

Theme Session E

Marine spatial planning in support of integrated management—tools, methods, and approaches

ICES CM 2008/E:01

A practical example of a successful strategic approach to marine spatial analyses and minimizing spatial conflict: how not to kill whales with vessels

A. S. M. Vanderlaan, C. T. Taggart, and M. W. Brown

We used vessel traffic and right whale survey data for the Scotia–Fundy region of the Northwest Atlantic to spatially quantify the relative risk of lethal vessel encounters, using two estimates: (i) the event—the relative probability of a vessel encountering a right whale, and (ii) the consequence—the probability of a lethal injury given an encounter. In the Bay of Fundy our estimates demonstrate that a 62% reduction in relative risk of lethal collision could be achieved through an amendment to the traffic separation scheme (TSS). The International Maritime Organization (IMO) subsequently adopted and implemented the TSS. On the Scotian Shelf our estimates demonstrate that a seasonal recommendatory area to be avoided (ATBA) could be designed to markedly reduce the risk of lethal collision. The ATBA was subsequently adopted and implemented by the IMO. Thus, the objective of achieving the greatest reduction in the risk of lethal vessel encounters with whales, balanced by some minimal disruption to vessel operations while maintaining safe navigation, can be reached. At the policy level of marine spatial planning (MSP), we demonstrate how the “vague and patchy understanding of how [MSP] might be practically implemented” can be transformed to an explicit, and comprehensive understanding of practical of implementation. We offer the added extra bonus of directly measuring the success of implementation, and thus the policy.

Keywords: spatial conflict, vessel, whale, risk, lethal encounter, mitigation, implementation.

Contact author: C. T. Taggart, Oceanography Department, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, Canada B3H 4J1 [tel: +1 902 494 7144, fax: +1 902 494 3877, e-mail: chris.taggart@dal.ca].

ICES CM 2008/E:02

Comparing patterns of fishing pressure and natural disturbance on UK marine landscapes and their implications for marine spatial planning

Vanessa Stelzenmüller, John Aldridge, and Stuart Rogers

In this study we compared spatio-temporal pattern of fishing pressure and natural disturbance on offshore UK marine landscapes based on both a time-series of fishing vessel monitoring system (VMS) data for UK and foreign fleets and a time-series of natural disturbance using a detailed hydrographical model for the region. Results revealed that marine landscapes with coarse or mixed sediments and weak or moderate tide stress were heavily fished, while shallow sand plains and shelf sand plains experienced high levels of natural disturbance. Marine landscapes experienced different intensities of fishing pressure depending on their spatial location in UK offshore waters and the regional heterogeneity of landscape types. The natural disturbance of landscapes also varied by region owing to heterogeneous hydrographical conditions across regions. Some locations in the North Sea were dominated by natural disturbance whereas in the southwest fishing pressure exceeded natural disturbance. These results show that the pressure exerted by fishing activity may be exceeded in some UK shelf seas by natural disturbance, so should not be used as the only basis on which to identify areas under threat and to designate management measures. In the context of marine spatial planning, areas where natural disturbance is high provide some flexibility to allow fishing activity to continue at moderate levels. In general, our results suggest that marine management plans at a regional scale should consider both the spatio-temporal variability of human pressures and natural processes. This will contribute to a comprehensive assessment of cumulative impacts on the marine environment based on habitat sensitivity assessments.

Keywords: GIS, fishing pressure dynamics, marine spatial planning, marine landscapes, VMS.

Contact author: Vanessa Stelzenmüller, Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Pakefield Road, Lowestoft NR33 0HT, UK [tel: +44 1502 527779, e-mail: vanessa.stelzenmuller@cefasc.co.uk].

ICES CM 2008/E:03

Comparative study of conservation planning strategies: a case study in the eastern English Channel using MARXAN and ZONATION softwares

S. Vaz, J. Delavenne, R. J. Smith, C. S. Martin, L. Dupuis, F. Coppin, and A. Carpentier

The marine environment of the eastern English Channel is a significant economic resource that supports a number of human-based activities, such as tourism and recreation, international ports and shipping, and the extraction of both living and non-living resources. In addition to human use, the region supports a number of important marine biological features. Responsible and integrated management aided by information systems and tools capable of assisting decision-making is essential to the construction of policies to ensure the sustainable exploitation of these marine resources. MARXAN and Zonation are two computer programs that deliver decision support for reserve system design. They find reasonably efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a suite of biodiversity targets. The aim of this study is to develop a tentative conservation plan for the eastern English Channel using both MARXAN/CLUZ and Zonation. These are used to identify important sites for conserving biodiversity, while using anthropological, economic, and legal data to minimize potential opportunity costs. Different scenarios with varying target thresholds are explored. A comparison between the two programs are made, both in terms of ease of use and results obtained.

Keywords: eastern English Channel, MPA, conservation planning, decision support softwares.

Contact author : S. Vaz, Ifremer, Laboratoire Ressources Halieutiques, 150 quai Gambetta, BP699, 62321, Boulogne/mer, France [tel : (+33) 3 21 99 56 00, fax : (+33) 3 21 99 56 01, e-mail : svaz@ifremer.fr].

ICES CM 2008/E:04

Marine protected areas as a fishery management tool for eastern Baltic cod: coupling of observational data with hydrodynamic model simulations

H.-H. Hinrichsen, B. Huwer, M. Schaber, and G. Kraus

Eastern Baltic cod has collapsed as a result of climate-driven adverse hydrographic conditions and overfishing. Because traditional fishery management efforts have largely failed to effectively prevent overexploitation of this stock, marine protected areas (MPAs) have become of increasing interest to fishery scientists and policy-makers in the Baltic Sea region. To identify spawning locations and regions where the surviving juveniles were spawned, we used traditional field samples, hydroacoustic distribution data, otolith microstructure analysis, and a hydrodynamic model to evaluate the extent and positions of appropriate MPAs in the central Baltic Sea, intended mainly to protect the spawning aggregations of adult cod. We found a clear influence of ambient salinity and oxygen concentration on the vertical distribution of spawning fish. In the horizontal domain, a clear preference for spawning at locations in deep water is evident. Coupling of otolith microstructure information from pelagically caught juveniles with a hydrodynamic model in order to backtrack spawning locations revealed that the majority of surviving pelagic juveniles were not spawned in the centre but on the slopes of the Bornholm Basin. Knowledge of the spatial and temporal distribution of juvenile cod is a prerequisite for the design of MPAs aiming at protection of juveniles. Results of our hydrodynamic modelling study indicated a clear dependence of juvenile settling probability on wind-induced drift of larval cod, which is controlled by the local atmospheric conditions over the Baltic Sea. Finally, we used the spatially explicit fishery simulation model ISIS-Fish in order to evaluate the performance of past, present, and proposed MPAs to help the stock to recover.

Keywords: Baltic cod, marine protected areas, fisheries simulation model.

Contact author: Hans-Harald Hinrichsen, IfM-Geomar, Düsternbrooker Weg 20, Kiel, D-24105, Germany [tel: +49 431 6004566, fax: +49 431 6004553, e-mail: hhinrichsen@ifm-geomar.de].

ICES CM 2008/E:05

A practical example of a successful strategic approach to marine spatial analyses and minimizing spatial conflict: how not to entangle whales in fishing gear

C. T. Taggart, K. R. Smedbol, and A. S. M. Vanderlaan

We used gear deployment and right whale survey data for the Scotia–Fundy region of the Northwest Atlantic to spatially quantify the relative threat of entanglement that fishing gear imposes on whales. Our estimates for focus regions in the Bay of Fundy and on the southwest Scotian Shelf demonstrate that large reductions in the relative threat to whales by gear can be achieved through time and space modifications to the amount and type of gear deployed. This leads to the consideration of spatially differentiated seasonal closures for gear types that should result in marginal impact among the various fishery interests. Thus, the aim of achieving the greatest possible reduction in the threat of gear entanglement, balanced by minimal disruption to fishing operations, can be reached. At the policy level of marine spatial planning (MSP), we demonstrate how the “vague and patchy understanding of how [MSP] might be practically implemented” can be transformed into an explicit, comprehensive, and practical implementation.

