat type A: these are recombined here.
(number) refers to explanatory notes to the key (following page)



Explanatory notes to the key: Level 2 marine habitats

17. The criterion distinguishes between vertical strata: the sea *bed* (non-tidal, inter-tidal and sub-tidal) from the *water column* (in shallow or deep sea, or enclosed coastal waters). Note that the water column includes bodies of ice.

18. Is the bed permanently covered by water (path = *Yes*), or either regularly exposed at some stage in the tidal cycle (littoral / inter-tidal), subjected to frequent non-tidal change in water level or above the high water mark but with a high water table (path = *No*)? Note that under extreme conditions the uppermost fringe of the “permanently water-covered” zone may be exposed.

19. *Hard or non-mobile substrates* include continuous hard and soft bedrock and also non-mobile boulders, rocks and cobbles, non-mobile artificial substrates and compacted substrates such as clay and peat; *soft or mobile sediments* include mobile or soft substrates such as cobbles, pebbles, sand and mud. Note that consolidated cobbles follow path = *Hard or non-mobile substrates*. Note also that mixed substrata comprising a mixture of cobble, pebble, gravel, sand and mud are categorised under *soft or mobile sediments*.

20. This criterion separates the deep seabed, beyond the shelf break and generally over 200 metres in depth (path = *Yes*), from sublittoral zones (including infralittoral and circalittoral zones) (path = *No*).

21. *Hard or non-mobile substrates* include continuous hard and soft bedrock and also non-mobile boulders, rocks and cobbles, non-mobile artificial substrates and compacted substrates such as clay and peat; *soft or mobile sediments* include mobile or soft substrates such as cobbles, pebbles, sand and mud. Note that consolidated cobbles follow path = *Hard or non-mobile substrates*. Note also that mixed substrata comprising a mixture of cobble, pebble, gravel, sand and mud are categorised under *soft or mobile sediments*.

22. The oceanic zone (bathyal zone) at depths of approximately 200–2000 m, lying to seaward of the shallower neritic zone, and landward of the deeper abyssal zone (beyond the continental slope) is distinguished (path = *Yes*). The bathyal zone is the region of the continental slope and rise and its upper limit is marked by the edge of the continental shelf.

Figure A3.1(c). Draft EUNIS Habitat Classification: Criteria for Littoral Rock and other Hard Substrata (A1) to Level 3.
(number) refers to explanatory notes to the key

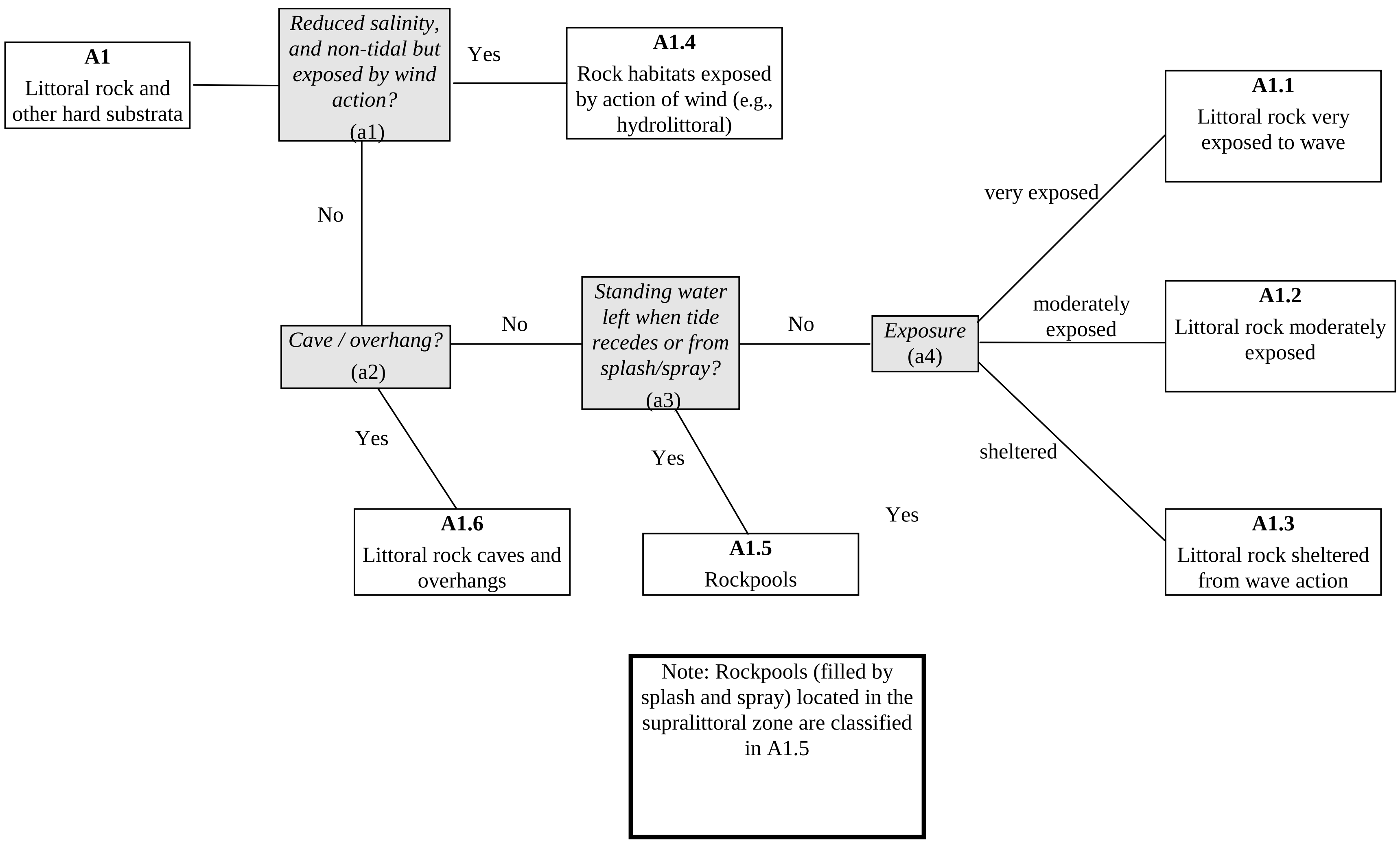


Figure A3.1(d). Draft EUNIS Habitat Classification: criteria for littoral sediments (A2) to Level 3.
(number) refers to explanatory notes to the key

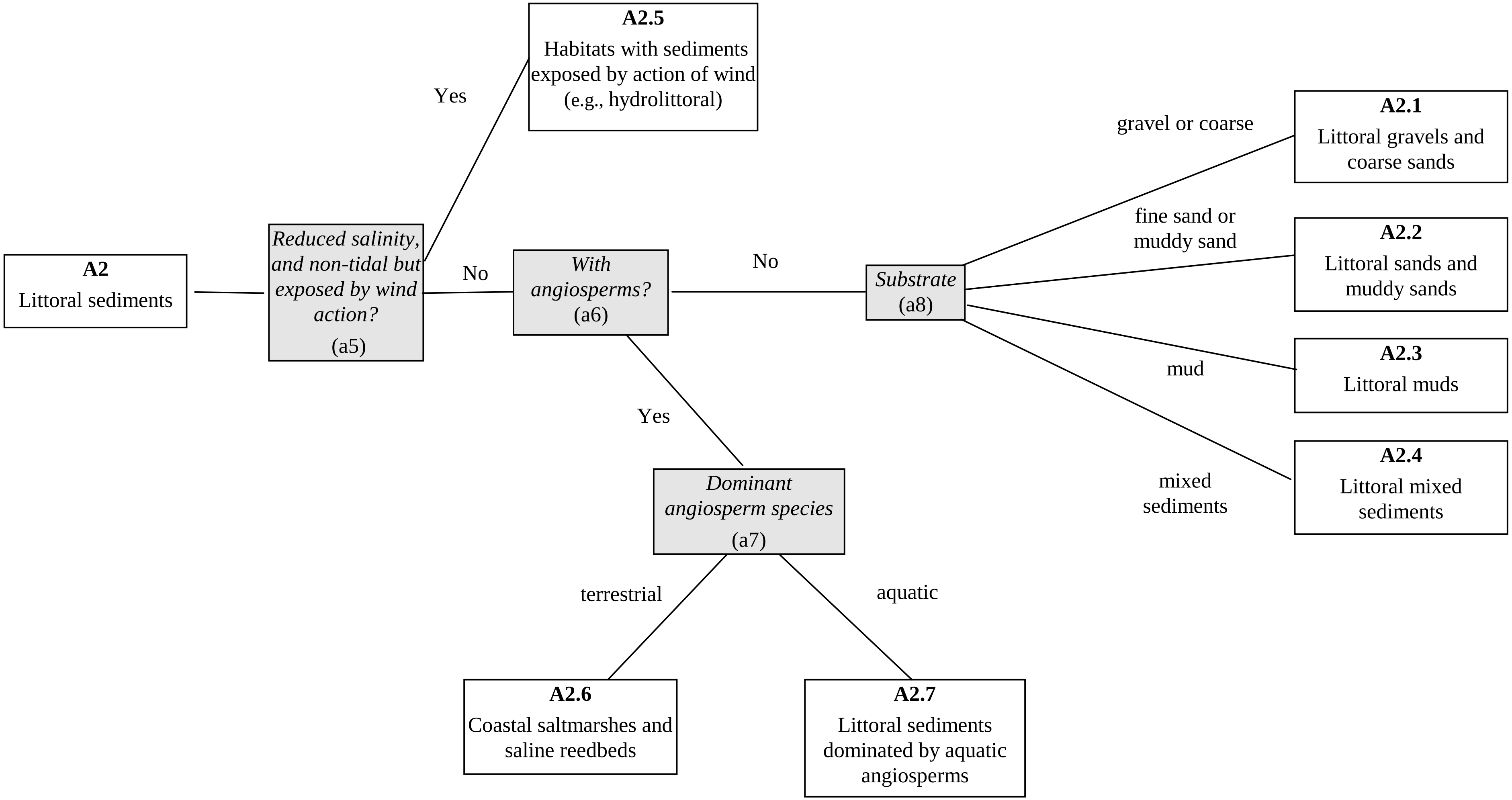


Figure A3.1(e). Draft EUNIS Habitat Classification: Criteria for Coastal Saltmarshes and Saline Reedbeds (A2.6) to Level 4.
(number) refers to explanatory notes to the key

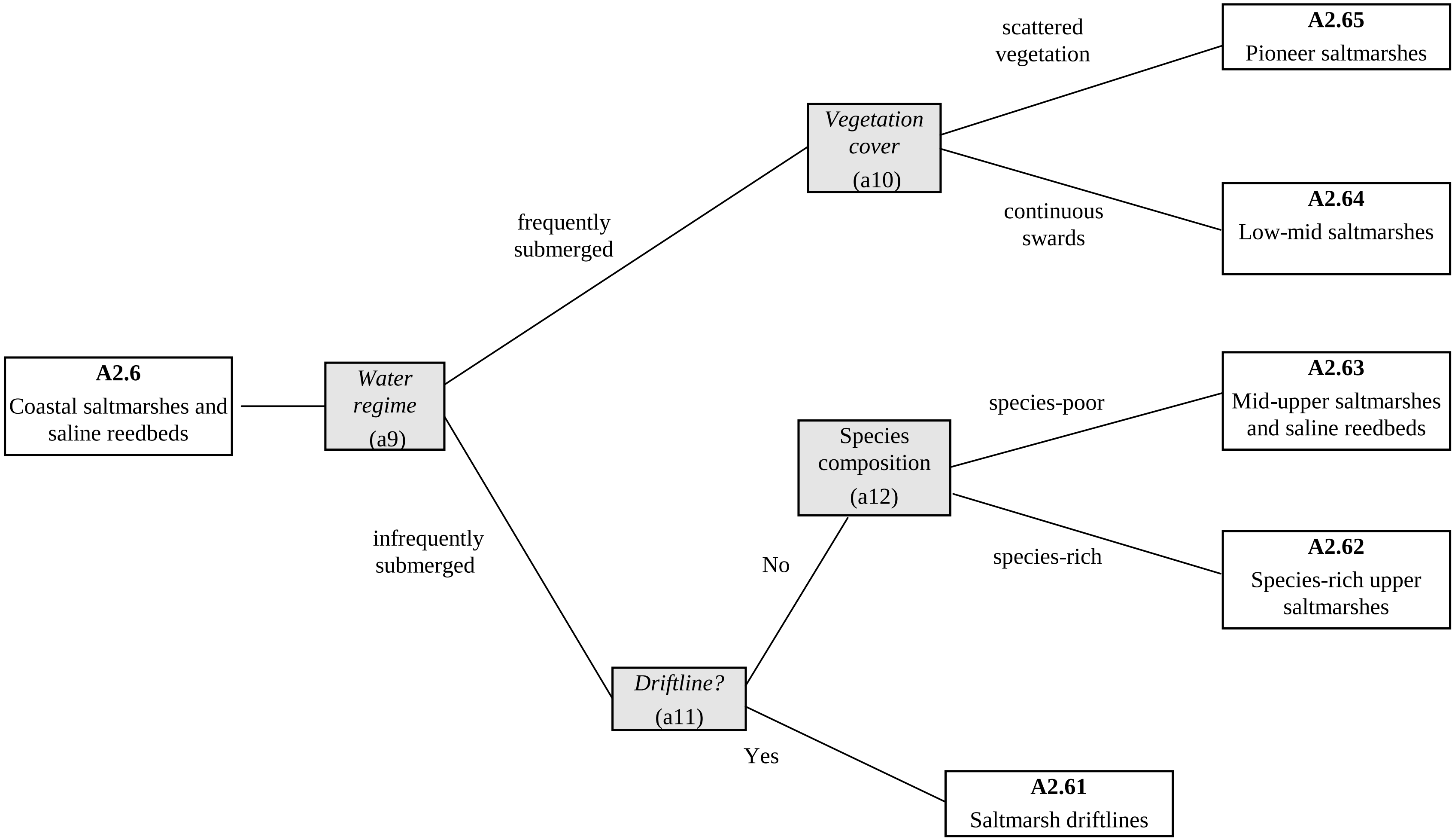


Figure A3.1(f). Draft EUNIS Habitat Classification: Criteria for Sublittoral Rock and other Hard Substrata (A3) to Level 3.
(number) refers to explanatory notes to the key

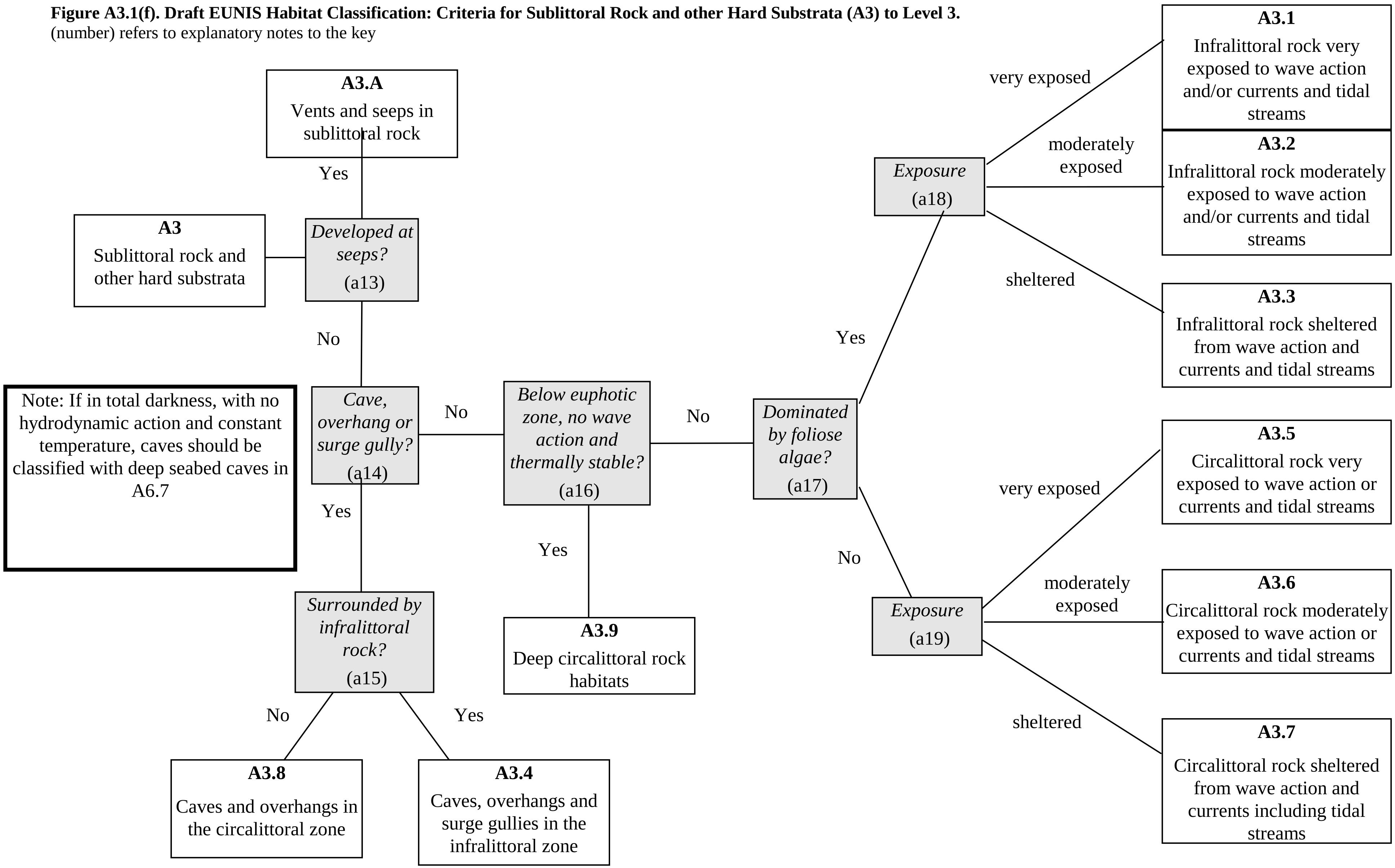
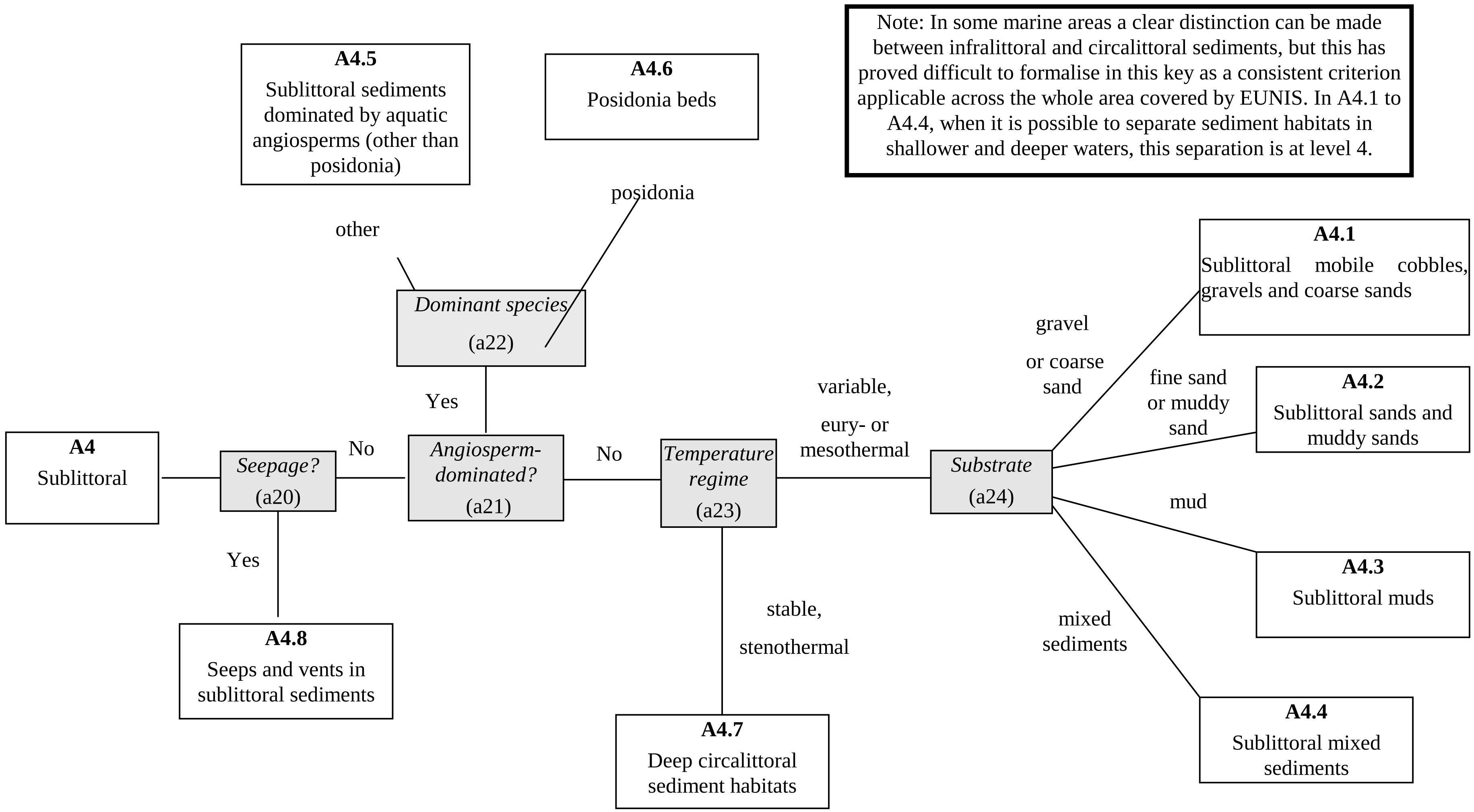


Figure A3.1(g). Draft EUNIS Habitat Classification: Criteria for Sublittoral Sediments (A4) to Level 3.
(number) refers to explanatory notes to the key



FigureA3.1(h). Draft EUNIS Habitat Classification: Criteria for the Bathyal Zone (A5) to Level 3.
(number) refers to explanatory notes to the key

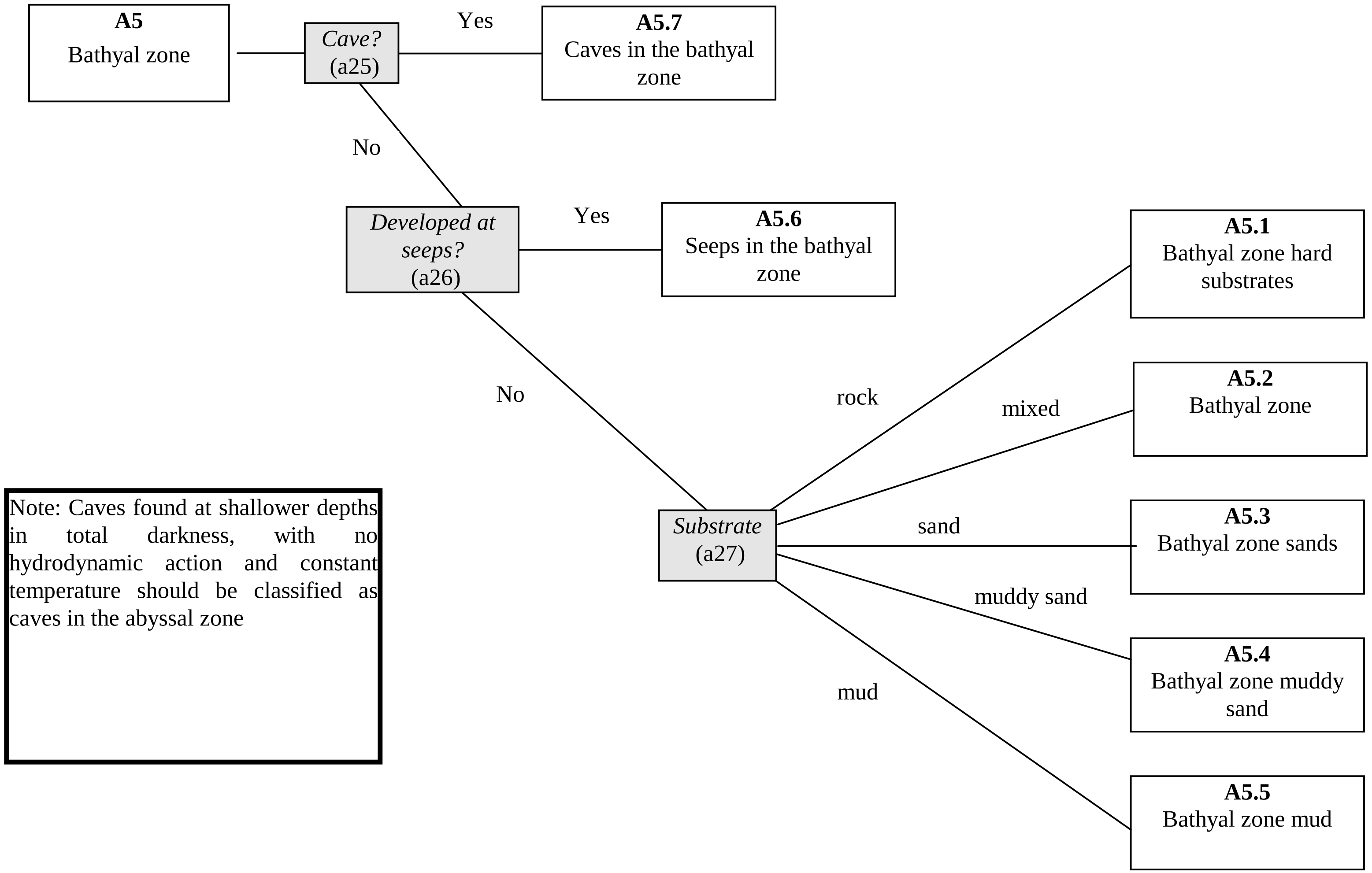


Figure A3.1(i). Draft EUNIS Habitat Classification: Criteria for the Abyssal Zone (A6) to Level 3.
(number) refers to explanatory notes to the key

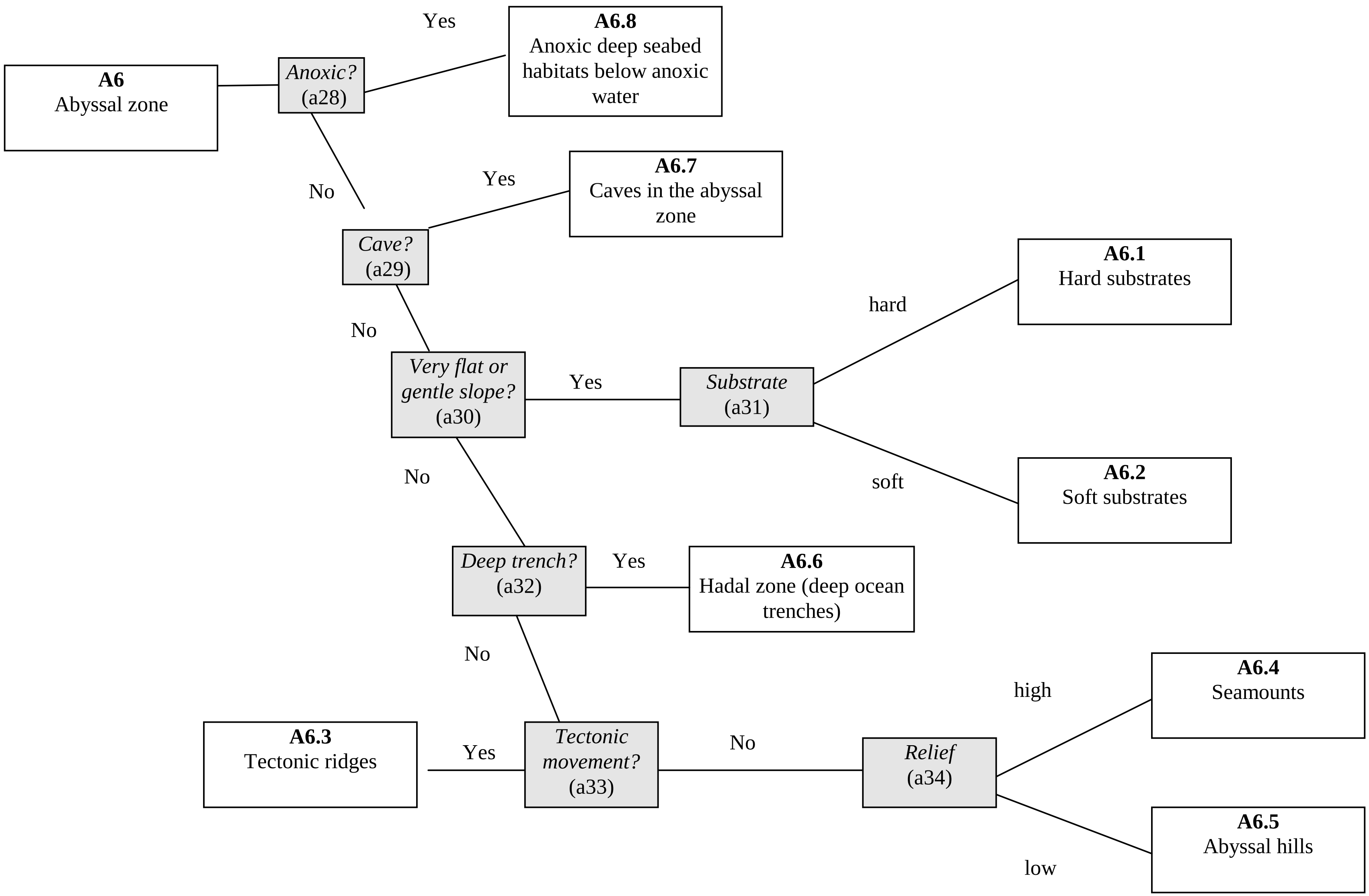
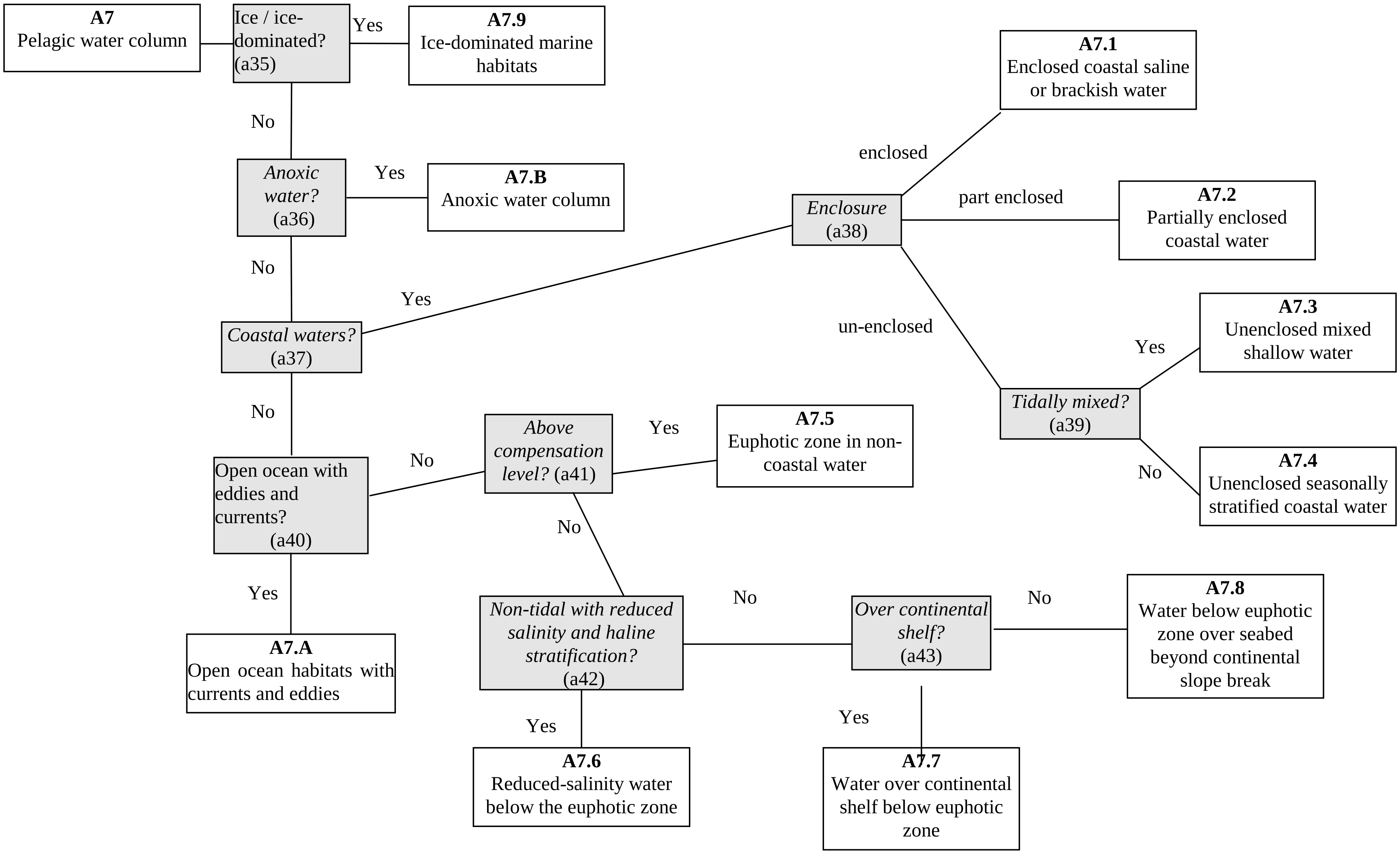


Figure A3.1(j). Draft EUNIS Habitat Classification: Criteria for the Pelagic Water Column (A7) to Level 3.
(number) refers to explanatory notes to the key



Explanatory notes to the key: Level 3 (Habitat type A)

a1. Hard substrate shores of non-tidal, reduced salinity waters which are either: below the mean water level and normally water-covered, but regularly or occasionally exposed by the action of wind, (hydrolittoral); or waterlogged shores between the mean and high water level (parts of the geolittoral, e.g., in the Baltic) (path = *Yes*) are separated from hard substrate littoral habitats in full salinity waters below the high water mark.

a2. Habitats developed either in rock caves, or underneath overhangs are separated (path = *Yes*).

a3. Rock pools (depressions filled by standing water left when tide recedes or by splash and spray, path = *Yes*) are distinguished from areas which are periodically submerged and drained.

a4. The criterion separates out habitats which are *very exposed* to wave and/or tidal action from those only *moderately exposed* or *sheltered*.

a5. Sedimentary shores of non-tidal, reduced salinity waters which are either: below the mean water level and normally water-covered, but regularly or occasionally exposed by the action of wind, (hydrolittoral); or waterlogged shores between the mean and high water level (parts of the geolittoral e.g., in the Baltic) (path = *Yes*) are separated from littoral habitats in full salinity waters below the high water mark (path = *No*).

a6. Habitats dominated by aquatic (e.g., *Zostera* spp.) or terrestrial (e.g., *Salicornia* spp.) angiosperms, (path = *Yes*) are distinguished from those dominated by animal communities, with or without algae.

