REPORT OF THE ICES/BSRP/HELCOM/UNEP REGIONAL SEAS WORKSHOP ON BALTIC SEA ECOSYSTEM HEALTH INDICATORS

30 MARCH–1 APRIL 2005

SOPOT, POLAND

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Recommended format for purposes of citation:
ICES. 2005. Report of the ICES/BSRP/HELCOM/UNEP Regional Seas Workshop on Baltic Sea Ecosystem Health Indicators, 30 March–1 April 2005, Sopot, Poland. ICES CM 2005/H:01 Addendum. 68 pp.

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Executive Summary

The ICES/BSRP Study Group on Ecosystem Health (SGEH) was given the task by the ICES Baltic Committee to “organize a BSRP Workshop in 2005 with participation of experts from HELCOM and US EPA on the topic of ecosystem health indicators in the Baltic Sea”.

To fulfil this task, prior to the meeting, specific ToRs were developed by the Workshop Steering Group (Annex 1). A number of key experts were approached to present issues related to the concept of Ecosystem Health and its relationship to the Ecosystem Approach to Management as well as to the aims of the European Marine Strategy (Section 4).

Further, four subgroups were created to develop EcoQOs and Indicators in the main problem areas in the Baltic Sea: eutrophication, contamination, overfishing and loss of biodiversity. They continued developing ecosystem health indicators which started at the SGEH 2004 meeting in Vilnius; and discussed and promoted possible future collaborative actions towards making further progress in the development and application of such indicators, including identification of specific areas of work requiring greater emphasis and attention (Section 5).

As a result of the Workshop, review of up-to date developments of EcoQOs and Indicators was performed and a battery of new indicators proposed. Further, a number of actions for future developments of ecosystem health management tools were proposed.

1 Planning, participation, and working procedures

The workshop has been planned by an ***ad hoc Steering Committee*** [Workshop Convener: Hein Rune Skjoldal (Norway); Workshop Organizer and Co-Convener: Eugeniusz Andrulewicz (Poland), together with the Local Host, Jan Marcin Weslawski (Poland). Steering Committee members: Jan Thulin (ICES BSRP); Andris Andrushaitis (ICES BSRP); Chris Hopkins (Sweden); Juha-Markku Leppänen (HELCOM); and Kevin Summers (USA)] in consultation.

The Workshop agenda comprises sessions conducted over three whole working days (30 March–1 April 2005).

Day 1 (March 30) focused on ten plenary presentations by Keynote Speakers (‘setting the scene’), with time for discussions and input from the participants, as well as summary presentations by the Co-Chairs of the four thematic subgroups (Effects of Eutrophication; Effects of harmful substances; Effects of fishing activities; Loss of biodiversity) regarding conclusions arising from the 2004 BSRP SGEH meeting, reporting on the follow-up intersessional work tasks assigned to this workshop, and specific ToRs and strategy for the deliberations of each subgroup at this workshop.

Day 2 (March 31) was devoted to separate sessions of the four subgroups, followed by reporting back in plenum on the outcome of these sessions, including submission of draft recommendations regarding appropriate follow-up actions. The plenary sessions included discussions of such proposals.

Day 3 (April 1) focused on a) a review of the workshop conclusions, including final consideration of the spectrum of ToRs required to be addressed, and adoption of recommendations for future actions, b) drafting the workshop report, and c) final remarks and closing of the workshop.

The Keynote Speakers produced their presentations as electronic documents, submitted by e-mail attachment to the Workshop Organizer, and made available to workshop participants through HELCOM DPS. The participants were requested to come to the workshop well prepared to provide their own substantial inputs to the various sessions based on their working backgrounds and knowledge.

After each of the sessions, the chairs and Rapporteurs summarized the main points and conclusions arising from their sessions for approval by the participants. These summaries formed the basis for constructing a list of overall conclusions and recommendations arising from the workshop for future actions.

A sketch illustrating the concept and flow-chart for the workshop is shown in Figure 1 (Annex 1).

2 Terms of Referene

The Workshop, which was held in Sopot in (Poland) from 30 March to 1 April 2005, focused *specifically* on the following Terms of Reference (ToRs):

1) Review the concept of Ecosystem Health and its relationship to the Ecosystem Approach to Management and the aims of the European Marine Strategy;

2) Examine how the assessment of the Baltic Sea Ecosystem corresponds with the objectives and requirements of the EC Water Framework Directive;

3) Examine how the US EPA 'indices approach' can be used in the Baltic Sea;

4) Consider existing indicator developments by the EEA, FAO, HELCOM, OSPAR, ICES, IOC/SCOR and US EPA/NOAA; and

5) Develop Ecosystem Health Indicators in relation to the effects of eutrophication, harmful substances, fishing activities, and the loss of biodiversity[1].

These Terms of Reference form the basis for the agenda with associated timetable (**Annex 1**).

3 Opening of the workshop and welcome addresses

Professor Stanisław Massel, director of Institute of Oceanology Polish Academy of Sciences (IOPAS), as the acting head of the host Institute, welcomed the workshop participants and presented briefly the institute activities.