Keywords: spatial conflict, fishing gear, whale, threat, entanglement, mitigation, implementation.

Contact author: C. T. Taggart, Oceanography Department, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, Canada B3H 4J1 [tel: +1 902 494 7144, fax: +1 902 494 3877, e-mail: chris.taggart@dal.ca].

ICES CM 2008/E:06

Preparing the ground for marine spatial planning in Ireland

W. Flannery, E. Nixon, and M. Ó. Cinnéide

Marine spatial planning (MSP) is advocated as a means of managing human uses of the sea in a manner that is consistent with the maintenance of the ecological goods and services of the marine environment. The adoption of an MSP system is seen as urgent in the face of ever-increasing demands on the marine resource. This is particularly so in Ireland, with its extensive seas belatedly being recognized as a significant development resource. MSP was recently promoted by the European Commission (EC) in a Green Paper to which Member States of the Union, including Ireland, generally responded positively. Arising from this consultative process the EC has published the "Blue Book" that commits support for MSP. There is evidence that a diverse range of stakeholders at national and local levels in Ireland are positively disposed toward MSP but no practical manifestation of the concept is in place, though much preparatory work is underway to facilitate its likely implementation in the future.

Keywords: marine spatial planning, marine resources, Ireland.

Contact author: Wesley Flannery, Room 121, Department of Geography, National University of Ireland Galway, Galway, Ireland [tel: +35391 492665, e-mail: w.flannery1@nuigalway.ie].

ICES CM 2008/E:07

Existing and planned technical installations in the Baltic Sea as an emerging pressure on the marine environment and the key component for the marine spatial planning

Eugeniusz Andrulowicz and Zbigniew Otremba

This paper offers an overview of the environmental effects of existing technical installations in the Baltic Sea. Relevant results have been obtained through data mining, screening environmental impact assessments (EIA), compilation of research results, and monitoring programmes. Information was also collected through bilateral national contacts and through an international HELCOM BIO project. This paper covers:

- Existing and planned traffic links (bridges, tunnels)
- High voltage power cables (HVPC)
- Oil and gas extraction platforms
- Baltic ports and terminals
- Coastal defence barriers (sea walls) and beach nourishment activities
- Wind power farms (planned)
- *Nord Stream* gas transmission line (planned).

It is suggested that environmental pressures created by existing and planned installations should be treated more cautiously because some effects of the constructions are not well understood. There is also a need for more research and the creation of an international information exchange platform. In some cases (e.g. wind power farms), there should be strategic environmental assessments (SEA) prepared to assess the combined and synergic effects of these constructions. Existing and planned technical installations in the Baltic Sea are also discussed in the context of the need for marine spatial planning. The Polish EEZ is used to demonstrate the potential for conflict between planned construction projects, protected marine areas (HELCOM BSPA and NATURA 2000), and important fishing grounds and fishing activities.

Keywords: Baltic Sea, marine spatial planning, marine technical constructions.

Contact author: Eugeniusz Andrulowicz, Sea Fisheries Institute in Gdynia, Kollataja 1, 81-332 Gdynia, Poland [tel: +48 58 73 56 149, fax: +48 7556 110, e-mail: eugene @mir.gdynia.pl].

ICES CM 2008/E:08

A Canadian example of using spatial management to minimize the impacts of trawling on benthic communities

D. C. Gordon, E. L. R. Kenchington, and K. D. Gilkinson

Spatial analysis of observer data from Atlantic Canada indicates that the distribution of trawling effort is very patchy. The short-term impacts of otter trawling on sand and gravel seabed habitats and communities have been studied in three-year manipulative experiments, one on the Grand Bank and one on Western Bank. In addition, the long-term impacts of scallop dredging have been studied by comparing two benthic datasets

collected 30 years apart on an actively fished scallop ground in the Bay of Fundy. The combined results, which are in concurrence with research elsewhere, indicate that the organisms most sensitive to disturbance by fishing gear are large epibenthic taxa, especially sessile, structure-forming organisms such as horse mussels. Deep-water corals share these characteristics and are commonly found off Atlantic Canada in channels, canyons, and along the slope. Video surveys have confirmed earlier anecdotal observations that important deep-water coral communities are particularly important in the Northeast Channel, the Gully, and at the Stone Fence in the Laurentian Channel. Evidence of significant fishing damage has also been observed. Using these spatial data, and in consultation with the fishing industry, all three areas are now closed to bottom-contacting fishing gear to protect these important benthic communities.

Keywords: spatial management, distribution of fishing effort, benthic impacts of fishing, deep-water corals, fishing closures.

Contact author: Donald C. Gordon, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2 [tel: +1 902 426 3278, fax: +1 902 426 6695, e-mail: gordond@mar.dfo-mpo.gc.ca].

ICES CM 2008/E:09

Use of a GIS for decision support in coastal zone management in the southwestern New Brunswick portion of the Bay of Fundy

B. D. Chang and F. H. Page

The southwestern New Brunswick portion of the Bay of Fundy sees considerable human activity in its marine waters despite a relatively low human population. Traditionally, fisheries have been the dominant activity and commercial shipping has also been of importance since the early days of European settlement. More recently, salmon aquaculture and marine recreational activities have developed and interest is growing in the potential for tidal power generation. The area is also used by endangered species, such as the northern right whale and wild Atlantic salmon, and proposals for new activities are increasingly coming into conflict with existing activities and users of the Bay. In order to help in the decision-making process, we have used a GIS to map existing knowledge of the various activities. In our preliminary analyses, we depended on the published literature. GIS has allowed us to overlay geo-referenced data to determine where overlaps occur, and where new activities can be located to cause the least negative interaction and potential for conflict. We also use oceanographic data and models to estimate the transport and dispersal of materials and which areas are technically best suited for certain activities, such as tidal power or offshore aquaculture. The presentation highlights some of our applications and our experiences of taking this approach to decision support.

Keywords: coastal zone management, decision support.

Contact author: B. D. Chang, Fisheries and Oceans Canada, Biological Station, 529 Brandy Cove Road, St Andrews, NB, Canada E5B 2L9 [tel: +1 506 529 5907, fax: +1 506 529 5862, e-mail: changb@mar.dfo-mpo.gc.ca].

ICES CM 2008/E:10

Meta-analysis of changing spatial distribution of Northwest Atlantic fish and invertebrate stocks in relation to temperature and stock structure

Janet Nye and Jason Link

Ecosystem-based approaches to fishery management require that we consider a broader set of considerations about how we manage our natural resources. This includes not only incorporating changing spatial distribution into assessments at the stock level, but also understanding changes in the spatial characteristics of multiple species in relation to each other. We used several techniques to analyse trends in the mean centroid of abundance, mean depth, and population density for 50 fish and invertebrate species using the National Marine Fisheries Service (NMFS) trawl survey data from 1968 to 2007. We identified several trends that are consistent with a response to the observed recent increase in Northwest Atlantic water temperatures. The centre of abundance of numerous fish and invertebrate species has shifted to more northern latitudes in recent years. The range of some southern species has expanded, while that of some northern species has become more restricted. Some species exhibit inshore/offshore shifts and have changed depth distribution. In contrast to these trends in distribution, some species, such as winter skate and spiny dogfish, appear to have shifted their distribution to more southerly waters. Depending on the stock, changes in distribution may be correlated with concomitant changes in temperature, abundance, and/or size structure over time. We examine the management consequences of such movements in more detail for representative species.

Keywords: climate change, population connectivity, spatial distribution, spatial management, ecosystem-based management.

Contact author: Janet Nye, NOAA, MNFS, NEFSC, 166 Water Street, Woods Hole, MA 02543, USA [e-mail: janet.nye@noaa.gov].

