

Theme Session C

Developing the ecosystem approach to the management of human activities in the Baltic Sea

ICES CM 2007/C:01

Implementation of ecosystem approach to the management of human activities in the Baltic Sea by the Helsinki Commission

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The 2003 joint HELCOM/OSPAR Ministerial Declaration put ecosystems at the centre of the approach of the Commissions in protecting their regional seas. Since that the Helsinki Commission, HELCOM, has worked towards implementation of the Ecosystem Approach in the Baltic Sea area.

The Commission has adopted a system of vision, strategic goals and ecological objectives as the backbone for the HELCOM Baltic Sea Action Plan. They have been defined together with a wide range of stakeholders to reflect the common vision of a healthy Baltic Sea, with balanced ecosystems also able to support sustainable economic activities. The Action Plan is the HELCOM tool in implementing the Ecosystem Approach. Currently HELCOM is in the process of defining targets for good ecological status and favourable status of biodiversity of the Baltic Sea as well as having the final series of consultations and drafting sessions before the adoption of the actions needed to reach the targets at the HELCOM Ministerial Meeting, scheduled for 15 November 2007. The management decisions and resulting actions should be based on sound scientific advice. It is a challenge to the scientific community to provide timely and understandable advice as well as to the decision makers to accept the advice.

The aim of this paper is to explain the role of HELCOM in bridging the gap between the scientific and management communities and to stimulate discussions how the gap can be removed.

Keywords: Baltic Sea, ecosystem approach, ecological objectives, good ecological status, favourable status of biodiversity.

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Using biological knowledge and decisions of society in spatial prioritization of oil combating

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Scientists and managers are perhaps more often than they realize confronted with questions concerning nature valuation, at least in relative terms. In oil spill compensation assessment, for instance, the amount of money the polluter has to pay for to compensate the loss is defined in dollars. It is however difficult or even impossible to put a price tag on some ecological values. A Finnish-Estonian Interreg IIIA project OILECO constructs a ranking system for populations to be used when there is a need to prioritize oil combating in the Gulf of Finland. Because of limited time and resources for oil combating after the oil accident, fast and difficult decisions have to be made on which populations should be safeguarded. Aesthetic and economic values have often had more weight than e.g. recoverability of species. This has led to the neglect of e.g. threatened plant and other taxa that can be as severely affected by oil spills. We suggest that the aim should be to minimize long term effects on the populations and therefore the ecological role, rarity and genetic uniqueness (probability to lose a genetically adapted population) of species should be used as a basis for valuation instead of aesthetic or economic values that can more readily recover after the oil accident. We use the decisions already made in the society to evaluate, which species should be considered to be more important than others. These decisions include e.g. nature conservation areas and the species' status in the IUCN classification and EU legislation.

Keywords: valuation, nature, oil spill, recovery potential, threatened species, prioritization.

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ICES CM 2007/C:03

Zooplankton indicators of eutrophication and productivity for the Baltic Sea

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The paper summarises results of the GEF funded Baltic Sea Regional Project (BSRP) search for successful and reliable indicators of eutrophication and productivity for the Baltic Sea.

Zooplankton plays an important role in the pelagic food web by limiting phytoplankton production. It is also critical for fish early life history stages survival and growth.

Zooplankton data provide fundamental information on the dynamics and functioning of the Baltic Sea ecosystem. In this respect the project offered a unique opportunity for cooperation between traditional productivity monitoring specialists and fishery scientists.

Results of various analyses covering the Central Baltic Sea, Gulf of Finland, and Gulf of Riga will be presented.

Basically, our results are showing only limited correlation with potential 'eutrophication' factors like winter nutrient concentrations, Secchi depth or chlorophyll a concentrations. On the other hand zooplankton might be very useful indicator of productivity being significantly related with recruitment of many fish stocks.

Keywords: zooplankton, indicators, productivity, Baltic Sea.

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ICES CM 2007/C:04

Average salinity as an index for environmental forcing on cod recruitment in the Baltic Sea

Outi Heikinheimo

Annual average salinity in deep water layers of the Baltic Sea was found to be a suitable index for environmental forcing that largely determines the level of recruitment of cod (*Gadus morhua*). Ricker's stock-recruitment equation with annually averaged salinity in the deepest basin of the central Baltic as an environmental factor explained 85% of the interannual variation in the recruitment of cod from 1974--2004. The reproductive volume index, which has commonly been used as an environmental variable in stock-recruitment models for Baltic cod, based on salinity and oxygen concentrations in the reproduction areas, does not provide such a high coefficient of determination. This finding is useful for multispecies modelling of the Baltic fish stocks, and also supports the hypothesis that hydrographic conditions play a dominant role in the recruitment success of cod. Predation on cod eggs and early stages by sprat (*Sprattus sprattus*) and Baltic herring (*Clupea harengus*) would thus be less significant as a regulating factor.