a7. Angiosperm-dominated habitats are differentiated between those whose dominant species are entirely *aquatic* but which can tolerate occasional emersion (e.g., *Zostera* spp., *Ruppia* spp., *Posidonia* sp.), and those which are primarily *terrestrial* but can tolerate varying amounts of immersion (e.g., *Salicornia* spp., *Spartina* spp.).

a8. Habitats are divided on the basis of the dominating particle size of the substrate. *Gravel or coarse sand* > 1 mm grain size (including shingle); *fine sand or muddy sand* <= 1mm with <=30% silt (less than 0.063 mm grain size); *mud* >30% less than 0.063 mm grain size; or *mixed sediments* intimate mixtures of the above.

a9. Saltmarsh habitats are separated according to the water regime (determined by the position on the shore), between those *frequently submerged*, with soil moisture and salinity relatively constant, and *infrequently submerged*, with soil moisture and salinity variable.

a10. Habitats with pioneer vegetation dominated by annual or perennial species with <30% vegetation cover (path = *scattered vegetation*) are separated from those with more-or-less *continuous swards*.

a11. Driftline vegetation of saltmarshes (the highest zone, characterised by annual nitrophiles) is separated (path = *Yes*).

a12. *Species-poor* saltmarshes and reedbeds (pure stands or those dominated by a few species) are distinguished from those which are *species-rich*, with a wide range of communities, and a rich flora, not dominated by any one species.

a13. Habitats in submarine hard substrata specific to sources of seeping or bubbling gases, oils or water are distinguished (path = *Yes*).

a14. Habitats developed in wave-disturbed rock caves, underneath overhangs or in wave-scoured surge gullies are separated (path = *Yes*). Note that where conditions are the same as at deeper levels of the seabed (i.e., total darkness, no hydrodynamic action and constant temperature) these habitats should be classified as enclaves of the caves of deeper zones.

a15. Surge gullies, caves and overhangs which are surrounded by infralittoral rock and wave or tide-disturbed are separated (path = *Yes*) from habitats developed in rock caves, or underneath overhangs below the limit of wave disturbance. Note that where conditions are the same as at deeper levels of the seabed (i.e., total darkness, no hydrodynamic action and constant temperature) these habitats should be classified as enclaves of the caves of deeper zones.

a16. Deep circalittoral habitats which are below the euphotic zone (aphotic), thermally stable and below the influence of wave action are separated (path = *Yes*) from habitats which do not satisfy all three conditions.

a17. Infralittoral zones dominated by foliose algae, within the euphotic zone in relatively shallow sub-tidal or non-tidal water, are separated (path = *Yes*) from deeper animal-dominated circalittoral zones (path = *No*). Circalittoral zones are below deeper sub-tidal or non-tidal water with insufficient light penetration to allow algae to dominate; however encrusting algae and very sparse foliose algae may be present. Note that habitats normally dominated by foliose algae, but which, as a result of storm damage or heavy grazing, are characterised by encrusting algae follow path = *Yes*.

a18. The criterion separates out habitats in the infralittoral which are *very exposed* to wave action, currents or tidal streams from those only *moderately exposed* or *sheltered*. Note that “very exposed” also includes extremely exposed and exposed categories and that sheltered also encompasses the categories very sheltered and ultra sheltered (see glossary).

a19. The criterion separates out habitats in the circalittoral which are *very exposed* to wave action, currents or tidal streams from those only *moderately exposed* or *sheltered*. Note that “very exposed” also includes extremely exposed and exposed categories and that sheltered also encompasses the categories very sheltered and ultra sheltered (see glossary).

a20. Habitats specific to sublittoral sources of seeping or bubbling gases or liquids through sediments are distinguished (path = *Yes*).

a21. Habitats dominated by aquatic angiosperms (path = *Yes*) are distinguished from those dominated by animal communities, with or without algae.

a22. Habitats with aquatic angiosperm species predominating are separated according to the dominant species: *Posidonia;* and o*ther*.

a23. The deep circalittoral zone below deeper water (sub-tidal or non-tidal), characterised by stable conditions and stenothermal organisms is distinguished (path = *stable*, *stenothermal*) from shallower zones where the temperature regime is variable to a greater or lesser extent and the biota are eurythermal or mesothermal (path = *variable, eury- or mesothermal*).

a24. Habitats are divided on the basis of the dominating particle size of the substrate. *Gravel or coarse sand* > 1 mm grain size (including shingle and mobile cobbles); *fine sand or muddy sand* <= 1mm with <=30% silt (less than 0.063 mm grain size); *mud* >30% less than 0.063mm grain size; or *mixed sediments*, intimate mixtures of the above.

a25. Caves in the bathyal zone are separated (path = *Yes*). Note that caves found at shallower depths in total darkness, with no hydrodynamic action and constant temperature should be classified as caves in the abyssal zone

a26. Habitats in the bathyal zone specific to sources of seeping or bubbling gases, oils or water are distinguished (path = *Yes*).

a27. Bathyal seabed habitats are separated into those with substrates predominantly *rock; mixed*, *sand*; *muddy sand*; or *mud*.

a28. Anoxic deep seabeds lying below anoxic water are separated (path = *Yes*).

a29. Caves in the abyssal zone are separated (path = *Yes*).

a30. Level or gently sloping habitats of the abyssal plain (path = *Yes*) are separated from areas which are abruptly raised above or significantly deeper than their surroundings (path = *No*).

a31. The abyssal plain is divided according to the substrate type: *hard* substrata (including artificial substrata and large animal carcasses); and *soft* sediments.

a32. Deep ocean trenches of the hadal zone are distinguished (path = *Yes*) from raised features of the deep sea floor.

a33. Raised ridges of the deep sea floor directly attributable to tectonic movement are distinguished (path = *Yes*) from other raised features.

a34. Seamounts (*high*-relief) are separated from abyssal hills (*low*-relief).

a35. Marine areas dominated by frozen saline or fresh water including open water completely surrounded by ice (polynya) (path = *Yes*) are separated from habitats of open water not so dominated.

a36. Anoxic water columns are separated (path = *Yes*) from those which are aerobic (path = *No*).

a37. Coastal saline or brackish water (path = *Yes*) is distinguished from open-sea water. Note that coastal water is characterised by its proximity to the coast over seabed approx. to 20m depth isobar, with or without tidal influence and freshwater discharges.

a38. Coastal water bodies with different degrees of connection to the open ocean are distinguished: *enclosed* coastal saline or brackish water, without a permanent surface connection but with either intermittent surface or subsurface connections to the sea *(see Figure A3.2)*; *part-enclosed* with sill and usually saline stratification or with riverine outflow; or *unenclosed* open sea water.

a39. Water over the shallow seabed, which is mixed vertically and horizontally either through the direct influence of the coast or over submerged shoals or reefs *(see Figure A3.2)* (path = *Yes*) is distinguished from unenclosed seasonally stratified coastal waters.

a40. Large oceanic fronts (zones at the interface between two masses of water of different properties) and transient open ocean patterns are distinguished (path = *Yes*).

a41. Water of the euphotic zone, above the compensation level (where oxygen production equals oxygen consumption) is separated (path = *Yes*). *(See Figure A3 3.)*

a42. Non-tidal water with reduced salinity (oligohaline and mesohaline waters (surface salinity <18 ppt, dividing point from Surface Water Directive (75/440/EEC, Annex II) and at least seasonal haline stratification (e.g., in Baltic Sea) are separated (path = *Yes*).

a43. The criterion separates saline pelagic waters below the euphotic zone over the continental shelf, (path = *Yes*) from water over a seabed beyond the shelf break. Note that the lower limit of the shelf is defined by the change in slope at the shelf break, and may occur at depths between c200–500m. (*See Figure A3.3.*).

Figure A3.2.

Figure 2

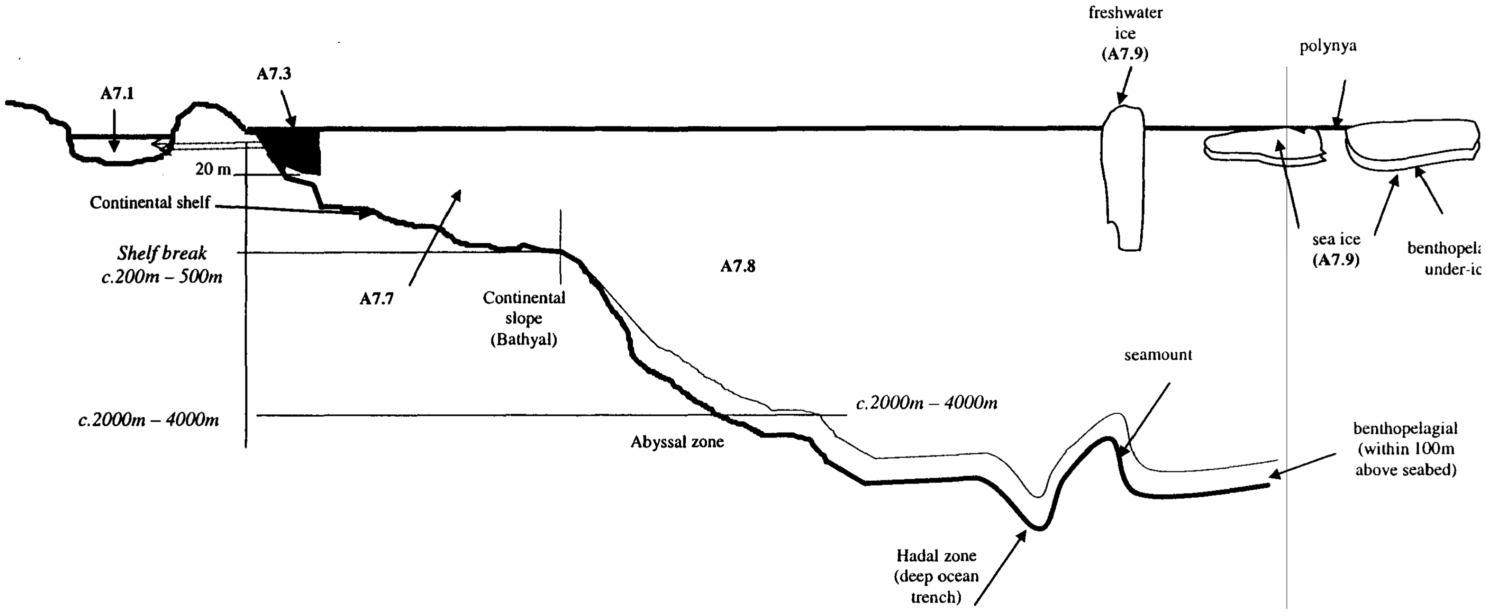
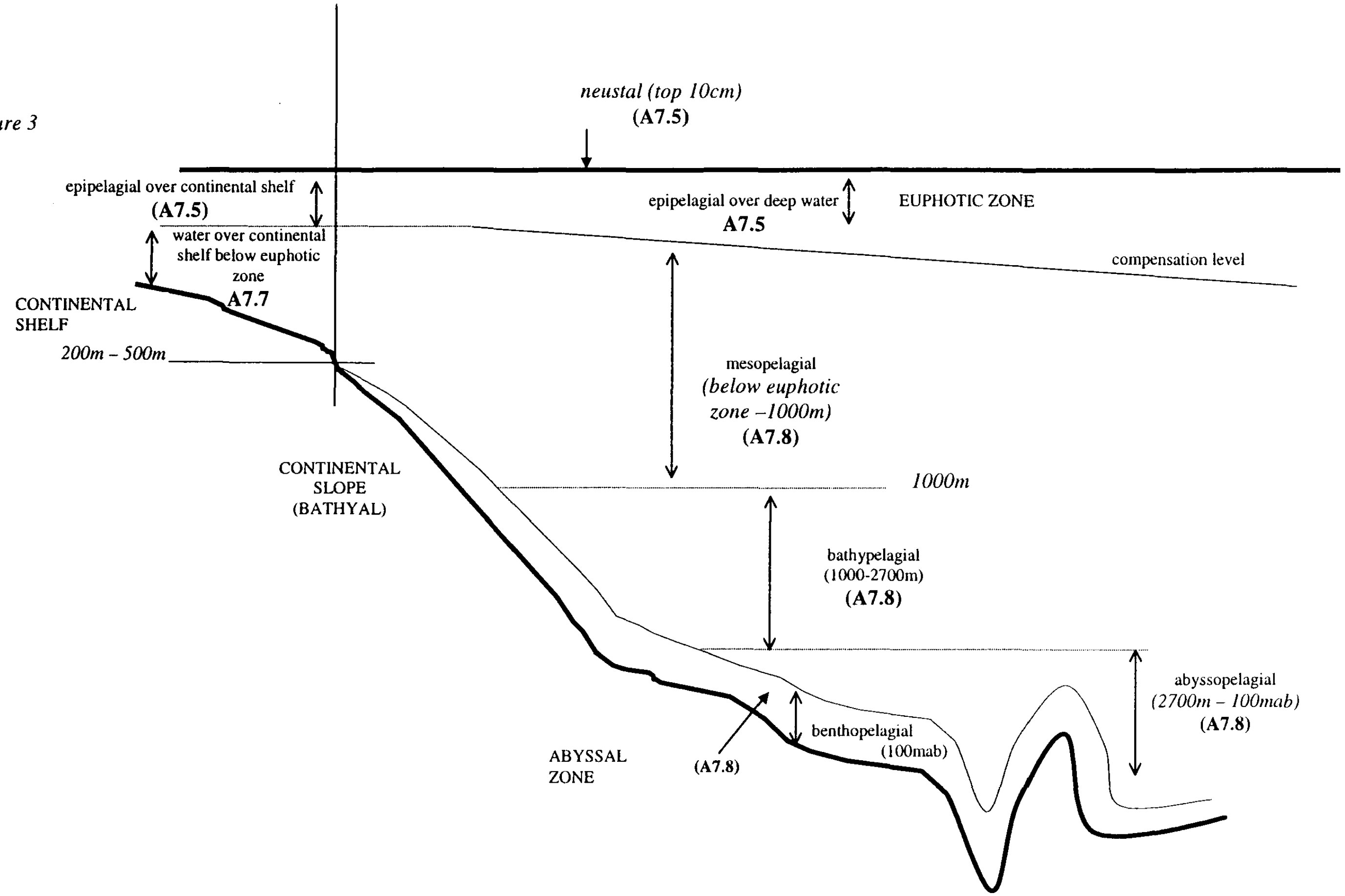


Figure A3.3.

Figure 3



Annex B

A Marine habitats

A1 Littoral rock and other hard substrata
- A1.1 Littoral rock very exposed to wave action
- A1.2 Littoral rock moderately exposed to wave action
- A1.3 Littoral rock sheltered from wave action
- A1.4 Rock habitats exposed by action of wind (e.g., hydrolittoral)
- A1.5 Rockpools
- A1.6 Littoral caves and overhangs

A2 Littoral sediments
- A2.1 Littoral gravels and coarse sands
- A2.2 Littoral sands and muddy sands
- A2.3 Littoral muds
- A2.4 Littoral mixed sediments
- A2.5 Habitats with sediments exposed by action of wind (e.g., hydrolittoral)
- A2.6 Coastal saltmarshes and saline reedbeds
- A2.7 Littoral sediments dominated by aquatic angiosperms

A3 Sublittoral rock and other hard substrata
- A3.1 Infralittoral rock very exposed to wave action and/or currents and tidal streams
- A3.2 Infralittoral rock moderately exposed to wave action and/or currents and tidal streams
- A3.3 Infralittoral rock sheltered from wave action and currents and tidal streams
- A3.4 Caves, overhangs and surge gullies in the infralittoral zone
- A3.5 Circalittoral rock very exposed to wave action or currents and tidal streams
- A3.6 Circalittoral rock moderately exposed to wave action or currents and tidal streams
- A3.7 Circalittoral rock sheltered from wave action and currents including tidal streams
- A3.8 Caves and overhangs in the circalittoral zone
- A3.9 Deep circalittoral rock habitats
- A3.A Vents and seeps in sublittoral rock

A4 Sublittoral sediments
- A4.1 Sublittoral mobile cobbles, gravels and coarse sands
- A4.2 Sublittoral sands and muddy sands
- A4.3 Sublittoral muds
- A4.4 Sublittoral mixed sediments
- A4.5 Shallow-water sediments dominated by angiosperms (other than [*Posidonia*])
- A4.6 [*Posidonia*] beds
- A4.7 Deep circalittoral sediment habitats
- A4.8 Seeps and vents in sublittoral sediments

A5 Bathyal zone
- A5.1 Bathyal zone hard substrates
- A5.2 Bathyal zone mixed substrates
- A5.3 Bathyal zone sand
- A5.4 Bathyal zone muddy sand
- A5.5 Bathyal zone mud
- A5.6 Seeps in the bathyal zone
- A5.7 Caves in the bathyal zone

A6 Abyssal zone
- A6.1 Hard substrates on the abyssal plain
- A6.2 Soft substrates on the abyssal plain
- A6.3 Tectonic ridges
- A6.4 Seamounts
- A6.5 Abyssal hills
- A6.6 Hadal zone (deep ocean trenches)
- A6.7 Caves in the abyssal zone
- A6.8 Anoxic deep seabed habitats below anoxic water

A7 Pelagic water column

- A7.1 Enclosed coastal saline or brackish water
- A7.2 Partially enclosed coastal water
- A7.3 Unenclosed mixed shallow water
- A7.4 Unenclosed seasonally stratified coastal water
- A7.5 Euphotic zone in non-coastal water
- A7.6 Reduced-salinity water below the euphotic zone
- A7.7 Water over continental shelf below euphotic zone
- A7.8 Water below euphotic zone over seabed beyond continental slope break
- A7.9 Ice-dominated marine habitats
- A7.A Open ocean habitats with currents and eddies
- A7.B Anoxic water column

B Coastal habitats

Annex C

A	**Marine habitats**
A1	Littoral rock and other hard substrata
A1.1	Littoral rock very exposed to wave action
A1.1/B-ELR.MB	Mussels and barnacles on very exposed littoral rock
A1.1/B-ELR.MB.MytB	[Mytilus edulis] and barnacles on very exposed eulittoral rock
	Mussels and barnacles on very exposed eulittoral rock
A1.1/B-ELR.MB.Bpat	Barnacles and [Patella] spp. on exposed or moderately exposed, or vertical sheltered, eulittoral rock
	Barnacles and limpets on exposed or moderately exposed, or vertical sheltered, eulittoral rock
A1.1/B-ELR.MB.BPat.Cht	[Chthamalus] spp. on exposed upper eulittoral rock
A1.1/B-ELR.MB.BPat.Lic	Barnacles and [Lichina pygmaea] on steep exposed eulittoral rock
A1.1/B-ELR.MB.BPat.Cat	[Catenella caespitosa] on overhanging, or shaded vertical, upper eulittoral rock
A1.1/B-ELR.MB.BPat.Fvesl	Barnacles, [Patella] and [Fucus vesiculosus] f. [linearis] on exposed eulittoral rock
A1.1/B-ELR.MB.BPat.Sem	[Semibalanus balanoides] on exposed or moderately exposed, or vertical sheltered, eulittoral rock
A1.1/B-ELR.FR	Robust fucoids or red seaweeds on very exposed littoral rock
A1.1/B-ELR.FR.Fdis	[Fucus distichus] subsp. [anceps] and [Fucus spiralis] f. [nana] on extremely exposed upper eulittoral rock
A1.1/B-ELR.FR.Coff	[Corallina officinalis] on very exposed lower eulittoral rock
A1.1/B-ELR.FR.Him	[Himanthalia elongata] and red seaweeds on exposed lower eulittoral rock
A1.1/M-II.4.1.	Biocenosis of the upper mediolittoral rock
A1.1/M-II.4.1.1.	Association with [Bangia atropurpurea]
A1.1/M-II.4.1.2.	Association with [Porphyra leucosticta]
A1.1/M-II.4.1.3.	Association with [Nemalion helminthoides] and [Rissoella verruculosa]
A1.1/M-II.4.1.4.	Association with [Lithophyllum papillosum] and [Polysiphonia] spp.
A1.1/M-II.4.2.(p)	Biocenosis of the lower mediolittoral rock very exposed to wave action
A1.1/M-II.4.2.1.	Association with [Lithophyllum lichenoides] (= entablature with L. tortuosum)
A1.1/M-II.4.2.5	Facies with [Pollicipes cornucopiae]
A1.1/M-II.4.2.2.	Association with [Lithophyllum byssoides]
A1.1/M-II.4.2.3.	Association with [Tenarea undulosa]
A1.2	Littoral rock moderately exposed to wave action
A1.2/B-MLR.BF	Fucoids and barnacles on moderately exposed littoral rock
A1.2/B-MLR.BF.PelB	[Pelvetia canaliculata] and barnacles on moderately exposed littoral fringe rock
A1.2/B-MLR.BF.FvesB	[Fucus vesiculosus] and barnacle mosaics on moderately exposed mid eulittoral rock
A1.2/B-MLR.BF.Fser	[Fucus serratus] on moderately exposed lower eulittoral rock
A1.2/B-MLR.BF.Fser.R	[Fucus serratus] and red seaweeds on moderately exposed lower eulittoral rock
A1.2/B-MLR.BF.Fser.Fser	Dense [Fucus serratus] on moderately exposed to very sheltered lower eulittoral rock
A1.2/B-MLR.BF.Fser.Fser.Bo	[Fucus serratus] and under-boulder fauna on lower eulittoral boulders
A1.2/B-MLR.BF.Fser.Pid	[Fucus serratus] and piddocks on lower eulittoral soft rock
A1.2/B-MLR.R	Red seaweeds on moderately exposed littoral rock
A1.2/B-MLR.R.XR	Mixed red seaweeds on moderately exposed lower eulittoral rock
A1.2/B-MLR.R.Pal	[Palmaria palmata] on very to moderately exposed lower eulittoral rock
A1.2/B-MLR.R.Mas	[Mastocarpus stellatus] and [Chondrus crispus] on very to moderately exposed lower eulittoral rock
A1.2/B-MLR.R.Osm	[Osmundea (Laurencia) pinnatifida] and [Gelidium pusillum] on moderately exposed mid eulittoral rock
A1.2/B-MLR.R.RPid	[Ceramium] sp. and piddocks on eulittoral fossilised peat
A1.2/B-MLR.Eph	Ephemeral green or red seaweeds (freshwater- or sand-influenced) on moderately exposed littoral rock
A1.2/B-MLR.Eph.Ent	[Enteromorpha] spp. on freshwater-influenced or unstable upper eulittoral rock
A1.2/B-MLR.Eph.EntPor	[Porphyra purpurea] or [Enteromorpha] spp. on sand-scoured mid or lower eulittoral rock
A1.2/B-MLR.Eph.Rho	[Rhodothamniella floridula] on sand-scoured lower eulittoral rock
A1.2/B-MLR.MF	Mussels and fucoids on moderately exposed littoral rock
A1.2/B-MLR.MF.MytFves	[Mytilus edulis] and [Fucus vesiculosus] on moderately exposed mid eulittoral rock
A1.2/B-MLR.MF.MytFR	[Mytilus edulis], [Fucus serratus] and red seaweeds on moderately exposed lower eulittoral rock
A1.2/B-MLR.MF.MytPid	[Mytilus edulis] beds and piddocks on eulittoral firm clay
	Mussel beds and piddocks on eulittoral firm clay
A1.2/B-MLR.Sab	[Sabellaria] reefs on littoral rock
	Honeycomb worm reefs on littoral rock
A1.2/B-MLR.Sab.Salv	[Sabellaria alveolata] reefs on sand-abraded eulittoral rock

A1.2/M-II.4.2.(p)	Biocenosis of the lower mediolittoral rock moderately exposed to wave action
A1.2/M-II.4.2.4.	Association with [Ceramium ciliatum] and [Corallina elongata]
A1.2/M-II.4.2.8.	[Neogoniolithon brassica-florida] concretion
A1.2/M-II.4.2.9.	Association with [Gelidium] spp
A1.2/M-II.4.2.10.	Pools and lagoons sometimes associated with [Vermetus] spp. (infralittoral enclave)
A1.3	Littoral rock sheltered from wave action
A1.3/B-SLR.F	Dense fucoids on sheltered littoral rock
A1.3/B-SLR.F.Pel	[Pelvetia canaliculata] on sheltered littoral fringe rock
A1.3/B-SLR.F.Fspi	[Fucus spiralis] on moderately exposed to very sheltered upper eulittoral rock
A1.3/B-SLR.F.Fves	[Fucus vesiculosus] on sheltered mid eulittoral rock
A1.3/B-SLR.F.Asc	[Ascophyllum nodosum] on very sheltered mid eulittoral rock
A1.3/B-SLR.F.Asc.Asc	[Ascophyllum nodosum] on full salinity mid eulittoral rock
A1.3/B-SLR.F.Asc.T	[Ascophyllum nodosum], sponges and ascidians on tide-swept mid eulittoral rock
A1.3/B-SLR.F.Asc.VS	[Ascophyllum nodosum] and [Fucus vesiculosus] on variable salinity mid eulittoral rock
A1.3/B-SLR.F.Fserr	[Fucus serratus] on sheltered lower eulittoral rock
A1.3/B-SLR.F.Fserr.T	[Fucus serratus], sponges and ascidians on tide-swept lower eulittoral rock
A1.3/B-SLR.F.Fserr.VS	[Fucus serratus] and large [Mytilus edulis] on variable salinity lower eulittoral rock
A1.3/B-SLR.F.Fcer	[Fucus ceranoides] on reduced salinity eulittoral rock
A1.3/M-II.4.2.7.	Association with [Fucus virsoides]
A1.3/B-SLR.FX	Fucoids, barnacles or ephemeral seaweeds on sheltered littoral mixed substrata
A1.3/B-SLR.FX.BLlit	Barnacles and [Littorina littorea] on unstable eulittoral mixed substrata
A1.3/B-SLR.FX.FvesX	[Fucus vesiculosus] on mid eulittoral mixed substrata
A1.3/B-SLR.FX.AscX	[Ascophyllum nodosum] on mid eulittoral mixed substrata
A1.3/B-SLR.FX.AscX.mac	[Ascophyllum nodosum] ecad. [mackaii] beds on extremely sheltered mid eulittoral mixed substrata
A1.3/B-SLR.FX.FserX	[Fucus serratus] on lower eulittoral mixed substrata
A1.3/B-SLR.FX.FserX.T	[Fucus serratus] with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata
A1.3/B-SLR.FX.EphX	Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata
A1.3/B-SLR.FX.FcerX	[Fucus ceranoides] on reduced salinity eulittoral mixed substrata
A1.3/B-SLR.MX	Mussel beds on sheltered littoral mixed substrata
A1.3/B-SLR.MX.Myt	[Mytilus edulis] beds on eulittoral mixed substrata *Mussel beds on eulittoral mixed substrata*
A1.3/M-II.4.2.(p)	Biocenosis of the lower mediolittoral rock sheltered from wave action
A1.3/M-II.4.2.6.	Association with [Enteromorpha compressa]
A1.4	Rock habitats exposed by action of wind (e.g., hydrolittoral)
A1.4/H-02.01.01.03	Hydrolittoral soft rock
A1.4/H-02.01.01.03.01	Hydrolittoral soft rock: level bottoms with little or no macrophyte vegetation
A1.4/H-02.01.01.03.02	Hydrolittoral soft rock: level bottoms dominated by macrophyte vegetation
A1.4/H-02.01.01.03.03	Hydrolittoral soft rock: reefs
A1.4/H-02.01.02.03	Hydrolittoral solid rock (bedrock)
A1.4/H-02.01.02.03.01	Hydrolittoral solid rock (bedrock): level bottoms with little or no macrophyte vegetation
A1.4/H-02.01.02.03.02	Hydrolittoral solid rock (bedrock): level bottoms dominated by macrophyte vegetation
A1.4/H-02.01.02.03.03	Hydrolittoral solid rock (bedrock): reefs
A1.4/H-02.03.03	Hydrolittoral hard clay
A1.4/H-02.03.03.01	Hydrolittoral hard clay: level bottoms with little or no macrophyte vegetation
A1.4/H-02.09.03	Hydrolittoral [Mytilus edulis] beds *Hydrolittoral mussel beds*
A1.4/H-02.09.03.01	Hydrolittoral [Mytilus edulis] beds: with little or no macrophyte vegetation *Hydrolittoral mussel beds: with little or no macrophyte vegetation*
A1.4/H-02.09.03.02	Hydrolittoral [Mytilus edulis] beds: dominated by macrophyte vegetation *Hydrolittoral mussel beds: dominated by macrophyte vegetation*
A1.4/H-02.11.02	Hydrolittoral peat
A1.5	Rockpools
A1.5/B-LR.Rkp(p)	Communities of littoral rockpools
A1.5/B-LR.Rkp.Cor	[Corallina officinalis] and coralline crusts in shallow eulittoral rockpools
A1.5/B-LR.Rkp.Cor.Par	Coralline crusts and [Paracentrotus lividus] in shallow eulittoral rockpools
A1.5/B-LR.Rkp.Cor.Bif	[Bifurcaria bifurcata] in shallow eulittoral rockpools
A1.5/B-LR.Rkp.Cor.Cys	[Cystoseira] spp. in shallow eulittoral rockpools
A1.5/B-LR.Rkp.FK	Fucoids and kelps in deep eulittoral rockpools
A1.5/B-LR.Rkp.FK.Sar	[Sargassum muticum] in eulittoral rockpools
A1.5/B-LR.Rkp.SwSed	Seaweeds in sediment-floored eulittoral rockpools
A1.5/B-LR.Rkp.H	Hydroids, ephemeral seaweeds and [Littorina littorea] in shallow eulittoral mixed substrata pools
A1.5/B-LR.Rkp(p)	Communities of rockpools in the supralittoral zone
A1.5/B-LR.Rkp.G	Green seaweeds ([Enteromorpha] spp. and [Cladophora] spp.) in upper shore rockpools
A1.5/H-04.02.01	Brackish permanent pools in the geolittoral zone

A1.5/H-04.02.01.01	Eutrophic brackish permanent pools in the geolittoral zone
A1.5/H-04.02.01.02	Mesotrophic brackish permanent pools in the geolittoral zone
A1.5/H-04.02.01.03	Oligotrophic brackish permanent pools in the geolittoral zone
A1.6	Littoral caves and overhangs
A1.6/B-LR.Ov	Communities of littoral caves and overhangs
A1.6/B-LR.Ov.RhoCv	[Rhodothamniella floridula] in upper littoral fringe soft rock caves
A1.6/B-LR.Ov.SR	Sponges and shade-tolerant red seaweeds on overhanging lower eulittoral bedrock
A1.6/B-LR.Ov.SByAs	Sponges, bryozoans and ascidians on deeply overhanging lower shore bedrock
A1.6/M-II.4.3.1.	Association with [Phymatolithon lenormandii] and [Hildenbrandia rubra]
A2	Littoral sediments
A2.1	Littoral gravels and coarse sands
A2.1/B-LGS.Sh	Shingle and gravel shores
A2.1/B-LGS.Sh.BarSh	Barren shingle or gravel shores
A2.1/B-LGS.Sh.Pec	[Pectenogammarus planicrurus] in mid shore well-sorted gravel or coarse sand
A2.1/B-LGS.Est	Estuarine coarse sediment shores
A2.1/B-LGS.Est.Ol	Oligochaetes in reduced or low salinity gravel or coarse sand shores
A2.1/M-II.3.1.	Biocenosis of the mediolittoral coarse detritic bottoms
A2.1/M-II.3.1.1.	Facies of banks of dead leaves of [Posidonia oceanica] and other phanerogams *Facies of banks of dead leaves of Posidonia and other phanerogams*
A2.2	Littoral sands and muddy sands
A2.2/B-LGS.S	Sand shores
A2.2/B-LGS.S.Tal	Talitrid amphipods in decomposing seaweed on the strand-line
A2.2/B-LGS.S.BarSnd	Barren coarse sand shores
A2.2/B-LGS.S.AEur	Burrowing amphipods and [Eurydice pulchra] in well-drained clean sand shores
A2.2/B-LGS.S.AP	Burrowing amphipods and polychaetes in clean sand shores
A2.2/B-LGS.S.AP.P	Burrowing amphipods and polychaetes (often with [Arenicola marina]) in clean sand shores
A2.2/B-LGS.S.AP.Pon	Burrowing amphipods [Pontocrates] spp. and [Bathyporeia] spp. in lower shore clean sand
A2.2/B-LGS.S.Lan	Dense [Lanice conchilega] in tide-scoured lower shore sand
A2.2/B-LMS.MS	Muddy sand shores
A2.2/B-LMS.MS.BatCor	[Bathyporeia] spp. and [Corophium] spp. in upper shore slightly muddy fine sands
A2.2/B-LMS.MS.PCer	Polychaetes and [Cerastoderma edule] in fine sand and muddy sand shores
A2.2/B-LMS.MS.MacAre	[Macoma balthica] and [Arenicola marina] in muddy sand shores
A2.2/B-LMS.MS.MacAre.Mare	[Arenicola marina], [Macoma balthica] and [Mya arenaria] in muddy sand shores
A2.2/M-II.2.1.	Biocenosis of the mediolittoral sands
A2.2/M-II.2.1.1.	Facies with [Ophelia bicornis]
A2.3	Littoral muds
A2.3/B-LMU.SMu	Sandy mud shores
A2.3/B-LMU.SMu.HedMac	[Hediste diversicolor] and [Macoma balthica] in sandy mud shores
A2.3/B-LMU.SMu.HedMac.Are	[Hediste diversicolor], [Macoma balthica] and [Arenicola marina] in muddy sand or sandy mud shores
A2.3/B-LMU.SMu.HedMac.Pyg	[Hediste diversicolor], [Macoma balthica] and [Pygospio elegans] in sandy mud shores
A2.3/B-LMU.SMu.HedMac.Mare	[Hediste diversicolor], [Macoma balthica] and [Mya arenaria] in sandy mud shores
A2.3/B-LMU.Mu	Soft mud shores
A2.3/B-LMU.Mu.HedScr	[Hediste diversicolor] and [Scrobicularia plana] in reduced salinity mud shores
A2.3/B-LMU.Mu.HedStr	[Hediste diversicolor] and [Streblospio shrubsolii] in sandy mud or soft mud shores
A2.3/B-LMU.Mu.HedOl	[Hediste diversicolor] and oligochaetes in low salinity mud shores
A2.3/O-	Saltmarsh creeks
A2.3/O-	Saltmarsh pools
A2.4	Littoral mixed sediments
A2.41	Mollusc and polychaete communities of littoral mixed sediments
A2.4/B-LMX.MytFab	[Mytilus edulis] and [Fabricia sabella] in poorly-sorted muddy sand or muddy gravel shores
A2.4/B-LMX.Mare	[Mya arenaria] and polychaetes in muddy gravel shores
A2.4/O-	Biogenic features (scars) on littoral mixed sediments
A2.4/O-	Sheltered mixed sediment shores
A2.5	Habitats with sediments exposed by action of wind (e.g., hydrolittoral)
A2.5/H-02.02.03	Hydrolittoral stony substrates
A2.5/H-02.02.03.01	Hydrolittoral stony substrates: level bottoms with little or no macrophyte vegetation
A2.5/H-02.02.03.02	Hydrolittoral stony substrates: level bottoms dominated by macrophyte vegetation
A2.5/H-02.02.03.03	Hydrolittoral stony substrates: reefs
A2.5/H-02.04.03	Hydrolittoral gravel substrates
A2.5/H-02.04.03.01	Hydrolittoral gravel substrates: level bottoms with little or no macrophyte vegetation
A2.5/H-02.04.03.02	Hydrolittoral gravel substrates level bottoms dominated by macrophyte vegetation