ICES CM 2008/E:11

Seabed mapping for integrated spatial management

Vladimir E. Kostylev, Brian J. Todd, John Shaw, and Richard A. Pickrill

Integrated spatial management (ISM) of offshore lands has always been constrained by a lack of high-quality information on the marine ecosystem. Precisely positioned multibeam imagery has revolutionized marine spatial planning and to many people the objective was the production of high-resolution bathymetric maps. We argue that the objective-oriented geological interpretation of this high-resolution data provides invaluable contextual information for habitat management, design of marine protected areas, and assessment of potential impacts of multiple human activities. Such interpretation requires interdisciplinary effort, bringing together an understanding of geological, oceanographic, and ecological processes in the benthic boundary layer. Geological interpretation of high-resolution bathymetric data, augmented by geophysical surveys and ground-truthing, allows information about the texture and stratigraphy of sediment to be inferred, and the nature of seabed features (e.g. sedimentary bedforms, glacial moraines) and large homogeneous bottom areas to be characterized. It also provides data for physical and ecological modelling, resulting in new layers of information, such as natural rates of seabed disturbance or sensitivity of seabed to anthropogenic impacts. We demonstrate our approach using examples of seabed mapping projects from Atlantic Canada.

Keywords: seabed mapping, geological interpretation, habitat management.

Contact author: Vladimir E. Kostylev, Geological Survey of Canada (Atlantic), Natural Resources Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada B2Y 4A2 [tel: +1 902 426 8319, fax: +1 902 426 4104, e-mail: vkostylev@nrcan.gc.ca].

ICES CM 2008/E:12

Linking marine protected areas, fisheries and integrated ocean management

Anthony Charles

Within marine environments, discussions of protected areas (MPAs), integrated management, and fishery management often take place in isolation—yet clearly these three interventions in the human use of oceans are interrelated, all having inherent spatial considerations. Both MPAs and fisheries need to be addressed in a broader context of integrated ocean management, and there is a particular need to assess and understand how MPAs affect fisheries as well as how they fit into the “toolkit” of fishery management. This presentation reviews recent work to address these interconnections, focusing on two fronts: (i) a Food and Agriculture Organization (FAO) initiative to examine links between MPAs and fishery management, and (ii) two recent studies assessing how human dimensions are incorporated into integrated management and MPA development. On the first of these, the presentation explores some fundamental spatially oriented issues arising from the interface between MPA implementation and fishery management. It then develops a decision support framework for use either in situations in which an MPA is already in place and has potential to support fishery management needs, or in situations in which a new MPA is being contemplated and can be linked to fishery management at the outset. With respect to human dimensions, an analysis of 16 international case studies is reviewed; in each case, socio-cultural, economic, and governance information relevant to marine management was collected and assessed, across varying contexts and geographic scales, with a focus on regional or ecosystem-based planning.

Keywords: Integrated Management, MPAs, Human Dimensions, Fisheries Management, Decision Support.

Contact author: Anthony Charles, Management Science/Environmental Studies, Saint Mary's University, Halifax, Nova Scotia, Canada B3H 3C3 [e-mail: tony.charles@smu.ca].

ICES CM 2008/E:13

Implementing networks of MPAs in Canadian waters: do we really know enough to proceed? Lessons from a proof-of-concept study in the Scotian Shelf and Gulf of Maine

Jennifer L. Smith, John Crawford, Hussein Alidina, Robert Rangeley, Marty King, John Roff, and Ken Larade

Well-planned networks of marine protected areas (MPAs) are recognized as a fundamental step toward ecosystem-based management and the precautionary principle, and Canada has committed to implementing such networks throughout its ocean waters by 2012. But effective network design necessitates a systematic approach—one which requires a comprehensive picture of the spatial distribution of ecological values to be developed, setting clear goals, and taking a transparent approach to designing networks that meet those goals. Although well-accepted in terrestrial systems, systematic conservation planning has only recently taken hold in the marine realm, and some argue that the science is not yet sufficiently developed to proceed. This paper describes WWF-Canada's methods and findings in carrying out a “proof-of-concept” systematic MPA network plan for the Scotian Shelf and Gulf of Maine. The study examined whether the state of knowledge

and experience about network design principles, conservation feature distribution data, and decision support tools is sufficient to begin planning and implementing MPA networks in Canada. The paper concludes with a brief update on the “state-of-the-art” of systematic MPA network design and scientific guidance as gleaned from a joint DFO/WWF-Canada workshop held in January 2008.

Keywords: MPAs, marine protected areas, MPA networks, systematic conservation planning, Scotian Shelf, Gulf of Maine.

Contact author: Jennifer L. Smith, WWF-Canada, 5251 Duke Street, Suite 1202, Halifax, Nova Scotia, Canada B3J 1P3 [tel: +1 902 482 1105, fax: +1 902 482 1107, e-mail: jsmith@wwfcanada.org].

ICES CM 2008/E:14

Identifying particularly valuable and vulnerable areas: a key tool for the integrated management plans for the Barents Sea and Norwegian Sea

Erik Olsen

In 2006 Norway implemented an integrated and ecosystem-based management plan for the Barents Sea, and is currently developing a similar plan for the Norwegian Sea. Norway aims to have such plans for all sea areas under Norwegian jurisdiction. The main aim of integrated management in the Barents Sea and Norwegian Sea is to ensure sustainable use of the ecosystem by balancing all human activities. A key tool in developing area-based management frameworks has been the identification of particularly valuable (biologically) areas and evaluation of their vulnerability to human impacts. Biological value was determined in relation to importance to biological production, biodiversity, or as key habitats to threatened or vulnerable species. Seven particularly valuable areas were identified in the Barents Sea and ten in the Norwegian Sea. Under the Barents Sea plan, human use of these areas is carefully managed to reduce impact and risk, in Lofoten–Vesterålen and along the coast new petroleum activities are banned, shipping traffic has been moved offshore using mandatory routing and traffic separation schemes, and a series of marine protected areas (MPAs) are planned along the coast. Similar area-based management frameworks are planned for the Norwegian Sea, and will be presented to Parliament in 2009.

Keywords: Barents Sea, Norwegian Sea, value, vulnerability, area-based, integrated management, ecosystem-based management.

Contact author: Erik Olsen, Institute of Marine Research, PO Box 1870, Nordnes, N-5817 Bergen, Norway [e-mail: eriko@imr.no].

ICES CM 2008/E:15

A method for assessing the ecological coherence of an MPA network with regard to fish

Ulf Bergström, Alfred Sandström, Göran Sundblad, and Lena Bergström

The juvenile stages of fish are often dependent on specific habitat types for their survival, and protecting these habitats may be crucial to the maintenance of strong adult stocks. The Natura 2000 protected area network of the European Union offers protection for habitats that are essential to the recruitment of a number of coastal fish species in the Baltic Sea. In this study, we present a method for assessing the representativity and connectivity of the marine protected area (MPA) network with regard to these fish species. The analyses were based on maps that were produced by relating species occurrence to environmental variables. We used generalized additive models and GIS to describe species–environment relationships and to produce high-resolution habitat maps for a 30 000 km² archipelago area in the northern Baltic Sea. The maps were used to assess how well the recruitment habitats were protected by the MPA network. In addition, using information on the dispersal ability of the fish, the connectivity of the protected recruitment habitats was assessed. The map-based method explicitly identified geographical areas where the network should be strengthened to ensure a high level of connectivity. It is concluded that both the representativity and the connectivity of the network is poor for the studied fish species. Current exploitation of the coastal zone may have a huge impact on recruitment habitats and thus on the viability of fish stocks, illustrating the need for habitat protection from a fisheries perspective.

Keywords: essential fish habitats, habitat suitability modelling, Baltic Sea, connectivity, MPA network.

Contact author: Ulf Bergström, Swedish Board of Fisheries, Institute of Coastal Research, Box 109, SE-742 22 Öregrund, Sweden [e-mail: ulf.bergstrom@fiskeriverket.se].

