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Report of the Working Group on Integrated Coastal Zone Management (WGICZM)

By Correspondence



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1 Terms of reference

The ICES Working Group on Integrated Coastal Zone Management (WGICZM) worked by correspondence during April 2005 and prepared the following report.

This Working Group is newly formed on the recommendation of the Study Group on Information Needs for Coastal Zone Management (SGINC) and chaired by J. Støttrup (Denmark). Most of the members of the SG switched to the WG and some new members were recruited. The Chair, J. Støttrup (Denmark), delegated the responsibility of different ToR items to different members who compiled these ToRs by correspondence. The complete report was compiled by the Chair, after having received the different ToR drafts. The whole report was sent for review to all the members of the Working Group before being submitted to ICES. This report should be classified as a preliminary report and will be further developed at the first WG meeting in 2006.

The terms of reference for 2005 (ICES C. Res. 2004/2E09) are to:

- a) update and report on activities of relevant ICES working and study groups to identify information pertaining to coastal zone and evaluate this information relative to ICZM needs;
- b) update and report on ICZM activities in different ICES countries, and in different international organisation;
- c) update report on available information relevant for ICZM, including list of data products required and list on gaps in knowledge;
- d) report on progress in valuable component or management tools (e.g., Essential or Critical Species Habitats, GIS, Coastal Protected Areas, coastal EcoQOs);
- e) report on the development of a framework for integrated evaluation of human impacts in the coastal zone and how to integrate this information for CZM, identifying ICES' role in the application of the WFD in the coastal zone.

The Terms of Reference for 2005 (ICES C.Res. 2004/2E09) are addressed in the following sections of this report:

TERM OF REFERENCE	SECTION OF THIS REPORT
ToR (a)	Not addressed
ToR (b)	2
ToR (c)	3
ToR (d)	4
ToR (e)	Not addressed

2 Current ICZM activities and progress in different ICES Member Countries

ToR (b)

At the 2003 meeting, national reports were provided on the status and progress of Integrated Coastal Zone Management (ICZM). This was updated at the 2004 meeting with information on national implementation of the EU Water Framework Directive and EU Habitat Directive. Information on ongoing ICZM activities in the different countries was updated for some countries for this report.

2.1 Canada

(Not updated)

Canada's Oceans Act, passed in 1997, gives the minister of the Department of Fisheries and Oceans (DFO) the responsibility to facilitate the development of integrated management plans. While the Act makes reference to coastal waters and marine waters it does not define these two terms. In practice the 12 nautical mile line (headland to headland) and the low water mark bound the coastal zone. However the provisions of the Oceans Act are very broad and thereby DFO has an obligation to facilitate oceans management without regard to these borders.

Canada has the longest marine coastline in the world with almost one-quarter of its population living in coastal communities. The area of its territorial seas is two-thirds of the landmass. Given this vast area a hierarchical or nested approach is being used to define management areas starting with the large ocean management areas or LOMAs, e.g., Beaufort Sea, Central Coast of British Columbia, Scotian Shelf and Gulf of St. Lawrence. Within each LOMA smaller management areas, ocean, OMAs, or Coastal Management areas, CMAs, may be needed. There will be a need for smaller management areas within a CMA.

To date there has been no discussion of temporal scales although it is understood that this will need to be addressed when monitoring programs and marine environmental quality objectives are defined.

The main goal for coastal zone management in Canada is the sustainable use of aquatic resources through integrated management and the application of the precautionary approach. DFO is being challenged to take an integrated approach in dealing with a number of current management and advisory issues. For the past 10 years sharply declining stocks of commercial groundfish have had severe impacts on the economies of coastal communities. The reasons for these declines are highly complex and poorly understood. But it has increased scrutiny on human activities including commercial fishing. The impact of mobile fishing gear such as trawls drags and suction dredges on commercial fish habitat and prey species is being questioned. Concern is being expressed about the potential impact of offshore oil and gas exploration, development and production activity on fish stocks. A wide range of negative environmental impacts is being attributed to coastal sea cage culture of salmon and suspended culture of blue mussels. These impacts include the degradation of fish habitat, effects of escapees from farm and disease transmission to wild fish stocks. Residential development and recreational and tourism use of the coastal zone are often in conflict with mariculture and traditional fishing uses. Land-based sources of pollution continue to be an issue in the coastal zone particularly near larger urban areas.

In addition there are a number of obligations resulting from international agreements with respect to biodiversity and endangered species that are common to all ICES member countries.

2.2 Denmark

The coastal zone in Denmark is an important spawning and nursery ground for both commercial and non-commercial fish species. Spawning grounds for local herring stocks are found both in the fjords and along the open coasts together with spawning sites for a large number of non commercial species. The Danish Wadden Sea as well as sandy coastal areas in the inner Danish waters are important nursery grounds for many flatfish species. Small cod are found on gravel bottom interspersed with eelgrass and macro algal meadows and the ecological quality of these areas is essential for the survival and later recruitment to the fishery.

Unlike many other countries, Denmark has defined a dividing line (the mean low-water line) between the sea and the land when dealing with management. The sea is managed by several

ministries and by the counties, while coastal land areas are managed by the counties and the municipalities. Denmark has therefore not formally adopted a clear definition of the coastal zone or a defined integrated coastal zone management system (ICZM). However, the ICZM-principles have been applied through a system of laws and regulations, co-ordination among sectors and a high degree of public participation, which has developed over several years.

In the *Protection of Nature Act* (1992), revised in 1994, a coastal protection zone is set within a 100 m from the beginning of continuous land vegetation in summer cottage areas and similarly within 300 m in rural areas. In 2002 a special commission terminated an 8-year process of defining a permanent coastal protection line according to the rules laid down in the act, with exceptions placing it closer to the coast. The *Planning Act* (2000) describes a coast-nearness zone – a coastal planning zone excluding urban areas – with guidelines on planning and management in the coastal zone; since 1993 defined as generally extending 3 km inland. This zone is neither a no-build nor a no-development zone, but development has to be planned carefully in harmony with nature and landscape.

The Protection of Nature Act can be applied within the entire fisheries zone and EEZ. According to the *Planning Act* from 2000 it is imposed on the county councils to elaborate and implement plans for the quality and use of coastal waters. These plans are, in part, based on the concept of “environmental quality objectives” as described in guidelines on water quality planning from the *Environmental Protection Agency* (1983). According to these guidelines, all bays and fjords and other coastal areas out to a depth of 6 m or at least within 1 NM from the shore are to be considered part of the counties responsibility regarding environmental protection and water quality.

Concerning the exploitation of natural resources and raw materials and the use of the seabed for construction of any form, these matters are regulated according to a number of different laws. Normally an *Environmental Impact Assessment* in accordance with the EU-directive has to be carried out by the applicant. With respect to the management of *marine fisheries*, a coastal zone extending 3 nm from the low-water line is defined in the *Sea Fisheries Act*. Within this zone the *Sea Fisheries Act* has laid down restrictions mostly on the use of different fishing gears. However, since Denmark is part of the European Union the fishery is managed within the framework of the *Common Fisheries Policy* (CFP). The Danish *Commission of Commercial Fisheries* with members from the Ministry of Food, Agriculture and Fisheries, The Fishermen’s Organizations, the PO’s and the Union manages national fishery. There is no distinction between coastal and high sea fisheries; all fisheries follow the same regulations with a few exceptions.

The EU Water Framework Directive was accepted by the Danish Parliament in December 2003 and the work with implementing the directive continues on schedule. Denmark has been divided in 12 water districts and the responsible local authorities (counties) have been nominated. This new directive is not expected to increase the number of monitoring programmes in the coastal zone since such programmes have been running for the last 20 years. At present it is not clear to which degree the implementation of the Water Framework Directive will affect fishing and aquaculture in the coastal waters in Denmark

The EU Habitat Directive has been in force since the beginning of the nineties and 254 habitats including bird protection zones have been defined (http://www2.skovognatur.dk/natura2000/om_natura2000/). There are only few restrictions for fishing activities within EU Habitats and several older marine fish farms established before 1992 are situated within EU Habitats. On the other hand no new aquaculture activities will be accepted within the EU Habitats

The Water Framework- and Habitats Directives may have some influence on the new developing mussel farming industry in DK and on existing mussel dredging activities in the coastal waters.

In the management of mussel dredging and marine aquaculture the use of GIS mapping has been taken into use. The largest fjord in Denmark including adjacent coastal areas has been the site for a case study for integrated management. GIS has been implemented to provide a good overview of the different usages or conservation needs within the system and is available at:

<http://gis.dfu.min.dk/website/Limfjord/viewer.htm>. Distance to beaches and summerhouse areas will also be incorporated.

Three counties bordering this fjord are involved in this case study and the partnership includes stakeholders such as fishermen and research institutes that advise on the stocks or the environment within the system. Inclusion of tourism, the terrestrial environment and other societal interests would provide a more integrated management for this ecosystem but have as yet not been addressed.

2.3 Germany

(Not revised)

There is no official definition of the coastal zone in Germany. For terrestrial planning purposes on the local level responsibility generally ends at the mean high tide. The state of Schleswig-Holstein has established a 100 metre inland-protected strip along the coast under its Nature Conservation Act and the state of Mecklenburg-Vorpommern has established a 200 metre wide inland- and a 200 m wide offshore-protected strip under its Nature Conservation Act.

Germany has a coastline of 3379 km divided roughly into 1300 km along the North Sea and 2000 km along the Baltic Sea. Along the German Baltic Sea coast, the tide is almost absent and the water is brackish with a salinity of 8 to 20 psu. It is a shallow coast with numerous bays, lagoons, cliffs, peninsulas and islands. The North Sea coast is mainly characterized by tidal flats and islands.

In relation to coastal management, both the federal government as well as the federal states (Bundesländer) have joint responsibility for most areas of coastal planning issues. The Federal Ministry of Transport, Construction and Housing is responsible for providing national guidelines and coordinating planning policy from which the individual states derive their own planning legislation. This entails that for regional planning, water management, coastal protection, nature conservation and others the federal states establish their own legislative structure and adhering laws, albeit having to be in accordance with the federal legal framework.