A2.5/H-02.04.03.03	Hydrolittoral gravel substrates: banks
A2.5/H-02.05.03	Hydrolittoral sandy substrates
A2.5/H-02.05.03.01	Hydrolittoral sandy substrates: level bottoms with little or no macrophyte vegetation
A2.5/H-02.05.03.02	Hydrolittoral sandy substrates: level bottoms dominated by macrophyte vegetation
A2.5/H-02.05.03.03	Hydrolittoral sandy substrates: bars
A2.5/H-02.05.03.04	Hydrolittoral sandy substrates: banks
A2.5/H-02.07.03	Hydrolittoral muddy substrates
A2.5/H-02.07.03.01	Hydrolittoral muddy substrates: with little or no macrophyte vegetation
A2.5/H-02.07.03.02	Hydrolittoral muddy substrates: dominated by macrophyte vegetation
A2.5/H-02.08.03	Hydrolittoral mixed sediment substrates
A2.5/H-02.08.03.01	Hydrolittoral mixed sediment substrates: with little or no macrophyte vegetation
A2.5/H-02.08.03.02	Hydrolittoral mixed sediment substrates: dominated by macrophyte vegetation
A2.5/H-03.07.01	Geolittoral wetlands and meadows: reed, rush and sedge stands
A2.5/H-03.07.01.01	Geolittoral wetlands and meadows: reed, rush and sedge stands: natural stands
A2.5/H-03.07.01.02	Geolittoral wetlands and meadows: reed, rush and sedge stands: harvested stands
A2.6	Coastal saltmarshes and saline reedbeds
A2.6/B-LMU.Smdr	Saltmarsh driftlines
A2.6/P-15.35	Atlantic saltmarsh and drift rough grass communities
A2.6/P-15.36	Atlantic saltmarsh driftline annual communities
A2.6/P-15.56	Mediterranean saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM24	[Elymus pycnanthus] with [Suaeda vera] or [Inula crithmoides] saltmarsh driftlines
	Sea couch with shrubby seablite or golden samphire saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM28	[Elymus repens] saltmarsh driftlines
	Couch saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM25	[Suaeda vera] saltmarsh driftlines
	Shrubby seablite saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM21	[Suaeda vera] - [Limonium binervosum] saltmarsh driftlines
	Shrubby seablite - rock sea-lavender saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM23	[Spergularia marina] - [Puccinellia distans] saltmarsh driftlines
	Lesser sea-spurrey - reflexed saltmarsh-grass saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM22	[Frankenia laevis] - [Halimione portulacoides] saltmarsh driftlines
	Sea-heath ([Frankenia laevis]) - pedunculate sea-purslane saltmarsh driftlines
A2.6/B-LMU.Sm.NVC.SM26	[Inula crithmoides] on saltmarshes
	Golden samphire on saltmarshes
A2.6/B-LMU.Sm.NVC.SM27	[Sagina maritima] ephemeral salt marsh in sand
	Sea pearlwort ephemeral salt marsh in sand
A2.62	Species-rich upper saltmarshes
A2.6/P-15.34	Atlantic brackish saltmarsh communities
A2.6/P-15.51	Mediterranean [Juncus maritimus] and [Juncus acutus] saltmarshes
	Mediterranean tall rush saltmarshes
A2.6/P-15.52	Mediterranean short [Juncus], [Carex], [Hordeum] and [Trifolium] saltmeadows
	Mediterranean short rush, sedge, barley, clover saltmeadows
A2.6/P-15.57	Mediterranean [Elymus] or [Artemisia] stands
	Mediterranean saltmarsh couch - wormwood stands
A2.6/P-15.58	Mediterranean [Juncus subulatus] beds
	Mediterranean fine-leaved rush beds
A2.6/P-15.61	Mediterranean saltmarsh scrubs
A2.6/P-15.62	Atlantic salt scrubs
A2.6/P-15.63	Mediterranean [Limoniastrum] scrubs
A2.6/P-15.64	Canarian saltmarsh scrubs
A2.6/B-LMU.Smm-u	Mid-upper saltmarshes and saline reedbeds
A2.6/P-15.33	Atlantic upper shore communities
A2.6/P-15.53	Mediterranean halo-psammophile meadows
A2.6/P-15.B2	Upper shore arctic salt meadows
A2.6/P-15.B3	Sulphurous arctic salt meadows
A2.6/B-LMU.Sm.NVC.SM18	[Juncus maritimus] mid-upper saltmarshes
	Sea rush mid-upper saltmarshes
A2.6/B-LMU.Sm.NVC.SM15	[Juncus maritimus] mid-upper saltmarshes with [Triglochin maritima]
	Sea rush mid-upper saltmarshes with sea arrowgrass
A2.6/B-LMU.Sm.NVC.SM20	[Eleocharis uniglumis] mid-upper saltmarshes
	Slender spike-rush mid-upper saltmarshes
A2.6/B-LMU.Sm.NVC.SM19	[Blysmus rufus] mid-upper saltmarshes
	Saltmarsh flat-sedge mid-upper saltmarshes
A2.6/B-LMU.Sm.NVC.SM17	Mid-upper saltmarshes: [Artemisia maritima] with [Festuca rubra], or open canopy of [Artemisia maritima] and [Halimione]
	Mid-upper saltmarshes: sea wormwood with red fescue, or open canopy of sea wormwood and sea purslane
A2.6/B-LMU.Sm.NVC.SM16a	[Festuca rubra] mid-upper saltmarshes

	Red fescue mid-upper saltmarshes
A2.6/B-LMU.Sm.NVC.SM16b	Mid-upper saltmarshes: sub-communities of [Festuca rubra] with [Agrostis stolonifera], [Juncus gerardi], [Puccinellia maritima], [Glaux maritima], [Triglochin maritima], [Armeria maritima] and [Plantago maritima] *Mid-upper saltmarshes: sub-communities of red fescue with creeping bent, saltmarsh rush, common saltmarsh-grass, sea-milkwort, sea arrowgrass, thrift and sea-plantain*
A2.63C	Saline beds of [Phragmites australis] *Saline reedbeds*
A2.64	Low-mid saltmarshes
A2.6/P-15.31	Saltmarsh grass lawns
A2.6/P-15.32	Atlantic lower shore communities
A2.6/P-15.55	Mediterranean [Puccinellia festuciformis] and [Aeluropus littoralis] swards *Mediterranean saltmarsh grass swards*
A2.6/P-15.B1	Lower shore arctic salt meadows
A2.6/B-LMU.Sm.NVC.SM14	[Halimione portulacoides] low-mid saltmarshes *Pedunculate sea-purslane low-mid saltmarshes*
A2.6/B-LMU.Sm.NVC.SM13a	[Puccinellia maritima] low-mid saltmarshes *Common saltmarsh-grass ([Puccinellia maritima]) low-mid saltmarshes*
A2.6/B-LMU.Sm.NVC.SM13b	Sub-communities of [Puccinellia maritima] saltmarsh with [Limonium vulgare] and [Armeria maritima]; [Puccinellia maritima] with [Glaux maritima] co-dominant in species-poor veg.; [Puccinellia maritima] with [Plantago maritima] and/or [Armeria maritima] *Sub-communities of common saltmarsh-grass saltmarsh with sea lavender and sea arrowgrass; common saltmarsh-grass with sea-milkwort co-dominant in species-poor vegetation; common saltmarsh-grass with sea plantain and/or sea arrowgrass*
A2.6/B-LMU.Sm.NVC.SM10	Annual [Salicornia], [Suaeda] and [Puccinellia maritima] low-mid saltmarshes *Annual samphire, sea-blite and saltmarsh-grass low-mid saltmarshes*
A2.65	Pioneer saltmarshes
A2.6/P-15.11(p)	[Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes *Glasswort pioneer saltmarshes*
A2.6/M-I.1.1.	Biocenosis of beaches with slowly-drying wracks under glassworts
A2.6/B-LMU.Sm.NVC.SM9	[Suaeda maritima] pioneer saltmarshes *Annual sea-blite pioneer saltmarshes*
A2.6/B-LMU.Sm.NVC.SM8	[Salicornia] spp. pioneer saltmarshes *Glasswort pioneer saltmarshes*
A2.6/P-15.1132	[Salicornia veneta] swards *Venetian glasswort swards*
A2.6/P-15.115(p)	Black Sea annual [Salicornia], [Suaeda] and [Salsola] saltmarshes *Black Sea annual glasswort saltmarshes*
A2.6/P-15.12(p)	Mediterranean coastal halo-nitrophilous pioneer communities
A2.6/P-15.13	Atlantic [Sagina maritima] communities *Atlantic sea-pearlwort communities*
A2.6/P-15.21	Flat-leaved [Spartina] swards *Flat-leaved cordgrass swards*
A2.6/B-LMU.Sm.NVC.SM6	[Spartina anglica] pioneer saltmarshes *Common cord-grass pioneer saltmarshes*
A2.6/B-LMU.Sm.NVC.SM5	[Spartina alterniflora] with [Spartina anglica], [Puccinellia maritima] and [Aster tripolium] *Smooth cord-grass with common cord-grass, common saltmarsh-grass and sea aster*
A2.6/B-LMU.Sm.NVC.SM4	[Spartina maritima] pioneer saltmarshes *Small cord-grass pioneer saltmarshes*
A2.6/P-15.22	[Spartina densiflora] swards *Rush-leaved cordgrass swards*
A2.6/B-LMU.Sm.NVC.SM12	Rayed [Aster tripolium] pioneer saltmarshes *Rayed sea-aster pioneer saltmarshes*
A2.6/B-LMU.Sm.NVC.SM11	[Aster tripolium] var. [discoides] pioneer saltmarshes
A2.6/B-LMU.Sm.NVC.SM7	[Arthrocnemum perenne] pioneer saltmarshes, sometimes with [Halimione], [Puccinellia] and [Suaeda] *Perennial glasswort pioneer saltmarshes, sometimes with sea-purslane, saltmarsh grass and sea-blite*
A2.7	Littoral sediments dominated by aquatic angiosperms
A2.7/B-LMS.Zos	[Zostera] beds on littoral sediments *Eelgrass beds on littoral sediments*
A2.7/P-11.321	Mainland Atlantic [Zostera noltii] or [Zostera angustifolia] meadows *Mainland Atlantic dwarf eelgrass meadows*
A2.7/B-LMS.Zos.Znol	[Zostera noltii] beds in upper to mid shore muddy sand *Dwarf eelgrass ([Zostera noltii]) beds in upper to mid shore muddy sand*

A2.7/P-11.322	Macaronesian [Zostera noltii] meadows *Macaronesian dwarf eelgrass meadows*
A2.7/P-11.3321	Mediterranean [Zostera noltii] beds *Mediterranean dwarf eelgrass beds*
A2.7/P-11.3322	Mediterranean [Zostera hornemanniana] beds *Mediterranean eelgrass beds*
A2.7/P-11.333	Pontic [Zostera marina] and [Zostera noltii] meadows *Pontic eelgrass meadows*
A2.7/P-11.42	[Eleocharis] beds *Marine spike-rush beds*
A2.7/P-11.421	[Eleocharis parvula] beds *Dwarf spike-rush ([Eleocharis parvula]) beds*
A2.7/P-11.422	Bothnian [Eleocharis acicularis] beds *Bothnian needle spike-rush beds*
A2.73	[Ruppia] beds on littoral sediments *Marine tasselweed beds on littoral sediments*
A3	Sublittoral rock and other hard substrata
A3.1	Infralittoral rock very exposed to wave action and/or currents and tidal streams
A3.1/B-EIR.KFaR	Kelp with cushion fauna, foliose red seaweeds or coralline crusts (exposed rock)
A3.1/B-EIR.KFaR.Ala	[Alaria esculenta] on sublittoral fringe bedrock
A3.1/B-EIR.KFaR.Ala.Myt	[Alaria esculenta], [Mytilus edulis] and coralline crusts on very exposed sublittoral fringe bedrock
A3.1/B-EIR.KFaR.Ala.Ldig	[Alaria esculenta] and [Laminaria digitata] on exposed sublittoral fringe bedrock
A3.1/B-EIR.KFaR.AlaAnSC	[Alaria esculenta] forest with dense anemones and sponge crusts on extremely exposed infralittoral bedrock
A3.1/B-EIR.KFaR.LhypFa	[Laminaria hyperborea] forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed infralittoral rock
A3.1/B-EIR.KFaR.LhypPar	Sparse [Laminaria hyperborea] and dense [Paracentrotus lividus] on exposed infralittoral limestone rock
A3.1/B-EIR.KFaR.LhypR	[Laminaria hyperborea] forest with dense foliose red seaweeds on exposed infralittoral rock
A3.1/B-EIR.KFaR.LhypR.Ft	[Laminaria hyperborea] forest with dense foliose red seaweeds on exposed upper infralittoral rock
A3.1/B-EIR.KFaR.LhypR.Pk	[Laminaria hyperborea] park with dense foliose red seaweeds on exposed lower infralittoral rock
A3.1/B-EIR.KFaR.LhypR.Loch	Mixed [Laminaria hyperborea] and [Laminaria ochroleuca] forest on exposed infralittoral rock
A3.1/B-EIR.KFaR.LsacSac	[Laminaria saccharina] and/or [Saccorhiza polyschides] on exposed infralittoral rock
A3.1/B-EIR.KFaR.FoR	Foliose red seaweeds on exposed or moderately exposed lower infralittoral rock
A3.1/B-EIR.KFaR.FoR.Dic	Foliose red seaweeds with dense [Dictyota dichotoma] and/or [Dictyopteris membranacea] on exposed lower infralittoral rock
A3.1/B-IR.FaSwV(p)	Fauna and seaweeds on vertical exposed infralittoral rock
A3.1/B-IR.FaSwV.CorMetAlc	[Corynactis viridis], [Metridium senile] and [Alcyonium digitatum] on exposed or moderately vertical infralittoral rock
A3.1/M-III.6.1.(p)	Biocenosis of infralittoral algae very exposed to wave action
A3.1/M-III.6.1.1.	Overgrazing facies with incrustant algaes and sea urchins
A3.1/M-III.6.1.2.	Association with [Cystoseira amentacea] (var. [amentacea], var. [stricta], var. [spicata])
A3.1/M-III.6.1.3.	Facies with [Vermetus] spp.
A3.1/M-III.6.1.4.	Facies with [Mytilus galloprovincialis]
A3.1/M-III.6.1.5.	Association with [Corallina elongata] and [Herposiphonia secunda]
A3.1/M-III.6.1.6.	Association with [Corallina officinalis]
A3.1/M-III.6.1.29.	Association with [Schottera nicaeensis]
A3.2	Infralittoral rock moderately exposed to wave action and/or currents and tidal streams
A3.2/B-MIR.KR	Kelp and red seaweeds on moderately exposed infralittoral rock
A3.2/B-MIR.KR.Ldig	[Laminaria digitata] on moderately exposed or tide-swept sublittoral fringe rock
A3.2/B-MIR.KR.Ldig.Ldig	[Laminaria digitata] on moderately exposed sublittoral fringe rock
A3.2/B-MIR.KR.Ldig.Ldig.Bo	[Laminaria digitata] and under-boulder fauna on sublittoral fringe boulders
A3.2/B-MIR.KR.Ldig.T	[Laminaria digitata], ascidians and bryozoans on tide-swept sublittoral fringe rock
A3.2/B-MIR.KR.Ldig.Pid	[Laminaria digitata] and piddocks on sublittoral fringe soft rock
A3.2/B-MIR.KR.Lhyp	[Laminaria hyperborea] and foliose red seaweeds on moderately exposed infralittoral rock
A3.2/B-MIR.KR.Lhyp.Ft	[Laminaria hyperborea] forest and foliose red seaweeds on moderately exposed upper infralittoral rock
A3.2/B-MIR.KR.Lhyp.Pk	[Laminaria hyperborea] park and foliose red seaweeds on moderately exposed lower infralittoral rock
A3.2/B-MIR.KR.Lhyp.TFt	[Laminaria hyperborea] forest, foliose red seaweeds and diverse fauna on tide-swept

	upper infralittoral rock
A3.2/B-MIR.KR.Lhyp.TPk	[Laminaria hyperborea] park with hydroids, bryozoans and sponges on tide-swept lower infralittoral rock
A3.2/B-MIR.KR.Lhyp.Loch	Mixed [Laminaria hyperborea] and [Laminaria ochroleuca] forest on moderately exposed or sheltered infralittoral rock
A3.2/B-MIR.GzK	Grazed kelp with algal crusts on moderately exposed infralittoral rock
A3.2/B-MIR.GzK.LhypGz	Grazed [Laminaria hyperborea] with coralline crusts on infralittoral rock
A3.2/B-MIR.GzK.LhypGz.Ft	Grazed [Laminaria hyperborea] forest with coralline crusts on upper infralittoral rock
A3.2/B-MIR.GzK.LhypGz.Pk	Grazed [Laminaria hyperborea] park with coralline crusts on lower infralittoral rock
A3.2/B-MIR.SedK	Sand-tolerant or disturbed kelp and seaweed on moderately exposed infralittoral rock
A3.2/B-MIR.SedK.Sac	[Saccorhiza polyschides] and other opportunistic kelps on disturbed upper infralittoral rock
A3.2/B-MIR.SedK.LsacChoR	[Laminaria saccharina], [Chorda filum] and dense red seaweeds on shallow unstable infralittoral boulders and cobbles
A3.2/B-MIR.SedK.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
A3.2/B-MIR.SedK.SabKR	[Sabellaria spinulosa] with kelp and red seaweeds on sand-influenced infralittoral rock
A3.2/B-MIR.SedK.EphR	Ephemeral red seaweeds and kelps on tide-swept mobile infralittoral cobbles
A3.2/B-MIR.SedK.HalXK	[Halidrys siliquosa] and mixed kelps on tide-swept infralittoral rock with coarse sediment
A3.2/B-MIR.SedK.PolAhn	[Polyides rotundus], [Ahnfeltia plicata] and [Chondrus crispus] on sand-covered infralittoral rock
A3.2/B-IR.FaSwV(p)	Fauna and seaweeds on vertical moderately exposed infralittoral rock
A3.2/B-IR.FaSwV.AlcByH	[Alcyonium digitatum] and a bryozoan, hydroid and ascidian turf on vertical moderately exposed infralittoral rock
A3.2/B-IR.FaSwV.AlcByH.Hia	[Hiatella arctica], bryozoans and ascidians on vertical infralittoral soft rock
A3.2/M-III.6.1.(p)	Biocenosis of infralittoral algae moderately exposed to wave action
A3.2/M-III.6.1.7.	Association with [Codium vermilara] and [Rhodymenia ardissonei]
A3.2/M-III.6.1.8.	Association with [Dasycladus vermicularis]
A3.2/M-III.6.1.9.	Association with [Alsidium helmenthochorton]
A3.2/M-III.6.1.10.	Association with [Cystoseira tamariscifolia] and [Saccorhiza polyschides]
A3.2/M-III.6.1.11.	Association with [Gelidium spinosum v. hystrix]
A3.2/M-III.6.1.12.	Association with [Lobophora variegata]
A3.2/M-III.6.1.13.	Association with [Ceramium rubrum]
A3.2/M-III.6.1.14.	Facies with [Cladocora caespitosa]
A3.2/M-III.6.1.15.	Association with [Cystoseira brachycarpa]
A3.2/M-III.6.1.16.	Association with [Cystoseira crinita]
A3.2/M-III.6.1.17.	Association with [Cystoseira crinitophylla]
A3.2/M-III.6.1.18.	Association with [Cystoseira sauvageauana]
A3.2/M-III.6.1.19.	Association with [Cystoseira spinosa]
A3.2/M-III.6.1.20.	Association with [Sargassum vulgaris]
A3.2/M-III.6.1.21.	Association with [Dictyopteris polypodioides]
A3.2/M-III.6.1.22.	Association with [Calpomenia sinuosa]
A3.2/M-III.6.1.30.	Association with [Rhodymenia ardissonei] and [Rhodophyllis divaricata]
A3.2/M-III.6.1.31.	Facies with [Astroides calycularis]
A3.2/M-III.6.1.32.	Association with [Flabellia petiolata] and [Peyssonnelia squamaria]
A3.2/M-III.6.1.33.	Association with [Halymenia floresia] and [Halarachnion ligatatum]
A3.2/M-III.6.1.34.	Association with [Peyssonnelia rubra] and [Peyssonnelia] spp.
A3.26	Baltic brackish water sublittoral biocenoses of hard substrata influenced by varying salinity
A3.2/H-02.01.01.02	Baltic soft rock bottoms of the infralittoral photic zone
A3.2/H-02.01.01.02.01	Baltic soft rock bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A3.2/H-02.01.01.02.02	Baltic soft rock bottoms of the infralittoral photic zone dominated by macrophyte vegetation
A3.2/H-02.01.01.02.03	Baltic soft rock reefs of the infralittoral photic zone
A3.2/H-02.01.02.02	Baltic solid rock bottoms of the infralittoral photic zone
A3.2/H-02.01.02.02.01	Baltic solid rock bottoms of the infralittoral photic zone: level bottoms with little or no macrophyte vegetation
A3.2/H-02.01.02.02.02	Baltic solid rock bottoms of the infralittoral photic zone: level bottoms dominated by macrophyte vegetation
A3.2/H-02.01.02.02.03	Baltic solid rock reefs of the infralittoral photic zone
A3.2/H-02.02.02	Baltic stony bottoms of the infralittoral photic zone
A3.2/H-02.02.02.01	Baltic stony bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A3.2/H-02.02.02.02	Baltic stony bottoms of the infralittoral photic zone dominated by macrophyte
A3.2/H-02.02.02.03	Baltic stony reefs of the infralittoral photic zone

A3.2/H-02.03.02	Baltic hard clay bottoms of the infralittoral photic zone
A3.2/H-02.03.02.01	Baltic hard clay bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A3.3	Infralittoral rock sheltered from wave action and currents and tidal streams
A3.3/B-SIR.K	Silted kelp communities on sheltered infralittoral rock
A3.3/B-SIR.K.LhypLsac	Mixed [Laminaria hyperborea] and [Laminaria saccharina] on sheltered infralittoral rock
A3.3/B-SIR.K.LhypLsac.Ft	Mixed [Laminaria hyperborea] and [Laminaria saccharina] forest on sheltered upper infralittoral rock
A3.3/B-SIR.K.LhypLsac.Pk	Mixed [Laminaria hyperborea] and [Laminaria saccharina] park on sheltered lower infralittoral rock
A3.3/B-SIR.K.Lsac	[Laminaria saccharina] on very sheltered infralittoral rock
A3.3/B-SIR.K.Lsac.Ldig	[Laminaria saccharina] and [Laminaria digitata] on sheltered sublittoral fringe rock
A3.3/B-SIR.K.Lsac.Ft	[Laminaria saccharina] forest on very sheltered upper infralittoral rock
A3.3/B-SIR.K.Lsac.Pk	[Laminaria saccharina] park on very sheltered lower infralittoral rock
A3.3/B-SIR.K.Lsac.T	[Laminaria saccharina], foliose red seaweeds, sponges and ascidians on tide-swept infralittoral rock
A3.3/B-SIR.K.Lsac.Cod	Sparse [Laminaria saccharina] with [Codium] spp. and sparse red seaweeds on heavily silted very sheltered infralittoral rock
A3.3/B-SIR.K.EchBriCC	[Echinus], brittlestars and coralline crusts on grazed lower infralittoral rock
A3.3/B-SIR.K.LsacRS	[Laminaria saccharina] on reduced or low salinity infralittoral rock
A3.3/B-SIR.K.LsacRS.FiR	Sparse [Laminaria saccharina] with dense filamentous red seaweeds, sponges and [Balanus crenatus] on tide-swept variable salinity infralittoral rock
A3.3/B-SIR.K.LsacRS.Psa	[Laminaria saccharina] and [Psammechinus miliaris] on reduced salinity grazed infralittoral rock
A3.3/B-SIR.K.LsacRS.Phy	[Laminaria saccharina] and [Phyllophora] spp. and filamentous green seaweeds on reduced or low salinity infralittoral rock
A3.3/B-SIR.EstFa	Estuarine faunal communities on shallow rock or mixed substrata
A3.3/B-SIR.EstFa.MytT	[Mytilus edulis] beds on reduced salinity tide-swept infralittoral rock *Mussel beds on reduced salinity tide-swept infralittoral rock*
A3.3/B-SIR.EstFa.CorEle	[Cordylophora caspia] and [Electra crustulenta] on reduced salinity infralittoral rock
A3.3/B-SIR.EstFa.HarCon	[Hartlaubella gelatinosa] and [Conopeum reticulum] on low salinity infralittoral mixed substrata
A3.3/B-SIR.Lag	Submerged fucoids, green and red seaweeds on reduced/low salinity infralittoral rock
A3.3/B-SIR.Lag.FChoG	Mixed fucoids, [Chorda filum] and green seaweeds on reduced salinity infralittoral rock
A3.3/B-SIR.Lag.AscSAs	[Ascophyllum nodosum] and epiphytic sponges and ascidians on variable salinity infralittoral rock
A3.3/B-SIR.Lag.PolFur	[Polyides rotundus] and/or [Furcellaria lumbricalis] on reduced salinity infralittoral rock
A3.3/B-SIR.Lag.FcerEnt	[Fucus ceranoides] and [Enteromorpha] spp. on low salinity infralittoral rock
A3.3/M-III.6.1.(p)	Biocenosis of infralittoral algae sheltered from wave action
A3.3/M-III.6.1.23.	Association with [Stypocaulon scoparium] (=[Halopteris scoparia])
A3.3/M-III.6.1.24.	Association with [Trichosolen myura] and [Liagora farinosa]
A3.3/M-III.6.1.25.	Association with [Cystoseira compressa]
A3.3/M-III.6.1.26.	Association with [Pterocladiella capillacea] and [Ulva laetevirens]
A3.3/M-III.6.1.27.	Facies with large Hydrozoa
A3.3/M-III.6.1.28.	Association with [Pterothamnion crispum] and [Compsothamnion thuyoides]
A3.4	Caves, overhangs and surge gullies in the infralittoral zone
A3.4/B-EIR.SG	Robust fauna on infralittoral surge gullies and cave walls
A3.4/B-EIR.SG.FoSwCC	Foliose seaweeds and coralline crusts in surge gully entrances
A3.4/B-EIR.SG.SCAn	Sponge crusts and anemones on wave-surged vertical infralittoral rock
A3.4/B-EIR.SG.SCAn.Tub	Sponge crusts, anemones and [Tubularia indivisa] in shallow infralittoral surge gullies
A3.4/B-EIR.SG.SCAs	Sponge crusts and colonial ascidians on wave-surged vertical infralittoral rock
A3.4/B-EIR.SG.SCAs.DenCla	[Dendrodoa grossularia] and [Clathrina coriacea] on wave-surged vertical infralittoral rock
A3.4/B-EIR.SG.SCAs.ByH	Sponge crusts, colonial (polyclinid) ascidians and a bryozoan/hydroid turf on wave-surged vertical or overhanging infralittoral rock
A3.4/B-EIR.SG.SC	Sponge crusts on extremely wave-surged infralittoral cave or gully walls
A3.4/B-EIR.SG.CC	[Balanus crenatus] and/or [Pomatoceros triqueter] with spirorbid worms and coralline crusts on severely scoured infralittoral rock
A3.4/B-EIR.SG.CC.BalPom	[Balanus crenatus] and/or [Pomatoceros triqueter] with spirorbid worms and coralline crusts on severely scoured vertical infralittoral rock
A3.4/B-EIR.SG.CC.Mob	Coralline crusts and crustaceans on mobile boulders in surge gullies
A3.5	Circalittoral rock very exposed to wave action or currents and tidal streams
A3.5/B-ECR.EFa	Faunal crusts or short turfs on exposed circalittoral rock
A3.5/B-ECR.EFa.CCParCar	Coralline crusts, [Parasmittina trispinosa], [Caryophyllia smithii], [Haliclona viscosa], polyclinids and sparse [Corynactis viridis] on very exposed circalittoral rock
A3.5/B-ECR.EFa.CorCri	[Corynactis viridis] and a crisiid/[Bugula]/[Cellaria] turf on steep or vertical exposed circalittoral rock
A3.5/B-ECR.Alc	[Alcyonium]-dominated communities on tide-swept circalittoral rock

	Communities dominated by the coral dead-man's fingers on tide-swept circalittoral rock
A3.5/B-ECR.Alc.AlcTub	[Alcyonium digitatum] with dense [Tubularia indivisa] and anemones on strongly tide-swept circalittoral rock
A3.5/B-ECR.Alc.AlcMaS	[Alcyonium digitatum] with massive sponges ([Cliona celata] and [Pachymatisma johnstonia]), and [Nemertesia antennina] on moderately tide-swept exposed circalittoral rock
A3.5/B-ECR.Alc.AlcSec	[Alcyonium digitatum] with [Securiflustra securifrons] on weakly tide-swept or scoured moderately exposed circalittoral rock
A3.5/B-ECR.Alc.AlcC	[Alcyonium digitatum], [Pomatoceros triqueter], algal and bryozoan crusts on vertical exposed circalittoral rock
A3.5/B-ECR.BS	Barnacle, cushion sponge and [Tubularia] communities on very tide-swept circalittoral rock
A3.5/B-ECR.BS.BalTub	[Balanus crenatus] and [Tubularia indivisa] on extremely tide-swept circalittoral rock
A3.5/B-ECR.BS.TubS	[Tubularia indivisa], sponges and other hydroids on tide-swept circalittoral bedrock
A3.5/B-ECR.BS.BalHpan	[Balanus crenatus], [Halichondria panicea] and [Alcyonidium diaphanum] on extremely tide-swept sheltered circalittoral rock
A3.5/B-ECR.BS.CuSH	Cushion sponges, hydroids and ascidians on very tide-swept sheltered circalittoral rock
A3.5/B-ECR.BS.HbowEud	[Halichondria bowerbanki], [Eudendrium arbusculum] and [Eucratea loricata] on reduced salinity tide-swept circalittoral mixed substrata
A3.6	Circalittoral rock moderately exposed to wave action or currents and tidal streams
A3.6/B-MCR.XFa	Mixed faunal turf communities on moderately exposed circalittoral rock
A3.6/B-MCR.XFa.PhaAxi	[Phakellia ventilabrum] and axinellid sponges on deep exposed circalittoral rock
A3.6/B-MCR.XFa.ErSEun	Erect sponges, [Eunicella verrucosa] and [Pentapora foliacea] on slightly tide-swept moderately exposed circalittoral rock
A3.6/B-MCR.XFa.ErSPbolSH	Cushion sponges ([Polymastia boletiformis], [Tethya]), stalked sponges, [Nemertesia] spp. and [Pentapora foliacea] on moderately exposed circalittoral rock
A3.6/B-MCR.XFa.ErSSwi	Erect sponges and [Swiftia pallida] on slightly tide-swept moderately exposed circalittoral rock
A3.6/B-MCR.ByH	Sand-influenced bryozoan and hydroid turfs on moderately exposed circalittoral rock
A3.6/B-MCR.ByH.SNemAdia	Sparse sponges, [Nemertesia] spp., [Alcyonidium diaphanum] and [Bowerbankia] spp. on circalittoral mixed substrata
A3.6/B-MCR.ByH.Flu	[Flustra foliacea] and other hydroid/bryozoan turf species on slightly scoured circalittoral rock and mixed substrata
A3.6/B-MCR.ByH.Flu.Flu	[Flustra foliacea] on slightly scoured silty circalittoral rock or mixed substrata
A3.6/B-MCR.ByH.Flu.HByS	[Flustra foliacea] with hydroids, bryozoans and sponges on slightly tide-swept circalittoral mixed substrata
A3.6/B-MCR.ByH.Flu.Hocu	[Haliclona oculata] and [Flustra foliacea] with a rich faunal turf on tide-swept sheltered circalittoral boulders and cobbles
A3.6/B-MCR.ByH.Urt	[Urticina felina] on sand-affected circalittoral rock
A3.6/B-MCR.ByH.Urt.Urt	[Urticina felina] on sand-scoured circalittoral rock
A3.6/B-MCR.ByH.Urt.Cio	[Urticina felina] and [Ciocalypta penicillus] on sand-covered circalittoral rock
A3.6/B-MCR.CSab	[Sabellaria spinulosa] communities on circalittoral rock
A3.6/B-MCR.CSab.Sspi	[Sabellaria spinulosa] crusts on silty turbid circalittoral rock
A3.6/B-MCR.M	Mussel beds on moderately exposed circalittoral rock
A3.6/B-MCR.M.MytHAs	[Mytilus edulis] beds with hydroids and ascidians on tide-swept moderately exposed circalittoral rock
	Mussel beds with hydroids and ascidians on tide-swept moderately exposed circalittoral rock
A3.6/B-MCR.M.Mus	[Musculus discors] beds on moderately exposed circalittoral rock
A3.6/B-MCR.M.ModT	[Modiolus modiolus] beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata
	Horse mussel beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata
A3.6/B-MCR.Bri	Brittlestar beds on circalittoral rock or mixed substrata
A3.6/B-MCR.Bri.Oph	[Ophiothrix fragilis] and/or [Ophiocomina nigra] beds on slightly tide-swept circalittoral rock or mixed substrata
A3.6/B-MCR.Bri.Oph.Oacu	[Ophiopholis aculeata] beds on slightly tide-swept circalittoral rock or mixed substrata
A3.6/B-MCR.GzFa	Grazed faunal communities on moderately exposed or sheltered circalittoral rock
A3.6/B-MCR.GzFa.FaAlC	Faunal and algal crusts, [Echinus esculentus], sparse [Alcyonium digitatum] and grazing-tolerant fauna on moderately exposed circalittoral rock
A3.6/B-MCR.GzFa.FaAlC.Abi	Faunal and algal crusts, [Echinus esculentus], sparse [Alcyonium digitatum], [Abietinaria abietina] and other grazing-tolerant fauna on moderately exposed circalittoral rock
A3.6/B-MCR.As	Silt-influenced ascidian communities on moderately exposed circalittoral rock
A3.6/B-MCR.As.StoPaur	[Stolonica socialis] and/or [Polyclinum aurantium] with [Flustra foliacea] on slightly sand-scoured tide-swept moderately exposed circalittoral rock
A3.6/B-MCR.As.MolPol	[Molgula manhattensis] and [Polycarpa] spp. with erect sponges on tide-swept

	moderately exposed circalittoral rock
A3.6/B-MCR.As.MolPol.Sab	Dense ascidians, bryozoans and hydroids on a crust of [Sabellaria spinulosa] on tide-swept circalittoral rock
A3.6/B-MCR.SfR	Communities on soft moderately exposed circalittoral rock
A3.6/B-MCR.SfR.Pid	Piddocks with a sparse associated fauna in upward-facing circalittoral very soft chalk or clay
A3.6/B-MCR.SfR.Pol	[Polydora] sp. tubes on upward-facing circalittoral soft rock
A3.6/B-CR.FaV	Faunal turfs on vertical circalittoral rock
A3.6/B-CR.FaV.Ant	[Antedon bifida] and a bryozoan/hydroid turf on steep or vertical circalittoral rock
A3.6/B-CR.FaV.Bug	[Bugula] spp. and other bryozoans on vertical moderately exposed circalittoral rock
A3.6/M-IV.3.1.(p)	Coralligenous biocenosis moderately exposed to hydrodynamic action
A3.6/M-IV.3.1.1.	Association with [Cystoseira zosteroides]
A3.6/M-IV.3.1.2.	Association with [Cystoseira usneoides]
A3.6/M-IV.3.1.3.	Association with [Cystoseira dubia]
A3.6/M-IV.3.1.4.	Association with [Cystoseira corniculata]
A3.6/M-IV.3.1.5.	Association with [Sargassum] spp.
A3.6/M-IV.3.1.6.	Association with [Mesophyllum lichenoides]
A3.6/M-IV.3.1.7.	Algal bioconcretion with [Lithophyllum frondosum] and [Halimeda tuna]
A3.6/M-IV.3.1.8.	Association with [Laminaria ochroleuca]
A3.6/M-IV.3.1.10.	Facies with [Eunicella cavolinii]
A3.6/M-IV.3.1.11.	Facies with [Eunicella singularis]
A3.6/M-IV.3.1.13.	Facies with [Paramuricea clavata]
A3.6/M-IV.3.1.14.	Facies with [Parazoanthus axinellae]
A3.6/M-IV.3.1.15.	Coralligenous platforms
A3.7	Circalittoral rock sheltered from wave action and currents including tidal streams
A3.7/B-SCR.BrAs	Brachiopods and solitary ascidian communities on sheltered circalittoral rock
A3.7/B-SCR.BrAs.AntAsH	[Antedon] spp., solitary ascidians and fine hydroids on sheltered circalittoral rock
A3.7/B-SCR.BrAs.SubSoAs	[Suberites] spp. and other sponges with solitary ascidians on very sheltered circalittoral rock
A3.7/B-SCR.BrAs.AmenCio	Solitary ascidians, including [Ascidia mentula] and [Ciona intestinalis], on very sheltered circalittoral rock
A3.7/B-SCR.BrAs.AmenCio.Met	Large [Metridium senile] and solitary ascidians on grazed very sheltered circalittoral rock
A3.7/B-SCR.BrAs.Aasp	[Ascidiella aspersa] on sheltered circalittoral rocks on muddy sediment
A3.7/B-SCR.BrAs.NeoPro	[Neocrania anomala] and [Protanthea simplex] on very sheltered circalittoral rock
A3.7/B-SCR.BrAs.NeoPro.CaTw	Brachiopods, calcareous tubeworms ([Placostegus tridentatus], [Hydroides]) and sponges on variable salinity circalittoral rock
A3.7/B-SCR.BrAs.NeoPro.Den	[Neocrania anomala], [Dendrodoa grossularia] and [Sarcodictyon roseum] on reduced or low salinity circalittoral rock
A3.7/B-SCR.Mod	Sheltered [Modiolus] beds *Sheltered horse mussel beds*
A3.7/B-SCR.Mod.ModCvar	[Modiolus modiolus] beds with [Chlamys varia], sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata
A3.7/B-SCR.Mod.ModHAs	[Modiolus modiolus] beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata *Horse mussel beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata*
A3.7/M-IV.3.1.(p)	Coralligenous biocenosis sheltered from hydrodynamic action
A3.7/M-IV.3.1.9.	Association with [Rodriguezella strafforelli]
A3.7/M-IV.3.1.12.	Facies with [Lophogorgia sarmentosa]
A3.8	Caves and overhangs in the circalittoral zone
A3.8/B-CR.Cv	Communities of circalittoral caves and overhangs
A3.8/B-CR.Cv.SCup	Sponges, cup corals and [Parerythropodium coralloides] on shaded/overhanging circalittoral rock
A3.8/M-IV.3.2.1.	Facies with [Parazoanthus axinellae]
A3.8/M-IV.3.2.2.	Facies with [Corallium rubrum]
A3.8/M-IV.3.2.3.	Facies with [Leptopsammia pruvoti]
A3.9	Deep circalittoral rock habitats
A3.91	Animal communities of deep circalittoral rock habitats
A3.9/H-02.01.01.01	Baltic soft rock bottoms of the aphotic zone
A3.9/H-02.01.02.01	Baltic solid bedrock of the aphotic zone
A3.9/H-02.02.01	Baltic stony bottoms of the aphotic zone
A3.9/H-02.03.01	Baltic hard clay bottoms of the aphotic zone
A3.9/H-02.09.01	Baltic [Mytilus edulis] beds in the aphotic zone of the Baltic *Baltic mussel beds in the aphotic zone of the Baltic*
A3.9/H-02.11.01	Baltic peat bottoms of the sublittoral zone
A3.A	Vents and seeps in sublittoral rock