ICES CM 2008/E:16

Poissons sans frontières: comparing contiguous surveys for major ecological and commercial species in the Northwest Atlantic, with a focus on trends, synchronies, and coherences

Alida Bundy, Nancy Shackell, Janet Nye, Kevin Friedland, and Jason Link

Fish know no national borders, yet for many reasons we delineate fish into distinct population or stock units that often reflect human institutional borders rather than biological factors. Across a wide variety of taxa, population dynamics can be synchronous over a range of spatial scales. Common patterns are generally attributed to a meta-population structure supported through dispersal, or a common response to large-scale environmental forcing. In the Northwest Atlantic, common species occur in the broader Gulf of Maine Area (GOMA), yet the area is managed in the south by the USA, and in the north by Canada. Many species occurring in the GOMA are subject to common forcing resulting in coherent patterns of recruitment and growth among distinct populations. To evaluate this, we compared six survey biomass time-series of 20+ representative species from US and Canadian waters. We further explored the biomass trends of aggregate groups such as large benthic feeders and total fish biomass. Many of these individual species and aggregates species groupings showed synchronous trends. For instance, Canadian and US populations of haddock, thorny skate, and white hake have comparable trends within species. Conversely, some species show differing time-series trends and asynchronous event timing, suggesting forcing processes may influence these species differently. Collectively our results demonstrate the value of comparing time-series for common species from contiguous ecosystems, with the potential to elucidate the relative importance of major factors affecting such species.

Keywords: population dynamics, synchrony, time-series, multivariate analysis.

Contact author: Alida Bundy, Fisheries and Oceans, Canada, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2 [tel: +1 902 426 8353, fax: +1 902 426 1506, e-mail: bundya@mar.dfo-mpo.gc.ca].

ICES CM 2008/E:17

Use of criteria for assessing ecological and biological significance in setting conservation objectives for integrated management

Jake Rice

Initiatives to implement the provisions of Canada's Oceans Act regarding both integrated management and an ecosystem approach were structured around the setting of conservation objectives on scientific grounds at a relatively early stage in the governance process. These conservation objectives were to serve as "boundary conditions" of ecological sustainability (in an ecosystem context), providing the envelope within which multistakeholder dialogue at the integrated management "tables" was to occur. This gives the conservation objectives a key role in the integrated management governance process, but also posed a significant challenge while the five initial integrated management initiatives were undertaken. On the one hand, it was important to equitable governance that the conservation objectives reflected consistent standards for conservation and consistent interpretations of what the "ecosystem approach" meant. On the other hand, the five initial integrated management projects were in three different oceans and very different ecosystems, so it was necessary for the conservation objectives for each project to reflect the ecosystem of concern and not just follow some rigid national template. The Department of Fisheries and Oceans Canada chose to set explicit criteria on which to assess the ecological and biological significance of areas (EBSAs), species (ESSs), and community properties (ESCPs) within each large ocean management area (LOMA; augmented by the IUCN criteria for assessing risk of extinction). The criteria were set by national expert workshops, as were additional guidelines for ranking the different candidate conservation objectives according to overall conservation needs. They were then applied to ecosystem overview and assessment reports (EOARs) prepared for each LOMA. The result was sets of prioritized conservation objectives for each LOMA that reflected both local ecosystem characteristics and nationally consistent standards. This paper reviews various sets of criteria briefly, but focuses on the contribution that criterion-based approaches to identifying conservation objectives made to both protection of vulnerable marine ecosystem components and sound governance processes at both LOMA and national scales.

Keywords: integrated management, Conservation Objectives, vulnerable marine ecosystems.

Contact author: Jake Rice, Department of Fisheries and Oceans, Canada [e-mail: Jake.Rice@dfo-mpo.gc.ca].

ICES CM 2008/E:18

Fisheries and marine spatial planning in German offshore waters—resolving spatial conflict issues

Heino Fock, Anne Sell, Søren Anker Pedersen, and Jake Rice

In May 2004, Germany nominated ten marine Natura 2000 sites to the European Commission, covering 31.5% of the German exclusive economic zones (EEZs) of the North Sea and the Baltic Sea. Assessments of the fishing impacts on Natura 2000 sites require fundamental data and information on the conservation status of the individual habitats and species, and on ongoing fishing activities. This paper describes the international fisheries catches and fishing efforts in the German EEZ and the potential conflicts between the fisheries and the Natura 2000 site objectives. In particular, benthic habitats, sandbanks and reefs, harbour porpoise, and seabirds are considered. Fine-scale distributions of trawl fishing efforts calculated from satellite-based vessel monitoring system data are used to allocate fine-scale distributions of reported catches in the German EEZ. Results of assessing fisheries impacts on habitats and species in and around Natura 2000 sites are presented and discussed. Based on standard data forms for the designation, a rank-based ecological risk assessment model has been used to analyse the impact of each stressor. The model is based on weighted factor inputs and overlaps of each conservation target and stressor. Single and combined effects are analysed. The effects on fisheries of potential management measures such as area closures to protect habitats and/or species are discussed.

Keywords: MPA, Natura 2000, fishing effort, fishing impact, area closures.

Contact author: Heino Fock, Johann Heinrich von Thünen-Institut (vTI), Institute for Sea Fisheries, Palmaille 9, D-22767, Hamburg, Germany [tel: +49 (0)40 38905 179, fax: +49 (0)40 38905 263, e-mail: heino.fock@ish.bfa-fisch.de].

ICES CM 2008/E:19

Lessons learned from developing and implementing integrated management plans in Norwegian waters

Lars Føyn and Inger Oline Røsvik

An integrated management plan for the Norwegian part of the Barents Sea and the areas outside Lofoten was presented to the Norwegian parliament, Stortinget, as a white paper from the government in spring 2006. Preparation is now in progress for a similar management plan for the Norwegian Sea, to be presented in spring 2009. Preparation has also started on the development of a management plan for the Norwegian part of the North Sea due in 2015. The Norwegian marine management plans are being developed with the aim of evaluating everything from petroleum activities, ship traffic, and fishing activities to handling of particular vulnerable areas including cold-water corals, spawning grounds, and seabirds. At the government level all ministries with interests in the use of the sea participated in the preparation which was led by the Ministry of the Environment. The Ministry of Fisheries and Coastal Affairs plays a particularly important role in both the development and the implementation of the plans. This paper describes the various processes for developing the plans, from initiating and gathering of background documentation, through the extraction and concentration of scientific knowledge from the different fields of interest, to hearing processes with NGOs and other interested organizations, and finally preparing a political paper, the white paper, to be presented to the parliament.

Keywords: integrated management plans, from scientific knowledge to political decisions.

Contact author: Lars Føyn, Ministry of Fisheries and Coastal Affairs, PO Box 8118 Dep., NO-0032 Oslo, Norway [tel: +47 22 24 26 64, fax: +47 22 24 95 85, e-mail: lars.foyn@fkf.dep.no].

ICES CM 2008/E:20

Use of marine spatial planning to build sustainable multispecies fisheries in the Florida, USA, coral reef ecosystem

Jerald S. Ault, Steven G. Smith, Jiangang Luo, James A. Bohnsack, and G. Todd Kellison

Southern Florida coral reefs generated an estimated 91 000 jobs and US\$6 billion in economic activity in 2007. These ecosystem goods and services, however, are threatened by increased exploitation and environmental changes from a rapidly growing regional human population. To address these threats, we adopted an ecosystem-based perspective in a systems science analysis framework to better assess and improve sustainable multispecies reef fisheries in the Florida Keys. Here we describe our progress and provide three example applications. We first built upon traditional catch and effort stock assessment methodologies by collecting spatially explicit, fishery-independent data covering all reef fish and reef habitats in the Keys. An optimized sampling strategy incorporating fish habitat GIS models with a length-based assessment framework provided synoptic spatial estimates of species abundance and size structures. Spatial models were developed that encompassed the complex biological dynamics of fish stocks and a broad range of environmental and human impacts, including fisheries, non-target species, predator-prey interactions, species movements, ontogenetic changes in habitat associations, and physical processes. We show that the snapper-grouper fishery in the Florida Keys is overfished relative to established benchmarks for resource sustainability. Spatially explicit models demonstrated the potential effectiveness of no-take

marine reserves to support sustainable fisheries, and were employed to objectively evaluate marine reserve boundary options. We show the importance of considering physical coupling and regional water quality changes resulting from Everglades restoration. A fishery systems science framework improves understanding of impacts from fishery extraction, ecosystem alterations, and natural oceanographic variability on the dynamics of exploited fish stocks.