The Federal Maritime and Hydrographic Agency (BSH) has established an information system called CONTIS, which is the acronym for Continental Shelf Information System. This GIS database comprises information on the different existing and planned uses like offshore windfarms, pipelines, cables for energy transfer and telecommunication, military training areas, sediment extraction sites, dumping sites for dredged material, shipping routes, anchoring areas as well as nature conservation areas on the German shelf. Maps can be downloaded from the BSH website (see www.bsh.de/en, go to CONTIS maps).

Due to increasing activities in offshore and coastal waters, especially planning of offshore windfarms, the federal states of Niedersachsen, Schleswig-Holstein and Mecklenburg-Vorpommern commenced the introduction of development plans for their territorial waters, which are presently at a draft stage. According to the Federal Building Act, development (spatial) planning will probably be introduced into the German Exclusive Economic Zone (EEZ)

by the end of 2004 for managing the different economic and ecological interests and minimize conflict potentials.

Key issues in Germany are:

- the development of offshore wind-farms in the EEZ;
- the increase in planned sediment extraction activities in offshore waters;
- the establishment of nature conservation areas in the framework of the EU habitat and bird directive;
- the development of ports and harbours, especially in Hamburg, Wilhelmshaven and Bremerhaven;
- the decline of fish stock due to over-fishing;
- the preservation of tourism as major economic factor for the coastal region;
- coastal defence strategies;
- the possible development of inshore and offshore aquaculture.

With respect to the EU Habitat and Bird Directive the federal states of Schleswig-Holstein, Niedersachsen and Mecklenburg-Vorpommern identified areas in the territorial waters that have been or will be soon reported to the Commission. Based on the work of the Federal Agency for Nature Conservation, the Federal Ministry of Environment is proposing seven areas under the Habitat Directive and two SPAs under the Bird Directive for the German EEZ to the federal government. The proposed areas comprise about 30% of the total EEZ area. The Federal Agency for Nature Conservation is presently updating further information and reviewing the size and shape of these areas to some extent. For information on their location see www.bsh.de/en (go to "CONTIS maps").

On 25 June 2002 the EU Water Frame Directive was implemented into national law. By the end of 2004 the different national working groups will finish their evaluation on the ecological state of the German coastal waters.

2.4 Norway

In Norway the coastal zone (equal to the definition in the EU Water Framework Directive) covers an area of about 100,000 km² and extends about 85,000 km (including islets and islands) with complex topography. The fisheries along the coast, and in more recent years fish-farming, are important to the Norwegian community, its welfare and economy in a long-term perspective. Crucial conditions for these industries are the maintenance of high, natural production and biodiversity and good water quality along the coast, which call for sustainable management of human activities and exploitation of resources. The utilisation and production of marine, renewable resources cannot be sustained where the functional integrity of coastal systems is degraded.

The coastal zone is the key area for many marine species. The areas where the large oceanic stocks spawn are important both for the stocks, the coastal ecosystem, the fishermen, and for the people living or recreating along the coast. These spawning areas should be treated as sacred and every necessary measure to secure these areas for spawning also in the future should be taken. The threats from anthropogenic activities to the fishery resources and to the health status and the biodiversity of the coastal ecosystems in general are much the same. Negative influences may be due to inputs of nutrients, toxic substances, habitat- alteration from physical encroachment, oil exploitation and transport and introduction of alien species. In addition, the fishery itself may overexploit the resources and use methods such as trawling that may damage bottom-ecosystems such as coral reefs and soft bottom habitats. Non-sustainable fisheries may thereby be a threat both to optimal utilization of the resources and to conservation of the nature and biodiversity. Several of the largest oceanic fish stocks in the North-East Atlantic region migrate to the Norwegian coast to spawn. These stocks thereby transform and transport

the vast oceanic plankton production from the Norwegian and the Barents Seas towards the coast. Their spawning products, eggs and larvae, are prey for local fish, mammals and birds and are consequently of vital importance to the sustainability of the coastal ecosystem. The large oceanic fish stocks are the basis for important fisheries that together with aquaculture support people living along the Norwegian coast. Therefore it is important to manage the fish stocks in a way that they are sustainable and support the coastal communities both now and in the future. Advanced genetic studies have recently demonstrated the existence of local stocks of the common species Atlantic cod along our coast and such populations may have difference in age- and size at maturity, survival rates and growth rates. The size of these local stocks is crucial for recruitment and future fisheries. This new knowledge calls for careful and sustainable management, both from a resource and biodiversity point of view. These local stocks use local spawning areas and are also dependent on nursery grounds in the neighbourhood. It is important to protect the spawning areas and nursery grounds from habitat-destruction, and to assess the size of local stocks in order to prevent over-exploitation. Because local stocks of cod are very small compared to the North Sea and the Norwegian Arctic stocks, they are easily neglected by the management authorities. Local populations are, however, valuable resources to the local public for leisure-and recreation-fishery, and may also attract tourists.

Key issues are:

- Ecosystem structure and function, and effects of intervention. An important part of this is knowledge about life history in marine organisms and dispersal/spreading of marine organisms.
- The environment's carrying capacity (including the significance of varying physical framework conditions and studies of species and system vulnerability).
- Species-demand on the environment including suitability and their vulnerability with respect to toxins and eutrophication (anthropogenic).
- The effect of the size of local fish stocks; cod, herring, capelin and invertebrates such as bivalves, crustaceans and echinoderms, on the environment.
- Interaction between wild and reared organisms, sustainable multi-mariculture and the interplay and interaction between wild species.
- There is little knowledge today on the effect of rearing and stock enhancement on local spawning grounds for e.g., cod, herring, capelin, etc., and areas for eggs, larvae and juveniles (cod, herring, etc).
- Climate changes.
- Knowledge to avert and reverse unwanted processes, rehabilitation and environmental actions (habitat improvement in the form of e.g., fertilizing and artificial reefs).
- Introduced species.
- EU's Water Frame Directive.
- Coastal management has to find the balance between exploitation and protection issues in the coastal zone.

Two projects to organize our knowledge on the coastal zone and to make it available to managers and stakeholders are now conducted in Norway. The aim of the first one is to organize all information on coastal resources and coastal use in maps. The other project aims to make information on how and where relevant knowledge on the coastal zone can be found and information on how to use it, available on the Internet. Implementation of the EU Water Framework Directive is in progress and is according to the timetable agreed upon.

Norway has started the work on the implementation of EU's Water Frame Directive. The coastal area is divided into water bodies where the borders follow natural boundaries as sills, wave exposure, and gradients in salinity, current etc. Through this work data on chemical and organic discharge are register for each water body. In the view of discharge an physical dis-

turbance from marine harvesting and sediment extraction, the water bodies are classified as “Not at risk”, “Possible at risk” or “At risk” in the view of the water quality in 2005 and in 2015.

2.5 Poland

(Not revised)

There is no precise legal definition of the entire coastal zone in Poland; therefore boundaries are taken according to the purpose of different needs and different activities. For the purpose of coastal defence against erosion the “Technical Belt” has been established legally. It is “an area designed for maintaining the coast in a state conforming to the requirements of safety and environmental protection”. It extends along the whole Polish coastline and includes the surf zone and a 200 meters wide terrestrial strip. In some areas, it has been increased to as much as 1 km in width, but in urban areas and along the shores of the lagoons it can be narrower. The relevant Maritime Office must approve all uses of the strip; however it is primarily intended for coastal defence and environmental protection

The total length of the open Polish coastline is 524 km and 843 km when including length of the coasts of lagoons. It includes mostly sandy shores (about 60%), cliff coast (about 20%) and delta plains (about 10%). Most of the coast is open and subjected to sea erosion. There are two open bays (Pomeranian Bay and the Gulf of Gdansk), one semi enclosed bay (Internal Puck Bay) and two lagoons (Szczecin and Vistula Lagoon). These morphological units can be regarded as ecological sub-systems (also managerial units).

Perhaps the most important key issue is erosion of the coast. Over 100 km of the coast is now protected in some form: groynes, seawalls, bulkheads, revetments, and increasingly, artificial beach nourishment.

The coastal zone is a traditional mass recreation and tourism activity which is almost exclusively concentrated on summer season, therefore in some places exceeding environmental and infrastructure capacity. A number of popular tourist spots have experienced devastation of flora on sand dunes and cliffs and deterioration of coastal forests.

There is no national legislation and/or national policy that can be identified as ICZM plans, however there is so called “spatial planning” which can be regarded as a sort of substitute to ICZMs. During the last decade there have been several local initiatives taken which can be regarded as ICZM planning. Unfortunately most of these initiatives were confined to administrative borders and did not really cover natural borders.

2.6 Spain

The National Shores Act, “Ley de Costas”, defines the coastal zone as the shore of the sea and its inlets between high and low water marks of equinoctial tides, or up to the limits reached by the waves of the major storms; along the river margins it extends as far as the effects of the tides are noticed. The coastal zone also includes all salt marshes, lagoons, and, in general, all lowlands than can be flooded by sea either through waves, tides or underground infiltration, the beaches and cliffs. The Act establishes a 100 m-wide area, “Servidumbre de protección”, extending along the landward side of the coastal zone where all human activities are strictly regulated; for some of them the regulated area extends to 500 m from the landward side of the coastal zone. The Territorial Sea extends from the sea side of the coastal zone to a distance of 12 nautical miles. Both the coastal zone and the territorial sea are public domain, can not be owned by private parties and all activities, developments are done after temporary permits, licenses granted by the different levels of the Government. Public domain of the coastal zone means also free, open access to it.