Keywords: cod, *Gadus morhua*, Baltic Sea, recruitment, salinity.

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Natural and anthropogenic background for development of ecosystem-based management in the Baltic Sea

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In the integrated management of human activities for sustainable exploitation of ecosystems in the Baltic Sea, the following issues should be taken into account:

- It is a young sea in the stage of rapid development of ecosystems;
- Its brackish water ecosystems differ from other areas of the World Ocean;
- Baltic ecosystems are highly vulnerable and unique as components of human environment;
- The productivity of once oligotrophic Baltic Sea has increased, especially during the last half-century, mainly due to anthropogenic impacts.

Sustainable management based on political agreements and international cooperation with social and educational problems in view, should be implemented. Two new basic ideas should be followed:

- The management should be implemented by natural ecosystem units of the Baltic Sea. The main negative effects of human activity differ by the regions and in time;

- Long-term forecast system on the state of the Baltic Sea ecosystems and resources based on the periodicity of climate changes should be further developed.

Integrated education of specialists in the evolution of ecosystems, socio-economics, ethics etc for the assessment and management is of key importance.

Keywords: ecosystem-based management, Baltic Sea, natural regions, ecosystems, climate change, human impacts.

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Some results of the ICES/BSRP SGEH approach to ecosystem-based management of the Baltic Sea

Eugeniusz Andrulewicz

ICES/BSRP Study Group on Ecosystem Health (SGEH) have been developing ecosystem health assessment concept in relation to the most important Baltic concerns: excessive eutrophication, contamination, overfishing and biodiversity loss. In addition, SGEH has been developing an assessment tools for these concerns: EcoQOs, indicators and reference conditions/values. From a large number of proposed ecosystem health indicators (after applying selection criteria) some limited number of priority indicators have been selected. They will be used for the ecosystem health assessments in the demonstration areas. They are also offered to HELCOM for application in the Baltic Monitoring Programme and ecosystem health assessments under the Baltic Sea Action Plan (BSAP).

Apart from that, a number of ecosystem-based related activities were undertaken by SGEH: workshop on fish health and fish diseases, an attempt to develop socio-economic indicators, conceptual paper on human health aspects in relation to the quality of marine environment, an approach to assess genetic diversity and an attempt to develop indices.

A number of eastern Baltic experts received BSRP support for scientific and technical capacity building to be able to participate in Baltic Monitoring Programme and HELCOM ecosystem health assessment activities.

Keywords: Baltic Sea, ecosystem-based management, ecosystem health, fish diseases.

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ICES CM 2007/C:07

EVAGULF – Protection of aquatic communities in the Gulf of Finland: risk-based policymaking

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Most of the analyses related to eutrophication focus on cyanobacterial blooms or increased primary production. However, eutrophication may also lead to disappearance of species, which is a real risk to the ecosystem. In this paper, we introduce the first version of a decision model that takes into account the biodiversity risks of eutrophication. The model is being developed within the EVAGULF project and it will also include a Bayesian classification tool for water areas, needed in the implementation of the EU water framework directive. Existing monitoring databases, knowledge from published literature and expert knowledge will be integrated and analysed by Bayesian risk assessment methodology. The selected computational methods enable combining data that are of different nature as well as concrete elucidation of benefits and risks associated with alternative management decisions. The anticipated results will enable determining the factors that are likely to cause changes in the occurrence of species and the effects of abatement measures: e.g. which populations can be managed only by national management actions and in which cases international co-operation is needed to achieve the objectives. This knowledge will enable more cost-effective use of the available financial resources.

Keywords: eutrophication, risk assessment, Bayesian methodology.