Keywords: spatial planning, coral reefs, multispecies fisheries, GIS modeling.

Contact author: Jerald S. Ault, University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, FL 33149, USA [e-mail: jault@rsmas.miami.edu].

ICES CM 2008/E:21

Weighing up the ecological vulnerability of marine components to different pressures: a critical element of marine spatial planning

L. A. Robinson, C. L. J. Frid, and S. I. Rogers

Marine spatial planning is a rapidly developing field, with efforts being made at a number of jurisdictional levels to move towards deliverable plans. Yet much of the progress to date is conceptual, and now is the time to ensure that all the critical elements of planning are included. Here we argue that taking account of the different ecological vulnerabilities of marine components is one of the critical elements. We present the findings of a number of studies in which we have explored the different methods used to evaluate the vulnerability of different ecological components. Ecological vulnerability depends on both the sensitivity of an organism to a particular pressure, and its exposure to the pressure. Sensitivity further depends on both the resistance and resilience of the organism. Considering the marine ecosystem as a whole, our understanding of these concepts (and confidence in this) varies considerably across and within ecosystem components (e.g. benthos, marine mammals, and seabirds). Trying to then prioritize the key pressures to the ecosystem in any given spatial unit requires a means for assessing this objectively. We describe an approach that we are developing for European regional seas, where overarching objectives related to sustainability are used to apply a consistent threshold across all components, and resistance and resilience are then considered against this. The outcomes are contextualized in the broader remit of making such an approach operational as a tool in the marine spatial planning framework.

Keywords: ecological sensitivity, marine pressures, sustainability, resistance, resilience, ecosystem approach, marine spatial planning.

Contact author: Leonie Robinson, Ecosystem Dynamics Group, School of Biological Sciences, University of Liverpool, Liverpool L69 7ZB, UK [tel: +44 (0)151 795 4387, fax: +44 (0)151 795 4404, e-mail: leonie.robinson@liverpool.ac.uk].

ICES CM 2008/E:22

Towards a regional, intergovernmental marine planning process in the Baltic Sea and HELCOM

Hermann Backer, Maria Laamanen, and Minna Pyhälä

In order to address the root causes of negative environmental effects to the ecosystem, we must examine and act upon the anatomy of the human system. This is achieved, supported by the parallel development of spatial statistics and GIS infrastructure, via the process of spatial planning, called marine spatial planning (MSP) in the marine environment. The development of a comprehensive and operational MSP process for the Baltic Sea was a major item adopted by the Helsinki Commission (HELCOM) Baltic Sea Action Plan in November 2007. A broad-scale MSP can help in meeting ecosystem-based management objectives set by the HELCOM Action Plan, as well as those set by EU initiatives such as the European Marine Strategy and European Maritime Policy. This spatial approach will be developed within HELCOM during 2008–2009, including the development of a regional marine spatial data infrastructure. Marine protected areas, such as the Baltic Sea Protected Areas (BSPAs), Natura 2000, and Emerald sites, are examples of already implemented regional spatial controls. Other such examples from the Baltic include International Maritime Organization (IMO) regulations, including Traffic Separation Schemes (TSS), HELCOM Declarations and Recommendations concerning shipping, as well as the EU and EU–Russian regulations to fishery management (areas closed for fisheries). A future Baltic-scale MSP process is thus founded on an existing network of such issue-based spatial plans. One main challenge for a regional MSP lies in the coordinated implementation and development of these existing components.

Keywords: Baltic Sea, marine spatial planning, HELCOM, GIS, geostatistics.

Contact author: Hermann Backer, HELCOM, Katajanokanlaituri 6 B, FI-00160 Helsinki, Finland [tel: +35 8207 412620, e-mail: hermanni.backer@helcom.fi].

ICES CM 2008/E:23

Habitat suitability modelling using the Kostylev Approach in support of fisheries management

Thomas Noji, Steven Fromm, and Suellen Fromm

The suitability of marine habitats for biota is dependent largely upon hydrography (e.g. temperature, currents) and surficial geology (e.g. substrate type). Recognizing this relationship, researchers in Canada developed a broad-scale modelling approach primarily using hydrographic data. This approach has become known as the Kostylev Approach, named after the principal developer. Researchers at the Northeast Fisheries Science Center (NEFSC) applied the Kostylev Approach to data collected in the Gulf of Maine. The model output is in the form of maps that characterize habitats in terms of their “growth potential” for biota as well as mechanical “disturbance”. Comparisons of these outputs with data from the NEFSC trawl surveys revealed correlations for many managed fish species, including redfish, summer flounder, winter flounder, and cod. This approach has potential as an important tool in fishery management.

Keywords: fish, habitat, mapping, model, fisheries.

Contact author: Thomas Noji, NOAA, Northeast Fisheries Science Center, 74 Magruder Rd., Sandy Hook, NJ 07732, USA [tel: +1 732 872 3025, fax: +1 732 872 3068, e-mail: thomas.noji@noaa.gov].

ICES CM 2008/E:24

Marine spatial planning: a promising new paradigm for applying an integrated, ecosystem approach to ocean management

Fanny Douvère and Charles Ehler

Many scientists have advocated reforms centred on the concept of ecosystem-based management to halt the degradation of the marine environment. The management of locations, including the range of human activities affecting them, is a key characteristic of ecosystem-based management and is a marked departure from existing approaches that usually focus on a single species, sectors, or activities. To date, however, no feasible method for translating this attractive concept into operational management practice has emerged. Although a range of measures will be needed to implement the multiple objectives of an ecosystem-based management approach to ocean management, a focus on spatial and temporal aspects, through marine spatial planning (MSP), is one way to make this process more realistic. MSP is a future-oriented activity that can not only directly address conflicts, fragmentation, and spatial mismatches in current ocean management, but also facilitates efforts to adjust governance to the rhythms of human institutions and the dynamics of spatially bounded ecosystems. A new UNESCO programme on ecosystem-based MSP (<http://ioc3.unesco.org/marinesp>) has taken up this idea and is currently developing a comprehensive, operational handbook of principles and guidelines that outlines the steps used to implement MSP. As part of the preparatory work, examples of MSP in Belgium, the Netherlands, Germany, the UK, China, Australia, and New Zealand have been analysed, providing information about what is and is not crucial in the use and application of MSP. The focus of this presentation is to illustrate the results of this analysis and some essential aspects of the new handbook.

Keywords: marine spatial planning, ecosystem approach, integrated management.

Contact author: Fanny Douvère, UNESCO, Intergovernmental Oceanographic Commission/Man and the Biosphere Programme, 1, rue Miollis, 75732 Paris, France [tel: +33674139361, e-mail: f.douvere@unesco.org].

ICES CM 2008/E:25

Using multivariate derived indicators of biodiversity as a tool for marine spatial planning: designating boundaries in time and space

A. Jordaan

It has been suggested that basic units of management should be structured along ecological gradients, as opposed to political ones, and that measures of biodiversity are an important metric of ecosystem health. The aggregation of human activities creates de facto zoning that distributes impacts (i.e. fishing effort) unevenly across the underlying biodiversity. Fisheries-independent surveys are often the most spatially and temporally broad measures of marine species abundance. A number of fisheries surveys will be used to demonstrate how species abundance data can be analysed to provide guidance on marine spatial planning. First, principal component analysis (PCA) bootstrap methodology is used to identify species' assemblages across survey regions using eigenvectors. Second, the PCA scores are tested against spatial and environmental variables to identify important ecological factors. Third, the spatial structure is demonstrated using GIS-generated maps from PCA scores. These can guide spatial planning management decisions by displaying spatial and temporal changes in biodiversity. Trends in biodiversity can be corroborated across common regions when different surveys overlap. Here it is demonstrated that the method can be applied to designating and locating marine

protected areas to effectively protect biodiversity, and that failing to account for biodiversity patterns can create unfavourable conditions. Potential problems caused by the scale of observation of surveys, aggregations of species, and seasonal patterns in habitat use are also identified.