A3.A/H-02.10.02	Bubbling reefs in the sublittoral euphotic zone
A3.A/H-02.10.02.01	Bubbling reefs in the sublittoral euphotic zone with little or no macrophyte vegetation
A3.A/H-02.10.02.02	Bubbling reefs in the sublittoral euphotic zone dominated by macrophyte vegetation
A3.A/H-02.10.01	Bubbling reefs in the aphotic zone
A3.A3	Freshwater seeps in sublittoral rock
A3.A4	Oil seeps in sublittoral rock
A3.A5	Vents in sublittoral rock
A4	Sublittoral sediments
A4.1	Sublittoral mobile cobbles, gravels and coarse sands
A4.1/B-IGS.Mrl	Seaweeds and maerl on coarse shallow-water sediments
A4.1/B-IGS.Mrl.Phy	[Phymatolithon calcareum] maerl beds in shallow-water clean gravel or coarse sand
A4.1/B-IGS.Mrl.Phy.R	[Phymatolithon calcareum] maerl beds with red seaweeds in shallow infralittoral clean gravel or coarse sand
A4.1/B-IGS.Mrl.Phy.HEc	[Phymatolithon calcareum] maerl beds with hydroids and echinoderms in deeper infralittoral clean gravel or coarse sand
A4.1/B-IGS.Mrl.Lgla	[Lithothamnion glaciale] maerl beds in tide-swept variable salinity shallow-water gravel
A4.1/M-III.3.2.1.	Maërl facies (= Association with [Lithothamnion corallioides] and [Phymatolithon calcareum])
A4.1/M-III.3.2.2.	Association with rhodolithes in coarse sands and fine gravels under the influence of bottom currents
A4.1/B-IGS.FaG	Animal communities in shallow-water gravels
A4.1/B-IGS.FaG.HalEdw	[Halcampa chrysanthellum] and [Edwardsia timida] on sublittoral clean stone gravel
A4.1/B-IGS.FaG.Sell	[Spisula elliptica] and venerid bivalves in infralittoral clean sand or shell gravel
A4.1/M-III.3.1.1.	Association with rhodolithes in coarse sands and fine gravels mixed by waves
A4.1/M-III.4.1.1.	Facies with [Gouania wildenowi]
A4.1/B-IGS.FaS(p)	Animal communities in shallow-water coarse sands
A4.1/B-IGS.FaS.Mob	Sparse fauna in marine infralittoral mobile clean sand
A4.1/B-IGS.FaS.ScupHyd	[Sertularia cupressina] and [Hydrallmania falcata] on tide-swept sublittoral cobbles or pebbles in coarse sand
A4.1/B-IGS.FaS.Lcon	Dense [Lanice conchilega] and other polychaetes in tide-swept shallow-water sand
A4.14	Animal communities of circalittoral mobile cobbles, gravels and sands
A4.1/B-CGS.Ven	Venerid bivalves in circalittoral coarse sand or gravel
A4.1/B-CGS.Ven.Neo	[Neopentadactyla mixta] and venerid bivalves in circalittoral shell gravel or coarse sand
A4.1/B-CGS.Ven.Bra	Venerid bivalves and [Branchiostoma lanceolatum] in circalittoral coarse sand with shell gravel
A4.1/B-ECR.EFa.PomByC	[Pomatoceros triqueter], [Balanus crenatus] and bryozoan crusts on mobile circalittoral cobbles and pebbles
A4.1/B-MCR.ByH.Flu.SerHyd	[Sertularia argentea], [Sertularia cupressina] and [Hydrallmania falcata] on tide-swept circalittoral cobbles and pebbles
A4.1/H-02.04.02	Baltic brackish water sublittoral biocenoses of gravel and coarse sand influenced by varying salinity
A4.1/H-02.04.02.01	Baltic level gravel bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A4.1/H-02.04.02.03	Baltic gravel banks of the infralittoral photic zone
A4.2	Sublittoral sands and muddy sands
A4.2/B-IGS.FaS(p)	Animal communities in fully marine shallow clean sands
A4.2/B-IGS.FaS.NcirBat	[Nephtys cirrosa] and [Bathyporeia] spp. in shallow-water sand
A4.2/B-IGS.FaS.FabMag	[Fabulina fabula] and [Magelona mirabilis] with venerid bivalves in shallow-water compacted fine sand
A4.2/M-III.2.1.	Biocenosis of fine sands in very shallow waters
A4.2/M-III.2.1.1.	Facies with [Lentidium mediterraneum]
A4.2/M-III.2.2.	Biocenosis of well sorted fine sands
A4.2/B-IGS.EstGS	Animal communities in variable or reduced salinity shallow clean sands
A4.2/B-IGS.EstGS.MobRS	Sparse fauna in reduced salinity shallow-water mobile sand
A4.2/B-IGS.EstGS.Ncir	[Nephtys cirrosa] and fluctuating salinity-tolerant fauna in reduced salinity shallow-water mobile sand
A4.2/B-IGS.EstGS.NeoGam	[Neomysis integer] and [Gammarus] spp. in low salinity shallow-water mobile sand
A4.2/H-02.05.02	Baltic brackish water sublittoral biocenoses of sands influenced by varying salinity
A4.2/H-02.05.02.01	Baltic level sandy bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A4.2/H-02.05.02.03	Baltic sand bars of the infralittoral photic zone
A4.2/H-02.05.02.04	Baltic sand banks of the infralittoral photic zone
A4.2/B-IMS.FaMS	Animal communities in fully marine shallow-water muddy sands
A4.2/B-IMS.FaMS.EcorEns	[Echinocardium cordatum] and [Ensis] sp. in lower shore or shallow sublittoral muddy fine sand
A4.2/B-IMS.FaMS.SpiSpi	[Spio filicornis] and [Spiophanes bombyx] infralittoral clean or muddy sand

A4.2/B-IMS.FaMS.MacAbr	[Macoma balthica] and [Abra alba] in infralittoral muddy sand or mud
A4.2/B-IMS.FaMS.Cap	[Capitella capitata] in enriched sublittoral muddy sediments
A4.2/O-	Animal communities in variable or reduced salinity muddy sands
A4.28	Animal communities of circalittoral muddy sands
A4.2/B-CMS.AbrNucCor	[Abra alba], [Nucula nitida] and [Corbula gibba] in circalittoral muddy sand or slightly mixed sediments
A4.2/B-CMS.AfilEcor	[Amphiura filiformis] and [Echinocardium cordatum] in circalittoral clean or slightly muddy sand
A4.2/B-CMS.VirOph	[Virgularia mirabilis] and [Ophiura] spp. on circalittoral sandy or shelly mud
A4.2/B-CMS.VirOph.HAs	[Virgularia mirabilis] and [Ophiura] spp. with hydroids and ascidians on circalittoral sandy or shelly mud with shells or stones
A4.2/M-IV.2.1.	Biocenosis of the muddy detritic bottom
A4.2/M-IV.2.1.1.	Facies with [Ophiothrix quinquemaculata]
A4.3	Sublittoral muds
A4.3/B-IMU.MarMu	Shallow marine mud communities
A4.3/B-IMU.MarMu.TubeAP	Semi-permanent tube-building amphipods and polychaetes in sublittoral mud or muddy sand
A4.3/B-IMU.MarMu.AreSyn	[Arenicola marina] and synaptid holothurians in extremely shallow soft mud
A4.3/B-IMU.MarMu.PhiVir	[Philine aperta] and [Virgularia mirabilis] in soft stable infralittoral mud
A4.3/B-IMU.MarMu.Ocn	[Ocnus planci] aggregations on sheltered sublittoral muddy sediment
A4.3/B-IMU.EstMu	Variable or reduced salinity non-mobile sublittoral muds
A4.3/B-IMU.EstMu.PolVS	[Polydora ciliata] in variable salinity infralittoral firm mud or clay
A4.3/B-IMU.EstMu.AphTub	[Aphelochaeta marioni] and [Tubificoides] spp. in variable salinity infralittoral mud
A4.3/B-IMU.EstMu.NhomTub	[Nephtys hombergii] and [Tubificoides] spp. in variable salinity infralittoral soft mud
A4.3/B-IMU.EstMu.CapTub	[Capitella capitata] and [Tubificoides] spp. in reduced salinity infralittoral muddy sediment
A4.3/B-IMU.EstMu.Tub	[Tubificoides] spp. in reduced salinity infralittoral muddy sediment
A4.3/B-IMU.EstMu.LimTtub	[Limnodrilus hoffmeisteri], [Tubifex tubifex] and [Gammarus] spp. in low salinity infralittoral muddy sediment
A4.3/B-IMU.EstMu.MobMud	Variable or reduced salinity shallow-water fluid mobile mud
A4.3/M-III.2.3.	Biocenosis of superficial muddy sands in sheltered waters
A4.3/M-III.2.3.1.	Facies with [Callianassa tyrrhena] and [Kellia corbuloides]
A4.3/M-III.2.3.2.	Facies with fresh water resurgences with [Cerastoderma glaucum] and [Cyathura carinata]
A4.3/M-III.2.3.3.	Facies with [Loripes lacteus], [Tapes] spp.
A4.3/M-III.2.3.6.	Association with [Caulerpa prolifera] on superficial muddy sands in sheltered waters
A4.3/M-III.2.3.7.	Facies of hydrothermal oozes with [Cyclope neritea] and nematodes
A4.3/H-02.07.02	Baltic brackish water sublittoral muddy biocenoses influenced by varying salinity
A4.3/H-02.07.02.01	Baltic muds of the infralittoral photic zone with little or no macrophyte vegetation
A4.353	Boreal Baltic narrow inlets with soft mud substrate
A4.36	Animal communities of circalittoral muds
A4.3/B-CMU.BriAchi	[Brissopsis lyrifera] and [Amphiura chiajei] in circalittoral mud
A4.3/B-CMU.SpMeg	Seapens and burrowing megafauna in circalittoral muds
A4.3/B-CMU.SpMeg.Fun	Seapens, including [Funiculina quadrangularis], and burrowing megafauna in undisturbed circalittoral soft mud
A4.3/B-CMU.Beg	Bacterial mats on anoxic sublittoral mud
A4.3/M-IV.1.1.	Biocenosis of coastal terrigenous muds
A4.3/M-IV.1.1.1.	Facies of soft muds with [Turritella tricarinata communis]
A4.3/M-IV.1.1.2.	Facies of sticky muds with [Virgularia mirabilis] and [Pennatula phosphorea]
A4.3/M-IV.1.1.3.	Facies of sticky muds with [Alcyonium palmatum] and [Stichopus regalis]
A4.3/O-	Periodically anoxic sublittoral muds
A4.4	Sublittoral mixed sediments
A4.4/B-IMX.KSwMx	Kelp and seaweeds on shallow-water mixed sediments
A4.4/B-IMX.KSwMx.LsacX	[Laminaria saccharina], [Chorda filum] and filamentous red seaweeds on sheltered shallow-water sediment
A4.4/B-IMX.KSwMx.Tra	Mats of [Trailliella] on shallow-water muddy gravel
A4.4/B-IMX.KSwMx.Pcri	Loose-lying mats of [Phyllophora crispa] on shallow-water muddy sediment
A4.4/B-IMX.KSwMx.FiG	Filamentous green seaweeds on low salinity shallow-water mixed sediment or rock *Filamentous green seaweeds on low salinity infralittoral mixed sediment or rock*
A4.4/M-III.1.1.2.	Facies with [Ficopomatus enigmaticus]
A4.4/M-III.1.1.6.	Association with [Gracilaria] spp.
A4.4/M-III.1.1.7.	Association with [Chaetomorpha linum] and [Valonia aegagropila]
A4.4/M-III.1.1.8.	Association with [Halopitys incurva]
A4.4/M-III.1.1.9.	Association with [Ulva laetevirens] and [Enteromorpha linza]
A4.4/M-III.1.1.10.	Association with [Cystoseira barbata]
A4.4/M-III.1.1.11.	Association with [Lamprothamnium papulosum]
A4.4/M-III.1.1.12.	Association with [Cladophora echinus] and [Rytiphloea tinctoria]

A4.4/B-IMX.MrlMX	Maerl beds on shallow-water muddy mixed sediments
A4.4/B-IMX.MrlMX.Lcor	[Lithothamnion coralloides] maerl beds on shallow-water muddy gravel
A4.4/B-IMX.MrlMX.Lfas	[Lithothamnion fasciculatum] maerl beds with [Chlamys varia] on shallow-water sandy mud or mud
A4.4/B-IMX.MrlMX.Lden	[Lithothamnion dentatum] maerl beds on shallow-water muddy sediment
A4.4/B-IMX.Oy	Oyster beds
A4.4/B-IMX.Oy.Ost	[Ostrea edulis] beds on shallow sublittoral muddy sediment
A4.4/B-IMX.FaMX	Animal communities in mixed shallow-water sediments
A4.4/B-IMX.FaMX.VsenMtru	[Venerupis senegalensis] and [Mya truncata] in lower shore or shallow-water muddy gravel
A4.4/B-IMX.FaMX.An	Burrowing anemones in sublittoral muddy gravel
A4.4/B-IMX.FaMX.Lim	[Limaria hians] beds in tide-swept sublittoral muddy mixed sediment
A4.4/B-IMX.EstMx	Variable and reduced salinity sublittoral mixed sediments
A4.4/B-IMX.EstMx.CreAph	[Crepidula fornicata] and [Aphelochaeta marioni] in variable salinity shallow-water mixed sediment
A4.4/B-IMX.EstMx.MytV	[Mytilus edulis] beds in variable salinity shallow-water mixed sediment
A4.4/B-IMX.EstMx.PolMtru	[Polydora ciliata], [Mya truncata] and solitary ascidians in variable salinity shallow-water mixed sediment
A4.4/H-02.08.02.01	Baltic level mixed sediment bottoms of the infralittoral photic zone with little or no macrophyte vegetation
A4.4/H-02.06.02	Baltic shell gravel bottoms in the infralittoral photic zone
A4.4/H-02.09.02	Baltic [Mytilus edulis] beds in the infralittoral photic zone *Baltic mussel beds in the infralittoral photic zone*
A4.4/H-02.09.02.01	Baltic [Mytilus edulis] beds in the infralittoral photic zone with little or no macrophyte vegetation *Baltic mussel beds in the infralittoral photic zone with little or no macrophyte vegetation*
A4.4/O-	Biogenic beds on sublittoral mixed sediments
A4.49	Animal communities of circalittoral mixed sediments
A4.4/B-CMX.SspiMx	[Sabellaria spinulosa] and [Polydora] spp. on stable circalittoral mixed sediment *Tube-building polychaetes on stable circalittoral mixed sediment*
A4.4/B-CMX.ModMx	[Modiolus modiolus] beds on circalittoral mixed sediment *Horse mussel beds on circalittoral mixed sediment*
A4.4/B-CMX.ModHo	Sparse [Modiolus modiolus], dense [Cerianthus lloydii] and burrowing holothurians on sheltered circalittoral stones and mixed sediment
A4.4/B-CMS.Ser	Serpulid reefs on very sheltered circalittoral mixed substrata *Tubeworm reefs on very sheltered circalittoral mixed substrata*
A4.4/M-IV.2.2.	Biocenosis of the coastal detritic bottom
A4.4/M-IV.2.2.1.	Association with rhodolithes on coastal detritic bottoms
A4.4/M-IV.2.2.2.	Maerl facies ([Lithothamnion corallioides] and [Phymatholithon calcareum])
A4.4/M-IV.2.2.3.	Association with [Peyssonnelia rosa-marina]
A4.4/M-IV.2.2.4.	Association with [Arthrocladia villosa]
A4.4/M-IV.2.2.5.	Association with [Osmundaria volubilis]
A4.4/M-IV.2.2.6.	Association with [Kallymenia patens]
A4.4/M-IV.2.2.7.	Association with [Laminaria rodriguezii]
A4.4/M-IV.2.2.8.	Facies with [Ophiura texturata]
A4.4/M-IV.2.2.9.	Facies with Synascidies
A4.4/M-IV.2.2.10.	Facies with large Bryozoa
A4.5	Shallow-water sediments dominated by angiosperms (other than [Posidonia]) *Shallow-water sediments dominated by angiosperms (other than posidonia)*
A4.5/P-11.35	[Cymodocea] beds
A4.5/P-11.351	Macaronesian [Cymodocea] beds
A4.5/P-11.352	Lusitanian [Cymodocea] beds
A4.5/P-11.331	Mediterranean [Cymodocea] beds
A4.5/M-III.2.2.1.	Association with [Cymodocea nodosa] on well sorted fine sands
A4.5/M-III.2.3.4.	Association with [Cymodocea nodosa] on superficial muddy sands in sheltered waters
A4.5/P-11.36	[Halophila] beds
A4.5/P-11.361	Canarian [Halophila] beds
A4.5/P-11.362	Mediterranean [Halophila] beds
A4.53	[Zostera] beds in infralittoral sediments *Eelgrass beds in infralittoral sediments*
A4.5/B-IMS.Sgr.Zmar	[Zostera] beds in lower shore or infralittoral clean or muddy sand *Eelgrass beds in lower shore or infralittoral clean or muddy sand*
A4.5/M-III.1.1.4.	Association with [Zostera noltii] in euryhaline and eurythermal environment *Association with dwarf eelgrass in euryhaline and eurythermal environment*
A4.5/M-III.1.1.5.	Association with [Zostera marina] in euryhaline and eurythermal environment *Association with eelgrass in euryhaline and eurythermal environment*
A4.5/M-III.2.3.5.	Association with [Zostera noltii] on superficial muddy sands in sheltered waters

	Association with dwarf eelgrass] on superficial muddy sands in sheltered waters
A4.5/P-11.41	[Ruppia] and [Zannichellia] communities *Marine tasselweed communities*
A4.5/P-11.411	Middle European [Ruppia] and [Zannichellia] communities *Middle European marine tasselweed communities*
A4.5/P-11.412	Mediterraneo-Pontic [Ruppia] communities *Mediterraneo-Pontic marine tasselweed communities*
A4.5/B-IMS.Sgr.Rup	[Ruppia maritima] in reduced salinity infralittoral muddy sand *Beaked tasselweed in reduced salinity infralittoral muddy sand*
A4.55	Aquatic macrophyte beds of coastal brackish waters
A4.5/B-IMU.Ang.NVC.S4	Vegetation of brackish waters dominated by [Phragmites australis] *Vegetation of brackish waters dominated by common reed ([Phragmites])*
A4.5/M-III.1.1.3.	Association with [Potamogeton pectinatus]
A4.5/P-11.43	Vegetation of brackish waters dominated by [Ranunculus baudotii] *Vegetation of brackish waters dominated by water crowfoot*
A4.5/H-02.04.02.02	Baltic level gravel bottoms of the infralittoral photic zone dominated by macrophyte vegetation
A4.5/H-02.05.02.02	Baltic level sandy bottoms of the infralittoral photic zone dominated by macrophyte vegetation
A4.5/H-02.07.02.02	Baltic muds of the infralittoral photic zone dominated by macrophyte vegetation
A4.5/H-02.08.02.02	Baltic mixed sediments of the infralittoral photic zone dominated by macrophyte vegetation
A4.5/H-02.09.02.02	Baltic [Mytilus edulis] beds of the infralittoral photic zone dominated by macrophyte vegetation *Baltic mussel beds sublittoral euphotic zone: dominated by macrophyte vegetation*
A4.6	[Posidonia] beds *Posidonia beds*
A4.6/M-III.5.1.	Association with [Posidonia oceanica] *Association with posidonia*
A4.6/M-III.5.1.1.	Ecomorphosis of striped [Posidonia oceanica] meadows *Ecomorphosis of striped posidonia meadows*
A4.6/M-III.5.1.2.	Ecomorphosis of "barrier-reef" [Posidonia oceanica] meadows *Ecomorphosis of "barrier-reef" posidonia meadows*
A4.6/M-III.5.1.3.	Facies of dead "mattes" of [Posidonia oceanica] without much epiflora *Facies of dead "mattes" of posidonia without much epiflora*
A4.6/M-III.5.1.4.	Association with [Caulerpa prolifera] on [Posidonia] beds
A4.7	Deep circalittoral sediment habitats
A4.71	Animal communities of deep circalittoral sediments
A4.7/B-COS.AmpPar	[Ampharete falcata] turf with [Parvicardium ovale] on cohesive muddy very fine sand near margins of deep stratified seas
A4.7/B-COS.ForThy	Foraminiferans and [Thyasira] sp. in deep circalittoral soft mud
A4.7/B-COS.Sty	[Styela gelatinosa] and other solitary ascidians on sheltered deep circalittoral muddy sediment
A4.7/M-IV.2.3.	Biocenosis of shelf-edge detritic bottom
A4.7/M-IV.2.3.1.	Facies with [Neolampas rostellata]
A4.7/M-IV.2.3.2.	Facies with [Leptometra phalangium]
A4.7/H-02.04.01	Baltic gravel bottoms of the aphotic zone
A4.7/H-02.05.01	Baltic sandy bottoms of the aphotic zone
A4.7/H-02.06.01	Baltic shell gravel bottoms of the aphotic zone
A4.7/H-02.07.01	Baltic muddy bottoms of the aphotic zone
A4.7/H-02.08.01	Baltic mixed sediment bottoms of the aphotic zone
A4.8	Seeps and vents in sublittoral sediments
A4.8/O-	Freshwater seeps in sublittoral sediments
A4.8/O-	Methane seeps in sublittoral sediments
A4.8/O-	Oil seeps in sublittoral sediments
A4.8/O-	Vents in sublittoral sediments
A5	Bathyal zone
A5.1	Bathyal zone hard substrates
A5.1/O-	Communities of bathyal zone bedrock or artificial substrates
A5.12	Communities of allochthonous material in the bathyal zone
A5.1/M-V.3.1.	Biocenosis of deep sea corals
A5.1/B-COR.Lop	[Lophelia pertusa] reefs
A5.2	Bathyal zone mixed substrates
A5.2/O-	Lag deposits in the bathyal zone
A5.2/O-	Biogenic gravels (shells, coral debris) in the bathyal zone
A5.2/O-	Calcareous pavements in the bathyal zone
A5.3	Bathyal zone sand

A5.3/M-V.2.1.	Biocenosis of bathyal detritic sands with [Grypheus vitreus]
A5.4	Bathyal zone muddy sand
A5.5	Bathyal zone mud
A5.5/M-V.1.1.	Biocenosis of bathyal muds
A5.5/M-V.1.1.1.	Facies of sandy muds with [Thenea muricata]
A5.5/M-V.1.1.2.	Facies of fluid muds with [Brissopsis lyrifera]
A5.5/M-V.1.1.3.	Facies of soft muds with [Funiculina quadrangularis] and [Apporhais seressianus]
A5.5/M-V.1.1.4.	Facies of compact muds with [Isidella elongata]
A5.5/M-V.1.1.5.	Facies with [Pheronema grayi]
A5.6	Seeps in the bathyal zone
A5.7	Caves in the bathyal zone
A5.7/M-V.3.2.	Caves and ducts in total darkness (including caves without light or water movement at upper levels)
A6	Abyssal zone
A6.1	Hard substrates on the abyssal plain
A6.1/O-	Boulders on the abyssal plain
A6.1/O-	Artificial substrates on the abyssal plain
A6.1/O-	Cetacean carcasses on the abyssal plain
A6.2	Soft substrates on the abyssal plain
A6.2/M-VI.1.1.	Biocenosis of abyssal muds
A6.3	Tectonic ridges
A6.3/P-11.215	Oceanic ridge with hydrothermal effects
A6.3/P-11.214	Oceanic ridge without hydrothermal effects
A6.4	Seamounts
A6.5	Abyssal hills
A6.6	Hadal zone (deep ocean trenches)
A6.6/P-11.216	Cold seep benthic communities of hadal zone
A6.62	Hadal zone without cold seeps
A6.7	Caves in the abyssal zone
A6.8	Anoxic deep seabed habitats below anoxic water
A7	Pelagic water column
A7.1	Enclosed coastal saline or brackish water
A7.1/H-04.01.03.02	Water body of Baltic mesotrophic glo-lakes
A7.1/H-04.01.03.01	Water body of Baltic eutrophic glo-lakes
A7.1/H-04.01.01.02	Water body of Baltic mesotrophic coastal lakes
A7.1/H-04.01.01.01	Water body of Baltic eutrophic coastal lakes
A7.2	Partially enclosed coastal water
A7.21	Estuarine water
A7.22	Fjord waters (with a sill)
A7.3	Unenclosed mixed shallow water
A7.3/P-11.121	Inshore shallow water
A7.3/P-11.125	Water over submerged shoals and reefs
A7.4	Unenclosed seasonally stratified coastal water
A7.4/H-01.02.02	Inner unenclosed seasonally stratified coastal water
A7.4/H-01.02.01	Outer unenclosed seasonally stratified coastal water
A7.5	Euphotic zone in non-coastal water
A7.51	Neustal zone
A7.52	Euphotic zone over continental shelf
A7.53	Upwelling from continental shelf
A7.54	Euphotic zone beyond continental shelf
A7.55	Upwelling into euphotic zone beyond continental shelf
A7.56	Low-salinity water overlying full-salinity water
A7.561	Baltic outflow with permanent halocline
A7.6	Reduced-salinity water below the euphotic zone
A7.61	Low-salinity water without or above halocline and below euphotic zone
A7.62	Low-salinity water below halocline
A7.7	Water over continental shelf below euphotic zone
A7.7/P-11.1221	High Arctic offshore waters
A7.7/P-11.1222	Low Arctic offshore waters
A7.7/P-11.1223	Boreal, temperate and subarctic offshore waters
A7.7/P-11.1224	Mediterranean and Macaronesian subtropical offshore waters
A7.8	Water below euphotic zone over seabed beyond continental slope break
A7.81	Mesopelagial zone
A7.82	Bathypelagial zone
A7.83	Abyssopelagial zone
A7.84	Benthopelagial zone
A7.9	Ice-dominated marine habitats

A7.91	Sea ice
A7.9/P-11.51	Permanent pack-ice
A7.9/P-11.52	Seasonal pack-ice
A7.9/P-11.53	Ice floes
A7.9/P-11.54	Icebergs and growlers
A7.921	Icebergs
A7.922	Growlers
A7.93	Polynya
A7.A	Open ocean habitats with currents and eddies
A7.A/P-11.1241	Water over continental slope with upwellings
A7.A/P-11.113	Deep water with upwellings
A7.A3	Open ocean fronts
A7.A4	Open ocean eddies
A7.B	Anoxic water column

B	**Coastal habitats**

X	**Habitat complexes**

NOTE: This list should be considered as provisional

X01	Estuaries
X02	Saline coastal lagoons
X03	Brackish coastal lagoons
X04	Raised bog complexes
X05	Snow patch habitats
X06	Crops shaded by trees
X07	Intensively-farmed crops interspersed with strips of spontaneous vegetation
X08	Rural mosaics, consisting of woods, hedges, pastures and crops
X09	Pasture woods (with a tree layer overlying pasture)
X10	Mixed landscapes with a woodland element (bocages)
X11	Large parks
X12	Atlantic parkland
X13	Land sparsely wooded with broadleaved deciduous trees
X14	Land sparsely wooded with broadleaved evergreen trees
X15	Land sparsely wooded with coniferous trees
X16	Land sparsely wooded with mixed broadleaved and coniferous trees
X17	Dehesa
X18	Wooded steppe
X19	Wooded tundra
X20	Treeline ecotones
X21	Archaeological sites
X22	Small city centre non-domestic gardens
X23	Large non-domestic gardens
X24	Domestic gardens of city and town centres
X25	Domestic gardens of villages and urban peripheries
X26	Baltic glo-lakes
X27	Machair complexes
X28	Blanket bog complexes
X29	Salt lake islands

ANNEX 4: RESULTS OF THE AQUATIC RESTORATION AND CONSERVATION WORKSHOP

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The Ecological Society of America and NOAA's Offices of Habitat Conservation and Protected Resources sponsored a workshop to develop a national marine and estuarine ecosystem classification system. Among the 22 people involved were scientists who had developed various regional classification systems and managers from NOAA and other federal agencies who might ultimately use this system for conservation and management. The objectives were to: 1) review existing global and regional classification systems; 2) develop the framework of a national classification system; and 3) propose a plan to expand the framework into a comprehensive classification system.

A consensus developed during the workshop that a classification system would provide a useful common language for description of habitat and a framework for interpretation of ecological function. However, all agreed that a system currently did not exist that was both broad enough in scope and fine enough in detail to be useful at the national level. Participants developed a classification framework that blended global scale systems with regional systems to provide a prototype classification system. The prototype system was hierarchical and used a combination of physical and biological information to classify ecological units (eco-units) which serve as a representation of the biological community or assemblage within a given habitat.

Efforts to inventory and classify ecosystems and to construct habitat maps require a classification system with common terminologies. Such efforts require that people who construct habitat maps, resource managers, and scientists have a common language. A marine and estuarine ecosystem classification system will enable natural resource managers to effectively and expeditiously identify threatened or representative biological communities, and gaps in their coverage (i.e., lack in conservation efforts to ensure protection), so these ecosystems can be protected and conserved. The research community at large will also derive significant benefits from a consistent classification framework within which to synthesize information on the ecological characteristics of marine and estuarine ecosystems.

Our goal was to develop a classification system that describes the spatial heterogeneity of marine and estuarine landscapes and is logically linked to underlying mechanisms structuring the ecosystem and biotic communities. This system should be broadly applicable and consistent, with categories that are mutually exclusive and additive (i.e., accommodating to additions resulting from new technology and information on ecosystems). This system should incorporate primary environmental variables and have modifiers that allow a general description to become incrementally more specific, so that eventually these variables describe the abiotic portion of a biotic community. This system represents a combination of expert knowledge and a consensus-based approach at the higher levels, and an empirical data-based approach at the lower levels.

The draft classification system is a blend of theoretical and pragmatic, and physical and biotic structuring variables. At the lowest level (eco-unit) of the system, we incorporate biotic features, highlighting the dependence of ecosystems on biological processes and interactions. An eco-unit is the smallest element of the ecosystem as a whole and it represents the biological community or assemblage that is the product of the physical and biotic variables above it. More importantly, however, the eco-unit is the closest approximation to the biotic community, the ultimate conservation target. The classification system is structured to allow aggregation at different levels depending on the amount of data available on an ecosystem. Aggregating at higher levels results in more general information. However, as more specific information becomes available, more specific categorization can occur. This was necessary because the amount of information available on many ecosystems is limited. To accommodate this practical need, the position in the hierarchy of some of the variables is somewhat arbitrary and is based on the probability of the information being available.