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Cultivation of green macroalgae – a method for de-eutrophication of coastal waters in the Gulf of Finland, Baltic Sea

Nikolay Kovalchuk

This abstract presents the results of experiments on the possibility of de-eutrophication of coastal waters of the Gulf of Finland highly affected by domestic sewages, agricultural activities, etc. The concept was to reduce the level of eutrophication by cultivation of green macroalgae and subsequently regular harvest of the produced biomass. Effects on the coastal ecosystem are 1) nutrient uptake by macroalgae, 2) aeration of the water column, which is especially important during the regular algae blooms in the Gulf of Finland. We obtain the next data:

- 1) Green macroalgae *Cladophora glomerata*, *Enteromorpha intestinalis* and *E. prolifera* grow well on artificial substrates (nets and ropes) in eastern part on the Gulf of Finland.
- 2) In the seaweed communities formed on artificial substrates *Cladophora glomerata* (at salinities from 0 to 2 ‰), and *Enteromorpha intestinalis* + *Enteromorpha prolifera* (at salinities from 2 to 4 ‰) dominated.
- 3) Experiments to obtain *Enteromorpha*'s zoospore suspension and to infect nets and ropes with the zoospores gave positive results in areas with salinities of 2-4 ‰.
- 4) The yield about 49000 kg fresh weight from *Cladophora* and 62000-87000 kg fresh weight from *Enteromorpha* may be taken from one hectare of plantation in the Gulf of Finland in the period from May to September (the algae planting in October is not rational because of little yield).

Keywords: de-eutrophication; aquaculture; green macroalgae.

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Structure and functioning of plankton communities in the Baltic Sea along the scheduled route pipeline "Nord Stream"

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In October 2005, April-May and July-August 2006 the researches of species composition, spatial and seasonal variability of phytoplankton, zooplankton, primary production, chlorophyll, chemical and hydrological parameters were carried out to provide the current characteristics of the Baltic Sea environment. Complex engineering-ecological survey was fulfilled by AtlantNIRO within the frames of "Nord Stream" project under the program of «Petergas». The studies were carried out at 47-89 stations along the proposed pipeline from the Gulf of Finland (60°07'N; 26°59'E) to the Arkona Sea (54°32'N; 14°04'E), as well as at series of HELCOM monitoring stations. The methods of multivariate statistic analysis, including the cluster analysis, were applied to identify communities and to analyze the environment factors effect. Plankton communities were characterized with considerable seasonal variability and spatial heterogeneity of phytoplankton and zooplankton species composition, abundance, biomass and productivity distribution. In the spatial distribution of phytoplankton and zooplankton 3-4 communities associated with the Gulf of Finland, the Central and Southern Baltic Proper were observed in different biological seasons. In the study period relatively low eutrophication according to the classification adopted in the Baltic countries were recorded. The increase of phytoplankton abundance and production was observed in the more eutrophicated areas - Gulf of Finland and the Arkona Sea, which may be explained with shallow depths and nutrients input from the coastal zone. No direct impact of the water pollution on plankton communities was revealed. The analysis of phytoplankton and zooplankton species composition, abundance, biomass, primary production relationship to 20 hydrological and chemical parameters indicated the strongest effect of such environment factors as the water salinity and temperature, concentration of silicon, ammonia nitrogen, phosphates. Phytoplankton abundance and production indices positively correlated with each other and negatively correlated with zooplankton abundance.

Keywords: the Baltic Sea, phytoplankton, zooplankton, primary production, eutrophication, pipeline.

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Net Environmental Benefit Analysis - linking ecological values in the decision making process on oil spill response in the Gulf of Finland (Baltic Sea)

Robert Aps, J. Kotta, R. Leiger, G. Martin, T. Saat, Ü. Suursaar, and E. Tulk

At International Maritime Organization's (IMO) Marine Environment Protection Committee's 53rd session in July 2005, the Baltic Sea was designated as a Particularly Sensitive Sea Area (PSSA). At the same time the oil transportation is growing significantly in the Baltic Sea area and especially in the Gulf of Finland

exceeding 200 million tons a year by 2010. Aim of the paper is to use the oil incident modeling framework to simulate the Net Environmental Benefit Analysis (NEBA) as a method to determine the most appropriate response options in order to minimize the overall environmental impact of an oil spill in the Gulf of Finland. Seatrack Web is used to simulate the spilled oil movement under the forcing fields provided by the weather model HIRLAM and the ocean model HIROMB. Incident response simulator PISCES II linked with Vessel Traffic System is used to simulate oil spill response options. Weather and sea input conditions for PISCES II simulations are calculated by Seatrack Web. GIS layers of ecological sensitivity maps are used to evaluate the sensitivity of particular marine and coastal natural resources and habitats to oil pollution. NEBA is simulated as a continuous evaluation and decision-making process that is repeated during an incident simulation in the light of changing information concerning the behavior of spilled oil, the overall environmental impact, and the effectiveness of the activated response technique.