Keywords: ecosystem approach, indicators, ecosystem structure and boundaries, multivariate, principal component analysis, bootstrap, GIS mapping, area-based management.

Contact author: A. Jordaan, Marine Sciences Research Center, Stony Brook University, Stony Brook, NY 11794-5000, USA [tel: +1 631 632 3137, fax: +1 631 632 8915, e-mail: Adrian.Jordaan@sunysb.edu].

ICES CM 2008/E:26

Keeping vulnerable mammals away from fishing grounds: an assessment of the extent of the area required to protect cetaceans from bycatch

Simon Northridge, Al Kingston, and Alice Mackay

Bycatch mitigation is an important goal of fishery management, and marine protected areas (MPAs) may be a method of minimizing cetacean bycatch, by excluding specific fisheries from areas of high cetacean density. However, for highly mobile species such as cetaceans this makes little sense. A more tractable solution may be to exclude the animals from the immediate vicinity of the fishing vessels by using acoustic deterrent devices (pingers). In this case the “MPA” is mobile and moves with the fishing vessels and works by excluding the vulnerable species of concern. The question then arises as to how large an area such animals need to be excluded from, and for how long, and ultimately the degree of exclusion must be balanced against the foraging requirements of the population concerned. Earlier attempts to examine this question have assumed that the area of exclusion around an active pinger is total and well defined. Our experimental work shows that exclusion is not absolute but decreases with distance from an active device. We have calculated the areas of exclusion for dolphins and porpoises under a number of different scenarios involving pingers on static gear and compare these with the total foraging area available in the UK sector of the western English Channel. Results suggest that the area of exclusion is only a small proportion of the total available foraging area if only vessels over 12 m use pingers, while the exclusion area is greatly increased, especially in coastal waters, if all static gear vessels use pingers.

Keywords: MPAs, pingers, bycatch, habitat exclusion.

Contact author: Simon Northridge, Sea Mammal Research Unit, University of St Andrews, St Andrews, Fife KY16, UK [tel: +44 1334 462654, fax: +44 134 462632, e-mail: spn1@st-andrews.ac.uk].

ICES CM 2008/E:27

Integrated approaches to assessment of seabed habitat and biodiversity in support of management on the continental shelf of the Great Barrier Reef

C. R. Pitcher, N. Ellis, W. Venables, T. J. Wassenberg, C. Y. Burrige, F. Pantus, G. P. Smith, M. Browne, P. J. Doherty, J. Hooper, N. A. N. Gribble, and I. R. Poiner

Assessing and understanding continental shelf seabed biodiversity distribution, abundance, and change (with a view to ensuring the future sustainability of marine resources) requires integration of information, methods, and approaches. Providing such information requires rigorous data and presents major challenges. Most areas have no or limited existing knowledge and vessel-based research is expensive, so there is a need for enabling technology, cost-effective science, and multidisciplinary skills. We aim to support effective management and conservation of seabed ecosystems, by synthesizing—in a modelling framework—information about human use; impacts of exploitation; habitat and biodiversity change; and, perhaps most importantly, what and how much marine life is where on the seabed. Our approach is demonstrated by research in the Great Barrier Reef, including: assessing impact on and monitoring recovery of benthos; measuring natural dynamics of sessile megafauna and their role as habitat for other species; mapping seabed habitats and biodiversity; and management strategy modelling, with the human use being bottom trawling for prawns. In addition to multiple traditional sampling techniques and authoritative taxonomy, this research deployed towed video cameras, remotely operated vehicles, acoustics and instruments; applied other large-scale datasets such as remote sensing, oceanographic model output, sediments, and bathymetry; and used modern statistical methods to extend the utility of results through biophysical prediction and mapping. The modelling framework synthesizes >15 years of research outputs and has evaluated the outcomes for benthos of management interventions, such as effort controls and spatial closures, implemented over the last 10 years.

Keywords: effects of trawling, impact, recovery, habitat and biodiversity distribution, management strategy modelling.

Contact author: Roland Pitcher, CSIRO Marine and Atmospheric Research, 233 Middle Street (PO Box 120), Cleveland, Queensland 4163, Australia [tel: +61 (7)3826 7250, fax: +61 (7)3826 7222, e-mail: roland.pitcher@csiro.au].

ICES CM 2008/E:28

Developments in national marine spatial planning systems within the OSPAR Maritime AreaE. Nixon *et al.*

The Bergen Declaration from the 5th North Sea Conference 2002 invited OSPAR to improve arrangements for the exchange of information and national experiences in the spatial planning processes of the North Sea states. In response, the First Joint Ministerial Meeting of the Helsinki and OSPAR Commissions 2003 issued the statement “Towards an Ecosystem Approach to the Management of Human Activities” in which all contracting parties agreed to pursue strategies that would promote cooperation in spatial planning between competent authorities across the entire OSPAR maritime area. As a means of fulfilling this commitment, OSPAR held a number of workshops on marine spatial planning and management and, to facilitate an exchange of information, an Intercessional Working Group on Marine Spatial Planning was formed. One of the tasks of this Group was to prepare an overview of the planning and control systems relevant to coastal and marine spatial planning within the OSPAR maritime area. This overview should be simple but should also recognize the diversity of national systems. Progress to date on this overview is presented.

Keywords: marine spatial planning, OSPAR.

Contact author: Eugene Nixon, Marine Institute, 80 Harcourt Street, Dublin 2, Ireland [tel: 00 353 1 4766500, e-mail Eugene.nixon@marine.ie].

ICES CM 2008/E:29

Assessing the performance of marine plans

Jo Foden, Stuart I. Rogers, and Andrew P. Jones

An important component of effective marine spatial planning is the ability to monitor and assess the performance of the plan against national and regional goals and objectives. Such performance assessment systems describe agreed methods for monitoring and assessing the status of ecosystem components, and provide managers with a coordinated mechanism for providing evidence of the effectiveness of the planning process, and the achievement of social, economic, and conservation targets. This paper describes recent progress in Europe with the identification of ecosystem goals for regional seas that will form the basis of the marine plans for Member States. It then reviews a variety of published examples of ecosystem assessments in fresh-water, estuarine, and fully marine environments, at local, national, international, and global scales. The overview shows a surprising lack of consistent terminology currently used to describe and differentiate different types of assessment. In particular the terms “ecosystem” and “integrated” were often misused. Some so-called ecosystem assessments do not in fact incorporate abiotic parameters, and some “integrated” assessments analyse parameters independently, with no attempt to analyse drivers and linkages between them. Clear definitions of assessment terminology are suggested that consolidate existing proposals. A new classification system is also proposed, based on the environmental components considered, the methodologies and nature of the linkages between components, and the inclusion or exclusion of socio-economic factors. The paper concludes by presenting an outline performance assessment system that shows how explicit goals and a clear approach to assessment will be fundamental components of effective marine planning.

Keywords: integrated assessment, performance assessment.

Contact author: Jo Foden [tel: +44 (0) 01603 591343, fax: +44 (0) 1603 591327, e-mail address: jo.foden@uea.ac.uk].

ICES CM 2008/E:30

ICES EcoSystemData—providing data for the ecosystem approach

Hans Mose Jensen and Carlos Pinto

In response to the data management implications of ecosystem approach-based assessments, the ICES Data Centre has undergone several changes within the last few years. Key initiatives undertaken by the ICES Data Centre include the EcoSystemData system and the development of integrated data structures. These initiatives are designed to improve our support of integrated data requests covering diverse scientific topics. By joining physical, chemical, and biological measurements into one system, data can be queried and analysed in ways that would have been far more difficult and cumbersome in previous disjointed data structures. One of the main challenges has been to design user-friendly interfaces for the system and at the same time to allow data to be viewed and queried in sufficient detail to accommodate the complexity of the data. By using visual tools like maps, charts and tables, data can be previewed and analysed prior to extraction across data disciplines. The aim is to achieve efficient data access for our data users and attract

new users of the data (including those for non-scientific purposes). Also, users of the system should be able to take advantage of the integrated data structure when accessing the system.