The following tables and figures give an impression of the classification system and the criteria used.

Table A4.1. Proposed Marine and Estuarine Ecosystem Classification System.

1. Life Zone –
    - 1a. Temperate
    - 1b. Tropical
    - 1c. Polar
2. Water/Land
    - 2a. Terrestrial
    - 2b. Water
3. Marine/Freshwater
    - 3a. Marine/Estuarine
    - 3b. Freshwater
4. Continental/Non-Continental
    - 4a. Continental
    - 4b. Non-Continental
5. Bottom/Water Column
    - 5a. Bottom (Benthic)
    - 5b. Water Column

6. Shelf, Slope, Abyssal
    - 6a. Shallow – on or over the continental shelf; <200m
    - 6b. Medium – on or over the continental slope; 200 - 1000m
    - 6c. Deep – on or over the rise and deeper features; >1000m
7. Regional Wave/Wind Energy
    - 7a. Exposed/Open – open to full oceanic wave or wind energies
    - 7b. Protected/Bounded – protected from full wave or wind energies
8. Hydrogeomorphic or Earthform Features
    - 8a. Continental - Nearshore (surfzone); Inshore (rest of shelf); Straight or partially enclosed shorelines; Lagoons; Fjords; Embayments; Estuaries - Shore zone; Off shore zone; Delta; Carbonate settings; Outer continental shelf; Upper continental slope; Upper submarine canyon
    - 8b. Non-Continental - Island (Volcanic; Low); Atoll; Submerged reef types
9. Hydrodynamic Features
    - 9a. Supratidal – above high tides
    - 9b. Intertidal – extreme high to extreme low water
    - 9c. Subtidal – below extreme low water
    - 9d. Circulation features – e.g., eddies
10. Photic/Aphotic
    - 10a. Photic
    - 10b. Aphotic
11. Geomorphic Types or Topography - Cliff; Bench; Flat; Reef flat; Spur-and-Groove; Sand bar; Crevice; Slump; Rockfall; Terrace; Ledge; Overhang; Steeply sloping; Riverine; Fringe; Inland; Beach face; Dunes
12. Substratum and Eco-type
    - 12a. Substratum (Not limited to this list) - Cobble; Pebble; Sand; Silt; Mud; Bedrock; Peat; Carbonate; Boulder; Biogenic; Organic; Anthropogenic
    - 12b. Eco-type (Not limited to this list) - Coastal; Soft bottom; Hard bottom; Water column; Beach; Mangrove; Wetland; Seagrass bed; Coral reef; Kelp bed; Mud flat
13. Local Modifiers and Eco-unit
    - 13a. Modifiers (Not limited to this list) - Temperature; Local energy regimes – waves, tides, current; Salinity; Nutrients; Alkalinity; Roughness/relief; Dynamism; Edge effects – from adjacent areas; Anthropogenic disturbances; Biological interactions; Extreme events – history
    - 13b. Eco-units - Unlimited representation of species resulting from modifiers applied at the above hierarchical levels.

Table A4.2. Preliminary list of eco-types as identified during the Marine and Estuarine Habitat Classification Workshop, October, 1999. Latitude and major climate characteristics are defined higher in the hierarchy.

ECO-TYPES Coarse level description of biological community - often as visible from aerial photographs. This list can be expanded or re-worked as regional experts discuss eco-types for a particular region.	**LOCAL MODIFIERS USED FOR ECO-TYPES** A non-exhaustive list of quantitative and qualitative modifiers. The most important modifiers for each eco-type should be listed and ranked. Examination of all the possible combinations of modifiers should provide a quantitative description of individual eco-units.	**EXAMPLES OF ECO-UNITS** Eco-units are the "product" of the entire hierarchy - a biological community or assemblage of species that can be defined by choices throughout all 13 levels, and then further defined by a set of local modifiers. Eco-units can refer to a specific location or many locations depending on the specific habitat. This process can be a mechanism of "grouping" or "splitting" habitat units. Eco-units are "user-defined" and are repeating units of species which can occur on a variety of scales.
1. Coastal eco-types with some component that is inter-tidal.		
Salt Marshes This eco-type can occur on a scale of 1 to 10s of kilometers. The size of the marsh community is dependent on the key modifiers	Components that can be present: creeks, emergent vegetation, mud flats. **Key Modifiers:** 1) Sediment source and composition 2) Local Temperature/Climate 3) Salinity regimes 4) Marsh vegetation/water interface 5) Tidal energy (range, frequency) 6) Nutrients sources and characteristics 7) Coastal geomorphology and elevation 8) Coastal hydrology and exposure	Salt marshes can be described as fringing, riverine, brackish or upland transition marshes. Salt marshes can also be named by the dominant vegetation species. The names and descriptions of salt marshes will vary with region
Mangrove Wetlands	Mangrove wetlands are defined globally by latitude, climate and biogeography.	
Mud Flats		
Beaches		
Cobble or Boulder Shores		
Coastal Cliffs		
Rocky Shores	Information on exposure type is included in upper levels of hierarchy - local modifiers include: 1) Dominant species or suites of conspicuous species 2) Minor geographical differences	
2. Soft bottom or unconsolidated bottom eco-types.		
Subtidal Sandy Bottom	**Key Modifiers:** 1) Depth 2) Bioturbation 3) Relief, sediment grain size and shell hash 4) Water movement and boundary currents 5) Geology	**Examples include:** Amphioxus Sands Mega Ripple sand communities

Table A4.2 (continued). Preliminary list of eco-types as identified during the Marine and Estuarine Habitat Classification Workshop, October 1999. Latitude and major climate characteristics are defined higher in the hierarchy.

Seagrass Beds	**Key Modifiers:** Sediment type and depth Water depth Species of seagrasses present Density of seagrass (biomass, stem count)	
Algal Beds		
Mud Bottom		
Oyster Reefs		
3. Hard bottom or consolidated bottom eco-types.		
True Coral Reefs (biogenic substrate actively accreting carbonate)	**Key Modifiers:** 1) Reef morphology- patch, bank barrier, fringing, etc. 2) Depth zone 3) Energy and nutrient zone 4) Dominant species 5) Whether contiguous to land	Florida Keys Patch Reefs Pacific Fringing Reefs Pacific Barrier Reefs Pacific Lagoon (patch and pinnacle) reefs Pacific Atolls Pacific Submerged Reefs (e.g., no association with emergent land)
Low Relief Hard Bottom, or Offshore Live Bottom (not a useful name based on the wide scope of modifiers and types discussed from different regions - this name includes kelp forests to soft coral/sponge reefs)	**Key Modifiers:** I) Water Depth II) Geological origins - sediment source or starvation, passive margins? III) Light levels on the substrate IV) Dominant species or co-dominance of benthos; shifting or steady state mosaics V) Outcroppings, topography VI) Currents and energy regime VII) Nutrient regimes VIII) Igneous rock or consolidated sediments	
Worm Reefs		
4. Water column eco-types. These can occur on a much larger scale than many benthic habitats, stretching into the 1000s of kilometers.		
Coastal Shelf	Key Modifiers: 1) Water column depth 2) Surface temperature regimes 3) Dynamic animal assemblages 4) Water masses and scale 5) Current systems, gyre and eddie dynamics 6) Upwelling and nutrient regimes	Southern California Bight

Table A4.3. A comparison of modifiers used in existing classification systems reviewed by Allee (in review) and those proposed for the National Marine and Estuarine Habitat Classification System. MC indicates the system was developed out of a modification to the Cowardin system.

Source	**Type of Habitat**	**Types of Modifiers Used**	**Region**
Proposed National Marine and Estuarine Habitat Classification	Marine and estuarine	Non-exhaustive: examples include: temperature, local energy regime (waves, tidal, current), salinity, nutrients, alkalinity, roughness/relief, dynamism, edge effects from adjacent areas, anthropogenic disturbances, biological interactions, history of extreme events	United States
Brown, 1993 (MC)	Benthic	Depth, salinity, mud, organic, bioherm, temperature	Maine
Cowardin *et al*., 1979	Deep water and wetlands	Water regime, salinity, pH, soil, special (excavated, impounded, diked, partly drained, farmed, artificial)	United States
Dethier, 1992 (MC)	Marine and estuarine	Energy, tidal, depth, salinity	Washington state
Greene *et al*., 1999 (MC)	Benthic	Bottom morphology, bottom deposition, bottom texture, physical processes, chemical processes, biological processes, anthropogenic processes	Pacific coast of the United States
Holthus and Maragos, 1995	Ocean/ benthic	Light level, geology, sediment type, salinity, steepness/slope gradient, exposure, reef top width, % reef perimeter, orientation, substrate, surface, lagoon size, lagoon area, No. of patch reefs/pinnacles, high island, atoll perimeter length, reef islet type	Tropical Island Pacific
Wieland, 1993 (MC)	Marine and estuarine	Depth, salinity	Mississippi

Table A4.4. Classification of a salt marsh habitat using the proposed classification system with a comparison to the EUNIS Habitat Classification.

Proposed USA Marine and Estuarine Habitat Classification System:

1. Life Zone
    1a. Temperate
2. Water/Land
    2b. Water
3. Marine/Freshwater
    3a. Marine/Estuarine
4. Continental/Non-Continental
    4a. Continental
5. Bottom/Water Column
    5a. Bottom (Benthic)
6. Shelf, Slope, Abyssal
    6a. Shallow
7. Regional Wave/Wind Energy
    7b. Protected/Bounded
8. Hydrogeomorphic or Earthform Feature
    8a. Estuary - Shore zone
9. Hydrodynamic Features
    9b. Intertidal
10. Photic/Aphotic
    10a. Photic
11. Geomorphic Types or Topography
    Beach face
12. Substrate and Eco-type
    12a. Organic
    12b. Salt marsh
13. Local Modifiers and Eco-unit
    13a. Salinity - Brackish
    13b. *Phragmites*

European Environment Agency, EUNIS Habitat Classification for marine habitats (to level 3):

A. Marine

A2. Littoral sediments

With angiosperms (see note a6)

Dominant angiosperm is terrestrial (see note a7)

A2.6 Coastal salt marsh and saline reed beds

Frequently submerged (see note a9)

Continuous vegetation (see note a10)

A2.64 Low-mid salt marshes

Notes:

a6 Habitats dominated by aquatic (e.g., *Zostera* spp.) or terrestrial (e.g., *Salicornia* spp.) angiosperms, are distinguished from those dominated by animal communities, with or without algae.

a7 Angiosperm-dominated habitats are differentiated between those whose dominant species are entirely aquatic but which can tolerate occasional emersion (e.g., *Zostera* spp., *Ruppia* spp., *Posidonia* sp.), and those which are primarily terrestrial but can tolerate varying amounts of immersion (e.g., *Salicornia* spp., *Spartina* spp.).

a9 Saltmarsh habitats are separated according to the water regime (determined by the position on the shore), between those frequently submerged, with soil moisture and salinity relatively constant, and thsse infrequently submerged, with soil moisture and salinity variable.

a10 Habitats with pioneer vegetation dominated by annual or perennial species with <30% vegetation cover are separated from those with more-or-less continuous

Table A4.5. Classification of a water column habitat using the proposed USA Marine and Estuarine Habitat Classification system with a comparison to the EUNIS Habitat Classification.

Proposed USA Marine and Estuarine Habitat Classification System:

1 Life Zone
  1a. Temperate
2 Water/Land
  2b. Water
3 Marine/Freshwater
  3a. Marine/Estuarine
4 Continental/Non-Continental
  4a. Continental
5 Bottom/Water Column
  5b. Water column
6 Shelf, Slope, Abyssal/Water Column
  6b. Water column
7 Regional Wave/Wind Energy
  7a. Open
8 Hydrogeomorphic or Earthform Features
  8a. Inshore (rest of shelf)
9 Hydrodynamic Features
  9d. Circulation features - Upwelling area
10 Photic/Aphotic
  Both 10a. Photic and 10b. Aphotic
11. Geomorphic Types or Topograpy
  Not applicable
12. Substrate and Eco-type
  12a. **Substrate not applicable**
  12b. Water column plankton community
13. Local Modifiers and Eco-unit
  13b. Birds: Sooty Shearwater (*Puffinus griseus*), Cassin' Auklet (*Ptychoramphus aleuticus*), Rhinoceros Auklet (*Cerorhinca monocerata*), Common Murre (*Uria aalge*); Mammals: Dall's Porpoise (*Phocoenoides dalli*), Humpback Whale (*Megaptera novaengliae*): Fish: Anchovy, Sardines, Juvenile Rockfish, Invertebrates: *Ehysanoessa spinifera*, *Euphausia pacifica*

European Environment Agency, EUNIS Habitat Classification for marine habitats (to level 3):

A. Marine
A7. Pelagic Water Column (see note a40)
A7. A Open ocean habitats with currents and eddies

Notes:

a40 Large oceanic fronts (zones at the interface between two masses of water of different properties) and transient open ocean patterns are distinguished.

Table A4.6. Classification of a continental shoreline habitat using the proposed classification system with a comparison to the EUNIS Habitat Classification.

Proposed USA Marine and Estuarine Habitat Classification System:

1. Life Zone
   1a. Temperate Eastern Pacific
2. Water/Land
   2b. Water
3. Marine/Freshwater
   3a. Marine/Estuarine
4. Continental/Non-Continental
   4a. Continental
5. Bottom/Water Column
   5a. Bottom (Benthic)
6. Shelf, Slope, Abyssal
   6a. Shallow
7. Regional Wave/Wind Energy
   7a. Exposed/Open
8. Hydrogeomorphic or Earthform Feature
   8a1. Nearshore

Modifiers: Mean annual water temperature, mean annual salinity

9. Hydrodynamic Features
   9b. Intertidal
10. Photic/Aphotic
   10a. Photic
11. Geomorphic Types or Topography
   Rock platform

Modifier: very exposed

12. Substrate and Eco-type
   12a. Boulder

Modifier: irregular low tide platform

   12b. Kelp bed
13. Local Modifiers and Eco-unit
   Local Modifiers
      Roughness/relief
      Dynamism
      Elevation
      Substrate size distribution
      Wave energy dissipation
      Wave runup
      Permeability
      Seepage
      Slope
   13b. Eco-unit - species list

European Environment Agency, EUNIS Habitat Classification for marine habitats (to level 3):

A. Marine
A1. Littoral rock and other hard substrata
   Moderately exposed (see note a4)
A1.2 Littoral rock moderately exposed to wave action

Notes:

a4 The criterion separates out habitats which are very exposed to wave and/or tidal action from those only moderately exposed or sheltered.

Table A4.7. Classification of a mangrove habitat using the proposed classification system with a comparison to the EUNIS Habitat Classification.

Proposed USA Marine and Estuarine Habitat Classification System:

1. Life Zone
   1a. Tropical
2. Water/Land
   2b. Water
3. Marine/Freshwater
   3a. Marine/Estuarine
4. Continental/Non-Continental
   4a. Continental
5. Bottom/Water Column
   5a. Bottom (Benthic)
6. Shelf, Slope, Abyssal
   6a. Shallow
7. Regional Wave/Wind Energy
   7b. Protected/Bounded
8. Hydrogeomorphic or Earthform Feature
   8a. Lagoon
9. Hydrodynamic Features
   9b. Intertidal
10. Photic/Aphotic
    10a. Photic
11. Geomorphic Types or Topography
    Riverine
12. Substrate and Eco-type
    12a. Sustrate
        Peat
    12b. Eco-type
        Mangrove
13. Local Modifiers and Eco-unit
    13a. Modifiers
        Salinity
    13b. Eco-unit - species

European Environment Agency, EUNIS Habitat Classification for marine habitats (to level 3):

A. Marine
A2. Littoral sediments
    With angiosperms (see note a6)
    Dominant angiosperms are aquatic (see note a7)
A2.7 Littoral sediments dominated by aquatic angiosperms

Notes:

a6 Habitats dominated by aquatic (e.g., *Zostera* spp.) or terrestrial (e.g., *Salicornia* spp.) angiosperms are distinguished from those dominated by animal communities, with or without algae.

a7 Angiosperm-dominated habitats are differentiated between those whose dominant species are entirely aquatic but which can tolerate occasional emersion (e.g., *Zostera* spp., *Ruppia* spp., *Posidonia* sp.), and those which are primarily terrestrial but can tolerate varying amounts of immersion (e.g., *Salicornia* spp., *Spartina* spp.).

Figure 1. Levels 1 through 8 of the proposed National marine and estuarine habitat classification system. Dashed boxes indicate a continuation of the classification system that is not shown on this diagram. Refer to Table 1 for a more comprehensive list.

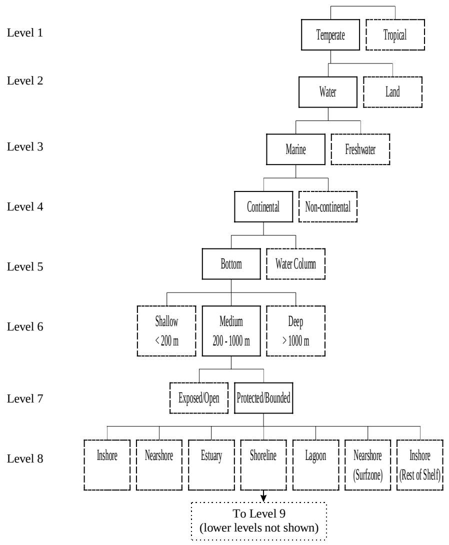

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Figure 2. Levels 9 through 13 of the proposed National marine and estuarine habitat classification system. Dashed boxes indicate a continuation of the classification system that is not shown on this diagram. Not all options for each level are shown on this diagram. Refer to Table 1 for a more comprehensive list.

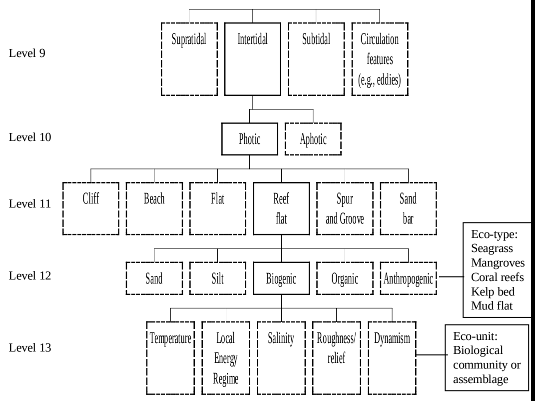

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Figure 3. Levels 8 through 13 of the proposed marine and estuarine habitat classification system for a salt marsh.

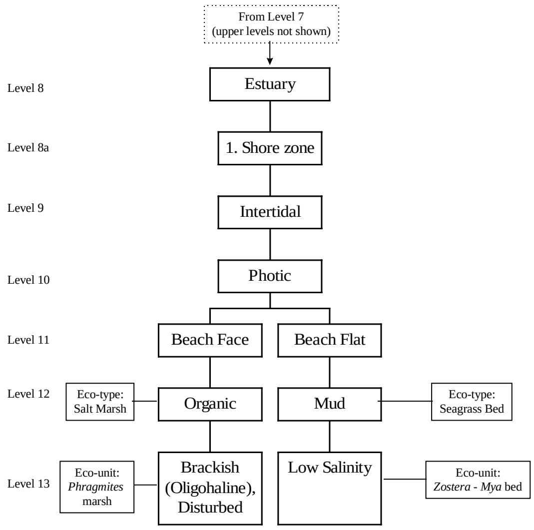

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Figure 4. Levels 5 through 13 of the proposed marine and estuarine habitat classification system for continental water column. Note that for water column habitats, Level 11, "Geomorphic Types or Topography" and Level 12, "Substratum", are not applicable.

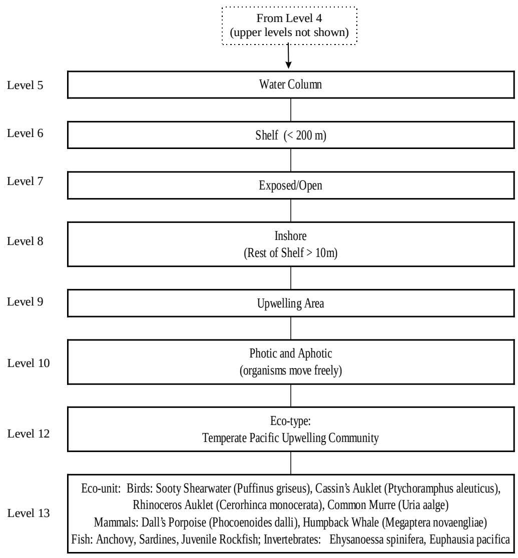

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Figure 5. Levels 8 through 13 of the proposed marine and estuarine habitat classification system for continental shoreline habitat.

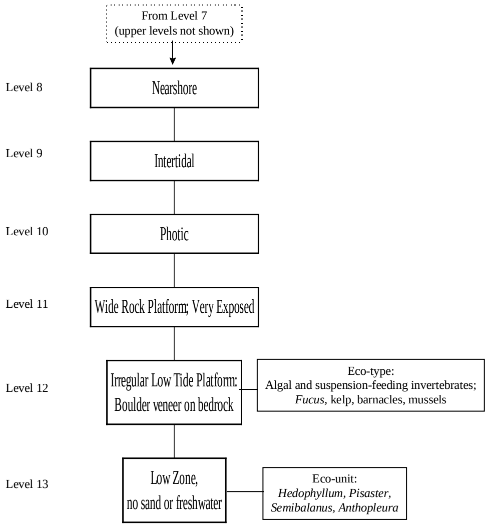

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Figure 6. Levels 8 through 13 of the proposed marine and estuarine habitat classification system for a mangrove ecosystem.

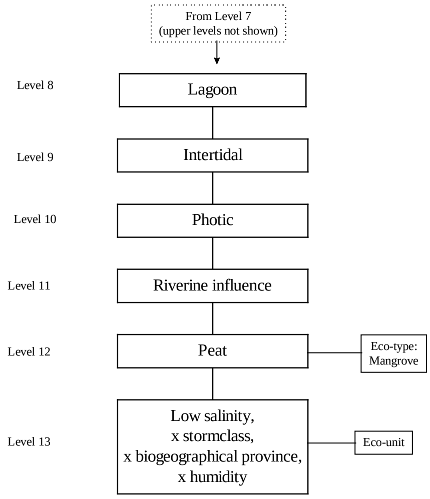

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Figure 7. Levels 8 through 13 of the proposed marine and estuarine habitat classification system for benthic continental outer shelf and upper slope.

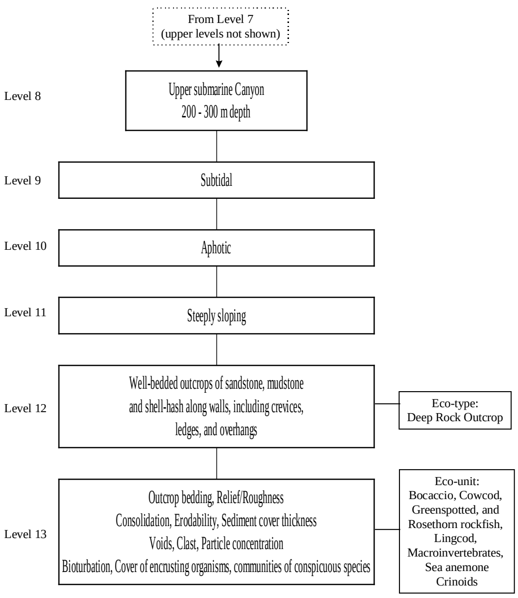

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Figure 8. Levels 8 through 13 of the proposed marine and estuarine habitat classification system for Pacific Reefs (mostly based on key marine plants & stony corals).

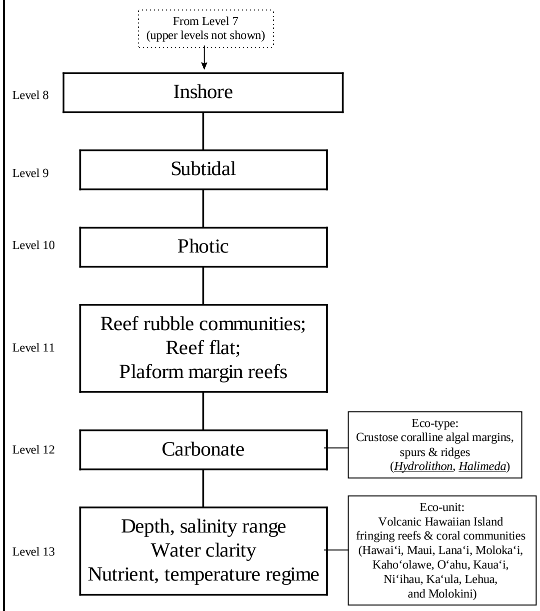

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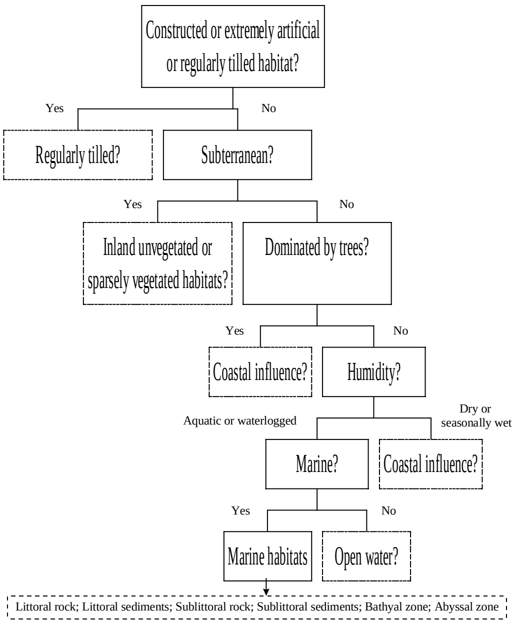
Figure 9. Upper levels of decision tree for the EUNIS Habitat Classification.



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ANNEX 5: TERMS OF REFERENCE AND PREPARATORY ACTIVITIES FOR A SECOND OSPAR/ICES/EEA WORKSHOP ON MARINE HABITAT CLASSIFICATION

Introduction

The *OSPAR Strategy on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area*, adopted at Sintra, Portugal in July 1998 to implement the new Annex V, states that OSPAR will assess which habitats need to be protected, including threatened habitats, based upon, *inter alia*, inventories of habitats in the maritime area. In implementing the Strategy (§ 3.2) "the Commission will collaborate with relevant scientific institutions including the International Council for the Exploration of the Seas (ICES) and the European Environment Agency (EEA). In the case of the EEA, the development of the EUNIS classification will be particularly important, in order to develop a classification system of habitats which can be used by OSPAR for assessment, comparison and mapping".

To contribute to the above requirement, the UK hosted an OSPAR/ICES/EEA workshop on habitat classification and biogeographic regions, in Oban, Scotland from 6–10 September 1999 (IMPACT 99/4/Info.2). The workshop contributed to ICES requirements to establish a habitat classification system and subsequently develop habitat maps (led by the Study Group on Marine Habitat Mapping which reports to the ICES Marine Habitat Committee) and to the EEA's current development of the European EUNIS habitat classification. The results of the workshop have been reflected in the most recent version (October 1999) of the EUNIS classification.

The Oban Workshop was successful in achieving a high degree of consensus on the upper levels of the EUNIS classification, but recognised that considerable further work was necessary on the detail of the classification (biological units at EUNIS level 4) to ensure that the full range of habitats in the OSPAR area are adequately represented. Given these considerations and the high degree of support for this work shown by IMPACT, a second workshop will be held, following appropriate activity by Contracting Parties and others, to further consolidate the classification. With adequate preparation and progress, completion to EUNIS level 4 should be possible by 2001.

Objectives of the workshop

The following objectives will be pursued at the workshop:

1) to further develop a habitat classification for the OSPAR area, thereby ensuring that habitat categories, agreed across the OSPAR area, are available to facilitate implementation of OSPAR Annex V, in particular further work to identify habitats requiring protection measures and future requirements for assessment, comparison and mapping.
2) to further contribute to ICES requirements for a marine habitat classification and to improve the Atlantic marine elements of the EEA EUNIS classification.

The Workshop will take into consideration the requirements of Annex V, as elaborated in the OSPAR strategy and the OSPAR Action Plan for 1999–2004, relevant work within IMPACT (or its successor body) including the Summary Record for the Oban Workshop (IMPACT 99/4/Info.2), ongoing work on the Faial criteria for habitats (IMPACT 99/4/1), and work undertaken by the ICES Study Group on Marine Habitat Mapping, in particular the outcome of the meeting in The Hague, 10–13 April 2000.

Work programme for the workshop

1) To further develop a habitat classification for the OSPAR area, building upon the relevant sections of the European EUNIS classification and following the approaches developed in the MNCR BioMar classification for Britain and Ireland. All marine habitats within the OSPAR area (inshore and offshore, shelf rock and sediment, deep water and pelagic) and covering the full geographical area of OSPAR will be included, developing a hierarchical classification with sufficient detail to suit the requirements of OSPAR to inventory and map habitats and for the selection of habitats in need of further protection. The revised habitat classification for the OSPAR area will be compatible with the EUNIS classification, and will have adequate definition for any new or modified habitats.
2) To build in appropriate biogeographical variants for habitats, taking into consideration the biogeographic regions proposed in IMPACT 99/4/6.
3) On the basis of progress made during the workshop, to recommend further work on habitats that may be appropriate to meet the ongoing needs of OSPAR, ICES and the EEA.
4) To consider data and information management issues:

In accordance with the generic agreement by IMPACT 1999, the lead party is requested to answer the following question: “Which recurrent data (and systematic information) collection and reporting schemes, requiring data handling facilities, infrastructure and activities within the OSPAR organisation are contemplated or envisaged within the ongoing development? Can something be stated about resource and infrastructural requirements?”

Participants at the workshop

Delegates to the workshop should be nominated to the UK[1] by Contracting Parties, Observers, the ICES Marine Habitat Committee or the EEA by 30 June 2000.

In order to fully achieve the aims of the workshop it is important that delegates have national or international expertise in:

- intertidal and shelf-sea rocky habitats;
- intertidal and shelf-sea sediment habitats;
- deep seabed habitats (below the continental shelf) of the OSPAR area;
- pelagic habitats.

As future OSPAR work on habitats is likely to focus on offshore areas, priority should be given to the nomination of delegates with expertise in deep-sea and offshore shelf sea habitats.

To make most efficient use of time during the workshop it is most important that Contracting Parties fully prepare information on habitats within their own country in the lead up to the workshop.

Logistics

The UK Joint Nature Conservation Committee will host a workshop during 18–22 September 2000 at Southampton, UK.

Preparatory activities and relation with other organisations

1) Contracting Parties, Observers, ICES, and EEA are requested to notify contact points for the workshop by 5 May 2000.
2) Contact points are requested to confirm their participants by 30 June 2000.
3) UK to send participants details concerning travel, accommodation and other logistical arrangements by 28 July 2000.
4) UK to send participants details of the most up-to-date version of the EUNIS classification and any other relevant documents by 28 July 2000.
5) Participants to undertake appropriate preparation of information on habitats within their area of expertise, under guidance from the UK, to facilitate a productive workshop.
6) Contracting Parties, Observers, ICES, EEA and participants are invited to contribute papers or make presentations at the workshop and to advise the organisers by 25 August 2000 of such proposals.

Outcomes of the workshop

The United Kingdom will prepare a summary record, addressing each of the objectives of the workshop, for adoption by the workshop participants. The summary record will be presented to IMPACT (or its successor body) for adoption, to the EEA and to ICES. The EEA will adopt the results of the Workshop, as appropriate, as an integral part of the EUNIS habitat classification.

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1 Nominations to:
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ANNEX 6: RECOMMENDATIONS ON THE DRAFT TERMS OF REFERENCE FOR A SECOND OSPAR/ICES/EEA WORKSHOP ON MARINE HABITAT CLASSIFICATION

18–22 September 2000, Southampton, UK

SGMHM strongly supports the continued participation of ICES representatives in the continued development, testing and implementation of the EUNIS classification for application to all ICES areas. This would be accomplished by ICES representatives attending the workshop and by incorporating the following points into the structure of the proposed workshop.

1. Geographic Area: it is important that further work on the classification includes consideration of habitats in all ICES areas, i.e., level 4 classes of the EUNIS classification to be developed and discussed during the workshop, should attempt to avoid the exclusion of ICES areas not in the OSPAR area.

2. Level of Detail of Classification: The workshop should focus on development of the classification below EUNIS level 3, primarily on establishing level 4. In doing so it will be necessary to consider classification units at level 5, particularly to confirm the structure of the level 4 units. Consideration should be given to using level 4 units based on functional or generic habitats that have broad application across the ICES area, and to using level 5 units for more specific regional variations.

3. Biogeography: There is a need for a general discussion on biogeographic differences within the ICES areas. This is similar to the needs of the OSPAR region. A common discussion at the workshop should focus on the most appropriate scale and location within the classification for biogeographical variations of habitats.

ANNEX 7: ABSTRACTS OF SHORT PRESENTATIONS

Craig J. Brown

A) Development of sub-tidal biotope mapping techniques in UK waters, with emphasis on gravel substrates

Steven Degraer, Vera van Lancken and Geert Moerkerke

B) Intensive evaluation of the evolution of a protected benthic habitat (HABITAT)

K. Essink

C) Monitoring of some general habitat features in the Trilateral Monitoring and Assessment Programme (TMAP) for the Wadden Sea

Jan Helge Fosså

D) The Norwegian MHM planned project "MAREANO"

D.J. de Jong

E) HABIMAP, a GIS-guided method to make ecotope and habitat maps

James Massey

F) Using Geographical Information Systems (GIS) to provide tools for Environmental Risk Assessment for the Oil & Gas Industry

R.A. Pickrill

G) The Application of Geoscience to Marine Habitat Research in Canada

M. Service

H) Habitat Mapping in Northern Ireland

A) Development of sub-tidal biotope mapping techniques in UK waters, with emphasis on gravel substrates

Craig J. Brown
CEFAS, UK

An overview of progress in the habitat mapping project "Mapping of gravel biotopes and an examination of the factors controlling the distribution, type and diversity of their biological communities (project A0908)". A summary of the project aims and details of the presentation are provided below.

Date project commenced: April 1998
Duration of project: 3 years
Organisation(s) undertaking research project: The Centre for Environment, Fisheries and Aquaculture Science
Funding bodies: MAFF

Abstract of research

To establish the utility of seabed mapping techniques for surveying habitats which can then be applied in other areas to provide an essential underpinning to future site-specific environmental assessments of potential dredging areas. It will also describe the biological variation in areas dominated by the gravel biotope (i.e. habitat and associated communities) over different spatial scales and determine the major factors influencing this biotope in an area of the eastern English Channel. The biology and sedimentology of the seabed will be investigated and, with available information on the hydrodynamic regime, used to explain variability in the benthic ecosystem. Together with information on fish/shellfish stocks and the distribution of fishing effort, that will enable an assessment of the implications for resource exploitation.