Keywords: Net Environmental Benefit Analysis, oil spill response simulation, Gulf of Finland (Baltic Sea)

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Interactions between cod, herring and sprat in the Baltic Sea, simulated with a robust dynamic model

Outi Heikinheimo

The interactions between cod (*Gadus morhua*), herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) in the Baltic Sea were examined by simulation with a robust dynamic model, an alternative to more complicated and data-demanding multispecies models. The main targets of the study were to find out structural uncertainties of the system and sensitivity of the model output to key parameter values. The results were then compared to the predictions made with the forward calculating multispecies model used by ICES for fish stock assessment in the Baltic Sea. The model output was sensitive to the functional response in predation by cod on herring and sprat. The type II functional response led to a collapse of the clupeid stocks when cod was abundant, while the type III response produced more plausible stock dynamics. According to the simulation, an abundant cod stock was able to keep the sprat stock at a low level. Herring was less affected. The functional response was the most important source of differences in the results obtained with the dynamic model compared to the ICES multispecies model.

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How does catching of grey seal (*Halichoerus grypus*) from the Bothnian Bay spring ice influence the population structure of seals and the local fish stocks?

Olavi Stenman

The traditional seal hunting on the Bothnian Bay spring ice (16th of April – 31st of May) resulted in a total of 136 grey seals shot in years 2003–2004. Hunters were obliged to deliver several samples from every individual killed: the uterus or the baculum, under jaw (for age determination from layers in cement of the canine teeth) and the alimentary tract.

Of the total catch, 71% were females, and of these 78% individuals aged more than 5 years old, which is the normal age in sexual maturity. This kind of sex and age ratio in the catch fits well with the population management regime that only aims to diminish the amount of seals. However, it is disadvantageous if the goal is to preserve the normal population structure among seals. Therefore, since the hunting quotas will most likely increase in the coming years, recommendations should be given to the hunters to favour the young grey seals as a catch.

The analysis of the contents of the alimentary tract using otoliths and other hard particles showed that the herring (*Clupea harengus*) was clearly the most important prey item in the sea, where no fishing took place because of the floating ice. Herring was found in 103 grey seals (83.1%); the amount varied between 1–309 individuals and was on average 41.1 ± 62.6 . Four grey seals (3.2%) had eaten 1–2 salmon/trout (*Salmo salar/trutta*) and two seals (1.6%) 1–3 whitefish (*Coregonus lavaretus*). In addition nine other fish species were found in very limited numbers. The results show that hunting of grey seals on the spring ice in the Bothnian Bay has an influence on the herring stock, but it does not, at least directly, help the management of the salmon stock.

The paper discusses also the advantage of shooting young individuals and the size classes of fishes eaten by grey seals.

Keywords: Bothnian Bay, spring ice, grey seal, hunting, population structure, foraging.

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Improvements of acoustic survey to support ecosystem-based management of marine resource for the Baltic Sea

V.N. Feldman and S.M. Kasatkina

The authors discussed three basic steps towards improving the Baltic International Acoustic Survey (BIAS) to support ecosystem-based management of marine resources.

The first step is the modification of the BIAS survey into the Baltic International Ecosystem Survey (BIES) applying advanced acoustic techniques for characterization and classification of the Pelagic Ecosystem over a broad range of spatial and temporal scales with emphasis on species identification by multifrequency methods. BIES will provide quantitative assessments of not only target fish species, but also organisms being at the various trophic levels of the pelagic ecosystem, as well as facilitates the improved understanding of the relation between the environmental characteristics and spatial and temporal dynamics of the pelagic ecosystem organisms.

The second step is the integration of advanced data processing methods into the methodology of the Baltic International Survey for quantifying and summarizing the survey uncertainty. In compliance with ICES activities, these errors must be incorporated into ecosystem analysis and accounted for in stock assessment models and management advice. Estimating the BIAS uncertainty applying simulation, classical geostatistics and Bayesian Maximum Entropy method are demonstrated. The third step is the combining the acoustic survey data with the commercial statistics and analytical methods of the trawl fishery for the ecosystem-based rational exploitation of marine resource. It is demonstrated the possibility to estimate the biomass in the fishing grounds, expected catches of different trawl-trawler systems, the allowable fishing effort in line with predetermined allowable removal fractions and etc. The investigations already fulfilled in the frames of BSRP in 2004–2007 are shown.

Keywords: ecosystem-based management of marine resource, acoustic survey, data processing.