Keywords: integrated management, ecosystem data, geographical information system.

Contact author: Hans Mose Jensen, ICES, H. C. Andersens Blv. 44-46, DK-1553 Copenhagen V, Denmark [tel: +45 33386736, e-mail: hans.jensen@ices.dk].

ICES CM 2008/E:31

Marine spatial planning on the Scotian Shelf (Nova Scotia, Canada)

Tim Hall and Glen Herbert

The 1996 Oceans Act and its supporting policy statement, *Canada's Oceans Strategy*, provide the national legal and policy context for integrated ocean management in Canada. Under the Oceans Act, Fisheries and Oceans Canada (DFO) is the lead federal authority for ocean affairs and is charged with leading and facilitating the development and implementation of integrated management plans for all marine waters. Integrated management efforts in Canada are being undertaken through an area-based approach that allows marine planning, management, and decision-making to occur at appropriate spatial scales, from regional to site-specific. It also promotes the consideration of various interactions among human activities, and between those activities and the environment. This presentation focuses on the Eastern Scotian Shelf Integrated Management (ESSIM) process, an offshore-focused effort to develop an integrated ocean management plan for a large portion of the Scotian Shelf, off Nova Scotia. The resulting ESSIM plan has been developed through a collaborative process involving all interested and affected government departments and ocean stakeholders. The ESSIM plan provides an objectives-based approach to ocean management. It contains a set of long-term, overarching goals for collaborative governance and integrated management, sustainable human use, and healthy ecosystems. These goals are supported by more specific objectives that express desired outcomes and conditions for the marine region. The objectives-based approach seeks to ensure that interrelationships among ecosystem and human use objectives are recognized and reflected in the identification of management strategies and supporting actions.

A number of the management objectives identified in the ESSIM plan can be addressed through spatial planning and management approaches. A significant amount of work is being undertaken to map and understand patterns of ocean use, identify and characterize spatial and temporal interactions, and develop tools to predict, avoid and resolve multiple use conflicts. Key examples include the need to address interactions between commercial fisheries and oil and gas activities, or with submarine cables and pipelines. In addition, a number of government and non-government partners are working together on an action plan focused on spatial conservation planning. This action plan is developing inventories of existing and legislated area-based conservation measures (ranging from voluntary to regulatory-based measures), areas of conservation value, and tools that can be used in spatial conservation planning. The intent is to build on existing conservation measures, using enhanced stewardship and management where necessary. Additional areas will also be identified as opportunities for conservation action by the responsible government agencies, by industry sectors on a voluntary basis, or by community-led conservation approaches.

Within the broader context of marine spatial conservation planning, Fisheries and Oceans Canada is leading the design of a network of federal marine protected areas for the region. The information collected and analysed through the ESSIM planning process will provide important information and guidance for the identification of appropriate and effective sites within this future protected areas network.

This presentation concludes by drawing out key lessons learned to date through the ESSIM process for marine spatial planning and with a look to the future in terms of the development of tool and approaches for this integral aspect of integrated ocean management.

Keywords: Spatial Planning, Integrated Management.

Contact author: Tim Hall, Oceans and Habitat Branch, Fisheries and Oceans Canada (Maritimes Region), Dartmouth, Nova Scotia, Canada [e-mail: halltj@mar.dfo-mpo.gc.ca].

ICES CM 2008/E:33

Poster

Application of spatial multicriteria evaluation with AHP method for coastal sensitivity assessment

Rozita Sharifipour and Afshin Danehkar

Assessing the sensitivity of coasts involves investigation of the extraordinary biological richness of coasts away from polluting sources using specified and predetermined standards and criteria. For this purpose, the limit subject of study was first defined with respect to the most recent findings of the plan for the integrated management of the coastal zone. Then a new model was planned, using spatial multicriteria evaluation (SMCE) to select areas under protection in the coastline by adopting the Analytical of Hierarchy Process (AHP) and ArcGIS software. This linear mathematical model was then used to assess the intrinsic sensitivity

of the region and the vulnerability of the region with respect to polluting sources and, ultimately, to assess the sensitivity of the region to determine the areas under the protection of the Department of the Environment in the geographic information system under ArcGIS program. In the new model, the value of factors that affect sensitivity were not employed homogeneously and instead, the value and importance of each factor were specified with respect to the sensitivity entering the environment by determining weight factors. In total, in the region of study, 2994.21 hectares were found to have very high sensitivity, 2701.76 hectares high sensitivity, 42124.19 hectares an average sensitivity, and 290 056.80 low sensitivity.

Keywords: sensitivity assessment, Analytical Hierarchical Process (AHP), spatial multi criteria evaluation (SMCE), geographical information system (GIS), Boushehr, environmental management, coastal zone.

Contact author: Rozita Sharifipour, No 40, Boostan 1, Farahzadi Blv, Shahrak Qarb Sq, Tehran, Iran [tel: +98 21 88088671, fax: +98 21 88844494, e-mail: sharify203@yahoo.com].

ICES CM 208/E:35

Poster

Requirements of VMS for assessing the impact of fishing

F. van der Hulst, G. J. Piet, and N. Hintzen

Fishing is considered to be the human activity with the largest impact on the marine ecosystem. Because fishing is known to have a patchy distribution there is a need for high-resolution spatial data on fishing activity to assess the effects of fishing. Vessel monitoring through satellite (VMS) is usually the source of this type of information. Prior to VMS the Netherlands started a monitoring programme in 1993 consisting of vessels equipped with automatic position registration (APR) devices. This long time-series of data collected using different techniques is used to evaluate the usefulness of the information coming from VMS to determine fishing impact and suggest how this can be improved.

Keywords: fishing activity, fishing impact, VMS.

Contact author: Foreno van der Hulst, Wageningen Imares, Haringkade 1, PO box 68 1970 AB IJmuiden, The Netherlands [tel: +31 317 486 997, e-mail: foreno.vanderhulst@wur.nl].

ICES CM 2008/E:36

Poster

What can we learn from a century of fisheries off Portugal using spectral analysis?

M. F. Borges, H. Mendes, J. Caiado, and N. Crato

How do historical time-series of fisheries on the main species exploited over the shelf of Portugal behave and how were they obtained in the first place? The data on sardine, horse mackerel, chub mackerel, anchovy, and hake caught in the Portuguese shelf were analysed for the period 1927–2006. Does the dynamic behaviour of a species dataserie change with time and are there significant regional differences? Are there possible links with climate variability dataserie? This paper presents the results of spectral analysis methods applied to attempt to answer these questions. All species presented a low-frequency periodicity of about 20 years, which seems to be linked to the Winter North Atlantic Oscillation Index. Possible mechanisms are discussed.

Keywords: catches, fish species, fisheries, environmental indices, climate, variability, Portugal, sardine, horse mackerel, chub mackerel, anchovy, spectral analysis, periodogram, cross-spectrum.

Contact author: M. F. Borges. IPIMAR/INRB, Avenida Brasilia 1449-006, Lisboa, Portugal [tel: +351 21 3027098, e-mail: mfborges@ipimar.pt].