There is no nation-wide legislation specific for coastal zone management. The 1978 Constitution transferred most components of environmental and territorial planning to the regional governments, “Comunidades Autónomas”. Municipalities are responsible for producing land-use plans. Jurisdiction overlaps are the rule among national, regional and local governments. ICZM is acknowledged as a desirable goal by the different government levels but there is no standard approach and the degree of implementation varies widely between the different regions. Each region can produce its own environmental legislation. The Spanish Government is currently elaborating the Spanish Strategy for Sustainable Development (EEDS), which adopts ICZM as a key element to assure the sustainable development of the coastal zone, and declares the cooperation among all levels of Government and the private sector in the design of integrated strategies for sustainable development as a main goal.

EEDS identifies urban development and tourism, coastal erosion, pollution and overexploitation of fisheries as the key issues affecting the Spanish coastal zone. Urban development affected 5% of the surface of a 10 km-wide area along coastline in 1990, and 30% of human population lived in coastal municipalities in 1995. Most part (65%) of Spanish industrial production is located in the coastal zone, and 90% of the imports and 80% of the exports are done by maritime transport. Nearly 70% of the 48 million foreign visitors to Spain have the coastal zone as their destination. Coastal mariculture is a fast-growing sector of Spanish economy and contributed 24% of total national fish production in 1998. Overall, more than 10% of gross national product is generated by economic activities performed in the coastal zone; this percentage can increase up to 65%–90% in some regions (i.e., Balearic Islands).

Following the EU Directive of 1992, Spain issued the 1997/1995 Directive for the identification and management of the protected areas. All the previously protected spaces for birds (ZEPAS included in the Bird Directive 79/409) were included in the Natura 2000 network. The Spanish Government approves the LICs, which are included in the Natura 2000 network. These have a wide ecological variation from terrestrial to marine ecosystems. The Regional Governments propose the areas to be identified as LICs and manages them, implementing the regional normative and protection measures. In a recent revision of the state of the implementation of the Habitat Directive at Mediterranean level, the retard in the identification of the LICs and on their protection was manifest.

Legislation establishing the basis for the Spanish National Hydrological Plan (SNHP) was passed by the Spanish Parliament in July 2001 and entered into force in August 2001. The Plan had two parts: A new water transfer of 1, 050 cubic hectometres of water per year from the Ebro River to another four basins in the east of the country and, secondly, a “package” of 889 public works. The Ebro water transfer was the main bulk of the SNHP. The impacts of this water transfer could ultimately include the total disappearance of the Ebro Delta (a proposed Special Area of Conservation under the EC Habitats Directive, a Ramsar site and the third most important wetland in Spain). The change of Government on 2004 and a more environmentally friendly attitude changed this approach, following EU environmental recommendations. A new strategic actuation towards sustainable water use and preservation and restoration of associated ecosystems is being developed to be applied from 2004 to 2008 (Programme A.G.U.A. Ministry of Environment, <http://www.mma.es/agua/informes.htm>). An urgent action on the Mediterranean littoral (RDL 2/2004) is addressing the sustainable management of the water resources and will implement numerous water desalination plants along the coasts. Measures to protect the *Posidonia* meadows are foreseen.

The Spanish scientific community works in the field of coastal ecology, both on applied (coastal management, environmental conservation, and biological monitoring) and basic aspects (biodiversity, benthic ecology, and productivity), with efforts on Integrated Coastal Zone Management (ICZM) studies and applications to fulfil the EC Recommendation on the application of ICZM (EC-30 May 2002). Spain is a part of the ICZM group of ELOISE (European Land Ocean Interaction Studies).

Additionally, Spain is building up a network of researchers and institutions interested in the integrated coastal zone management (HISPACOSTA) and is an active part of the European Network for Coastal Research Coordination Action (<http://www.encora.org>) and is involved on INCOME Integrated Project and Research Consortium, an Integrated Project on ICZM issues under the FP6 programme of the European Commission. Also, Spain has participated in international agreements on Coastal Zone Management and Research such as the second Euro-Med Forum of the High Representatives of Euro-Med RTD Public Institutions as a tool for the development of the Euro-Mediterranean Partnership held in Antalya (Turkey) in 2002. Moreover, there re participation on analysis of European environmental policy and their interaction with national and regional policies, including an specific analysis of the potential links between the forthcoming Directive on the management of wastes in the extractive industries, and the Water-Framework, Habitats and Bird Directives (documents are available at: <http://www.minewater.net/ermite/>) and a number of case studies of estuarine systems affected by mine water pollution.

The increasing demand for sustainability and for the improvement of the “scientifically” basis for wise use of coastal resources in the long run is the main driver for the development of both basic and applied research in the Spanish scientific community. The problems of land use; tourism, overfishing, and pollution are main concerns on the Spanish coastal zone.

2.7 Sweden

(Not revised)

There is no formal definition of the coastal zone but the jurisdiction of the smallest administrative unit, the municipality, comprises land and coastal waters to the 12 nautical mile line. Each municipality is obliged to have an overall plan for land and water use within their jurisdiction. On regional and national scales, the definition of the coastal zone varies depending on activities and resources being managed, e.g., coastal fishery are sometimes defined by distance to the baseline (1–4 nautical miles) and sometimes by vessel size rather than by geographic boundaries.

Sweden’s coastline is about 7,600 km long, including mainland bays and the coasts of the larger islands. The salinity of the water decreases from about 30 parts per thousand in the Skagerrak to about 1 part per thousand in the northern Bothnian Bay. The marine ecosystems off the Swedish west coast are rich in species whereas the estuarine ecosystems in the Baltic are characterised by few species occurring in large numbers, and the co-occurrence of marine and freshwater species.

To obtain a long-term sustainable development the Swedish parliament has approved on 15 national environmental quality objectives. One of them – “A Balanced Marine Environment, Sustainable Coastal Areas and Archipelagos” – specifically apply to the marine and coastal areas. To achieve this objective eight interim targets were decided in 2001 (<http://miljomal.nu/english/english.php>). The interim targets include actions such as long-term protection of the marine environment, action programmes for endangered species and fish stocks, control of catches to enable fish stocks to recover and to reduce by-catch of mammals, as well as birds and undersized fish, to levels that do not have an adverse effect on the populations.

In accordance with the EU Water Framework Directive, Sweden is being divided into 119 catchment areas, which are subsequently divided into five water districts, based on the location of the catchment areas and the morphology of the coast. To begin with, each district is to be governed by a local water authority that will be connected to a County. This authority is to ensure that the water quality objectives that are decided on are reached within the given time-frame.

In the inshore areas of Sweden, several problems threaten a sustainable use of the coastal resources, e.g., local over-fishing, rapidly developing recreational fishing and fishing tourism, conflicts between stakeholders with differing interests, poor economy in the commercial fisheries and increased use of ecosystem goods and services in coastal areas. Several studies are being conducted to address these issues. Thus, areas of current and future research relevant to coastal zone management in Sweden are as follows:

- Integrating fishery with environmental management and social sciences.
- To harmonize management units with spatial distribution of local resources (e.g., genetic characterization of sub-populations) and to identify important local spawning sites and nursery areas.
- Assessing effects of eutrophication, physical disturbances (such as increased boat traffic, dredging, constructions as e.g., harbours, obstacles in migration routes etc) and biological interactions (predation by seals and cormorants) on fisheries dependent on local resources.
- To develop fishery-independent monitoring systems of coastal stocks and schemes to obtain statistics concerning recreational fishing, as well as improving the quality of statistics obtained from commercial catches.

2.8 The Netherlands

(Not revised)

The coastal zone is the relatively small and dynamic zone between land and sea. It is defined as a strip of land and sea of varying width depending on the nature of the environment and management needs. It seldom corresponds to existing administrative or planning units. The natural coastal systems and the areas in which human activities involve the use of coastal resources may therefore extend well beyond the limit of territorial waters and many kilometres inland. The coastal zone system is an integrated complex of marine coast and land subsystems. The coast-subsystem includes the foreshore, the beach area and natural coastal protection systems such as dunes.

Natural ecological processes on the one hand, and socio-economical and political processes on the other hand, act on different temporal and spatial scales. Human activities as for instance dredging, sand-nourishment and recreation have there implications on a short term scale of days to several years or even decades, while for instance habitat alteration and climate change have effects on larger time scales of decades to centuries. Local authorities are responsible for coastal defence and recreation, while fishing management is carried out within a European framework, and global warming for instance should be addressed on a global scale. An important question now arises on what temporal- and spatial scales information is needed on ecological processes, entities to play a role in integrated coastal zone management.

The Dutch government has developed by the end of 2002 the contours for integrated coastal zone policy. In accordance with the European recommendation a national strategy must be ready by 2004 / 2005. This policy document, "Towards an Integrated Coastal Zone Policy – policy agenda for the coast", examines subjects of imminent importance, giving priority to safety policy. A number of safety and risk problems in the near future must be faced. Topping the policy agenda are the weak links in the coastal defences, which must be mitigated in time to continue to guarantee the safety of the hinterland. In addition to the weak links, risk management and quality boosts present a challenge for coastal towns. The coastal foundation zone concept illustrates the philosophy that sand is the basis of Dutch coastal defences and other functions in the coastal zone. Another duty of the national government is to ensure effective coastal zone policy and administration. With regard to communication and education the policy agenda takes consideration of the storm surge awareness. Finally, the policy agenda places great importance on shaping integrated coastal zone policy. It stimulates the development of

the national government's vision of the coastal zone, which is based on the basic qualities of the coast: resilience, cohesion and horizon.

In October 2001, the European Environment Council made recommendations for integrated coastal zone management, stressing the strategic importance of coastal areas as residential areas and links in the trade and transport chain. Attention was drawn to the fact that these areas contain ecologically valuable habitats and are favourite holiday spots. However, a number of serious problems can be identified. Habitats are threatened and the coast is eroding.