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ICES CM 2007/C:15

Dynamics of biodiversity in the eastern Gulf of Finland (Baltic Sea): the role of climatic and anthropogenic factors

Sergey Golubkov

Assessment of biological diversity of the Neva Estuary (eastern Gulf of Finland), which is one of the largest Baltic estuaries affected by very high human activity, has been conducted applying BSRP SGEH indicators. Biodiversity status of most indicators ranges from moderate to poor. Especially low status was estimated for communities of the coastal zone. Alien species and eutrophication are the most important threats to biodiversity of the Neva Estuary. At present, alien species contribute about 8 per cent of species richness and 60 - 90 per cent of biomass of the bottom animal communities. Climatic mediated fluctuations in the River Neva runoff and near bottom oxygen conditions are the main natural factor responsible for the dynamics of benthic and planktonic communities in the open waters of the estuary. These fluctuations also lead to decline of aboriginal and prosperity of invasive species. Filamentous algae blooms and macroalgal floating mats affect biodiversity dynamics in shallow littoral zone. Large-scale digging and dumping of bottom sediments connected with constructions of new lands, ports and oil terminals are the main factor affected fish and submerged macrophyte communities. Most of fish spawning grounds in the shallow Neva Bay were lost during the last few years. Construction of 22 km long flood protection dam in the lower part of the Neva Bay led to expansion of reeds and prosperity of waterfowl. New protected areas are supposed to be established in the reed zones and on the islands of the eastern Gulf of Finland.

Keywords: biodiversity, alien species, climatic factors, eutrophication, anthropogenic impact.

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Mapping and Classifying the Marine Habitats of the Archipelago Sea, the northern Baltic Sea

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We show the methods used and the results of marine habitat mapping project (VALKO) from the Archipelago Sea, the northern Baltic Sea. The VALKO -project is part of the Finnish Inventory Programme for the Underwater Marine Environment (VELMU). VALKO is a co-operative project between a numbers of authorities. GTK coordinates the project, which main objective is to produce marine habitat data from the Archipelago Sea. In addition one of the aims is to develop a collaboration model for the implementation of the geological and biological field inventories. These results and experiences will be used to prepare a plan of action for the inventories in the other sea areas. Our approach is hierarchical. Broader areas are first mapped with remote methods to obtain the geophysical parameters like depth, substrate, fetch and salinity. The resulting maps are then used to target the fine-scale methods, such as remote video census and SCUBA diving. For extrapolating the fine-scale observations, we use habitat modelling with case-based reasoning (CBR). The resulting maps show the existence probabilities of the different habitat types. We classify the marine habitats according to the EUNIS (European Nature Information System) Habitat classification system. As this is not yet complete for the Baltic Sea, we use a classification tool BalMar (Key and definitions available at: <http://alleco.fi>) to get the necessary parameters for determining the EUNIS habitat types or - if not existing - to create new habitat descriptions that fit in to the EUNIS logic and can be added to it later.

Keywords: Marine Habitat Mapping, Habitat Modelling, Habitat Classification, EUNIS, BalMar, the Baltic Sea.

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ICES CM 2007/C:17

What did Baltic Sea science produce in the years 2002–2006 and what did it cost?

Pauli Snoeijis, Kaisa Kononen, and Christopher C. E. Hopkins

We document and critically analyse the current Baltic Sea research volume and quality by linking research funding (input) to international publication (output). As measure of the input we used a questionnaire investigation for the year 2004 carried out within the EU programme BONUS ERA-net Work Package 1.6 (www.bonusportal.fi). The questionnaire was directed to both research councils and research institutions, mainly universities, in the Baltic Sea area. In the year 2004, altogether 882 research projects were active at a total cost of 52 million EURO. As measure of the output we made a bibliometric analysis using 12 university library databases for the years 2002-2006. About 400 scientific papers in international journals were produced per year. Our study provides information and comparisons on scientific class, thematic research focus, degree of cooperation within and between countries and institutes, bibliometry (including scientific quality), costs per publication, etc. for the whole volume of Baltic Sea research as well as for each Baltic Sea country separately.

Keywords: Baltic Sea, Bibliometry, Research input, Research output, Research projects, Scientific publications.