ICES CM 2008/E:37

Poster

Policy analysis of the “MPA-process” in temperate continental shelf areas

Marijn Rabaut, Steven Degraer, Jan Schrijvers, Sofie Deros, Dirk Bogaert, Frank Maes, Magda Vincx, and An Cliquet

The policy to designate, implement, and manage marine protected areas (MPAs) is often *ad hoc* without clear guiding procedures. This study evaluates the establishment and management of MPAs in temperate soft-bottom marine areas, including the identification of objectives, site selection, designation, implementation, ecological effectiveness, and socio-economic impacts. For the first time, the literature on marine conservation strategies in soft-bottom temperate areas is brought together in one “systems approach” that provides answers to questions regarding the effectiveness of MPAs. This is visualized in a flowchart including three phases: setting policy objectives, making decisions, and evaluating the eventual effects of the MPA. Policy objectives are easy to identify, in general, and in most cases national policy objectives are driven by international obligations. The decision-making process is the most complex phase, as the acceptance of MPAs has to be balanced against the human activities that take place in the area. The relationship between fisheries and MPA management appears to be most challenging in soft-bottom temperate marine areas because of conflicting

interests and institutional differences. Activities limited in space and not relying directly on ecosystem functions (e.g. offshore energy production and aggregate extraction) are generally easier to manage than fisheries. The "systems approach" was applied to the Belgian coastal environment and has proved to be useful in providing insight into the complex interactions of various authorities with scattered jurisdictions. The relationship between ecology, habitat protection, and beam trawl fisheries appears to be crucial.

Keywords: MPA process, policy, systems approach, fisheries, ecology, legalities, soft-bottom marine areas.

Contact author: Marijn Rabaut, Ghent University (UGent), Biology Department, Marine Biology Section, Sterre Campus, Krijgslaan 281-S8, B-9000 Ghent, Belgium [tel: +32 9 2648533 fax: +32 9 2648598, e-mail: Marijn.Rabaut@UGent.be].

ICES CM 2008/E:40 Poster

Interpolation of vessel trajectory from vessel monitoring system data

N. T. Hintzen and T. Brunel

Satellite-based vessel monitoring systems (VMS) were originally designed for fishery control and enforcement, but they also provide potentially valuable source information on spatial and temporal patterns of fishing activity. With VMS, information on vessel position, speed, and heading are sent every 2 hours. On some occasions, however, this resolution has proven to be too low to measure fishing activity and impact precisely. Therefore a method is developed to interpolate vessel trajectories from VMS data points to obtain high-resolution data on vessel trajectories. The method is based on a spline interpolation technique, using GPS positions, heading, and speed to interpolate the trajectory of a vessel between two succeeding VMS data points. To take account of the uncertainty of the interpolated trajectory, the method also produces a confidence interval, representing the spatial distribution of the probability of presence of the vessel during the time interval between two VMS positions.

Keywords: VMS, vessel movement, interpolation, fishing impact.

Contact author: N T Hintzen, Wageningen IMARES, Haringkade 1, 1976CP IJmuiden, The Netherlands [tel: +31 317 487090, fax: +31 317 487326, e-mail: niels.hintzen@wur.nl].

ICES CM 2008/E:42 Poster

You are what you eat ... whenever you eat it: an integrative analysis of fish food habits across different seasons in eastern US and Canadian waters

Alida Bundy, Jason Link, Brian Smith, and Adam Cook

How much does fish diet change across seasons, particularly over broad scales? Few multi-seasonal trophic studies exist over large areas to address this question. We examined this question for the first time in temperate, contiguous Northwest Atlantic waters by comparing food habit data for 10 species of fish collected concurrently during the spring and autumn surveys in the USA (Gulf of Maine proper and Georges Bank) and in the summer survey in Canada (western Scotian Shelf/Bay of Fundy) over the past 10 years. The US and Canadian samples were collected from slightly different but largely overlapping regions; as such we treat them as representative of the broader Gulf of Maine area. For most species, there was a general concurrence between the three seasons: summer diets had the same dominant prey items as spring and autumn diets. Although a suite of multivariate analyses did elucidate some differences in specific proportions of the diet for these species across seasons, again the main prey did not substantially change for most of these species. These results suggest that (i) these fish have a preference for specific prey items, and (ii) the prey field is relatively consistent for these species in this part of the Atlantic. Many fishery ecosystem and multispecies models are dependent upon food habit data where resolving seasonal differences in diet remains an important consideration; however, the present work implies that amalgamated estimates of diet from seasonal surveys may be a reasonable approach when no finer seasonal resolution exists.

Keywords: food habits, seasonal comparison, multivariate analysis.

Contact author: Alida Bundy, Fisheries and Oceans, Canada, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2 [tel: +902 426 8353, fax: +902 426 1506, e-mail: bundya@mar.dfo-mpo.gc.ca].

ICES CM 2008/E :43 Poster

Rotational management of Atlantic sea scallops (*Placopecten magellanicus*) in theory and practice

Deborah R. Hart

The US sea scallop fishery in the Northwest Atlantic is one of the most valuable fisheries in the USA and the most valuable wild scallop fishery in the world. Rotational closures (i.e. closures followed by reopenings)

have been an important component of US sea scallop management since 1994. Rotational fishing of sea scallops on average increases yield and biomass per recruit only slightly near F_{\max} , the fishing mortality that maximizes yield per recruit. However, rotation gives greater gains under overfished conditions or when a closure is timed to benefit a large year class. A spatially explicit simulation model is described that is used to analyse adaptive rotational management, where closures are triggered by observations of strong recruitment in the area. This theory is then compared with the observed experiences of rotational management in the US sea scallop fishery, including both multispecies closures on Georges Bank and adaptive closures for sea scallops only in the Mid-Atlantic Bight. Although there have been a few failures, the rotational areas have generally generated higher landings following their initial closure than before the commencement of rotational management. Rotational management has been a major factor contributing to the marked increase in sea scallop biomass and landings during recent years.

Keywords: rotational fishing, *Placopecten magellanicus*, spatial fishery management, scallop fisheries.

Contact author: Deborah R. Hart, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543, USA [tel: +1 508 495 2369, fax: +1 508 495 2393, e-mail: Deborah.Hart@noaa.gov].

ICES CM 2008/E:44 Poster

Baltic fisheries as a spatial resource

Robert Aps, J. Kotta, and K. Herkül

Marine spatial planning (MSP) is seen as a tool that allows integrated, forward-looking, and consistent decision-making on the use of the sea, taking account of environmental as well as social and economic objectives. In the fisheries context, MSP is believed to promote the sustainable use of living resources of the sea, to provide security for existing fishing possibilities and systems of fishery resource allocation, and to aid in the implementation of ecosystem-based management. The presentation of baseline spatial information is seen as an important precondition in bringing the Baltic fishery into the MSP context. This paper attempts to map some spatial patterns of allocation, use, and conservation measures of the Baltic internationally regulated fishery resources (herring, sprat, and cod) using ArcView and ArcGIS Spatial Analyst software for data editing, map generation, analysis, and visualization. Some problems in the identification of priority areas of fishing to support and protect fisheries interests in the context of MSP are discussed.

Keywords: marine spatial planning, Baltic fisheries, fisheries interests.

Contact author: Robert Aps, Estonian Marine Institute, University of Tartu, 10A Maealuse Str., 12618 Tallinn, Estonia [tel: +37 25062597, fax: +37 26718900, e-mail: robert.aps@ut.ee].

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Incidental take of seabirds on longlines in the North Atlantic

J. Reid, T. Anker-Nilssen, J. Arcos, R. Barrett, J. Chardine, E. Dunn, J. Fric, R. Furness, O. Hüppop, M. Nunes, B. Olsen, I. Ramirez, and R. Veit

Mortality of seabirds occurs in longline fisheries because they become hooked while attempting to feed on bait. The criteria previously used by national governments to assess the extent of this incidental catch of seabirds in their waters are reviewed with reference to the extent of the problem in European Union waters. Although there are too few data to inform the degree to which seabird populations in the EU (and within individual ICES Areas and other European seas) are being affected by mortality in longline fisheries, information is provided to indicate that there is indeed a problem. The problem would appear to be especially acute in the Mediterranean. This indicates that some form of remedial action might be required. Potential mitigation measures are reviewed and various actions and research are discussed, including the immediate need to quantify seabird bycatch more precisely.

Keywords: seabirds, longlines, bycatch, incidental take.

Contact author: John Chardine, Science and Technology Branch, Environment Canada, PO Box 6227, Sackville, NB, Canada E4L 1G6 [tel: +1 506 364 5046, fax: +1 506 364 5062, e-mail: john.chardine@ec.gc.ca].