The work is of direct relevance to the development of policy for extraction of the aggregate resource from the seabed ensuring sustainability of the associated ecosystems. Knowledge and techniques developed by this work will enable a more effective and structured approach to the assessment of the potential environmental impacts of applications for licences to extract aggregates from the seabed by aggregate companies and their consultants. This will both enhance the scientific basis for prediction of the effects of extraction activities and improve judgements of acceptability for licence applications.

Purpose of research

Much of the seabed surface around the England and Wales coastline is comprised of coarse material. Where these deposits are present in sufficient quantity, are of the right consistency, and are accessible to commercial dredgers, they may be exploited as a source of aggregate for the construction industry, to supplement land-based sources and as a source of material for beach nourishment.

It is likely that the demand for marine-won aggregate will further increase in the near future (especially to meet coastal defence needs), and construction companies are already prospecting on a much wider geographical scale for new sources of material. In timely anticipation of this demand, the present research programme seeks to establish the utility of seabed mapping techniques for surveying habitats and also to evaluate the fundamental role of superficial coarse deposits in the coastal marine ecosystem.

Research aims

- Establish the utility of seabed mapping techniques for surveying habitats to provide an essential underpinning to future site-specific environmental assessments of potential dredging areas.
- Fill fundamental gaps in knowledge by elucidating the major factors that operate over various scales (km^2 to m^2) and are responsible for determining the character of the gravel biotope. Such factors include substrate composition and bathymetry coupled with dynamic features of the water column. This will provide a greater understanding of the sources of ecological variation and supplement knowledge regarding the functional significance of the gravel biotope to fisheries and as an environmental resource.

A major challenge for the proposed work is to sample at relevant scales. This will be achieved by deployment of state-of-the-art seabed mapping tools, closely linked with physical and biological sampling, to derive descriptions of the nature and extent of the habitat. As an aid to interpretation of the output the data will be incorporated into a geographic information system (GIS) which will be of subsequent use in the provision of advice on specific licence applications within the areas surveyed. Appropriate measures will be identified to quantify the biological "sensitivity" of seabed types in the event of future exploitation. Site specific findings will be used to derive generic hypotheses for change, thereby ensuring the wider application of the experienced gained.

Research Objectives

Summary Objective: To assess the utility of seabed mapping techniques for surveying habitats and examine the environmental influences affecting gravel biotope communities.

1) To characterise the seabed in an area of the eastern English Channel using various physical and geophysical techniques.
2) To incorporate biological, sedimentological and hydrographic information along with existing environmental and fisheries data into a geographic information system, in order to evaluate the functional role and importance of the gravel biotope relative to other substrate types, and for use in licensing procedures for the area surveyed.
3) To determine the causes of biological variation and of observed patchiness and to devise appropriate sampling strategies to allow for this variation. This work will take particular account of dynamic aspects of the environment within which the benthic communities have developed.
4) To establish the utility of seabed mapping techniques for surveying habitats.
5) To examine broad-scale fishery-independent beam trawl survey data from the eastern English Channel. Describe the range of assemblages sampled using dominance of commercially important fish and macro-epibenthic invertebrates by-catch, and where possible explain the ecological rationale for observed patterns in species affinities.
6) To evaluate the susceptibility of gravel biotope benthic communities to anthropogenic disturbances in contrasting areas, particularly by dredging. This will involve the testing of established and novel methods for describing and quantifying biological status and sensitivity.
7) To report on the significance of the findings for the management of aggregate extraction activities.

Summary of the project to date

Work began in 1998 with a preliminary survey covering a small area of seabed (approx. 4 km × 11 km) to the east of the Isle of Wight (Figure A7A.1). Methodology was developed and trials of a number of acoustic techniques were conducted. Results from the preliminary mapping survey revealed a complex relationship between physical seabed type (derived from acoustic information) and the associated fauna (derived from grab samples), reflecting the small-scale variability of the sediments within this region. In order to widen the scope of the study, and further develop the biotope mapping methods that were applied in year 1, three locations exhibiting a wider range of physical and biological gradients were selected for study in year 2. An area of seabed in the English Channel off Shoreham (12 km × 28 km), with strong biological and physical gradients, displaying a high level of sediment homogeneity within discrete habitat boundaries, was selected as the main site for study. The other two areas (each 12km x 4km), one offshore from Hastings and the other to the east of Dungeness (Figure A7A.1), were selected on the grounds that both contained similar sediment types to those encountered off Shoreham, but were widely separated geographically (forcing biological differences between areas) and displayed greater small-scale complexity in the arrangement of their sediment types.

The Shoreham and Dungeness areas were intensively surveyed in July 1999 using a combination of acoustic techniques (sidescan sonar and two seabed discrimination systems, RoxAnn and QTC View). A mosaic of the sidescan sonar traces from each area was produced to give a textural representation of the seabed, covering 100% of each survey area. Using this output in conjunction with the other acoustic data, and treating each survey area separately, the seabed was divided into acoustically distinct regions (Figures A72A.2 and A72A.3). Early post-processing of these acoustic data sets revealed general agreement in the interpretation of sediment types between each of the acoustic techniques, although work is still ongoing to fully evaluate the utility of each acoustic system as a mapping tool.

Sediment interpretations of the acoustic outputs from each distinct region ranged from cobbles and gravel, through to various sand wave features and mud. These regions were sampled during the follow up “ground-truth” and biological survey in August 1999 using a suite of sampling techniques. The main sampling tool deployed was a 0.1 m^2 Hamon grab fitted with a video camera. During the preliminary survey of year 1 there were often discrepancies between the predicted sediment type, determined from the acoustic records, and the actual sediment type collected during the physical sampling programme. Fitting a camera to the grab allowed an image of the undisturbed seabed directly adjacent to the sampling bucket of the grab to be obtained. This revealed that thin surface deposits of one type of sediment can often “mask” the dominant sediment type below, and this approach to sampling proved to be an invaluable procedure when attempting to map biotopes, due to the additional visual information gained from the video footage regarding the physical habitat. The acoustically distinct regions were further ground-truthed using a Rallier du Baty dredge (a heavy-duty sampling tool suited for use on coarse substrates), and using underwater video and photography collected through deployment of a drop camera frame. Two microloggers in lobsterpots (equipped with instrumentation to collect data on current speeds, suspended load, temperature and pressure) were deployed in the north and south of the Shoreham area to record data on the hydrography of the region. An identical acoustic, biological and ground-truthing approach was carried out at the Hastings area during surveys in October and November 1999.

Biological samples collected using the Hamon grab from the Shoreham survey area have been worked up. Statistical analysis of data has revealed that there is a high degree of variation between replicate samples taken from each of the acoustically distinct regions, but, nonetheless, there is evidence of statistically distinct biological assemblages within most of these regions. Further analysis of acoustic and biological data, incorporating physical data sets such as particle size distributions of sediments, and the hydrographic data from the loggerpots, will assist in establishing the relationships between biological assemblage structure and physical habitat. Biological and sedimentological samples from the Hastings and Dungeness survey areas are presently being worked up.

Figure A7A.1. Survey locations for Project A0908, eastern English Channel.

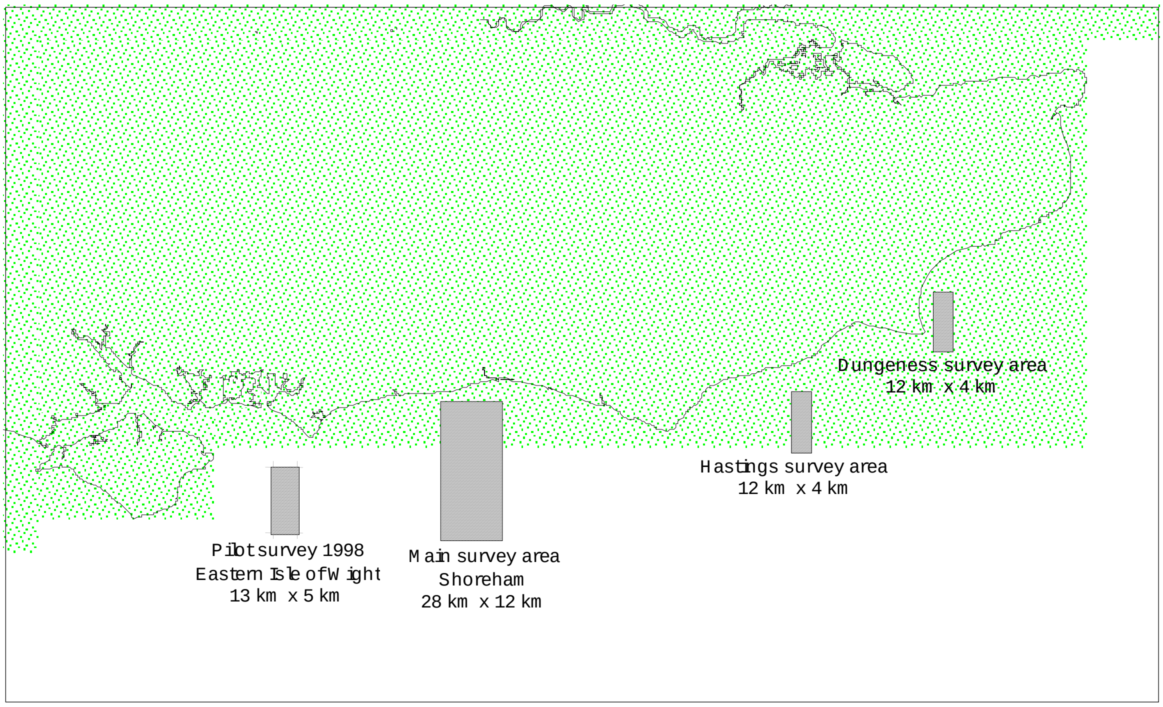


Figure A7A.2. Representation of the Shoreham survey area showing delineation of the 7 acoustically distinct regions (determined from the sidescan data) and positions of the Hamon grab stations. Bathymetry interpolated from QTC data.

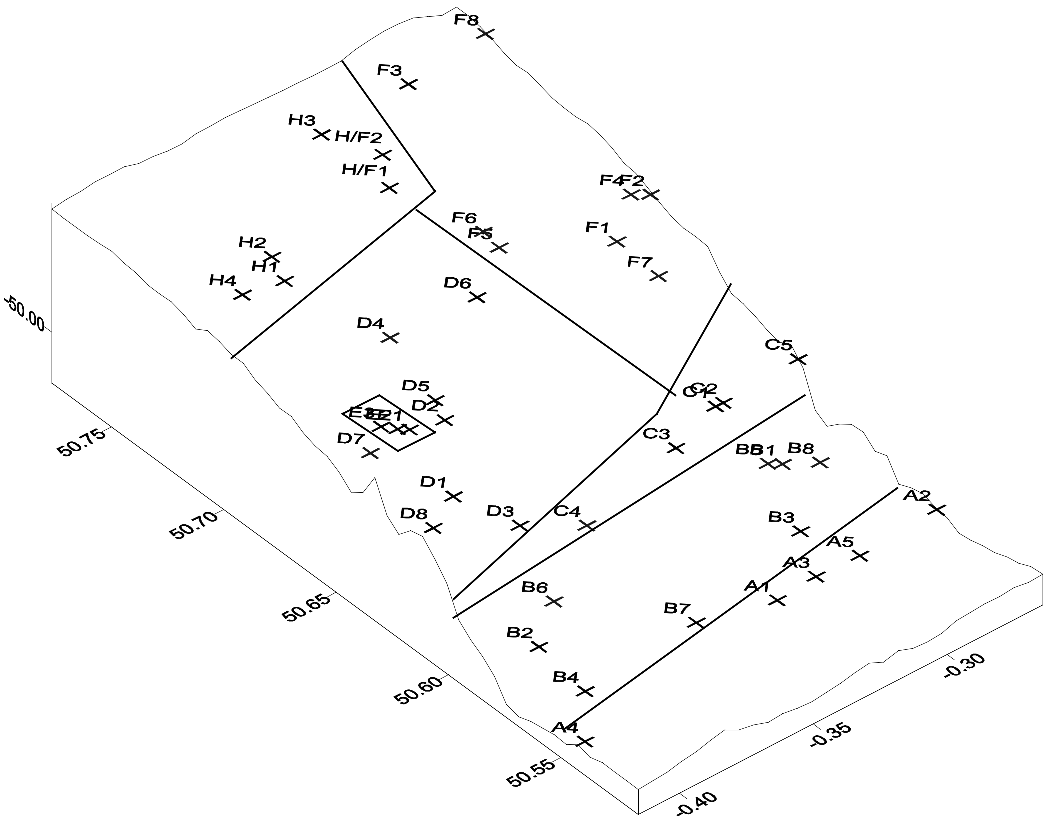
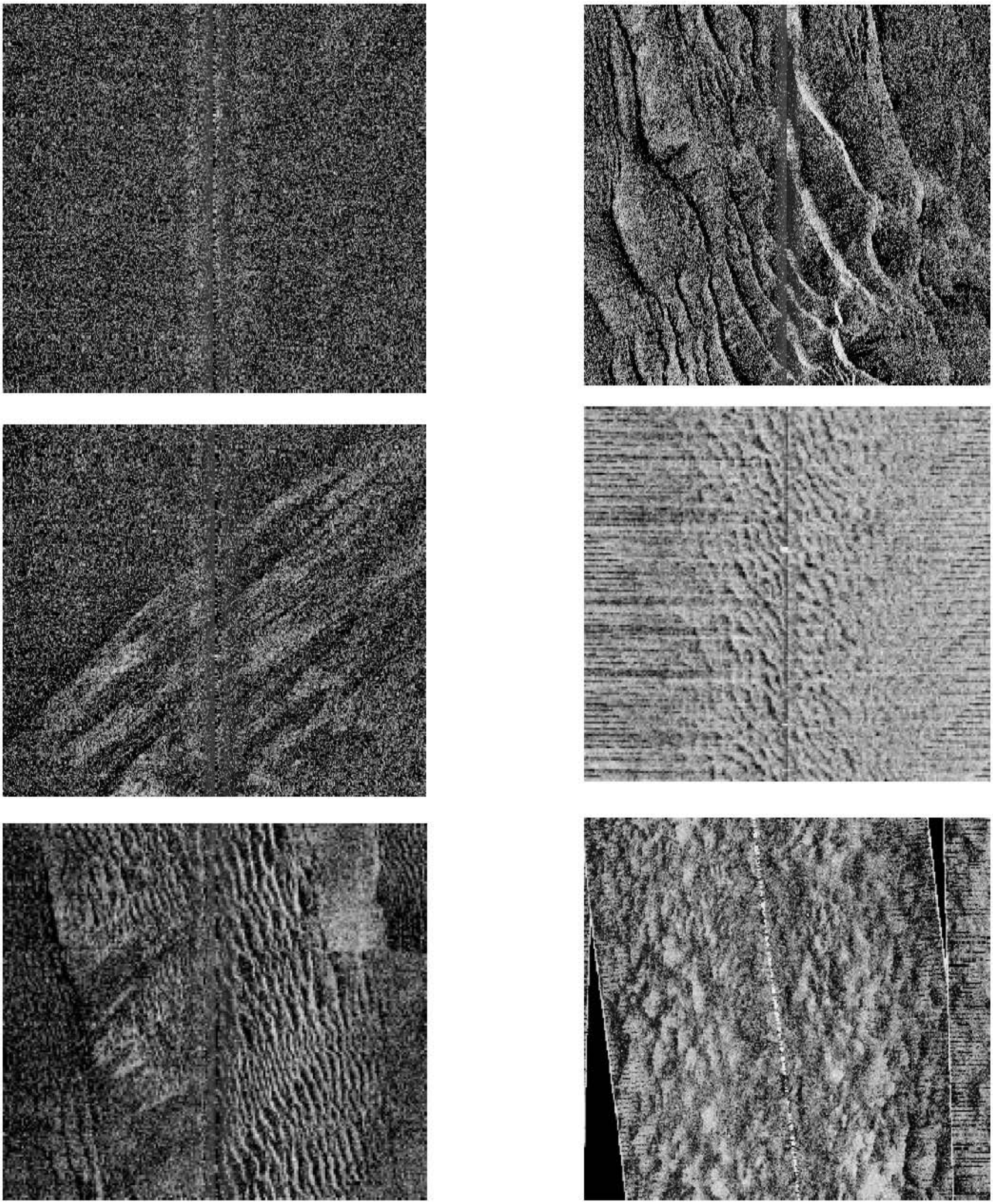


Figure A7A.3. Examples of sidescan sonar images from acoustically distinct regions. 1) Area A - Offshore clean gravel; 2) Area B Offshore gravel with thin sand veneer; 3) Area B - Offshore gravel with thick sand veneer; 4) Area C - Mega sand waves; 5) Area F - Inshore rippled sand; 6) Area E - Mixed heterogeneous sediment.



B) Research project: Intensive evaluation of the evolution of a protected benthic habitat: HABITAT

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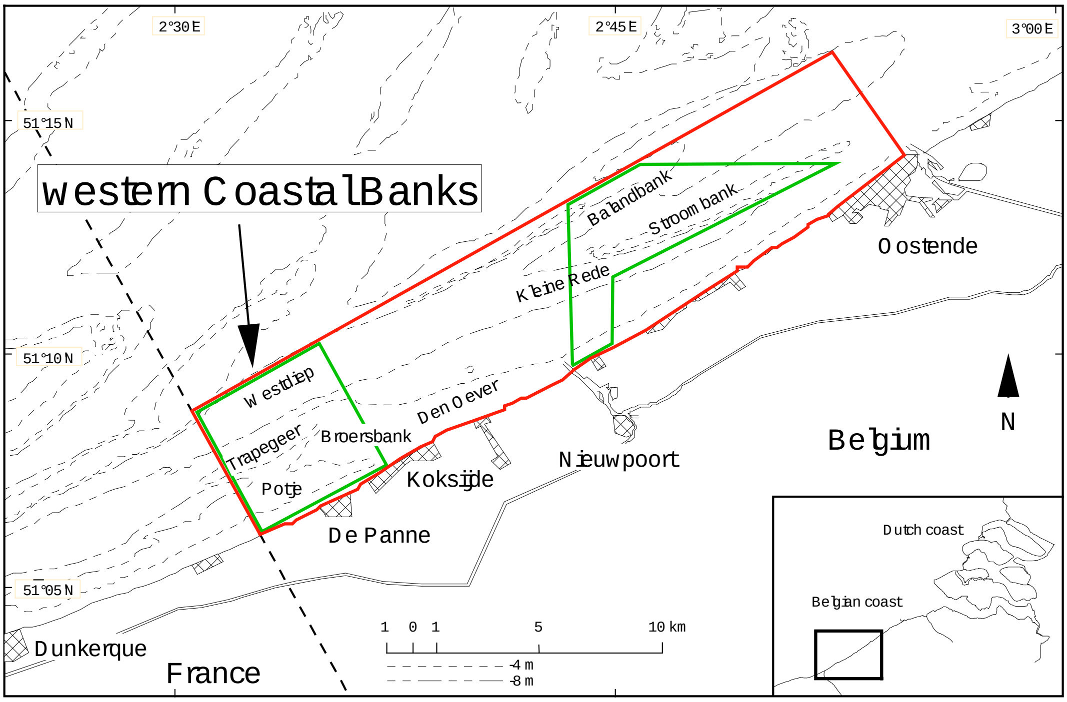
Introduction

The western Coastal Banks (3400 ha) are situated between the French-Belgian border and Koksijde-bad and from the low-water level to about 5.5 km offshore (Figure A7B.1). The area includes some Coastal Banks (Trapegeer, Broersbank, and Den Oever), as well as two gullies (Potje and Westdiep). Because of the geomorphological diversity in combination with the presence of several shallow sites (Broersbank), the area was proposed as a special area within the EC Habitat Directive. The geomorphological structure, being the most diverse along the Belgian coast, is directly responsible for the high biological diversity and richness of the area.

At first, the ecological importance of the area is illustrated by the high numbers of different species of birds wintering in the area. Studies revealed that, next to Divers (Gaviidae), Grebes (Podicepidae), Auks (Alcidae), etc., especially Seaducks (Melanitidae) are wintering at the western Coastal Banks (Devos, 1990). During some winter periods more than 1% (> 8000 individuals) of the NW European population of the Common scoter (*Melanitta nigra*) can be found on the western Coastal Banks. Because of the presence of the Common scoter, the area is regarded as an area with international importance for waterfowl (Ramsar Convention, 1972). Furthermore the area fulfills the demands of the EC Bird Directive and is proposed as an EC Habitat Directive area. The Belgian government is planning to give the western Coastal Banks the status of marine protected area (MPA).

Figure A7B.1. The western Coastal Banks, with indication of the Ramsar area (red line) and the proposed marine protected areas (green line).

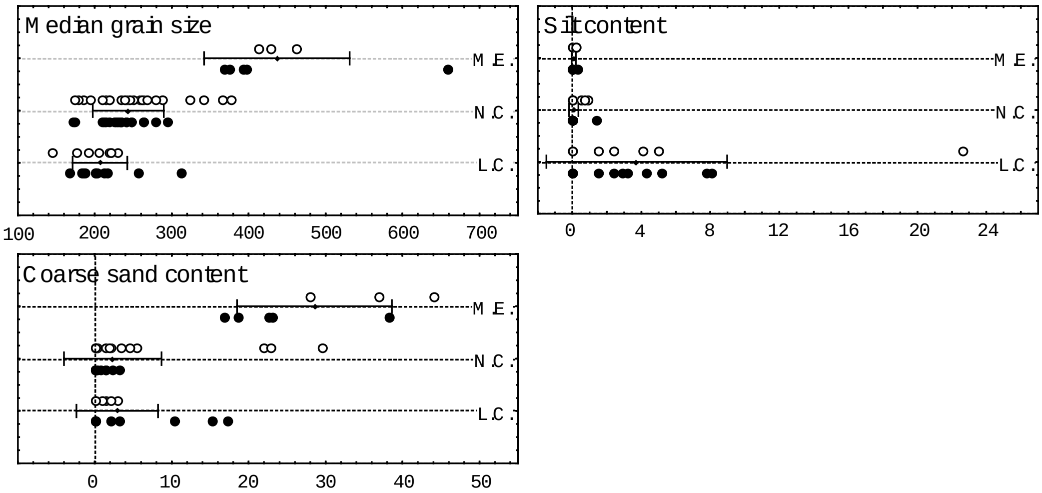


The spatial distribution of the wintering seaducks is defined by several factors, of which food availability and the undisturbed character of the biotope are very important (Kirchoff, 1981). The high bathymetrical diversity of the area, including intertidal sites, is directly responsible for the restricted access of ships, hence ensuring optimal conditions for the seabirds. Because seaducks are directly dependent on the macrobenthos, and more specifically the Bivalvia as their food resource (Cramp and Simmons, 1977), the presence of high numbers of bivalves (e.g., *Abra alba*, *Tellina fabula* and especially *Spisula subtruncata* (Degraer *et al*., 1999) is extremely important. Moreover, the macrobenthos is also important as a food resource for several commercial and non-commercial fishes (e.g., cod and Gobiids). The macrobenthos is thus an extremely important component within the ecosystem functioning of the western Coastal Banks. Therefore, knowledge of the natural spatial distribution and seasonal variation of the macrobenthos is extremely important when setting up a management plan for the proposed marine protected area (MPA).

Prescience: Macrobenthos

During a study of the macrobenthos in the area of the western Coastal Banks (excluding the gully Westdiep) from October 1994 to April 1998 (Degraer *et al*., 1999), three macrobenthic communities were detected (Figure A7B.2). One community, the *Lanice conchilega* community, is very rich in macrobenthos and its spatial distribution is restricted to the fine sandy sediments of the Potje and the northern slope of the Trapegeer and Den Oever.

Figure A7B.2. The distribution of the three macrobenthic communities (M.E., "*Mytilus edulis*" community; N.C., *Nephtys cirrosa* community *s.l.*; L.C., *Lanice conchilega* community) in 1994 (●) and 1997 (❍) over the three most differentiating environmental variables: the median grain size (µm) and the silt content (%) and the coarse sand content (%). The whiskers indicate the average value over the two years and the standard deviation.



The two other communities also showed a clear preference for typical environmental conditions. The study resulted in the development of a model, predicting the spatial distribution of the macrobenthic communities by means of sedimentological and depth information of the area (Degraer *et al*., 1999). The possibility of predicting the macrobenthic spatial distribution by means of the knowledge of the physico-chemical environment of an area is the major merit of the model. The major restriction of this model is the absence of a standardised methodology for the analysis and interpretation of the sedimentological data. The use of known environmental data, concerning the sedimentology and bathymetry, within the model may thus lead to a wrong prediction of the macrobenthic communities' spatial distribution. Some ecologically important environmental data, such as pigments (chlorophyll *a*), organic carbon, and nutrients in the bottom, were also not included in the model.

Meanwhile, the situation of the benthic ecosystem before application of the management plan (0-situation) will be presented by means of "distribution" maps of the macrobenthos, sedimentology and hydrodynamics within the protected area. These maps may serve as input for a geographical information system (GIS).

Objectives and methodology of the habitat project

The general objective of the project includes the provision of data, necessary for the definition and evaluation of a scientific management plan of the future MPA. Due to the crucial role of the macrobenthos within the coastal ecosystem, especially, the distribution of macrobenthic communities in relation to sedimentological, bathymetrical and hydrodynamic characteristics will be determined. This relation will be used for setting up efficient and low-cost tools to evaluate the management plan of the future marine protected area. Furthermore, the applicability of those tools will be evaluated along the whole Belgian coast

The research project is structured as follows:

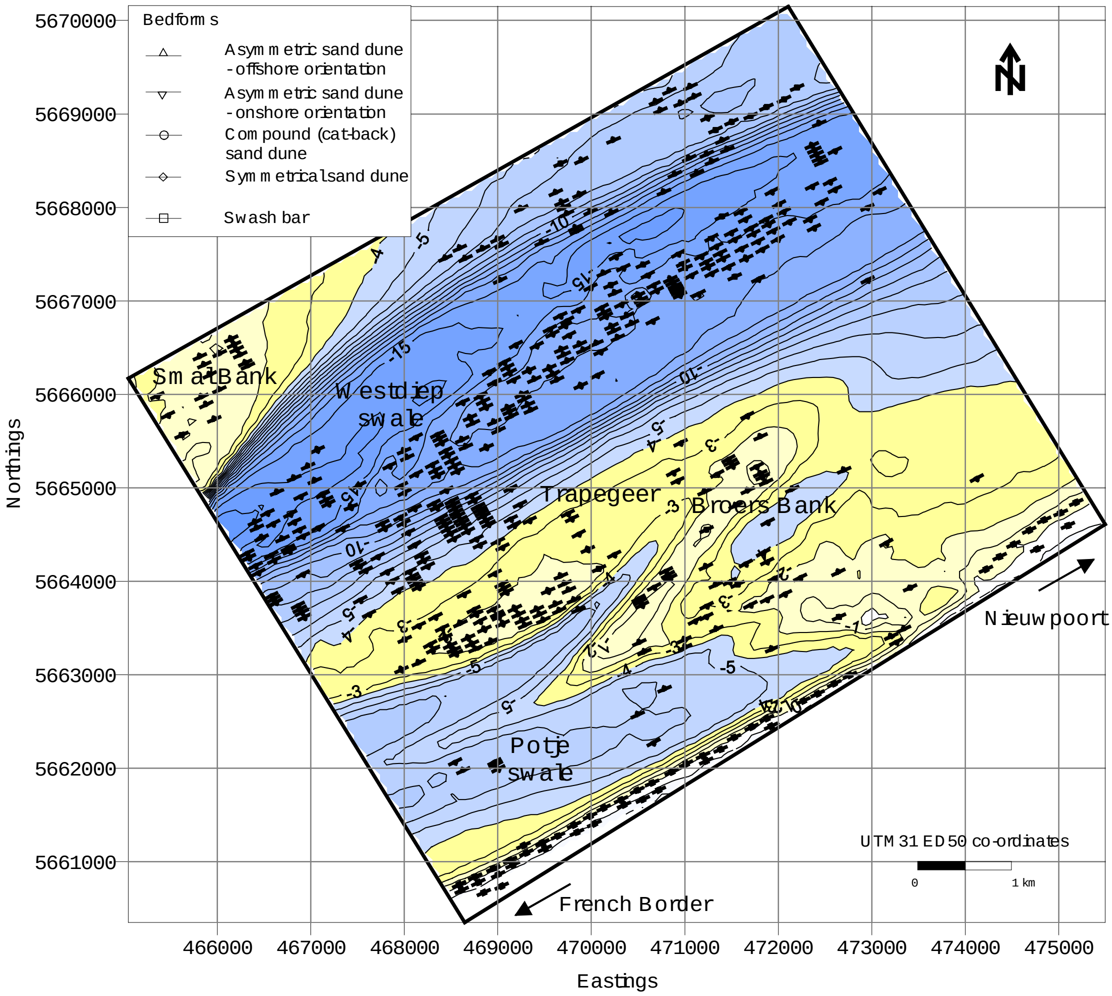
1) regional presentation of the macrobenthic and physico-chemical variables: the creation of biological and geological digital maps, based on the existing and newly gathered data, through the setup of an interactive database with future perspectives for the development of a Geographical Information System (GIS);
2) a detailed and interdisciplinary macrobenthic, sedimentological and hydrodynamic case study of a selected part within the potential protected area, aiming at the development of efficient and low-cost tools for the evaluation of the management plan through
   a) a “modelling” approach of the relation between the macrobenthic spatial distribution and the standardised physico-chemical variables (HABITAT model), and
   b) a standardised macrobenthic interpretation of sidescan sonar images (MSSSI);
3) a description of the seasonal macrobenthic and physico-chemical variables;
4) synthesis of the scientific results in a HABITAT map;
5) an evaluation of the applicability of the HABITAT model and the MSSSI along the whole Belgian coast.

1 Regional presentation of the macrobenthic and physico-chemical environmental variables in the future MPA

This part of the study will pay attention to the development of a database and the production of maps with future perspectives for the development of a Geographical Information System (GIS). Existing and newly gathered data will be included. The mapping is an important factor in the identification of the biological diversity and the consequent monitoring of the conservational status (Sotheran *et al*., 1997).

A first necessity when setting up a management plan is the development of a detailed *bathymetrical-morphological map*. Given the absence of such a base map of the study area and the importance of this map within other parts of the proposed research strategy, existing bathymetric data were compiled into contour maps and superimposed with the occurrences of bedforms (Figure A7B.3) (Honeybun, 1999). A digital sidescan sonar reconnaissance survey aided the selection of a subarea for further intensive interdisciplinary field campaigns (Autumn 1999, Spring 2000).

Figure A7B.3. Scheme of the bedform distribution in the Westdiep – Broersbank coastal system (Depths are in m MLLWS) (Data supplied courtesy of the Belgian Waterways Coast Division, Ministerie van de Vlaamse Gemeenschap) (Honeybun, 1999).



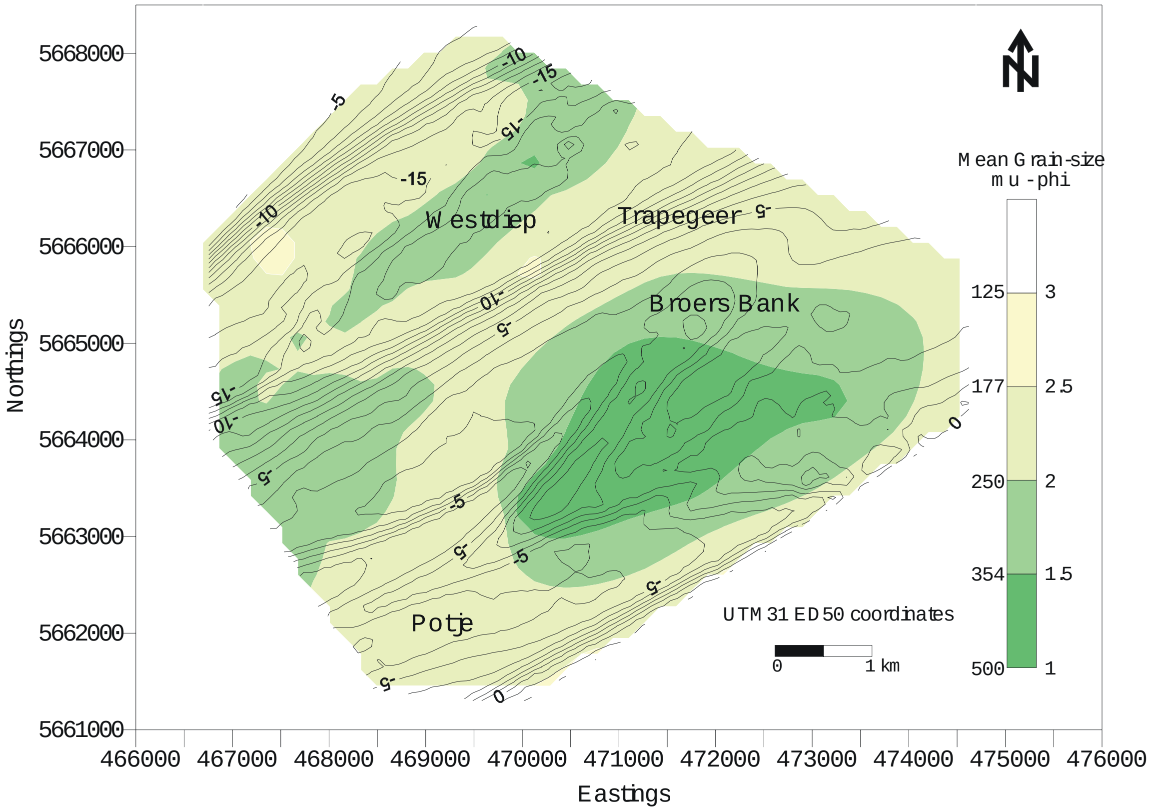
Secondly, a *preliminary sedimentological map* was drawn on the basis of existing data and aided by the integration with the bathymetrical-morphological map (Figure A7B.4). In this phase, attention is also paid to the development of a standardised, well-defined sampling strategy and specific classification schemes including geological as well as biological topics.

A third aspect includes the compilation of *hydrodynamic data*, based on existing current meter data and numerical models. Current meter data were provided by the Belgian Waterways Coast Division (Flemish Government) and were analysed as a first estimate for sediment transport calculations (Van Lancker *et al*., 2000). However, this aspect will be fully dealt with by the Management Unit for the Mathematical Model of the North Sea and Scheldt Estuary, who offered their know-how and assistance for the project.

Fourthly, the available *macrobenthic data* were schematically mapped and provide a first indication of the areas that are rich in macrobenthos (Figure A7B.5).

It has to be stressed that each presentation (map) is the result of a compilation of the available information, structured in a database. On the basis of this data, it will be decided (1) on what scale the data can be presented and (2) what spatial resolution has to be used in order to map the habitats in detail. Through the possibility to integrate and superpose all data, this first phase provides a tool to visualize the natural evolution of the area (e.g., changes between the 1970s and the present situation). Moreover, all information is of direct use when defining the present situation of the ecosystem of the western Coastal Banks (before the application of the management plan or 0-situation).

Figure A7B.4. Contour map of the mean grain size of the surficial sediments (moment values) (Honeybun, 1999).