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ICES CM 2007/C:18

Analyses of ecosystem state and development as a basis for ecosystem-based management of the Baltic Sea – results of the ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea

Bärbel Müller-Karulis, Christian Möllmann, Rabea Diekmann, Juha Flinkman, Georgs Kornilovs, Maris Plikshs, Anna Gårdmark, Piotr Margonski, Philip Axe, Arno Pllumae, Jari Pekka Pääkkönen, and Martin Lindegren

Integrated Ecosystem Assessments are an important component of implementing the Ecosystem Approach to Management of the Marine Environment. We present first results of the ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea [WGIAB]. These comprise meta-analyses of 4 Baltic sub-systems, i.e. the Central Baltic Sea (encompassing the Bornholm Basin, the Gdansk Deep and the Gotland Basin), the Gulfs of Riga and Finland as well as the Bothnian Sea. We compiled time-series on oceanographic, nutrient, phyto- and zooplankton as well as fisheries data covering the period 1974 to 2005. We used these in Principal Component Analysis, Redundancy Analysis and Chronological Clustering to (i) extract the main trends in the various ecosystems, (ii) detect major changes in ecosystem structure (regime shifts), and identify the major

drivers. Our results report similar patterns of ecosystem development between the 4 sub-systems displaying major changes in the late 1980s/early 1990s. Our results contribute to the understanding of the functioning of these ecosystems under anthropogenic and climatic pressure, and will be the basis for developing adaptive management strategies for the Baltic Sea.

Keywords: Central Baltic Sea, Bothnian Sea, Chronological Clustering, Gulf of Finland, Gulf of Riga, Integrated Ecosystem Assessment, Meta-analysis, Principal Component Analysis, Redundancy Analysis

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A strategy for Ecosystem-Based Fisheries Management of the Central Baltic Sea based on the available knowledge of ecosystem functioning

Christian Möllmann

Ecosystem-based fisheries management (EBFM) has recently emerged as an alternative approach to single-species management. The Baltic Sea is a test area for the implementation of ecosystem-based management approaches of human activities, with a number of initiatives and developments towards this goal, e.g. the Baltic Sea Regional Project. However, no detailed strategies for a more holistic management of the Baltic ecosystem have been developed yet, based on the available scientific knowledge in the area. Here I explore the basis for an EBFM-strategy for the Central Baltic Sea with emphasis on the upper trophic levels, i.e. zooplankton, planktivorous and piscivorous fish. I first review the knowledge on ecosystem functioning under anthropogenic and environmental forcing leading to a conceptual model of the ecosystem. Based on this, I suggest *operational objectives* and *indicators* with *targets/limits* attached of potential use for future EBFM of the area. Finally I review further steps needed to implement EBFM in the Central Baltic Sea.

Keywords: Anthropogenic forcing, Ecosystem-based fisheries management, Central Baltic Sea, climate variability, conceptual ecosystem model, management strategy.

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ICES CM 2007/C:20

Implementation of the Large Marine Ecosystem Concept in the Baltic Sea

J. Thulin and A. Andrushaitis

The Large Marine Ecosystems strategy for the assessment and management of international coastal waters implies that: (1) activities aiming to achieve sustainable use of marine resources and protection of the marine environment shall incorporate the whole geographic area defined as a Large Marine Ecosystem (LME), and (2) all five LME modules: *Productivity, Fish and Fisheries, Ecosystem Health, Socioeconomy and Governance* shall be dealt with, all being equally important. The LME concept has been adopted as a leading paradigm by a number of international and national agencies, e.g. GEF, UNDP, US NOAA.

To support the development of preconditions for implementation of the LME concept in the Baltic, the Baltic Sea Regional Project, BSRP, was started in 2003. Originally this GEF-supported project was planned as a 3-phase activity aiming at first to introduce the Ecosystem Approach to Management, EAM, in the Baltic (2003-2006), then to demonstrate application of this approach (2007-2008) and finally to expand the EAM throughout the whole Baltic (after 2008). In contrast to many other projects of the LME family, BSRP had to be evolved in a region with rich traditions of marine research and monitoring and with several previous attempts to implement cooperative measures to protect the marine environment and secure sustainable use of its resources. The Helsinki Commission (HELCOM) was established in 1974, and ICES has been a convention for scientific cooperation and advice since 1902. Thus, instead of creating new structures and mechanisms the BSRP task was to mobilize the existing ones to work jointly. To facilitate closer collaboration between the two Commissions, the project was organized so that both HELCOM (as implementing agency) and ICES (as responsible for marine activities), were responsible and heavily involved. Another challenge was to level the assessment capacity between Denmark, Finland, Germany and Sweden on the one hand and the new EU member states and Russia on the other. HELCOM created a Project Implementation Team and recruited staff for the thematic Coordination centres (CC), and Lead laboratories (LL) in the 12 partner institutes in the Eastern Baltic, while ICES established 4 new Baltic study groups to support these CCs and LLs scientifically. Significant support was given to procure needed monitoring equipment to eastern Baltic laboratories. BSRP coincided with a time when the necessity of an EAM was understood and accepted both in the European Union and in the Baltic region. EU started to develop the European Marine Policy with clear emphasis on Ecosystem-based management as a leading concept while HELCOM started to elaborate a suite of tools and procedures for an objective-based evaluation of the