On the basis of the three basic qualities of the Dutch coast, resilience, cohesion and horizon, the Dutch vision of the coastal zone includes the following with respect to ecosystems:

- To protect existing ecosystems, there should be sufficient space for natural processes (resilience) in the coastal area. The aim with respect to estuaries is to restore the natural freshwater/saltwater interfaces (cohesion). Human activities, such as fishing should be carried out in a sustainable manner. Given the connection between the coast and the sea, the (ecological) quality must be ensured. An example is the development of a marine reserve to compensate for the loss of nature resulting from the development of an offshore industrial site in the North Sea.
- Space for the development of human activities is limited in the coastal areas. This requires special attention to spatial planning. Therefore, a growing search for space is thought to be found in the marine part of the coastal zone, for instance the planning of an artificial island to be used as a new airport and locations for wind turbine parks. A major concern is the minimal amount of ecological knowledge of the near shore coastal areas, i.e., the sandy shores and surf-zone area, as well as the lack of instruments to integrate this ecological knowledge into integrated coastal zone management. The different temporal- and spatial-scales acting in both the natural environment and in the political and socio-economical planning need special attention.

The protection of species according to the EU Bird- and Habitat Directive has been fully implemented in the Netherlands since 2002 (Flora en Fauna Wet). Special protected zones have already been put forward to the EC, according to Natura 2000. These areas are, however, not yet fully implemented. The Voordelta and the Wadden Sea including the part of the North Sea coastal zone will be implemented according to the B&H Directive as an adjustment of the Natuurbeschermingwet (1998). There is only very limited protecting of specific species and habitats in the sandy shores in the coastal zone in the Netherlands, other than some birds and sea mammals. This has partly to do with the lack of knowledge on the ecology of sandy shores in the Netherlands. Therefore it is also unknown how vulnerable and valuable the species and habitats of the coastal zone are. The Water Framework Directive aims at the protection of all water bodies (including coastal waters) in Europe and must have achieved a "good ecological status" in 2015. Coastal areas will be part of river basin plans (Rijn, Schelde, Maas and Eems). The ecological status will be judged using chemical and biological quality elements (phytoplankton, macrofauna, macrophytes and fish). The Ems-Dollard estuary, as transitional waters, will be judged on all four biological elements. The Wadden Sea and other coastal areas, being coastal waters, don't have to be judged on the presence of fish.

2.9 The United Kingdom

2.9.1 ICZM in the UK: a stocktake

www.defra.gov.uk/environment/water/marine/uk/iczm/stocktake/index.htm

This report was published in April 2004 and successfully summarises the current legal framework for managing coastal activities, including the roles of Government departments, executive agencies and non-departmental public bodies and local government.

The Stocktake findings present a mixed picture of how the principles of ICZM are being implemented in the UK. There are examples of good practice, for example local and regional coastal fora, communication links between local to regional government level appeared to be improving, but there is room for improvement in many other areas. These include: the sectoral approach to managing coastal issues in the UK, minimal long-term planning for ICZM, lack of engagement of the private and commercial sector, the need for clarification of the roles of individuals and organisations, and how ICZM can support other government policies (e.g., ecosystem approach), initiatives (e.g., marine stewardship), requirements (e.g., Water Framework Directive), and developing marine spatial planning.

The report also outlined Drivers that would influence future ICZM in the UK. Across the UK these include: The outcome of the Government's review of development in coastal and marine waters (to be published shortly); the outcome of the Government's Review of Marine Nature Conservation (Published July 2004); the development of the ecosystem approach to management and planning of activities at the coast; implementation of the EU Water Framework Directive and the programme of offshore renewable development. In England: the development of regional spatial strategies and the expected revision of planning policy guidance for the coast; the study by the Inter-Agency Committee on Marine Science and Technology into integrating marine and coastal data; development of second generation shoreline management plans; development of English Nature's Maritime Strategy. In Scotland, the Scottish Coastal Forum coastal strategy (published July 2004), the Scottish Sustainable Marine Environment Project and the development of a Strategic Framework for the Marine Environment by the Scottish Executive (Published September 2004) are current ICZM initiatives. In Wales there is the work of the Wales Coastal and Marine Partnership and the development and implementation of *People, Places, Futures - The Wales Spatial Plan* and Northern Ireland are trying to establish a Coastal Forum to take forward a strategy for the management of the Northern Ireland coast.

The Stocktake findings suggest that the progress of local ICZM initiatives has been uncoordinated and many initiatives have been constrained by the lack of long term resources and commitment by some stakeholders. This need for a more secure funding arrangement to support ICZM, coupled with stronger leadership at all levels (national, regional and local) is a key message of the Stocktake. A second message is that more coastal stakeholders at all levels need to engage in ICZM activity.

2.9.2 EU Habitat Directive

The most recent tranche of SACs was submitted to the European Commission on 30 July 2004. This comprised of no new marine sites, and minor amendments to 4 of the existing 382 marine SACs. As at 24 December 2004 there were 379 Marine Coastal and Halophytic Habitat SACs and 3 SCIs.

2.9.3 Marine Stewardship

The first Marine Stewardship Report "Safeguarding Our Seas" was published in May 2002 and sets out the Governments vision and strategy for the conservation and sustainable development of our marine environment. A consultation paper (Seas of Change 2002) provided an up-date on progress made since May 2002; the responses to this have now been published. Key proposals in this report include application of the ecosystem approach, commitment to undertake a pilot for spatial planning and establish a working group to support and engage local coastal fora in England. A 'State of the Seas' report has also been published (March 2005) as part of the Marine Stewardship Initiative. (www.defra.gov.uk/environment/water/marine/uk/stateofsea/index.htm)

EU Water Framework Directive

Characterisation reports have been written for England and Wales (www.environment-agency.gov.uk), Scotland (<http://www.sepa.org.uk/publications/wfd/index.htm>) and Northern Ireland (www.ehsni.gov.uk/environment/waterManage/policy/policy.shtml).

Assessment tools and monitoring schemes are being devised to start monitoring at least some of the habitats in the water bodies in 2006.

SCF: The Scottish Executive is committed to adopting an ICZM strategy by spring 2006. The Scottish Coastal Forum has prepared a draft strategy for Ministers to consider.

MESH

This marine habitat mapping project commenced in spring 2004.

IFREMER are developing survey techniques for shallow water. Some of these are covered in the protocol manual.

2.9.4 A Strategic Framework for Inshore Fisheries in Scotland

The strategic review was undertaken by the Scottish Inshore Fisheries Advisory Group, with the fishing industry and other stakeholders directly involved. The key output is a strategic framework for inshore fisheries in Scotland. This sets out a strategic direction for inshore fisheries policy and a network of inshore fisheries groups around Scotland to plan the management of inshore fisheries locally. This also signifies a change in the processes for policy development and decision making in relation to inshore fisheries. The fishing industry and other stakeholders have been directly involved in developing this new structure and direction for inshore fisheries, which is reflected in the plans for inshore fisheries groups. An action plan has been prepared in association with this strategic framework:

(www.scotland.gov.uk/library5/fisheries/sfifs-00.asp).

This was published in March 2005, and includes consideration of the results of the collaborative project between Scottish Natural Heritage and the Royal Society for the Protection of Birds into Scottish Inshore fisheries:

(www.rspb.org.uk/scotland/policy/inshorefisheriesreport.asp).

Wavelength

Wavelength is Defra's biannual newsletter, which is issued in the spring and autumn and designed to cover crosscutting government initiatives in the coastal and marine environment.

3 New data products and research

ToR (c)

As more information on ICZM is generated, awareness has shifted towards the need for comprehensive coastal programs designed to resolve conflicting demands on the use of coastal resources, maintain coastal biodiversity and ensure long-term economic sustainability of these resources. While expert knowledge is valuable it represents a narrow point of view and does not represent a systems view; rather ICZM requires generalist expertise able to understand the interaction between sea and coast and between nature and socio-economic driven pressures.

There is a need for valorisation of natural resources including the analysis of proper allocation and valorisation of coastal zone functions and uses to integrate socio-economic and natural scientific data. This is necessary to obtain a balance between the social and economic benefits

derived by human activities and the productivity and long-term capacity of the ecosystem that supports these activities while recognising that the ecosystems are constantly changing, driven by external forcing processes that need to be understood.

The approach to ICZM may differ between countries and between regions due to differences in needs, traditions, cultures or management systems. A list of issues that need to be addressed before or while setting up an ICZM programme could be useful to encourage a comprehensive programme rather than the single-factor form of management practised today. This may counteract problems arising from the management of a system based on single-purpose management, and encourage cooperation between different agencies which have jurisdiction over the different activities or resources.

This could be organised in such a manner:

Natural Resources: identification of these resources (e.g., fish, invertebrates, minerals, land), the requirements for their sustainability, needs for conservation, exploitation levels, anthropogenic impacts (e.g., beach erosion, landfill or reclamation, habitats, climate change, etc.) or problems that may arise such as xenobiotic organisms introduced directly or indirectly by human activities.

Coastal Zone Conflicts: Mainly socio-economic aspects and resolving conflicts that arise from different activities such as urbanisation, tourism, aquaculture, or other uses.

Ecological consequences of different Coastal Zones Uses: pollution from industry, domestic, agricultural, water desalinisation or other (e.g., dredging) sources.

The work for this Working Group should be to integrate the biological, ecological and environmental information emerging from the different ICES groups and continue to identify areas where certain ICES groups have expertise that can be utilised to inform this process. This information could feed into the description of natural resources within different areas, deal with primarily cross-border issues, but endeavour to process this information in a format that would be useful in ICZM; i.e., processing the data to meet the need of managers.

The role of stakeholders needs to be addressed because systems management decisions which do not consider the views or concerns of stakeholders may be as problematic as those taken catering entirely to stakeholders interests. This includes gaining an understanding of the economic contribution of coastal resources to society. Although this may be beyond the realm of ICES, it may provide information on the state of knowledge on potential impacts of different stakeholder activity such as fishery, shipping, dredging and offshore constructions on the marine resources as well as on the marine environment.