2. Development of methodologies aiming at an efficient and low-cost monitoring of the future MPA: an interdisciplinary case study

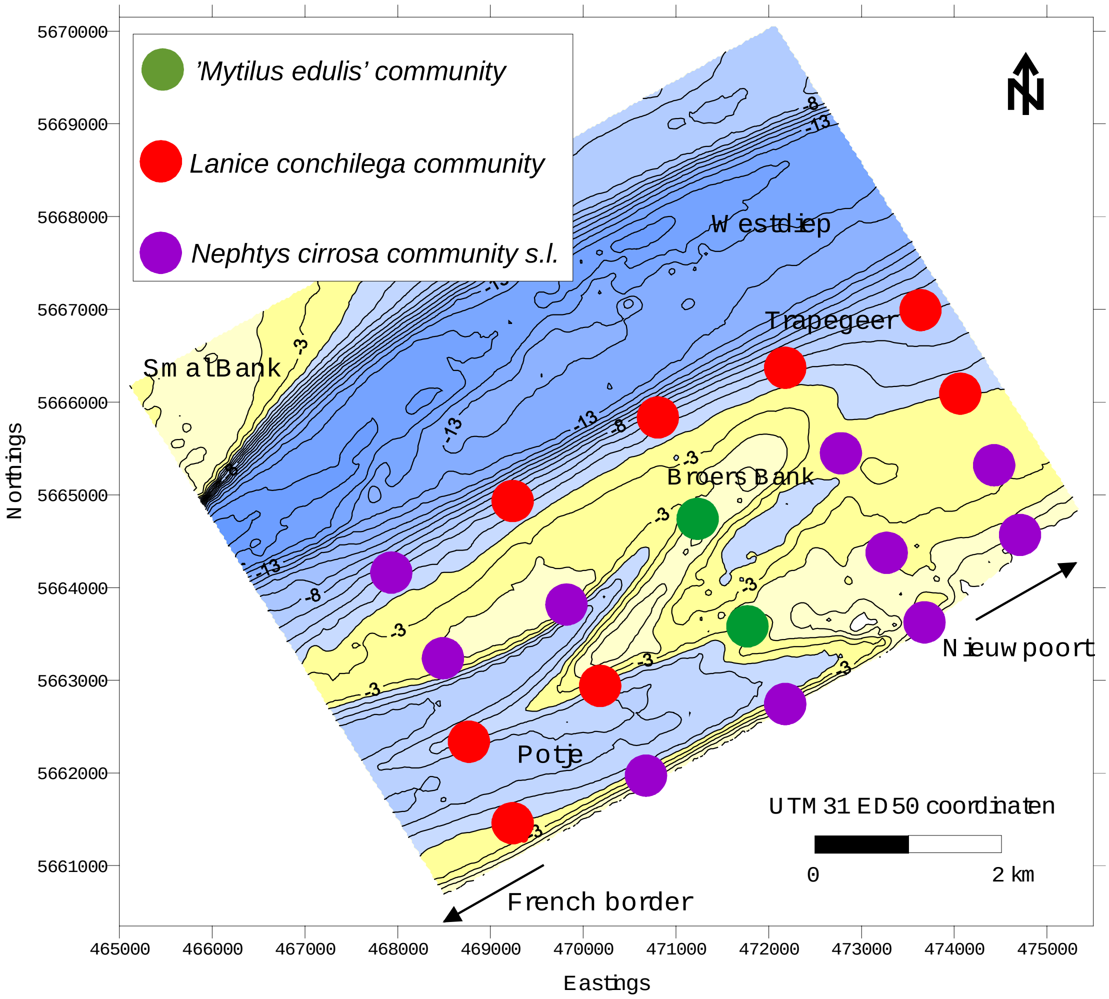
The detailed and interdisciplinary macrobenthic, morphological, sedimentological and hydrodynamic case study of a selected area (sub-area) within the potential protected area aims at the development of efficient and low-cost tools for the evaluation of the management plan. Two strategies will be used:

<u>Modelling of macrobenthic habitat preferences</u>

A first strategy relies on the clear relation between the spatial distribution of the macrobenthic organisms and the physico-chemical environment. Within the future MPA, macrobenthic organisms show a distinct preference for a very specific environment or habitat (Degraer *et al*., 1999). A combination of all organisms found in the same habitat are indicated as a macrobenthic community or species association. These communities are showing a clear seasonal variability. Obvious differences within the relative abundance of the composing species occur and some species can even be absent during a certain period, causing a large seasonal variation. The combination of all species possibly encountered in a certain habitat, is therefore called the "potential" of the habitat.

The "potential" of a habitat can be studied by extended sampling campaigns within different seasons over several years. When (1) the different macrobenthic communities and their seasonal variability and (2) their habitat preferences are known, information on the biologically relevant physico-chemical parameters of a new site allows prediction of the "potential" of this site. This model thus allows the evaluation of the "potentials" of non-studied places within the protected area on an efficient and low-cost basis.

Figure A7B.5. Schematic representation of the important macrobenthic communities.



For this purpose an extended, interdisciplinary sampling campaign was carried out in a selected area (sub-area) within the western Coastal Banks zone in Autumn 1999. Within this sub-area a maximum of possible habitats is included based on the bathymetric and sidescan sonar data. During this campaign primarily biological and sedimentological (physical and chemical) data were gathered simultaneously.

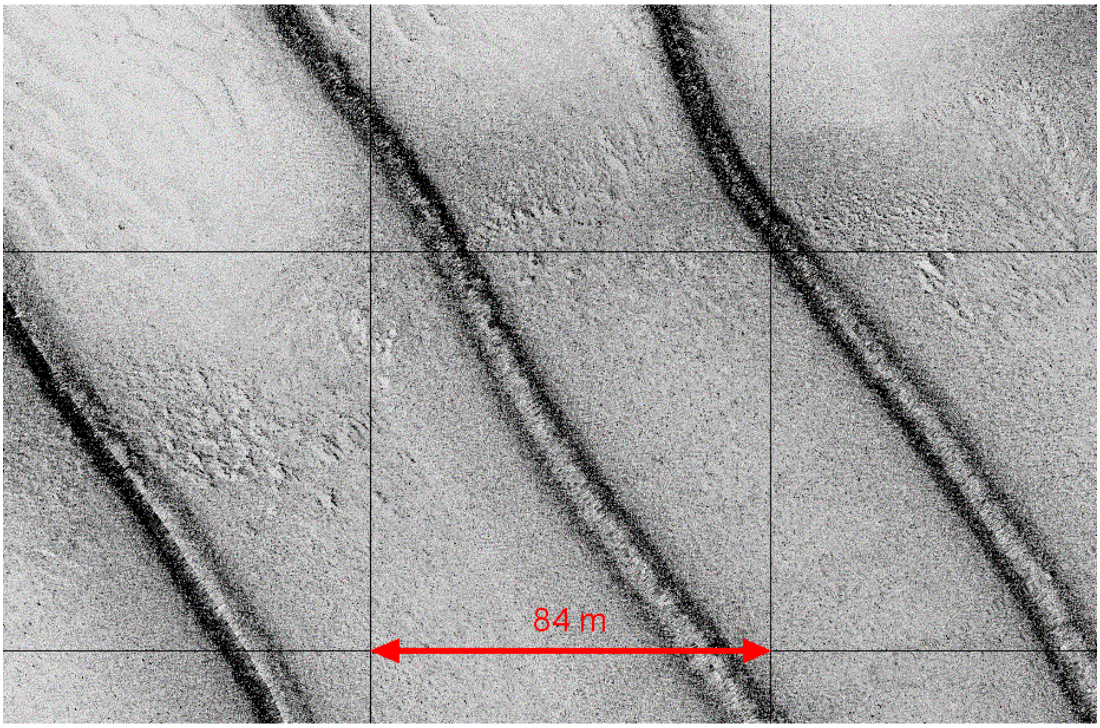
In a later phase, an "acoustic doppler current profiler" (ADCP) will be deployed to measure the velocity profile throughout the tidal cycle. This will allow hydrodynamic characterization of specific habitats. Moreover, these data are useful for the optimalisation of existing numerical models (Management Unit for the Mathematical Model of the North Sea and Scheldt Estuary).

The entire information will eventually allow the spatial distribution of the macrobenthic communities to be related to the physico-chemical characteristics. In order to study the "potentials" of the different communities (see 3. Seasonal variation within the future MPA), the same interdisciplinary campaign was repeated in Spring 2000.

Macrobenthic interpretation of sidescan sonar images (MSSSI)

Generally, the intensity of the reflected acoustic signals is an important tool for the mapping of seafloor substrates. Not taking into account the sedimentological aspect, differences in intensity can, however, also be a translation of the presence of living and even organic materials (Curran 1995). Many macrobenthic organisms influence the sedimentological structure by building (semi)-permanent tubes. For instance, the tubes of the tube-building polychaete worm *Lanice conchilega*, indicator species for the richest macrobenthic community in the area, extend above the sediment for some centimetres and can thus significantly alter and even raise the sediment surface (Berne *et al.*, 1988). If the density of this polychaete worm is high enough, these areas can be detected on sidescan sonar images. Figure A7B.6 shows an example of likely *Lanice conchilega*-related structures detected on the sidescan sonar images recorded in Autumn 1999 within the planned MPA.

Figure A7B. 6. Digital sidescan sonar mosaic along the northern upper slope of the Potje swale. The irregularities are likely related to the presence of *Lanice conchilega* fields.



As the macrobenthic sampling and sidescan sonar recordings are conducted simultaneously during the two interdisciplinary campaigns, the detected differentiation within the sidescan sonar images can be evaluated by means of the spatial distribution of the macrobenthic communities and their species. The standardised MSSSI can hence be tested as a second method to evaluate the management plan on an efficient and low-cost base.

Once both models have been developed and used to predict the macrobenthic "potentials" of a site, given known ecologically relevant physico-chemical characteristics, the reliability of the model has to be tested in the complete planned MPA. Therefore, a new interdisciplinary campaign is planned with the sampling of new stations (= outside the sub-area). After analysing the physico-chemical environment, the macrobenthic "potentials" of the stations can be predicted by means of the HABITAT model. These predictions will then be compared with the actual macrobenthic species composition of the different stations. Also, sidescan sonar images will be recorded. After analysis of the macrobenthic samples and the interpretation of the sidescan sonar imagery, the reliability of the MSSSI within the planned MPA can be tested.

3. Seasonal variation within the future MPA

Knowledge on the seasonal variation of the macrobenthos of the western Coastal Banks is necessary to define the "potentials" of the different macrobenthic communities. The study of the seasonal variation will provide information on the minimum and maximum densities, biomass, and diversity. The "minimum" and "maximum" situation hence indicates the "potentials" of the community. On a sedimentological and chemical level (nutrients, pigments, and organic carbon in the sediments), the variables are assumed to show slight changes.

From a physical point of view, also the bathymetrical variability and the differences in grain-size distribution will be studied. Given the shallowness of the area, the meteorological conditions preceding the sampling campaigns can be of primary importance to explain the nature of the physical envirommment (Van Lancker *et al.*, 1997; Van Lancker, 1999). In order to define the causes of all these variations, the data will be correlated with known hydrodynamical-meteorological data, provided by the Waterways Coast Division (Flemish government).

4. Synthesis of the scientific results in a HABITAT map

This part specifically aims at the creation of a *"habitat" map* that interactively combines the available and, especially, the newly gathered data. Because of the standardised methods, and the uniform production of maps, a future integration of all information into a geographical information system will be possible. This approach will allow rapid decisions about alternative measures in the protected area.

Sedimentological and geophysical methodologies provide information on the distribution, structure and changes of the environment. However, the biodiversity of the sediments is a very good ecological indicator to evaluate the impact of anthropogenic influences causing physical disturbances. The macrobenthic communities are hence an extremely powerful tool to evaluate biotic and physico-chemical processes in and above the sea bottom. In the case of disturbances, first of all the most vulnerable species will disappear, influencing the structure of the communities. The biological-geological synergism will thus lead to a strategy for the sustainable management of the marine protected area along the western coast of Belgium.

5. Evaluation of the applicability of the HABITAT model and the MSSSI along the whole Belgian coast

When performing an environmental impact study (EIS) of planned activities in the coastal zone (e.g., coastal defence works, windmill parks, etc.), policy makers are often confronted with fragmented or even absence of ecological information within a certain area and a detailed ecological study is often time consuming and expensive. Efficient and low-cost evaluation tools of the ecological importance are hence very valuable to overcome this problem.

Mainly because of the shallowness of the Belgian coastal zone, only few and scattered information on the macrobenthos is available. The application of the newly developed efficient and low-cost evaluation tools of the macrobenthic "potentials" in the planned MPA (HABITAT model and MSSSI) may help to assess the spatial distribution of the macrobenthic importance along the Belgian coast. Therefore, a new and extended interdisciplinary sampling campaign is planned in Autumn 2000. During this campaign information on the macrobenthic habitat (macrobenthos and physico-chemical environment) will be gathered along the whole Belgian coast. This information will be used to test the applicability of the HABITAT model and MSSSI along the whole Belgian coast.

Acknowledgements

The HABITAT project is funded by the Federal Office for Scientific, Technical and Cultural Affairs (DWTC) and the Belgian Waterways Coast Division (WWK). Within this framework, the Belgian Waterways Coast Division also provided bathymetrical and hydrodynamic data and shiptime on board "Ter Streep" and "Oostende XI". The field experiments were strongly enhanced by an intense cooperation between the crew and both the biology and geology teams. The firm MAGELAS was responsible for the acquisition of the very high resolution digital sidescan sonar imagery. Hydrodynamic modelling will be performed by the Management Unit of the Mathematical Model of the North Sea and the Scheldt Estuary (MUMM). This institute also provided shiptime on the Belgian oceanographic vessel "Belgica".

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C) Monitoring of some general habitat features in the Trilateral Monitoring and Assessment Program (TMAP) for the Wadden Sea

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Within the framework of the Trilateral Cooperation on the Protection of the Wadden Sea (Denmark, Germany, The Netherlands) a Trilateral Monitoring and Assessment Programme (TMAP) was developed. The TMAP comprises a wide set of specific parameters providing information on the chemical and biological status and developments of the Wadden Sea. In addition, human activities are monitored. Presently under development is a set of so-called general parameters. These comprise among other properties aspects of the morphology (extent of high/low tidal flats, extent of sediment types) and hydrology (salt marshes, inundation frequency, wave climate) of the area, climatic and weather conditions.

D) Present status of the mapping of deep-water corals and the planned Norwegian MHM project “MAREANO”

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An overview of the distribution of coral reefs of *Lophelia pertusa* in Norway and the damage by fishing activities was presented. This information was compared with the localisation of trawling grounds. Information on the presence of corals has been obtained from fishermen, scientific literature, the Directorate of Fisheries, Statoil and our own investigations. Damaged coral reefs are reported by fishermen and from our own studies. The results show a concentration of corals along the continental break between 200 m and 400 m depth. Large reefs are also found on the continental shelf, e.g., the reef on the Sula ridge which is about 15 km long and 350 m wide. The reefs seem to lie on ridges of morainic origin and similar prominent features on the shelf. Reefs have been registered in the fjords, where the shallowest distributions are found. The scale of damage varies from minor impact to severely affected reefs over large areas. The impact from human activities is depicted by comparing photographs of intact reefs with photographs of damaged reefs. We estimate that an area between 1500 km^2 and 2000 km^2 within the EEZ of Norway are covered by coral reefs, of which about 1/3 to 1/2 may be damaged or affected. Information provided by the fishermen was the cheapest and most effective way to survey the main distribution of the coral reefs. More accurate methods would have been expensive and time consuming and hence unrealistic for obtaining the quick overview that was demanded.

MAREANO - Marine Areal Database for the Norwegian Sea

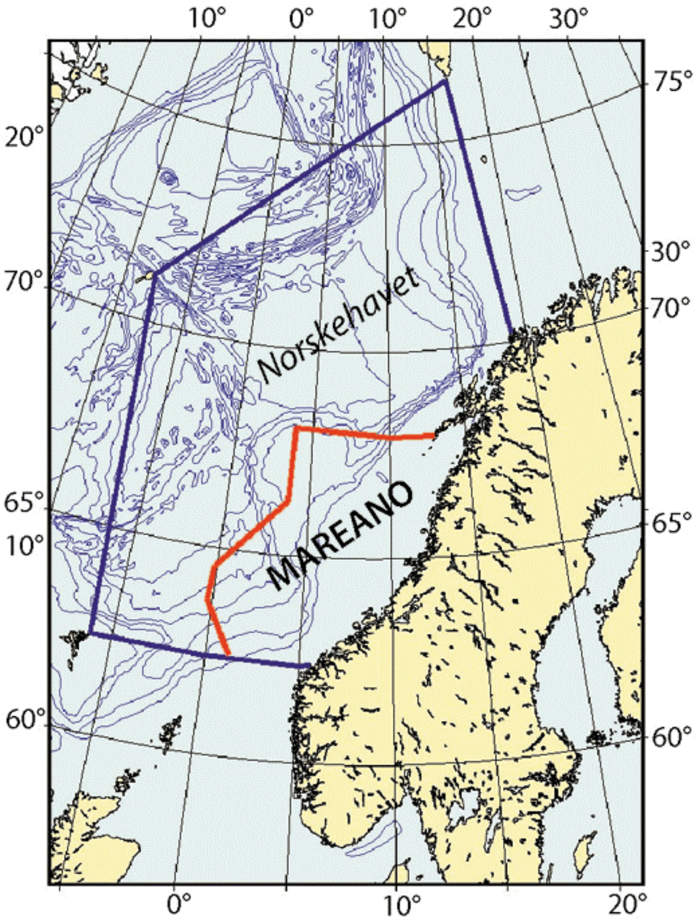
Thomas Noji and Jan Helge Fosså
Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway

An initiative is currently being taken by several Norwegian organizations to obtain funds to intensify ongoing investigations on marine sea-floor mapping off Norway. Planning during the last two years has led to the inception of a large-scale mapping project entitled **MAREANO - Marine Areal Database for the Norwegian Sea**.

NGU Norges geologiske undersøkelse
Oljedirektoratet
sft:
STATENS KARTVERK SJØKARTVERKET
HAVFORSKNINGSINSTITUTTET

The project partnership consists of the following government institutions:
Institute of Marine Research (IMR; havforskningsinstituttet)
Geological Survey of Norway (NGU)
Norwegian Hydrographic Society (SKSK)
State Pollution Control Authority (SFT)
Petroleum Directorate (OD).

Figure A7D.1. The investigation area for MAREANO covers 270 000 km^2, which corresponds to 83 % of mainland Norway. The area is a commercially important region for fisheries and the offshore petroleum industry. It also includes the world's largest deep cold-water coral reefs.

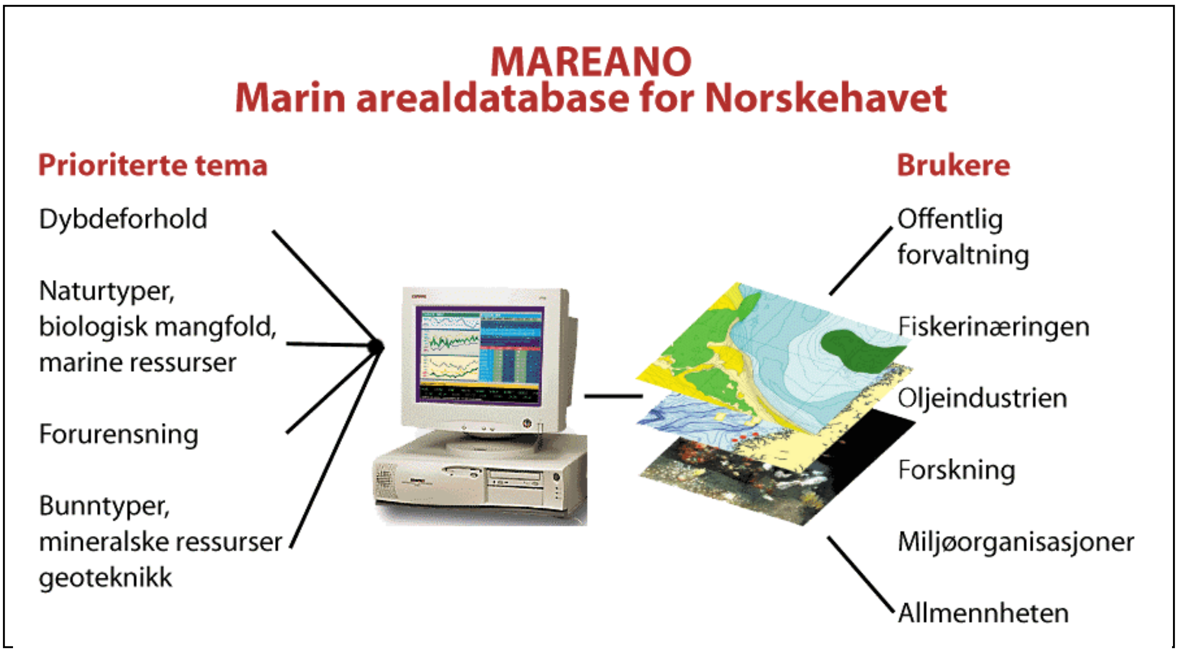


The aim of **MAREANO** is to collect new as well as historical data elucidating the physical, chemical, and biological characteristics of the seabed along the mid-Norwegian shelf and parts of the deeper Norwegian Sea.

The project shall produce maps and/or provide information on the following prioritised areas of research:

- bathymetric features of the seabed;
- marine habitats, biological diversity and marine biological resources coupled to the seabed;
- marine contaminants in sediments;
- sediment types, mineralogical resources and geological features.

Figure A7D.2.



Users of the **MAREANO** GIS database are intended to be:

- Public administration
- Fisheries industry
- Petroleum industry
- Researcher organisations
- Environmental interest groups
- Community interests, marine aquaculture, etc.

MAREANO is intended to provide tools directly useful for the industry and environmental managers.

Detailed bathymetric maps and electronic sea charts shall assist:

- Fisheries: bottom trawling
- Petroleum industry: offshore engineering
- Identification of marine habitats

Information on mineralogical, geological and anthropogenic seabed features can be useful for:

- Petroleum industry: offshore engineering, petroleum sources, e.g., gas hydrates
- Aggregate industry: gravel extraction

- Other mineralogical resources

Mapping of contaminants in sediments shall assist:

- Management restrictions on fisheries in contaminated areas
- Interpretations of transport of contaminants, e.g., transnational fluxes
- Identify sources of contaminants, e.g., barium (barite) as an indicator of North Sea contaminant fluxes originating from offshore petroleum activities

Mapping of marine habitats shall assist:

- Establishing Marine Protected Areas
- Assessment of biodiversity
- Assessment of biological resources: fisheries, bioprospecting

Figure A7D.3. A region within the MAREANO investigation area, which has been a focal point of previous mapping activities by IMR, NGU and SKSK.

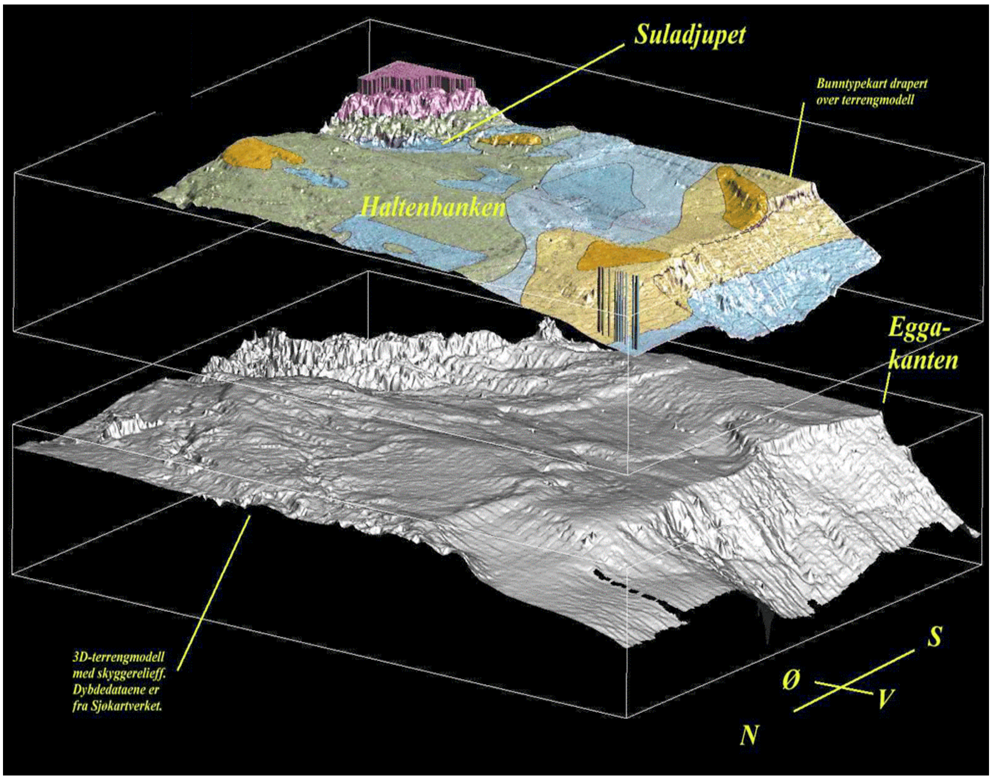


Figure A7D.4. The *Lophelia* ecosystems off Norway have been the focus of environmental interest groups on one hand and fisheries on the other. Recently, biprospecting activities at the reefs have begun as well. Illustration by Pål Mortensen (IMR).

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Ribber korallrev for gener

Korall og svamp fra revene på Sularyggen utenfor Frøya kan inneholde enzymer som har gunstig effekt på immunforsvaret hos mennesker. Gen-forskere fra tyske universiteter har kastet seg over «gullgruven» utenfor trøndelagskysten. Forskerne har i fem år dykket etter råstoff til nye legemidler som kan finnes i korallrevene. Norge står i fare for å tape milliardbeløp, fordi vi mangler lover som regulerer uttak av gen-ressurser. Den økonomiske gevinsten av nye legemiddelråstoff fra mikroorganismer i et korallrev kan bli like stor som inntekten fra et middels norsk oljefelt i to og et halvt år, ifølge i et notat fra Miljøverndepartementet. Direktør Sissel Rogne i bioteknologinemnda understreker at tyskerne ikke har gjort noe ulovlig.

Side 3

The total budget for MAREANO during an initial three-year period of investigation is over 7 million Euros. The project is presently under consideration for funding by the Norwegian government.

<u>For further information contact:</u>
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E) HABIMAP, a GIS-guided method to make habitat maps

D. J. de Jong
RWS, RIKZ, NL

Abstract

To predict the effects of intended steps and measures on aquatic ecosystems, the use of habitat maps has increased in the past decade. In the Netherlands, a GIS-method was developed for the marine tidal waters to define the habitats that occur there and to depict them into maps. This method, HABIMAP, uses the relations between communities or species and their abiotic environment. For each relevant parameter these relations are determined and they are mapped, using a "layering" of the various parameter maps leading to the eventual habitat map (Figure A7E.1). This method allows to make habitat maps on an ecosystem level (using a classifying strategy; Figure A7E.2) and on a species level (using a gradual scale from suitable to unsuitable; Figure A7E.3). It must be stressed that the habitat maps made are "potential maps". This means that it does not concern an actual mapping of habitats but a prediction of habitats being present in a certain area.

Apart from the rendering of current habitats the HABIMAP-method makes it possible to test the effects on habitats (situation, extent) of measures taken by man as well as to work retrospectively. The HABIMAP-method, in fact, can be viewed as a general spatial model, that can be a part of a larger Decision Support System, if desired.

In the lecture a workable definition is given for the habitat concept, both on ecosystem level and species level, and the methods used to create the maps in question is illustrated and discussed. Consequently results are presented for habitat classifications of the North Sea-Dutch Continental Shelf and the marine coastal tidal waters respectively at EUNIS level 3, and a further classification on an possible level 4 (Figure A7E.4) is shown, also illustrated by maps.

Figure A7E.1. Procedure for making a habitat map.

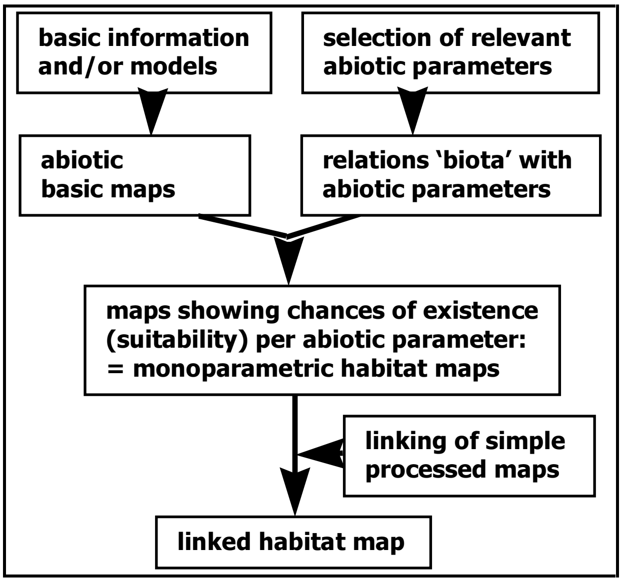


Figure A7E.2. Classification of parameter boundaries as determined by the benthic assemblages.

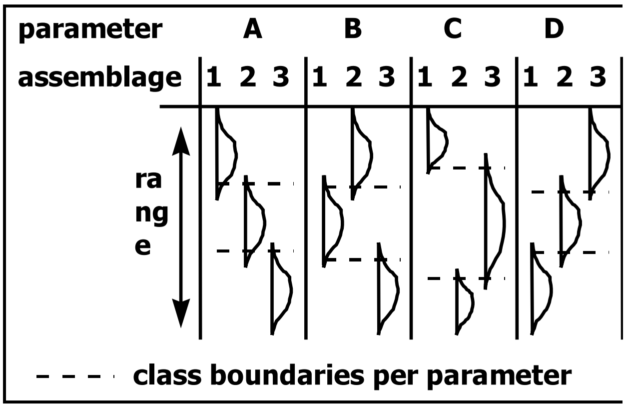


Figure A7E.3. Determination of the suitability index of a species (cockle) for a parameter: a curve is drawn around the sample points.

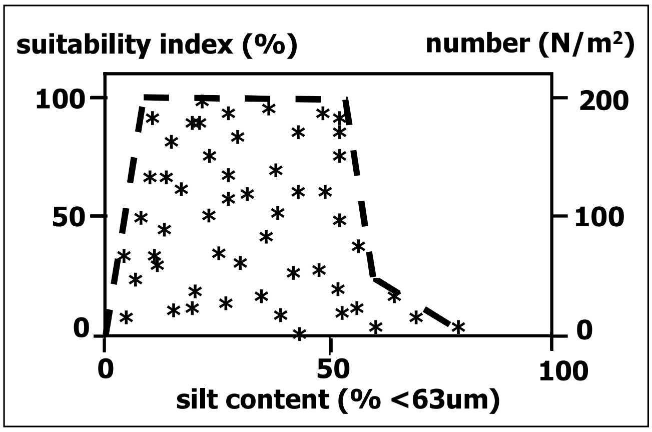
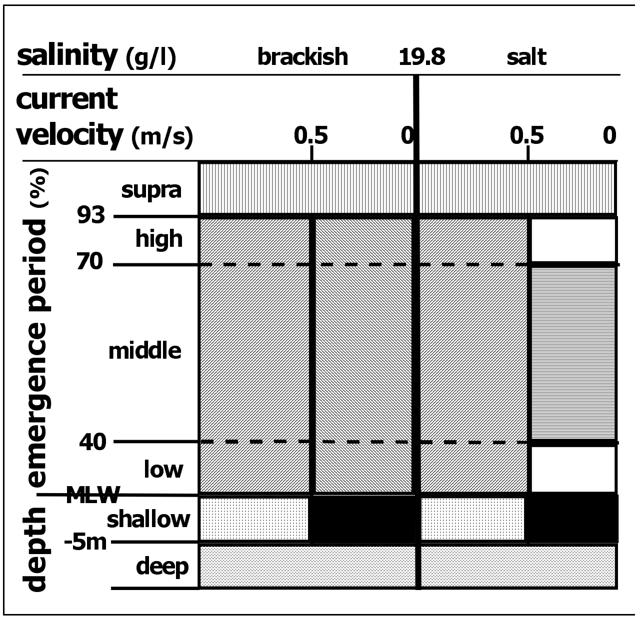


Figure A7E.4. Habitat classification on a possible level 4 for an estuary (Western Scheldt, NL).



The relations with the ecotope classification made up within the frame work of the European Union (EUNIS) is discussed.

F) **Using Geographical Information Systems (GIS) to provide tools for Environmental Risk Assessment for the Oil and Gas Industry**

James Massey
The Marine Technology Group, University of Glasgow

Environmental Risk Assessment has so far been limited to the development of existing environmental management systems (EMS). Strategic Environmental Risk Assessment is concerned with limiting emissions in conjunction with predicted future legislation for discharge limits. Costs and benefits, environmental harm, public concerns, technology advances and legislation influence this Strategic Risk Assessment.

Individuals, groups, and organisations make decisions about the risk under consideration using information on hazard, vulnerability, and risk assessment. There is a basic problem with all of these attempts at environmental management, which is a lack of information on biological systems in general, and specifically the North Sea. At present the systems for oil spill prediction and emergency management have little, if any, biological information included. Desktop GIS allows the user to access layers of data that are spatially referenced, thereby creating maps of data that can be quickly visually interpreted. In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e., data identified according to their locations.

There is an additional problem that though these systems can be used to analyse data that include three-dimensional data or include temporal information ("four-dimensional data"), at present there are no systems that will successfully graphically represent this data. In the North Sea, survey groups, oil and gas companies, consultants and other interested parties, have collected a great amount of information.

The use of GIS in environmental risk assessment and management has rapidly increased in the last decade. Of particular importance is the ability of GIS to integrate biophysical and socio-economic data on environmental risks. Compared to hazard assessment, the applications of GIS in vulnerability assessment are relatively recent and fewer in number.

Up to the present a considerable amount of time was spent identifying the information available for the North Sea study area. Unfortunately, the majority of the data available for the North Sea are not accessible.

Other information is very expensive. The other was using GIS and spatial analysis to study the commercial squid populations in the North Sea, data could potentially be added to a GIS-based North Sea biological resource at a later date. This data will be used as the first GIS phase of the project. The data will be added to two systems to form GIS data layer.

The data represented in the map layer used for analysis could be represented as habitat or community structure. Distributions of each species or large amounts of comprehensive species data, whilst important, should not be represented for the risk assessment user.