ecosystem status which eventually led to the development of the current work on a Baltic Sea Action Plan (BSAP). Thus, the BSRP was perfectly positioned also to assist in the developments e.g. by establishment of indicators of the ecosystem health (including eutrophication), biological diversity, and productivity. At the same time several innovative and cost effective monitoring and assessment methods were improved, e.g. advanced echo-sounding techniques for fish surveys, the use of ships of opportunity to gather high geographical resolution data, as well as integrated assessment of fish age determination to better assess population dynamics and the transfer from single species to multi species modelling in fisheries management. In addition BSRP was instrumental in the development of the Science Plan for the Joint Baltic Sea Research Program BONUS-169 to be funded in the nearest future jointly by the coastal states and EC.

In conclusion, it is considered that the BSRP has played a key role in the introduction and implementation of the Large Marine Ecosystem Concept into the Baltic Sea area.

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The mutual dependence between productivity and community respiration of a summer system in the Baltic Proper

Michael Olesen

Primary production expressed as the maximum chlorophyll a-normalized rate of photosynthesis (PBm) was measured during two fortnight summer cruises in the Gotland Basin. The nutrients required for the photosynthesis was during both summer periods primarily based on local remineralization (regenerated production) but differs none the less in their trophical nature. PBm was relative high and constant during the sunny and calm summer of the first year (about 6 g C g chl-1 h-1) indicating primary production to be close its physiological limitation. The second year summer was cold and windy with PBm varying from < 1 to > 5 g C g chl-1 h-1 indicating production to be mainly nutrient limited. Community respiration relative to gross production was twice as high during the warm summer compared to the cold summer. The relative higher heterotrophic activity the first year on one hand stimulates the primary productivity (higher PBm) on the other hand lowered the phytoplankton biomass. This was likely also the reason for the higher inorganic N and P concentration in the mixed layer in that year. A chlorophyll a-normalized rate of community respiration (CRB) is suggested as overall indices of whether regenerated systems are nutrient limited or not. Apparently a CRB above 2 g C g chl-1 h-1 indicated that heterotrophic remineralization satisfies the nutrient requirements of the autotrophs.

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The new European on-line journal “Aquatic Invasions”: a services for management of aquatic invasive species in the Baltic Sea area

Vadim Panov and Stephan Gollasch

“Aquatic Invasions” is a rapid on-line applied journal focusing on biological invasions in European inland and coastal waters and potential donor areas of aquatic invasive species for Europe (ISSN: 1818-5487, <http://www.aquaticinvasions.ru>), published with support of ICES WGBOSV and BMB WGNEMO. The journal provides opportunity of timely publication of first records of biological invaders and their biology in support of decision-making, specifically, for consideration in risk assessments and early warning systems. Also, the journal provides the opportunity to publish relevant technical reports and other accounts not publishable in regular scientific journals. In Baltic Sea region, “Aquatic Invasions” is servicing as an important part of the regional early warning system on aquatic invasive species, providing primary geo-referenced information on invasive species records for on-line GIS “Invasive Species of the Baltic Sea (a part of the HELCOM project on development of open information resources on alien invasive species for the Baltic Sea area, <http://www.zin.ru/rbic/projects/invader/>) via rapid publication of geo-referenced data of biological monitoring and surveys. Currently 5 issues of “Aquatic Invasions” are available online since release of the first issue in February 2006. In 2006, research articles and short communications in 4 regular issues of the first volume of “Aquatic Invasions” included geo-referenced information on range expansions and first records in the Baltic Sea of such highly invasive species as round goby *Neogobius melanostomus*, Conrad’s false mussel *Mytilopsis leucophaeata*, Chinese mitten crab *Eriocheir sinensis* and ctenophore *Mnemiopsis leidyi*, submitted, among others, by national focal points on aquatic invasive species for HELCOM HABITAT/MONAS.