The ecosystem based approach to the management of human activities as the leading principle for integrated coastal zone management implies that knowledge on the critical ecosystem processes and properties in the coastal zone will be the core business of the information ICES will be able to add into the process of ICZM. The 'value' of ecological niches, particular habitats, etc. needs to be addressed as part of the input. The identification of Essential and Critical Species Habitats are important components together with valuable management tools such as GIS and Coastal Protected Areas. An important feature of the ecosystem approach is that it calls for strong stakeholder participation, which places a spotlight on human behaviour as the central management dimension. Also of some significance is that the ecosystem approach recognises that in order to develop a coherent policy for addressing the impacts of multiple human uses of marine ecosystems it is necessary to consider how impacts occur in space and over time, as well as how different factors interrelate (complexity).

The ICES WG must help on the process of creation of new convincing arguments to help in the implementation of sustainable policies and plans; due to the fact that decisions taken on

coastal development are often irreversible and engage life support conditions for many future generations.

A list of research/expertise needs identified is given below:

- a) Expertise in taxonomy is required for the assessment of biodiversity and ecosystem dynamics in the coastal zone
- b) There is a need for collating information on macrophyte systems focused on macroalgae as a resource and as habitat for other species, such as fish, in order to provide sustainable advice on macrophytes.
- c) There is a need for further information on fish spawning, nursery and feeding areas and fish migratory corridors in the coastal zone. No ICES WG addresses this issue at the moment.
- d) There is a need for information on coastal zone habitat requirements of different life stages of (epi-) benthic organisms, birds and mammals.
- e) There is a need to map the different habitats in marine shallow waters, the intertidal zone and near-sea zone. For example MESH (www.searchmesh.net) is an international marine habitat mapping programme that started in spring 2004 and will last for 3 years. A consortium of 12 partners across the UK, Ireland, the Netherlands, Belgium and France has been established.
- f) There is an increasing need for demarcation and effective monitoring of coastal and off-shore commercial fisheries.
- g) There is a need to develop a suite of monitoring, assessment and management tools for MPAs. This is being picked up in a newly-started EU project, PROTECT.
- h) There is a need to examine the use and utility of MPAs that include both terrestrial and marine systems.
- i) There is a need for harmonising coastal ecosystem EcoQ's with those of the Bird and Habitat Directives, the Water Framework Directive and the EcoQ's presently developed by several ICES Working Groups for OSPAR
- j) There is a need for data and information on the recreational fishery.
- k) Further guidelines for monitoring and assessment programmes for impacts of human activities related to coastal zone management should be developed where necessary
- l) There is a need for the standardisation of monitoring methods and tools for environmental assessment, which need to be acceptable to all other users of the coastal area. (A major problem is that most developments (ports, marine barriers, beach promenades) act as a barrier to bio-physical fluxes, resulting in erosion and instability of the coastal zone. These complex interactions must be studied to guarantee sustainability and to find adequate management tools).
- m) Revise the restoration ecology of estuarine systems, with emphasis on the ecology of brackish water macrophytes.
- n) Revise the activities taken in relation of harmful algae proliferations (HABs) in the coastal zone, with special emphasis of the relationships with oceanography and eutrophication
- o) Analysis of European Environmental Policy and the interaction with national and regional policies, including a specific analysis of the potential links between the forthcoming Directive on the management of wastes in the extractive industries, and the Water-Framework, Habitats and Bird Directives (documents are available at: <http://www.minewater.net/ermite/>) and there is a number of case studies of estuarine systems affected by mine water pollution.
- p) The following research areas were identified as being valuable for integrated coastal zone management:
 - critical ecological processes; the ecosystem interactions between the chemical, physical and biological environment in the coastal zone

- appropriate time and space scales in coastal ecosystemsrelationship between marine and terrestrial coastal ecosystemsthresholds of nutrient and contaminant inputs for the sustainability of coastal ecosystems. This is being assessed within the framework of the project TRESHOLDS (<http://www.thresholds-eu.org>)
- effects of alien species on the littoral communities, changes in the fauna and effects upon the trophic structure of the ecosystemimportance of macroalgae in the biodiversity and sustainability of the phototrophic littoral algae
- abundance, productivity and spatial fragmentation of angiosperm meadows in relation to human impacts
- impact of both off-shore and terrestrial human uses on the coastal ecosystemEcoQ-elements and EcoQ-objectives that best represent the coastal ecosystem
- Develop quantitative methods for monitoring the recreational fishery

4 Management tools

ToR (d)

4.1 Operational tools to support the ICZM (ToR d)

The ICZM concept implies a holistic approach where diverse interests and goals should be integrated into an all-purpose management plan. Although the concept is attractive it has been difficult to develop tools to describe, assess and manage coastal areas. Objectives have often been vague or too general and evaluation has some times been omitted (Olsen *et al.*, 1997). In addition legislative problems (Tegner Anker *et al.*, 2004) or unclear scientific support (Castilla 2000) have hampered a successful integrated approach. It is clear that ICZM should be based on an assessment of biological resources and that the ecosystem approach (FAO 2003) needs to be applied. However, socio-economic aspects and co-management by stakeholder participation are also essential parts of ICZM. These diverse interests can be integrated and assessed by a range of performance indicators and operational tools that have been developed to account for ecological, socio-economic and management aspects. ICES has recommended that such performance indicators should be in summary:

- easy to understand by non-scientists,
 - sensitive to human activity but less to other causes of variability,
 - linked to human activity in space and time,
 - easily and accurately measured over a large part of the management area,
 - based on a time-series of data to allow a realistic setting of objectives.
- (see www.ices.dk/iceswork/ace.asp).

4.2 ICZM progress indicator tools

The Commission of the European Union has presented “A strategy for Europe in ICZM” as described in the SGINC report 2004. Once an ICZM process is started it is important to evaluate the implementation. Hence, a progress indicator was designed to measure the level at which ICZM is being implemented in the EU. The Coastal Union (EUCC) was commissioned by the European Topic Centre – Terrestrial Environment to develop this indicator. The request came from the EU Working Group on Indicators and Data, set up by the Group of Experts on ICZM, itself a product of the EU Recommendation on ICZM. It is the first, practical methodology worked out to measure the degree of implementation of ICZM but, set alongside indicators of sustainable development or state of the coast. It is also a test of the hypothesis underpinning the EU Recommendation – that an ICZM process is a prerequisite for a sustainable coastal environment. The indicator recognises five phases grouping 26 actions. A simply binary response to each action allows a semi-quantitative assessment of how far a country, region or locality is progressing with their implementation. A number of tests have now been

conducted principally by ICZM practitioners at all administrative levels in Spain, France and in the southern North Sea region (including coastal planners and managers from Belgium, France, UK and Holland).

The results show that in order to ensure that ICZM implementation is actually leading to the sustainable use of coastal resources it will also be necessary to measure, concomitantly, whether there has been any improvement in the coastal environment. Only then, with any degree of certainty can it be stated that enhanced implementation of ICZM is leading towards sustainability locally, regionally and nationally. Therefore, any indicator developed to measure the progress of ICZM implementation will need to be augmented with a number of other indicators to measure sustainable development of the coastal zone. Used together, they can give an indication of the degree to which the implementation of ICZM is correlated with a sustainable coast. (EUCC website <http://www.eucc.net>). The role that ICES may take is that of developing indicators to measure sustainable development of the coastal zone, i.e., biological indicators, and make sure that the indicators are in a useful format for managers and stakeholders. Knowledge transfer must be pivotal in the process of implementing ICZM.

The ICZM progress indicator has been accepted and approved by the EU Group of Experts. The results are published in *Ocean and Coastal Management*, Volume 47, Issues 9–10, Pages 429–535 (2004).

4.3 Ecological performance indicators

Fisheries management have traditionally been based on single-species assessments. ICES have established reference indicators of spawning biomass and fishing mortality that are used to characterise single stock status. It is recognised that these indicators might be misleading or even obsolete in a multi-species context. As an example, simulations of multi-species interactions in the Baltic indicate that the reference values for cod should be set considerably lower than by traditional methods in order to promote the recovery of Baltic cod (Gislason 1999). The example demonstrates that ICZM should rely on an ecosystem-based approach rather than an array of single stock assessments. The ecosystem approach may be defined as a strategy to integrate management of human activities in order to achieve a sufficient conservation and sustainable use of living resources (strict definitions are found in Laffoley *et al.*, 2004). This strategy can be further explicit by the formulation of ecological quality objectives (EcoQOs).

The EcoQO approach was initiated in 1990 when the Ministers at the 3rd International Conference on the Protection of the North Sea in den Haag, requested that a method for setting ecological objectives should be elaborated. The OSPAR Biodiversity Committee has an ongoing project where the concept of EcoQO has been applied on the North Sea ecosystem (Table 4.3).

Table 4.3: OSPAR proposal for EcoQOs in the North Sea.

QUALITY ISSUE	QUALITY INDICATOR
Reference points for commercial fish species	Spawning stock biomass
Threatened or declining species	Presence and extent
Sea mammals	Seal population trends Utilization seal breeding sites By-catch of harbour porpoises
Sea birds	Proportion oiled guillemots Hg in seabird eggs and feathers Organochlorines in seabird eggs Plastic particles stomachs Sand-eel availability and kittiwakes Seabird population trends
Fish communities	Proportion of large fish
Benthic communities	Changes/kills – eutrophication Imposex in dog whelk Density of sensitive species Density of opportunistic species
Plankton communities	Chlorophyll <i>a</i> Indicator species for eutrophication
Habitats	Habitat quality
Nutrient budgets and production	Winter nutrient concentrations
Oxygen consumption	Oxygen concentration

By a similar approach, HELCOM have identified four quality categories, i.e., eutrophication, hazardous substances, fisheries, loss of habitats and biodiversity and have formulated ecological quality objectives (EcoQO) for each of them (http://www.helcom.fi/environment2/ecoqo/en_GB/intro/). These EcoQOs will serve as a quality reference when quantitative indicators are being developed.