G) The Application of Geoscience to Marine Habitat Research in Canada

R.A. Pickrill
NS, Canada

The wide, shallow continental shelf of Atlantic Canada has supported a highly productive commercial fishery for more than 200 years. Today the three mainstays of this fishery, groundfish, lobster and scallops are under considerable pressure. Conservation strategies are being developed to rebuild stocks and manage a sustainable fishery. One of the roles of science in this strategy is to identify and understand critical habitats. The GSC was involved in collaborative projects with fisheries research scientists and the fishing industry in each of the key fisheries:

- sidescan sonar and high resolution seismic surveys have been included in a multidisciplinary study to assess the impacts of trawling on groundfish habitats;
- a neutrally buoyant sidescan sonar system was developed to map lobster habitat, as a base map for lobster abundance surveys, to identify spawning grounds, and to explore sites for artificial reef formation for lobster farming;
- the banks off southern Nova Scotia support a rich scallop fishery. In a collaborative project between DFO and the fishing industry a suite of mapping tools (including high resolution seismics, sidescan sonar, multibeam mapping, and seafloor characterisation) is being used to map the sea floor, map benthic communities and develop relationships between catch returns and substrate. Data will enhance fisheries management and cost-effective harvesting techniques.

In a collaborative programme growing out of these studies three government departments (Fisheries and Oceans, Natural Resources Canada and the Department of National Defence) have developed a multi-year, multidisciplinary research proposal (SEAMAP) to provide basic information for management of the seafloor habitat. Systematic data aquisition will incorporate multibeam bathymetry, sidescan sonar, high resolution seismic reflection profiling, grab sampling and bottom photography to characteristic sediments and biotopes. Data and interpretive maps will be archived in GIS format and output as electronic charts, maps and interpretive reports.

SEAMAP will provide basic data for sustainable management of offshore resources. Applications include fisheries management, offshore mineral resource assessment, selection and management of Marine Protected Areas, siting of offshore structures (platforms, pipelines and cables, and national defence).

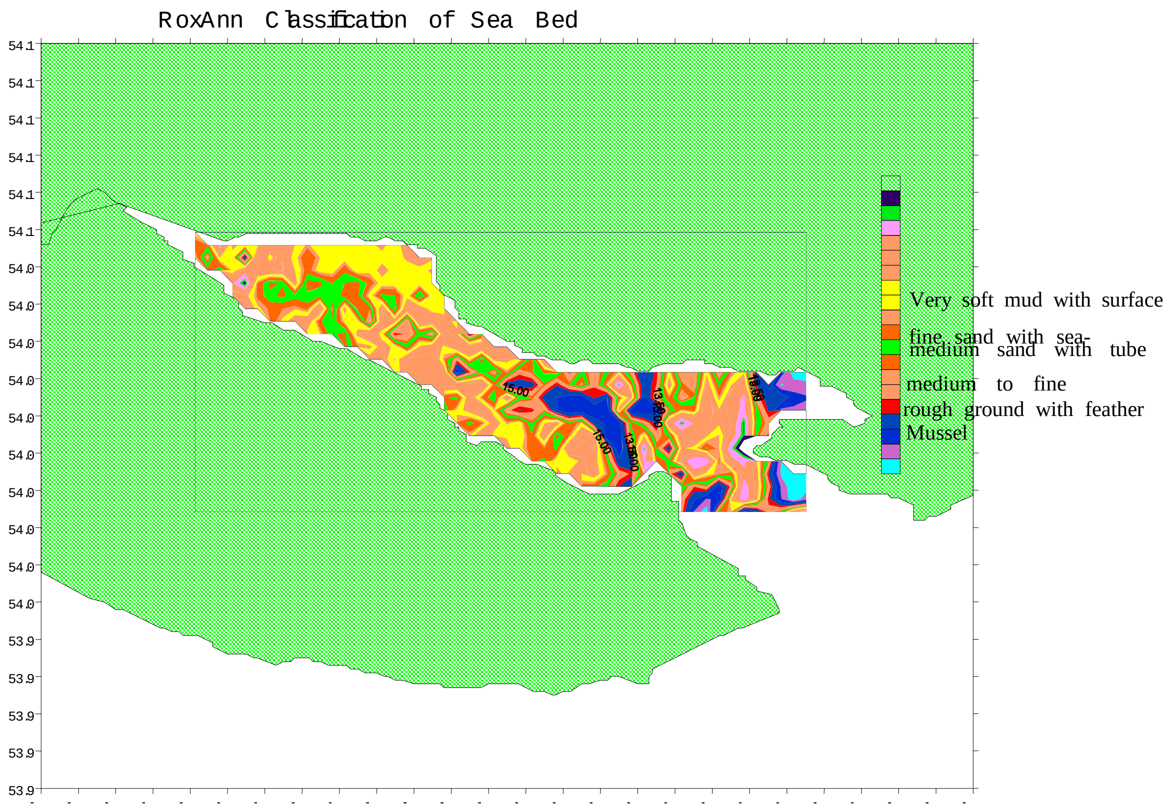
H) Habitat Mapping in Northern Ireland

M. Service
United Kingdom

Habitat mapping in Northern Ireland is carried out under a number of headings:

- Fisheries Impact Studies
- Shellfish Resource and Habitat Mapping (Figure A7H.1)
- Disposal Site Monitoring
- Habitat Status Monitoring
- Fisheries Habitat

Figure A7H.1. Survery of seed mussel, Carlingford Lough, Northern Ireland.



Many of the above were originally undertaken as “one-off” surveys with no follow up in mind.

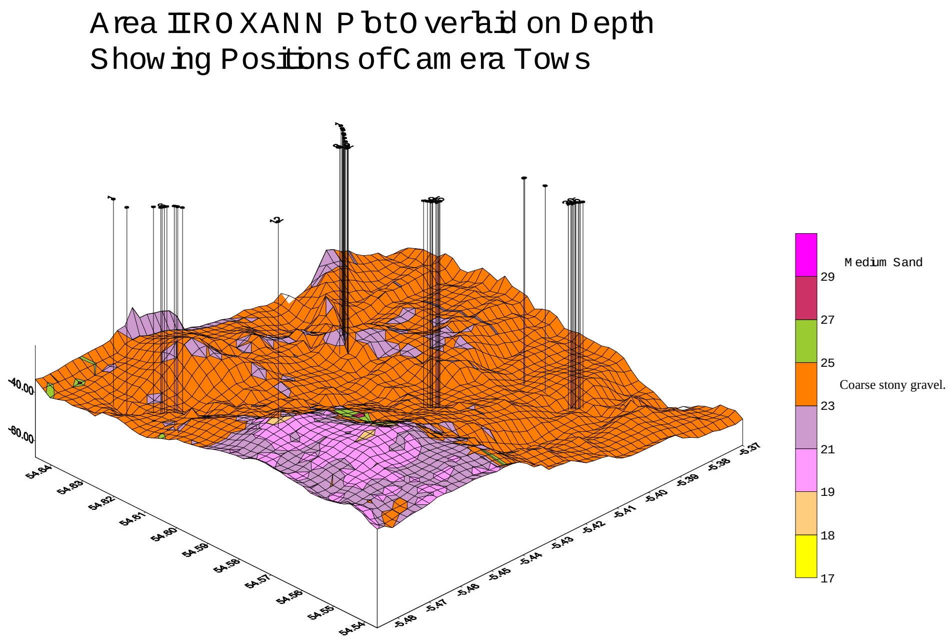
In 1999 DARD(NI), in conjunction with DOE(NI) EHS and Queens University of Belfast, initiated a project entitled the Broadscale Mapping of the Nearshore Habitats of Northern Ireland. This project was intended to concentrate on areas between the ELWS and the 50m contour. This study complements other DARD and QUB research, mapping shellfish habitat/resources and major habitat features of the Northern Ireland *Nephrops* fishery (Figure A7H.2).

Figure A7H.2. Burrows of *Nephrops norvegicus* and other megafauna.

The studies are being based on the use of a tiered approach as far as possible and include a range of techniques:

- Broadscale, i.e., sidescan sonar
- Overlayed with other, i.e., RoxAnn
- Targeted video and camera (Figure A7H.3)
- Spot sampling by diver or grab
- Quantifying video and photographic studies

Figure A7H.3. RoxAnn data from scallop habitat overlayed on bathymetry showing camera tows used for ground truthing.



The initial phase of the project will concentrate on a detailed re-survey and mapping of the seabed of Strangford Lough examining the current extent and quality of the habitats identified during earlier surveys in the Lough in 1990 and 1993 (Service and Magorrian, 1997). Special attention will be paid to *Modiolus modiolus* beds both in the context of the management of Strangford Lough candidate Special Area of Conservation (cSAC) and with regard to various biodiversity initiatives at a European, United Kingdom, and Northern Ireland level.

Data Quality Issues

As the habitat mapping develops both on national and international scales there will be an increasing need to put in place tools to ensure that data gathered by different organisations are compatible.

The UK National Marine Biological Control Scheme (NMBAQC) was established to monitor marine biological quality control for benthic faunal studies, particularly in relation to the UK National Marine Monitoring Programme. To date the focus on quality control has been on infaunal species, but with the recent requirement to monitor marine Special Areas of Conservation for the EC Habitats Directive, there is now a growing need to establish similar quality control standards for epibiota.

The issue of epibiota standards was discussed by NMBAQC in October 1999 when it was agreed that a pilot study should be established which would:

- assess the level of interest in developing standards for epibiota recording,
- gain an understanding of the current ability of field surveyors to identify epibiota, and assess possible ways in which epibiota standards could be further developed.

Although it was recognised that there were various ways of establishing a person's ability in this area, such as identification of specimens and *in situ* testing, it was agreed that the pilot study should focus on an initial photographic ring test with the possibility of a follow-up workshop. Accordingly is the UK JNCC has agreed to organise this pilot study in conjunction with NMBAQC.

Service, M., and Magorrian, B. H. 1997. The extent and temporal variation of disturbance to benthic communities in Strangford Lough. Co. Down. Journal of the Marine Biology Association of the UK, 77:1151–1164.

ANNEX 8: DRAFT TERMS OF REFERENCE AND PRELIMINARY WORK PROGRAMME FOR AN ICES WORKSHOP ON DEEP-WATER SURVEY TECHNOLOGIES AND THE DEVELOPMENT OF STANDARDS FOR MARINE HABITAT MAPPING

Background

Recent developments in integrated habitat mapping techniques offer powerful tools for deep-water sustainable resource management. There is a growing interest in OSPAR and ICES countries to conduct marine habitat mapping surveys. This is due to the growing dependency upon marine habitats for meeting current social and economic needs, and due to advances in acoustic as well as database technology (GIS) enabling the rapid collection, archiving and presentation of survey and other data. Acknowledging the growing importance of marine habitat mapping for marine science and environmental management, the ICES Marine Habitat Committee decided to establish a Study Group on Marine Habitat Mapping (SGMHM) (ICES C.Res. 1998/2:39), which is to provide advice in relation to the development of a classification system for marine habitats, development of a marine habitat quality tool, knowledge on effects of human-induced habitat change, and knowledge on the effects of anthropogenic pollutants/contaminants on habitat and depending living resources.

At the first SGMHM meeting, which was held in conjunction with the OSPAR/ICES/EEA Workshop in Oban, Scotland from 6–10 September 1999, SGMHM agreed with the usefulness of marine habitat maps and supported three joint OSPAR/ICES proposals designed to advance developments in the production of high-quality habitat maps:

1) to carry out a joint cooperative comparison of deep-sea survey technologies and to explore the possible development of standards in this field;
2) to produce a detailed habitat map of the North Sea using existing data, to test data access and cooperation between Contracting Parties;
3) to carry out a pilot project for habitat mapping to EUNIS level 3 in the entire OSPAR area, which would test the EUNIS classification.

SGMHM recommended that OSPAR and ICES give support to these three initiatives.

Because of the need to initiate collaboration between institutes conducting or planning marine habitat investigations and in response to the proposals made by ICES and OSPAR, the Institute of Marine Research intends to host a Marine Habitat Mapping workshop to discuss survey technologies, strategies, and data formats and map products for deep-sea habitats. The intention is to cover a range of environments from shelf depths to the deep sea. The workshop will also provide the opportunity for participants to present ongoing or planned marine habitat mapping activities and to discuss international cooperation as well as joint projects. Work needs to be done with full recognition of the work of SGMHM and OSPAR/EUNIS habitat classification work to ensure that techniques/standards for data storage, interpretation and presentation are compatible.

Objectives of the Workshop

To bring together geologists, benthic ecologists and GIS database experts to develop an integrated approach to deep-water habitat mapping and to:

a) compile and review information on deep-sea survey technology to map the seabed and benthic habitats;
b) identify and compile information on existing data sets on mapping of the seabed and benthic habitats;
c) consider harmonisation or standardisation of survey technology, data processing, interpretation and map products (GIS) for future applications;
d) consider collaboration and possible joint projects between ICES Member Countries on marine habitat mapping field activities.

Preliminary Work Programme for the Workshop

Marine habitat mapping activities

- Discuss field and data collecting strategies with regard to marine habitat mapping.
- Compare technologies used for marine habitat mapping, e.g., acoustic mapping technologies (sidescan sonars, multibeam echosounders, and navigation), and groundtruthing and biological sampling (ROV video, grab, etc.).
- Integration of physical and biological data, broad- and fine-scale data.

Storage and presentation of marine habitat mapping data

- Discuss formats for marine data, in order to facilitate data exchange.
- Discuss database requirements, in order to facilitate database links, and compare usefulness of different GIS and database systems for marine habitat mapping.
- Can standards be developed/recommended? Consider data and information management issues.

  In accordance with the generic agreement by IMPACT 1999, the lead party (Norway) is requested to answer the following question: "Which recurrent data (and systematic information) collection and reporting schemes, requiring data handling facilities, infrastructure and activities within the OSPAR organisation are contemplated or envisaged within the ongoing development? Can something be stated about resource and infrastructural requirements?"

Encourage international cooperation

- Present ongoing and planned marine habitat mapping activities.
- Consider establishment of metadatabase (adopt metadata standards) so that available data (type, extent, location) can be made better known to all relevant parties (preferably Internet-based system or tune in with existing metadatabase), discuss collaboration and possible joint projects between ICES Member Countries on marine habitat mapping field activities. A more detailed work programme will be worked out later.

Logistics

The workshop venue shall be the Institute of Marine Research, Bergen, Norway (winter 2000/2001). The contact person will be:

Dr. Thomas Noji
Institute of Marine Research
P.O. Box 1870, Nordnes
N-5817 Bergen,
NORWAY
Tel: +47 55 23 85 00
Fax: +47 55 23 85 84
E-mail: thomas.noji@imr.no

Outcome of the Workshop

Norway will prepare a Summary Record, addressing each of the objectives of the workshop. The Summary Record will be presented to IMPACT for adoption and to ICES.

ANNEX 9: HABITAT MAPPING OF THE OSPAR AREA

Background and justification

1) There is a need to develop habitat maps at the OSPAR level, to contribute to the longer term needs for assessment and management of the OSPAR area or its sub-regions (cf. OSPAR Strategy §3.2), and to help with immediate priorities with respect to threatened or declining habitats; however it is recognised that the level of data, expertise and resources required to achieve this varies considerably across the OSPAR area.

2) ICES, through the Study Group on Marine Habitat Mapping of its Marine Habitat Committee, is also aiming to establish a habitat classification and to develop habitat maps for the ICES area to facilitate improved understanding and management of the marine ecosystem.

3) OSPAR and ICES are cooperating in the development of a marine habitat classification (a prerequisite for habitat mapping) for the OSPAR and ICES areas, in conjunction with the EEA, through further development of the EUNIS European habitat classification.

4) There are currently no schemes for mapping marine habitats covering all or significant parts of the OSPAR area; however mapping schemes exist at a European level for certain terrestrial species groups and habitats.

5) A proposal for mapping habitats throughout the OSPAR area, developed *inter alia* at the OSPAR/ICES/EEA Workshop on Habitat Classification and Biogeographic Regions, held in Oban, UK in September 1999 (IMPACT 99/4/Info.2, Annex 16), was further considered at IMPACT 1999 (IMPACT 99/15/1, Annex 9) and at the ICES Study Group on Marine Habitat Mapping, held in The Hague, Netherlands in April 2000 and was strongly supported at all meetings.

Overall aim

6) To develop a habitat mapping scheme for the entire OSPAR area, mapping initially at a very coarse level of detail or for a few specified habitats, using a rapid and easy collation of existing data.

Goals and objectives

7) The proposal has the following goals and objectives:

a) to develop simple maps of broadly-defined habitats for the OSPAR area (initially to EUNIS level 3), using a presence/absence mapping scheme based on 50 km × 50 km UTM grid squares (i.e., requiring no sophisticated spatial information or comprehensive knowledge of each grid square being mapped), to provide an initial understanding of the distribution and abundance of broad-scale habitats within the OSPAR area;

b) to map the distribution of selected habitats (more finely defined in the EUNIS classification), such as *Lophelia* reefs or seagrass beds, which are being considered for further protection under Annex V, to show their distribution and abundance;

c) to establish a collation mechanism for marine habitat data across the whole OSPAR area, and thereby test the feasibility of collection of finer-level data in the future, which can further contribute to OSPAR requirements;

d) to consider the feasibility of including pelagic habitats within the mapping scheme;

e) to produce completed maps within a short time-frame (e.g., two years), thereby providing a rapid contribution to OSPAR requirements, before considering further steps. The maps should be available in printed form or as an interactive GIS application, available on CD-ROM or via the Internet.

Considerations

8) This mapping initiative was formulated to be achievable at the OSPAR level, both with modest resources and within a reasonable time frame, and has been further elaborated below. The proposal should be considered as a parallel and complementary initiative to more detailed mapping of parts of the OSPAR area, such as that suggested for the North Sea (IMPACT 99/4/Info.2, Annex 14).

9) The mapping scheme should be fully compatible with current European standards, particularly the European EUNIS habitat classification and the 50 km x 50 km UTM grid square mapping system, to facilitate future use of the data at a European scale or its integration with other data sets.

10) Due to the range in data and information, this proposal will have to deal with the variable resolution in available data, using high-resolution UTM coordinates. It could attempt to properly represent the fine-scale high-resolution data available for some nearshore areas as well as areas in the deep ocean or other poorly surveyed coasts. Areas where data are lacking can be highlighted for possible future action. Similarly, areas with exemplary treatment will be highlighted as examples for future work.

Requirements

11) Coordination of the mapping scheme by a lead country, including reporting on progress to IMPACT or IMPACT's successor, with contact points in each contributing country being supported by technical expertise from the lead country. Each country would be responsible for data collation within its own territory.

12) Development of a database and GIS to hold, display and interrogate habitat data for the OSPAR area. Consideration should be given to enable direct access to the database by a variety of institutes in OSPAR countries, possibly via the Internet, for data access and possibly also for data entry. Data transfer formats would need to be established.

13) Collation of data on the occurrence (presence) of habitats in the marine UTM grid squares of each country, initially for:

    a) habitats defined to EUNIS level 3 only;
    b) for specified more finely defined habitats (e.g., *Lophelia* reefs, seagrass beds).

14) In establishing the data structure and database, consideration should be given to adequate documentation of the source data and to collection of more detailed data (e.g., more specific locations, more detailed habitat types, habitat extent) if readily available. The latter would facilitate linkages to more detailed mapping schemes, such as being proposed for the North Sea by the ICES Study Group on Marine Habitat Mapping.

Future activities

15) Further consideration is needed of the technical feasibility for development of the mapping scheme, possible links with other relevant activities, including by the European Environment Agency and its Topic Centres, and possible sources for funding.

16) The UK will consider ways of taking the above mapping proposal forward and report on progress to IMPACT 2000 or IMPACT's successor and to the ICES Marine Habitat Committee.

ANNEX 10: PROPOSED ECOTOPE MAP OF THE SOUTHERN NORTH SEA

Dick J. de Jong

Introduction

In the European framework of OSPAR/EUNIS a uniform classification system was adopted in Oban (Scotland) last autumn, which should be applicable to all countries involved in OSPAR and possibly also in ICES. This system is uniform to a certain level (3 levels deep) and, based on this uniform part, local classifications should be made going from level 4 and deeper.

At the same workshop, ICES participants decided that they would like to try to make ecotope maps of larger, international areas in order to test the EUNIS classification for the ICES area and for ICES purposes. One of the proposals concerned an ecotope map of the southern part of the North Sea (roughly from Dover to the north side of the Dogger Bank) and maybe of the English Channel.

Aim of the proposal

The aims of this proposal are:

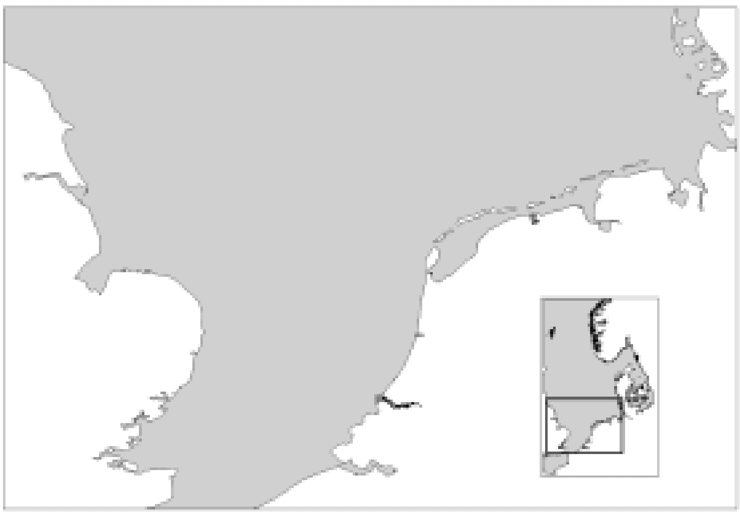
1) to make an ecotope map of an international area testing the EUNIS classification up to level 3 and proposing a classification to one or more lower levels, and
2) to investigate the possibilities and difficulties to be overcome in making such an international ecotope map in which more countries are contributing.

Method

Area

It is proposed that the area of the map be confined to the southern part of the North Sea, roughly from Dover to the Dogger Bank (see Figure A10.1). This is a surveyable area that is more or less uniform compared to the whole North Sea. In this way it is possible to start in a simple way.

Figure A10.1. Proposed area. Inset: southern North Sea as part of the whole North Sea.



Steps

In order to make an international ecotope map, a sequence of steps has to be followed:

1) an inventory of the people that are willing (and able) to contribute to the work (should be done in the workshop in April);
2) an inventory of the data available in the UK, the Netherlands, Belgium, Germany, and Denmark;

3) gathering of the data, and converting them into an uniform coordinate system and geographical projection (e.g., UTM);
4) making of an ecotope classification based on the classification system of the EUNIS/OSPAR classification;
5) extension of the classification to level 4 (or level 5 when possible);
6) presentation of the results in a report and, as a lecture, at the scientific meeting in Bruges in September 2000.

Ecotope classification

The following way of working is proposed to compose the ecotope map:

1) the ecotope classification will be based on a classification of the benthic communities;
2) based on this benthic community classification relevant abiotic parameters and parameter-classes will be distinguished;
3) by combining the parameter classes with the abiotic parameter maps followed by the combination of the reworked parameter maps the ecotope map will be composed.

This method is described in the report "Ecotopes in the Dutch Marine Tidal Waters" by D.J. de Jong (handed out at the workshop in Oban).

Results

The following results are aimed for:

1) insight into the problems one has to overcome in making an international ecotope map (organisation of data, adaptation of data, etc.);
2) a test of the EUNIS classification up to level 3;
3) a proposal for a classification to level 4 (or more);
4) insight into the available abiotic parameter maps for the southern North Sea and in the biotic classifications used in this area;
5) a test of the proposed procedure for making an ecotope classification and an ecotope map on an international scale.

Organisation

After adoption of this proposal (in this or a revised form) a coordinator of the work has to be identified as well as co-workers in the different countries.

RIKZ (NL) offers the opportunity to serve as a central point for these activities, providing GIS facilities and a coordinator and a part-time executor.

Examples

Figures A10.2 and A10.3 give examples of habitat maps according to the EUNIS classification at levels 3 and 4, respectively.

Figure A10.2. Habitat map of the southern North Sea; EUNIS classification at level 3.

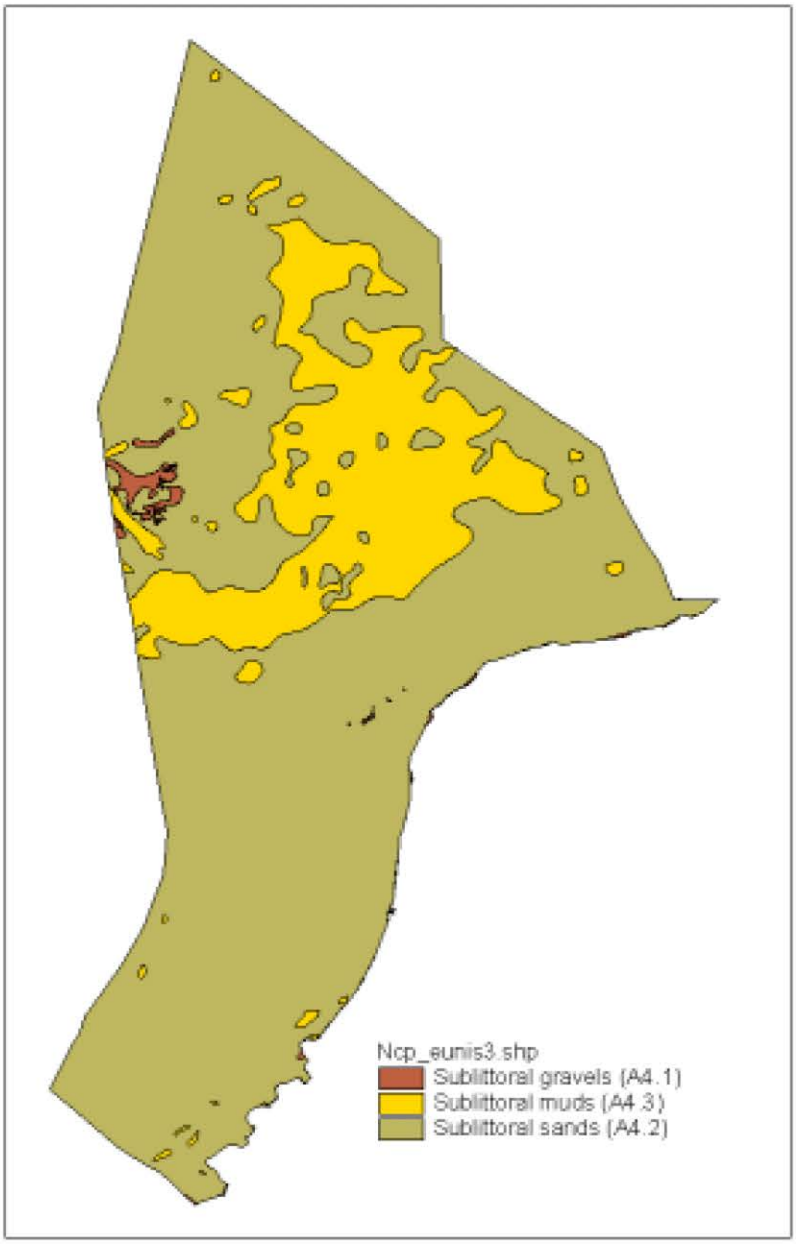
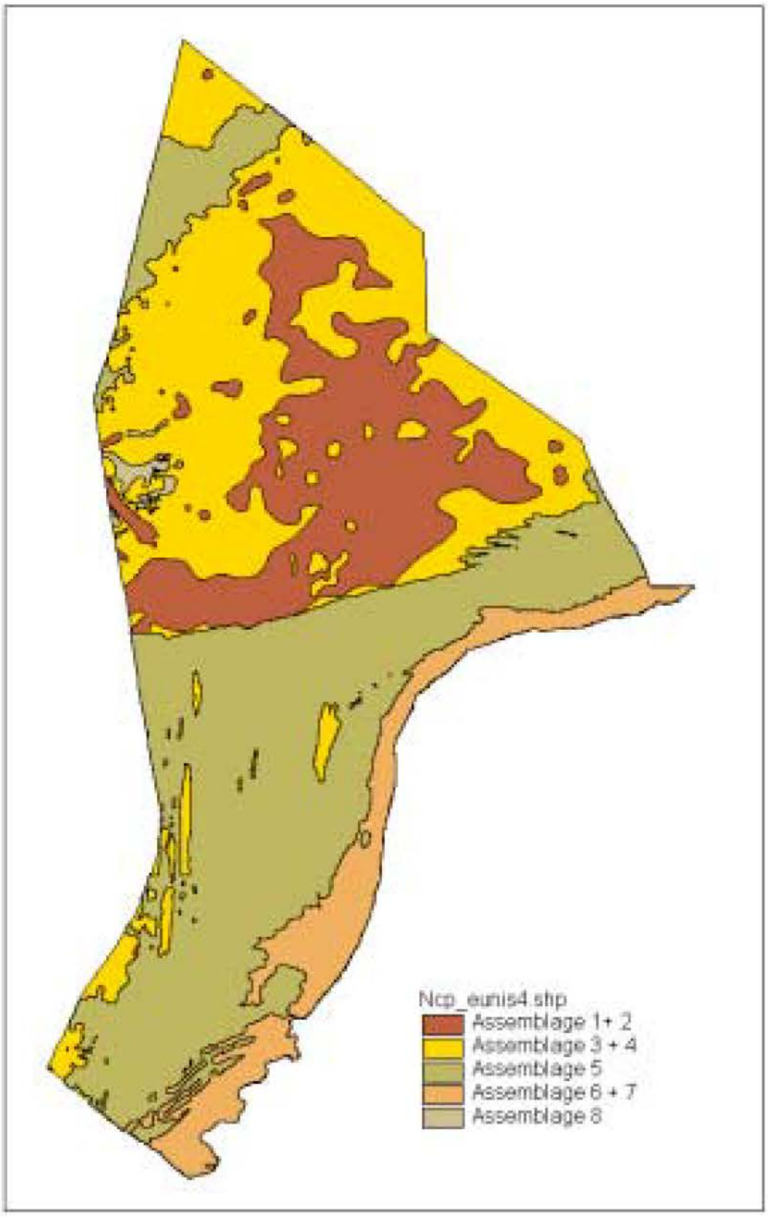


Figure A10.3. Habitat map of the southern North Sea; EUNIS classification at level 4.



ANNEX 11: RECOMMENDATIONS ON THE POTENTIAL ROLE IN COORDINATING JOINT MAPPING EFFORTS WITHIN THE ICES AREA

VISION

An acceptable habitat classification mapped over the full ICES area for use in management towards sustainable use of coastal and marine habitats and resources.

PRIORITIES

ICES through its committee structure has identified habitat classification as a high priority.

OVERALL SGMHM GOALS

To ensure the application of the best science in the collection, compilation, and presentation of data towards the development of a habitat classification that can be implemented for all ICES areas. This goal is best reached through a collaborative and cooperative initiative that will draw on available experts within ICES countries. Although the goal is long term (decades), it is the agreement of SGMHM that immediate steps are required and possible to make progress towards this goal.

DETAILED SGMHM GOALS

- To facilitate use of data by promoting harmonisation of terminology and definitions
- To provide a common language
- To enable mapping of units at a regional level
- Comprehensive and applicable at different levels of complexity
- To allow aggregation, evaluation and monitoring of habitat units
- To provide a common framework: new information and links to other classifications

POSSIBLE BENEFITS TO ICES AND MEMBER COUNTRIES

Trans-national fishing efforts need an ICES-scale (European) approach to habitat protection.

Common identification and quantification of biotopes within ICES areas will allow a rational approach to the selection of areas requiring priority attention, such as important fish habitat, etc.

An agreed approach to biotopes will promote a common approach to the development of measures that affect fishing, and its management, across several countries.

Generation of ecotype maps may allow the proper use of confidential information without compromising the confidentiality.

An agreed biotope methodology may provide useful and up-to-date products from information compiled within ICES databases.

PRINCIPLES

- Goals are best reached in cooperation with complementary efforts such as EUNIS, etc.
- The goals will require the appropriate application of old and new techniques, tools, experience, and knowledge.
- No one country can achieve the goals in isolation.

WORKPLAN

At meetings in September (1999) and The Hague (2000), SGMHM has brought together experts from many ICES member countries to review the present state of habitat mapping. It has drawn heavily from the experience of the EUNIS classification as a means of considering possible ICES actions for the timely development of a suitable approach.

From these discussions, four proposals for immediate action have been developed and are supported by SGMHM to continue the development of a useful habitat classification and mapping of ICES areas. The proposals, although they deal with somewhat isolated geographic and thematic scales and/or issues, need to be strongly linked to ensure that they provide combined support for the overall ICES goals. The Study Group can play an essential role in the continued coordination of both the overall general development as well as the following detailed proposed actions:

1) **Proposal for detailed ecotope mapping of the Southern North Sea—**this work will make an ecotope map of an international area to test the EUNIS Level 3 classification in an area with excellent data quality and quantity. It will investigate the possibilities and difficulties involved in such a collaborative effort (September 2000).
2) **Proposal for ICES participation in the Second OSPAR/CES/EEA Workshop on Marine Habitat Classification—**there is a commitment to further develop the EUNIS classification to the next level(s) of detail. ICES participation will extend the scientific input to greater geographic and thematic areas and ICES will directly benefit from the discussions and agreements on approaches and details of the higher levels of classification (September 2000).
3) **Proposal for a Workshop on Offshore Survey Technologies and the Development of Standards for Marine Habitat Mapping—**this work will compile and compare interpretative techniques available for use in converting "standard" benthic mapping data into information for use in marine habitat mapping. The result will be a harmonisation and standardisation of techniques for application to ICES areas (winter 2000/2001).
4) **Proposal for Habitat Mapping of the OSPAR Area at a large scale—**this work will test the application of Level 3 EUNIS classification over a very broad geographic region to test the availability of data, test and validate the classification, attempt to identify rare and endangered biotopes, identify data gaps, and provide the results of these tests for the continued development of the classification (2 years);
5) **Other SGMHM business—**it is proposed that, with the support of the members of SGMHM present, Eric Jagtman be appointed Chair of the new working group. ICES is asked to give support to the proposed workplan, as written out in detail in the Annexes of this report. The new working group will have strong links with WGEXT and the BEWG.

ANNEX 12: PRELIMINARY PROGRAMME FOR THE THEME SESSION ON HABITAT CLASSIFICATION AND MAPPING

1)	**Technologies and sampling techniques**	
	Review	Andrew Kenny
	Multi-beam	Gordon Fader
	Synthetic aperture sonar	Ron McHugh
	Mapping using autonomous vehicles	Joao Rendas
	Application of acoustic seafloor mapping technology (sidescan sonar and multibeam) to habitat mapping	Bob Courtney
	Benthic sampling	Don Gordon
2)	**Examples of applications of classification systems and habitat maps**	
	U.S. system	
	BioMar	David Connor
	Habimap, a GIS-guided method to make ecotope and habitat maps	Dick de Jong
	CEFAS habitat mapping work	Hubert Rees & Craig Brown
	Mapping the marine benthic habitat: a bio-geological approach	Steven Degraer, Vera van Lancker and Geert Moerkerke
	Integrating acoustic mapping techniques with biological sampling (with test EUNIS)	Brian Todd & Vladimir Kostylev
	Marine Habitat Mapping for the Norwegian Sea	Thomas Noji, Terje Thorsnes, and Jan Helge Fosså
3)	**Classification systems**	
	system developed in U.S.	Becky Allee
	EUNIS	Cynthia Davies & Dorien Moss
4.	Marine Habitat Mapping and Classification: how to proceed	Eric Jagtman