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Abundance dynamics of herring larvae in the NE Gulf of Riga (Baltic Sea) in 1947–2005 and its relation to stock recruitment

Timo Arula, Ain Lankov, Heli Shpilev, and Evald Ojaveer

Regular cruises for quantitative sampling of larval herring (*Clupea harengus membras* L.) were initiated in the NE Gulf of Riga in 1947 and are continued until now, however, with data gaps for several years. The main intention of these investigations was early estimation of the year-class abundance of recruitment for the prediction of catches of the spring spawning herring. The mean annual abundance of herring larvae exhibited substantial multi-annual dynamics with the peak values of over 500 ind. catch⁻¹ in 1984 and minimum of 8 ind. catch⁻¹ in 1961 (10-min. hauls with the Hensen net, the mouth area 0.12 m², trawling speed 2 knots). The correlation coefficient between the numbers of larvae and the corresponding year-class abundance of herring improves with increasing length of larvae. The coefficient varies by periods. Lower larval abundances were found in the 1940s–1960s with general increasing trend later on. The observed year-to-year larval dynamics is obviously triggered by variations in temperature and mixing conditions of water layers in the spawning/retention areas resulting in different survival rates of larvae. The large-scale (periodic) fluctuations in larval abundance can probably be connected with climate changes, anthropogenic impacts, etc.

Keywords: Gulf of Riga, herring, larvae, recruitment, long-term dynamics.

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Impact of anthropogenic and non-anthropogenic factors influencing bacterial productivity of the southern Baltic Sea coastal waters

Anetta Ameryk and Zbigniew Witek

The research was carried out in two southern Baltic Sea areas: in the Pomeranian Bay and in the Gulf of Gdańsk, during eleven cruises conducted in various seasons in years 1995–2002. Several physical, chemical, and biological factors were considered to check their influence on bacterial production (BP).

Temperature had the greatest impact on BP in both regions. Another group of factors mostly influencing BP was connected with primary production (PP) and organic matter content.

Significant differences were observed between the BP/PP ratios in the inner and the open-water areas in the Gulf of Gdańsk, with the highest values recorded in vicinity of the Vistula River mouth. It suggests that allochthonous organic matter has a great influence on BP in the Gulf of Gdańsk. There were small and not significant differences in the BP/PP ratios found in the inner and the outer part of the Pomeranian Bay. The Oder River is apparently not a direct source of organic matter for bacterial growth in the Pomeranian Bay. The Gulf of Gdańsk is the first recipient of the Vistula water while the first recipient of the Oder water is the Szczecin Lagoon, not the Pomeranian Bay. Human made artificial outlet of the Vistula River and lack of estuary similar to the Szczecin Lagoon is the main explanation of differences in intensity of organic matter transformations between the Gulf of Gdańsk and the Pomeranian Bay.

Keywords: bacterial production, bacterial to primary production ratio, organic matter transformation.

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Baltic Sea thermal fronts from satellite data

Igor M. Belkin and Peter C. Cornillon

We used the 12-year (1985–1996) Pathfinder SST dataset for the first comprehensive survey of the Baltic Sea thermal fronts. The Cayula-Cornillon edge detection and cloud-masking algorithms were applied to 8364 twice-daily 9-km resolution AVHRR images obtained from Jet Propulsion Laboratory. Objectively derived fronts detected in these synoptic images were mapped for each month from January 1985 through December 1996. Long-term frontal frequencies normalized by cloudiness were computed and mapped for each 9-km pixel. These maps emphasize persistent fronts observed in three major areas: the Bothnian Bay, Bothnian Sea, and Baltic Proper. The fronts wax and wane and shift seasonally, therefore long-term monthly frequency maps retain and bring out all major fronts observed in monthly frontal composite quasi-synoptic maps. The following fronts are distinguished: the Bothnian Bay Front (BBF), Bothnian Sea Front (BSF), North Baltic Proper Front (NBPFF), South Baltic Proper Front (SBPF), Gotland Front (GF), Irbe Strait Front

(ISF), and Arkona Front (AF). Most fronts appear topographically controlled: BBF and BSF encircle the respective depressions, while NBPF, SBPF, and GF extend along the 100-m isobath that outlines the Baltic Proper basin. The ISF is situated over the outer edge of the sill that separates the Gulf of Riga from the Baltic Proper. Some fronts are distinct year round (BSF, NBPF, and likely SBPF). Other fronts emerge and persist during two or three seasons only, then disappear. The entire frontal pattern is fairly stable and reproducible from one year to another.

Keywords: fronts; Baltic Sea; Large Marine Ecosystems; sea surface temperature.

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