As noted fishery scientists have established quantitative indicators for stock biomass and fishing mortality for single fish stocks. In addition, fishing will affect life history events, e.g., age at maturity, growth rate and maximum size (Jennings *et al.*, 1997). Hence, these parameters may be used to develop quantitative reference indicators. However, ecosystem indicators have also been tested. Potential examples are size-biomass spectra, mean weight, mean maximum length and a range of biodiversity indices. Further research is needed before they can be applied (Piet and Jennings 2005).

The impact of fish exploitation in the open sea has been documented by changes in mean trophic level among fish communities (Pauly *et al.*, 1998). Other trophodynamic indices such as biomass ratios and food web relations have been tested with various successes (Cury *et al.*, 2005a). The usefulness of these indicators in coastal ecosystems is not known and remains to be evaluated. However, trophodynamic indicators appear to be conservative and respond slowly to structural changes in an ecosystem.

Although impact of human activities (e.g., fisheries) may appear unpredictable from single ecosystem indicators the impact can be assessed by including several indicators in the analysis (as indicated by the ICES fisheries advice using both SSB and F). Thus, methods that consider many indicators should increase the probability for a reliable assessment of environmental status. The development of the viability model approach is one example (Cury *et al.*, 2005b). The approach is based on an ecosystem food web model, which yields a multiple of quantitative indicators. The results can be presented in a multidimensional space and compared to reference indicators. Another elaborate model identifies 23 indicators based on characteristics of the North Sea ecosystem (Kabuta and Laane 2003). The indicators range from abundance of indicator species to extent of various seabed types. The model output can be visualized in an “amoeba” presentation where each indicator are normalised and plotted as a

radii axis within a radar chart. Extra long or short radii indicate deviations from a desired state. A less elaborate but pragmatic model includes four basic variables: biomass and trophic structure, endangered species, uniqueness of species composition, successional stage (Done and Reichelt 1998). These variables were quantified and combined to assess the degree of “degraded” or “desired” state of the studied ecosystem.

A problem in all assessments is to establish naturalness, i.e., is there a “natural” state of the studied ecosystem unaffected by human activities (Hiscock *et al.*, 2003). In experimental ecology this problem is dealt by including affected and unaffected replicates (Castilla 2000). In coastal and marine environments such experiments are seldom possible due to the large-scale processes that are studied. Furthermore, there is often a lack of unaffected areas, which could be used to assess naturalness. Instead, the approach has been to evaluate changes in quantitative indicators over time. Therefore, access to long time series from standardised monitoring is crucial (Hiscock *et al.*, 2003).

Relevant ecosystem indicators yield an indication on the state of the available biological resource. However, ICZM must also include a number of non-biological considerations. Examples are risk assessments, number of stakeholders, involvement of authorities, administrative and legislative tools, outcome in terms of results (decision-making, public awareness), evaluation protocols, methods for adaptive assessments, etc. In France these and other process variables have been defined and quantified for comparison of six coastal sites (Henocgue 2003). The goal was to develop and initiate a “good practice guide” that can be used to compare and evaluate ICZM activities.

The nature of the ICZM implies that a wealth of data needs to be collected and analysed. Therefore, good data management is a necessity (Dyer and Millard 2002). Such data management should comprise data understanding, legal considerations, description of data processing, technological competence and an audit and evaluation protocol.

4.4 Alternative fisheries management tools

Traditional fisheries management with TAC and quotas has not been very successful. Overcapacity in the fisheries and declining fish stocks remains a major problem. In addition the sectorial objectives such as the optimisation of fish yield are expected to be replaced by environmental objectives that have been formulated within the ecosystem approach.

Fisheries are one of the stakeholders in the coastal zone and often an economically and ecologically important one. With depleted stocks and decreasing profits in the fishing industry, the fisheries sector is looking for new partners. New coalitions are being made, which look much like ICZM constellations. At the same time, there is a movement within the fisheries sector in EU to decentralise decision-making and increase stakeholder participation to increase legitimacy in management and governance. The EU Regional Advisory Councils (RAC) is a good example, where one has been established for the North Sea and five more are to follow for the Baltic and Mediterranean Seas, North-Western and South-Western waters and pelagic stocks.

Three types of management can be defined; consultative management, where authorities consult different stakeholders but take all the decisions themselves, co-management where participation of authorities and stakeholders is more on equal terms, and decentralised management, where authorities have delegated the decision-making process to a group of formally organised stakeholders.

A good example of the processes described above, is an initiative taken by the Swedish government in 2004. The National Board of Fisheries was given the task of coordinating and leading a project involving groups wanting to develop a system for local co-management. The main objective of this initiative is to test, support and evaluate new and ongoing local and regional collaborative management processes, in both coastal and inland waters. The govern-

ment also wants to see tools and processes developed that may lay the foundation for co-management and indicate directions for future work.

A large part of the work is to define the conditions under which local and regional co-management can become successful. The work conducted within the initiative should include conservation and regional development aspects with focus on rural areas and make ecological, social and economic considerations. It is expected there will be more involvement of stakeholders in fisheries management and the decision-making process. It is stressed that not only commercial fishermen should take part in this initiative but also recreational fishermen.

The Swedish co-management initiative has included broad stakeholder participation and is parallel with the initiatives taken within EU on RACs as well as the ICZM guidelines.

4.5 Marine protected areas (MPA)

MPAs are coastal or oceanic management areas designed to conserve ecosystems together with their functions and their resources. MPAs range from small, highly protected reserves that sustain species and maintain natural processes to larger multiple-use areas in which conservation is coupled with various socioeconomic activities and concerns. Marine protected areas are important economically as they contribute to the creation of jobs and services important for tourism and recreation. They play an increasingly critical role in sustaining commercially important marine resources such as fisheries.

The concept of MPA is widely used, often as a synonym to marine reserves, closed areas, no-take zones and Marine Fisheries Sanctuary. The most generally accepted definition of a marine protected area was adopted by the World Conservation Union (IUCN) in 1988. In accordance with this definition a marine protected area is

... any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.

Currently, OSPAR and EU are developing a coherent network of marine protected areas. The Habitats Directive requires the maintenance or restoration of natural habitats and species of European Interest at favourable conservation status, with the management of a network of Special Areas of Conservation (SACs) being one of the main vehicles to achieve this. Among the habitats and species specified in the Annexes I and II of the Directive, several are marine and SACs have already been selected for many of these in several countries. To manage specific habitats and species effectively there needs to be clear understanding of their distribution, their biology and ecology and their sensitivity to change.

The OSPAR work on marine protected areas is based on the OSPAR list on threatened and /or declining species and habitats. The development of this list has been consistent with the Texel-Faial criteria for the identification of species and habitats in need of protection and has taken account of other relevant available information. This list does not refer to species managed by fisheries authorities and for which the only threat is their exploitation by fisheries. At the Ministerial Meeting in Bremen 2003 HELCOM and OSPAR stressed the need for joint action to protect threatened and declining species and habitats. The two commissions pledged themselves to create by 2010 a joint network of well managed marine protected areas that together with the Natura 2000 network is ecologically coherent.

The MPA concept is used differently in different countries and the national jurisdiction for MPAs also differs between countries. The primary purpose of establishing a marine protected area may either be nature conservation with protection of species and habitats or fisheries management, including MFS and/or regulation of fisheries. In several countries, MPAs for nature conservation falls under the jurisdiction of environmental law, while MPAs for fisher-

ies management falls under the jurisdiction of fisheries law. An MPA for conservation is focused on protection of a species or habitat and the regulation is directed towards activities, including fishing, that pose a threat to the nature values to be protected. In this case, it is not a fisheries management instrument although fishing can be addressed and regulated. An MPA for fisheries management, on the other hand, focuses on management of fish stocks by protecting spawning, nursery and feeding grounds or migration routes. An MPA under the fisheries law is often referred to as a closed fishing area, a no-take zone or a Marine Fisheries Sanctuary. In many cases MPAs may be established both for nature conservation and fisheries management purposes simultaneously.

The synergies between biodiversity and fisheries objective are many. Protection of critical marine habitats has become an issue of great concern and is the focus of current effort on the part of all fishery management councils. To conserve biodiversity, certain species and habitats are protected in an MPA. These protected species and habitats may also be valuable areas for the growth of fish embracing spawning and nursery areas, feeding grounds and migration routes.

There should be a joint interest between nature conservancy interests and fisheries for protecting the biodiversity of an area. The primary focus of a management scheme in such a case is to manage operations and activities taking place within a MPA to protect its species and habitats.

An EU-project has been launched in 2005 to examine and develop the use of MPAs within fisheries management.

4.6 Cross-border and research programmes

Cross-border programs, for example within Interreg, or other EU-funded projects, provide an excellent possibility to work internationally with these issues. The focus may be on regional development, pollution, tourism, fisheries etc. Programs like this are already underway (for example Coastatlantic, <http://www.coastatlantic.org>) but there is a need for constant development to meet the needs of stakeholders and take into consideration results from already implemented programs.

Research programmes may act to increase ICZM as they bring together scientists from differing disciplines and encourage communication between scientists and other stakeholders. Interdisciplinary communication is the foundation for much of the work with ICZM and is necessary in order to provide information of a kind that meets the needs of managers.

The Swedish research programme for Sustainable Coastal Zone Management (SUCOZOMA) is a good example. It has brought together research groups to provide an integrated analysis of coastal zone problems and find possible solutions. The programme has been one of Europe's largest on ICZM of marine resources and it had its finishing seminar in April 2005. The results from this programme are published in a special issue of the journal *AMBIO*, (Volume 34, number 2, March 2005).

4.7 Physical planning

The legal and regulatory framework may be used as a tool for a more integrated coastal management. Vertical integration is important, i.e., integration between national, regional and local levels of regulation and legislation. Land and water management are two other important areas where more integration is needed. Physical planning may act as a tool for more stakeholder participation in the decision making process. However, the method and current ways of working with physical planning is not optional for participation from stakeholders. If this could be made more "participatory friendly", ICZM could be facilitated (*AMBIO*, Volume 34, number 2, March 2005.)

4.8 Decision support systems

Decision Support Systems, as applied in decision making for the establishment of aquaculture farms, should be applied more generally for the coastal zone. This kind of tool helps in deciding what kind of data or information is required.

4.9 Coastal monitoring by spatial analysis

GIS-based maps for the mapping of different activities, habitat-mapping, etc., are useful to give a visual overview of an activity or the geographical map of a resource. When merged this information provides a general overview and can be used for management purposes. An example of this is found in the BSH website of CONTIS (continental Shelf Information System) where maps provide spatial information on different stakeholder activities and protection sites in the German sector of the North Sea and the Baltic Sea: <http://www.bsh.de/en/Marine%20uses/Industry/CONTIS%20maps/index.jsp>

Institute of Marine Research, Norway has since the late 1990s collected information on distribution of cold-water coral reefs. Fishermen with good knowledge and long experience with offshore fisheries supported IMR with positions on areas where corals was caught in trawls and gillnets. Data on areas where it use to be corals where reported. This information is stored in a database. In addition information from literature and data from the oil-industry are added to the database.

The coral reefs along the cost of Norway have a very high diversity. Studies on the reefs have shown that more than 600 taxa are associated to these complex structures. Deep-water coral reefs are built up through hundreds of years with the live species growing on top of piles of dead skeletons. These fragile structures are very vulnerable to physical disturbance, especially from impacts from repeated fishing activity and oil exploration.

Since 1 July 2000, all Norwegian fishing vessels longer than 24 m have been monitored with a satellite tracking system (ARGOS/INMARSAT-C) operated by the Norwegian Directorate of Fisheries. Each hour the vessels send their identity, position, speed and heading to the Directorate.

A spatial combination of the coral database and the satellite tracking data from the Barents Sea show an overlap of high insensitive fished areas and areas with coral reefs observations (Figure 1). Some of the observations have not been verified, but there is a higher probability of damage on coral reefs in areas with high fishery activity. Similar analysis will be carried out for the rest of coral areas.

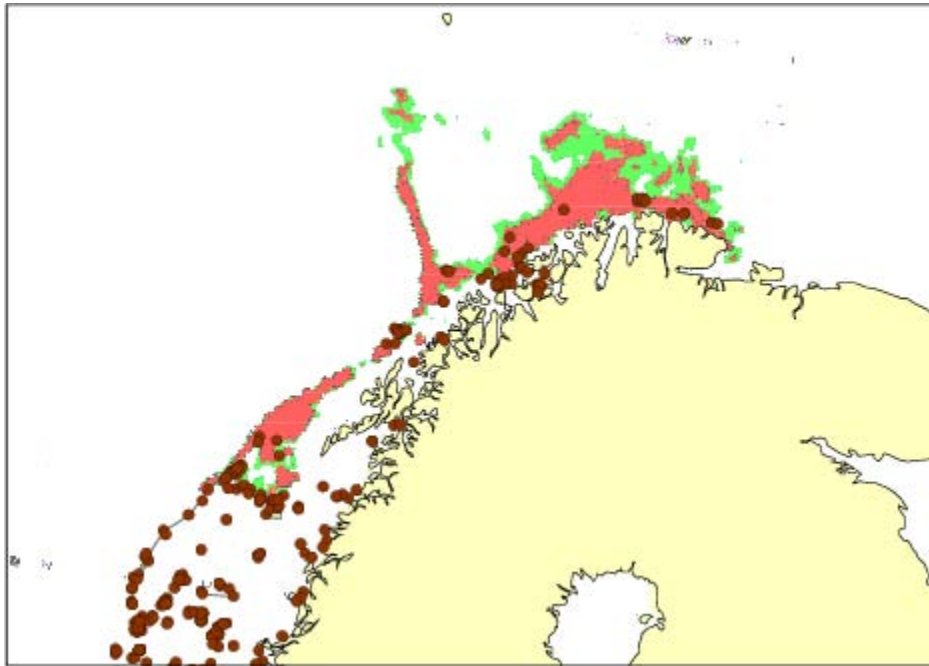


Figure 1: Distribution of coral reefs (*Lophelia pertusa*) in northern areas of Norway, and estimate of fishing activity from satellite tracking of fishing vessels. Spatial distribution of recorded VMS-positions of the Norwegian fishing fleet in the Barents Sea (from Kolle *et al.*, 2002) combined with distribution of coral reefs (*Lophelia pertusa*) in northern areas of Norway. The filled areas indicate the number of recorded positions in 11× 11 km squares where the speed was lower than 4.5 knots during January-March 2002 (light green: 1–13 positions, dark green: 14–26 positions, orange: 27–39 positions and red: >39 positions).

Institute of Marine Research has since the mid 1970s monitored abundance of the Barents Sea demersal stocks. From collected otoliths the cod population can be divided into Northeast Atlantic cod and costal cod. Visual examination of gonads gives information on maturity stages. Figure 2 shows a density analysis of observations of costal cod with maturity stages indicates spawning (observations for the period 1997–2002). The highest densities (dark blue) show the main spawning grounds.

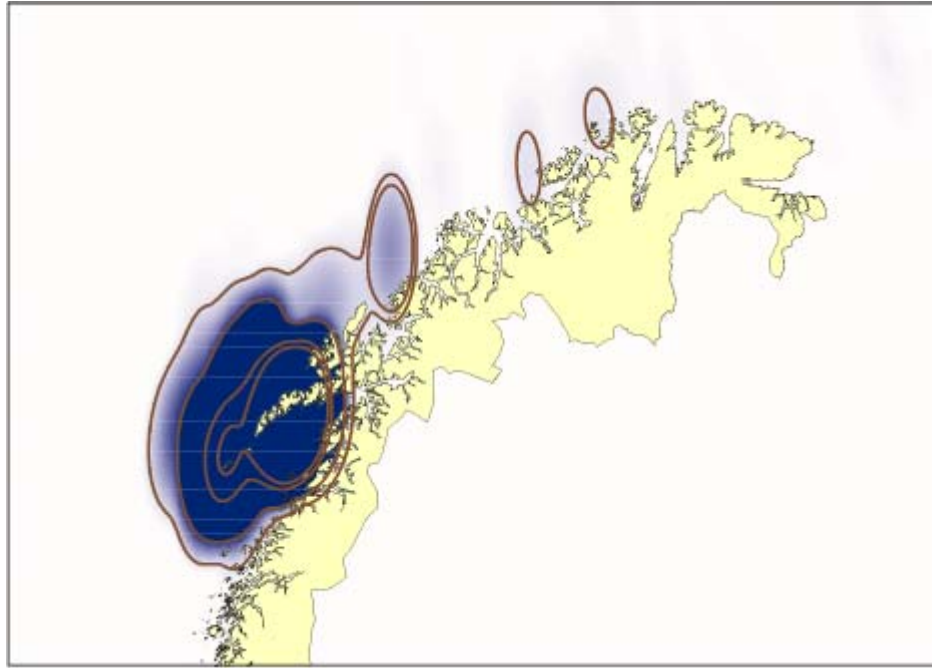


Figure 2: Main spawning area. Data are collected on Norwegian research vessels from 1995–2002.

In coastal areas registration on spawning areas has to be achieved from local knowledge. Main cod spawning grounds was identified in the county of Hordaland by interviews of local fishermen, and the information where put into a GIS system (Figure 3). In a recent survey this area was sampled for cod eggs. The data are not yet analysed.

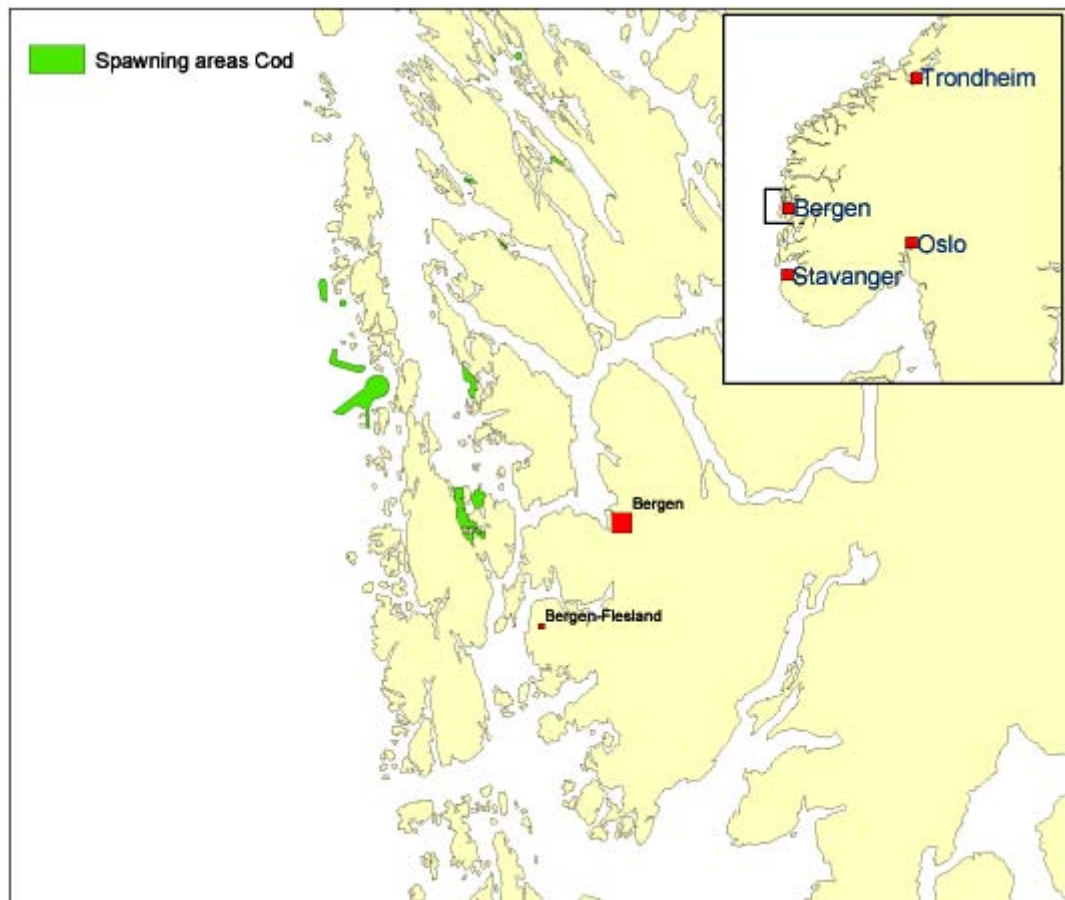


Figure 3: Spawning areas of cod. Information achieved from interviews of local fishermen.

4.10 Interactions between vulnerability habitats and the oil industry

IMR gives advices on the development of the offshore oil drilling. Analysis of egg and lava drift combined with a grid of oil blocks is an important tool in the development of these advices (Figure 4).

The combination of the coral database and planned oil installations also gives us a tool in the advising process (Figure 5).

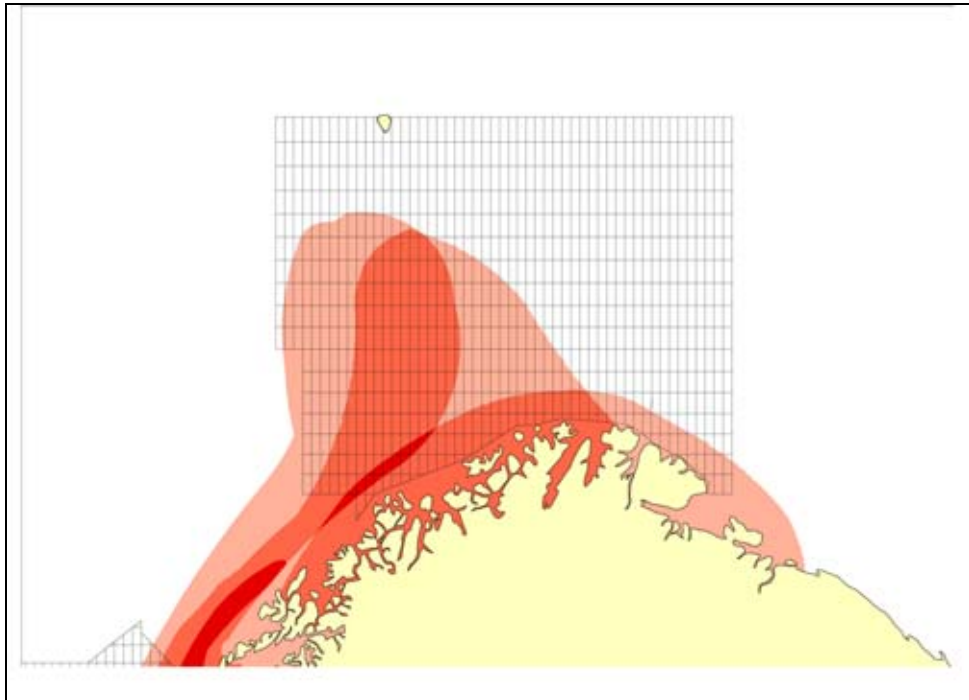


Figure 4: Important larva areas for commercial species and a grid of oil blocks. Dark red indicate areas with the highest densities of larva.

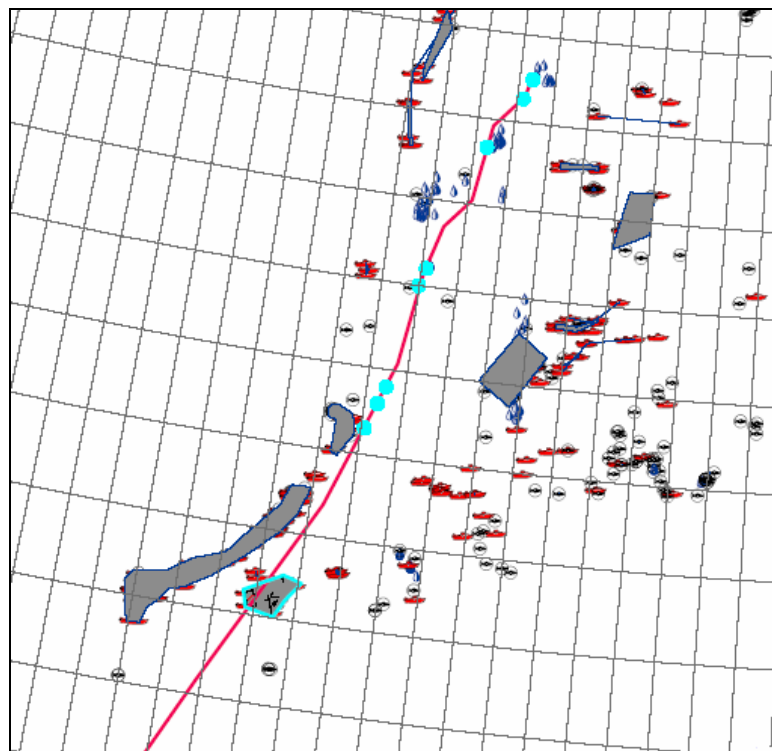


Figure 5: Data from the coral database combined with a theoretical gas/oil pipeline. The points show source of coral observations, the dark areas indicate larger coral areas, and the pink line shows the theoretical pipeline and the light blue markings shows possible interactions between the pipeline and corals.

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5 Recommendations

- 1) The first meeting of the WGICZM will take place at the ICES Headquarters in Copenhagen from 19–21 April 2006.
- 2) Update and report on activities of relevant ICES Working and Study groups to identify information pertaining to coastal zone and evaluate this information relative to ICZM needs. (Responsible G. Janssen, Holland).
- 3) Update and report on ICZM activities in different ICES countries, and in different international organisations. (Responsible E. Hoffmann, DK).
- 4) Revise and update list of tools and data products and research needs (J. Støttrup, DK).

- 5) Monitor and report results generated from larger EU funded projects (PROTECT, MESH, etc) that are directly relevant to ICZM needs. (Responsible C. Greathead, UK).
- 6) Report on different national attempts at monitoring recreational fisheries and evaluate the progress.
- 7) Report on the effects of hypersaline waters produced by desalination plants (Responsible Beatriz Morales-Nin)
- 8) Report on progress in valuable component or management tools. (Responsible J. Modin/E. Moksness).
- 9) Revise and develop the draft on the development of a framework for integrated evaluation of human impacts in the coastal zone and how to integrate this information for CZM, identifying ICES' role in the application of the WFD in the coastal zone. (Responsible P. Berthou)

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Annex 2: Draft 2005 Terms of Reference

2E09 The **Working Group on Integrated Coastal Zone Management** [WGICZM] (Chair: J. Støttrup, Denmark) and will meet at ICES Headquarters, Copenhagen, from 19–21 April 2006 to:

- a) Update and report on activities of relevant ICES Working and Study groups to identify information pertaining to coastal zone and evaluate this information relative to ICZM needs.
- b) Update and report on ICZM activities in different ICES countries, and in different international organisations.
- c) Revise and update list of tools and data products and research needs.
- d) Monitor and report results generated from larger EU funded projects (PROTECT, MESH, etc) that are directly relevant to ICZM needs.
- e) Report on different national attempts at monitoring recreational fisheries and evaluate the progress.
- f) Report on the effects of hypersaline waters produced by desalination plants.
- g) Report on progress in valuable component or management tools.
- h) Revise and develop the draft on the development of a framework for integrated evaluation of human impacts in the coastal zone and how to integrate this information for CZM, identifying ICES' role in the application of the WFD in the coastal zone.

WGICZM will report by 5 May 2006 for the attention of the Marine Habitat Committee, ACME and ACE.

Supporting Information

Priority:	In order to maintain and improve the quality of ICES advice, the specific requirements for scientific advice in support of client initiatives on ICZM need to be evaluated. In response to demands for ecosystem-based advice, ICES has adopted an ecosystem-based approach. Including the coastal zone would allow ICES to provide better holistic advice. Consequently these activities have high priority.
Scientific Justification and relation to Action Plan:	<p>All TOR also relate to Action Plan 1.9, 2.2, 2.3, 2.9, 2.11, 2.12, 2.13, 3.3, 4.7, 4.8, 4.14.</p> <p>Many ICES Study and Working groups do address specific coastal zone issues. Others do not include coastal zone issues in their work, but have the expertise to, or could with added expertise, address these issues. All the information being generated needs to be compiled and analysed to ensure consistent and integrated advice.</p> <p>The ecosystem based approach to the management of human activities as the leading principle for integrated coastal zone management implies that knowledge on the key ecosystem processes and properties in the coastal zone will be the core of the information ICES will be able to add into the process of ICZM. Important components include the valuation of coastal ecological niches, specific habitats, identification of essential and critical species and habitats particular to coastal areas, and development of EcoQOs specifically for the coastal zone.</p> <p>This work will contribute directly to the applications of emerging and present coastal directives (e.g., EU-WFD) and other management issues within ICES Member Countries.</p>
Resource	Much of the research is already underway and a list of data products has been

Require-ments:	already drawn up. Some of these may constitute the remit of the Group. Many from this list should, however, be fed back to other ICES expert groups.
Participants:	ICES Member Countries working with coastal zone issues and 1–2 socio-economic experts also involved with ICZM.
Secretariat Facilities:	Meeting room at ICES headquarters, if available.
Financial:	No financial implications
Linkages To Advisory Committees:	There are obvious direct linkages with all three advisory committees, but especially ACE and ACME
Linkages To other Committees or Groups:	MHC, MARC and several Working Groups within these committees.
Linkages to other Organisations:	OSPAR, HELCOM.
Secretariat Marginal Cost Share:	ICES 100%