The Institute originated as the Marine Station in Sopot in 1951. It grew and evolved gradually becoming the Institute of Oceanology of the Polish Academy of Sciences (IO-PAS) in 1983. It is the Polish Academy of Sciences institution with responsibility for research in the marine sciences. It employs about 150 persons, including 18 professors and 29 doctors and it is the largest institute of marine sciences in Poland. The institute is divided into four departments: Marine Chemistry and Biochemistry, Marine Physics, Hydrodynamics and Marine Ecology and subdivided into 20 specialized laboratories. The area of main activity is the Baltic Sea region as well as the North

The Institute participates in a number of international research programmes like BASYS, BIOCOLOR, ESOP 2, ENRICH, MARINA BALT, PROWESS, VEINS, BIODAFF, ACSYS, BALTEX, IAPP, SeaWiFS and others. It operates its own research vessel R/V "Oceania" equipped with standard equipment like DGPS, CTD, ADCP, meteo, radar, echo sounders, spectrophotometers, airframe and winches. The ship accommodates 14 persons scientific crew (18 persons for short cruises).

A peer reviewed, English-language, quarterly journal named "Oceanologia" has been edited by the Institute for over 25 years. More information on the institute is given at the website: http://www.iopan.gda.pl.

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[1] Specifically targeted ToRs will be developed prior to the meeting to guide the work of the individual Subgroups: a) Effects of eutrophication, b) Effects of harmful substances, c) Effects of fishing activities, d) Loss of biodiversity.

4 Background presentations by invited speakers

Andris Andrušaitis, the Chair of the Session, welcomed the speakers and the audience. The Ecosystem Health approach currently develops together with many other strategies aiming at proper management of marine ecosystems. For the Baltic Sea ecosystem management, it will be important to learn form experiences in other areas and other conventions. Therefore this workshop will, among others, report on experiences from the US coastal management and assessments, developments within the EU marine strategy, the approach taken in the EU Water Framework Directive, and the concepts embedded into OSPAR management of the North Sea.

4.1 Chris Hopkins (Sweden): The concept of Ecosystem Health and association with the Ecosystem Approach to Management and related initiatives

There is a basic similarity in the concept of human health and ecosystem health. Commonly, human health is defined as "a state in which you are fit and well", and regarding an organization or system the term "health" refers to the extent to which it is working well. Good health, or deviation from good health, is measured against various reference levels. When a person's condition has deviated substantially from a desirable **target level** of good health it is implicit that a **limit level** has been crossed beyond which **serious or irreversible harm** will result. Accordingly, we can take precautions ('action intended to prevent something dangerous or unpleasant from happening) and establish **precautionary levels** beyond which we should not transgress. Keeping within the precautionary levels is desirable as it avoids the significant **socioeconomic costs** that arise from ill-health and its treatment. When a person's health condition has transgressed particular undesirable levels, it is necessary that **remedial actions** (treatment) be taken for restorative purposes. It is recognized that poor health is **unsustainable** in the long-term.

It is pertinent to note that the concept of human health is applied to the **whole body** but it is understood that health is dependent on the good functioning of all the organs, and supporting physiology, in the body. Thus, it is appreciated to have a **holistic and integrated view** of our body's health system.

Many international agreements/instruments promote requirements for prudent and sustainable use of the marine environment, protecting also the biodiversity of living marine resources, marine ecosystems and habitats:

UN Convention on the Law of the Sea (1982); Bruntland Report (1987) and *Rio Declaration, Principle 15 of UNCED (1992)/Agenda 21; Convention on Biological Diversity (1992); Article XV of Treaty on European Union (Maastricht 1992); UN Agreement on Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995); FAO Code of Conduct on Responsible Fisheries (1995); Elaboration of 'new' OSPAR (1992* and *1998 Annex V)* and *HELCOM (1992) Conventions - Protection* and *conservation of ecosystems* and *biodiversity; North Sea Conferences – Intermediate Ministerial Meeting (1997) on Integration of Fisheries and Environmental Issues* and *Ministerial Declaration (Bergen) from the Fifth International Conference on the Protection of the North Sea (2002); Joint OSPAR* and *HELCOM (Bremen) Declaration (2003); EC Water Framework Directive (2000)* and *European Marine Policy (2002 – ongoing).*

To ensure sustainability, exploitation of marine ecosystems has to be balanced with the needs of conservation. Therefore, the precautionary principle and the ecosystem approach to management have been promoted. The Precautionary Principle and the way to implement it (the precautionary approach)—have arisen from the Rio Declaration (UNCED 1992), which states that:

'*where there are* ***threats of serious or irreversible damage****, lack of full scientific certainty shall not be used as a reason for postponing* ***cost-effective measures to prevent environmental degradation***'.

This principle recognizes that changes in exploited systems are slowly reversible, difficult to control, not well understood, and calls for early action in the case of uncertainty and ignorance in order to prevent potential harm. Precaution places the ***burden of proof*** on the proponents of the activity, i.e. it is not appropriate to assume that environmental impacts are negligible until proved otherwise. This reversal of the burden of proof is fundamental to precautionary action, and creates incentives for the proponents of an activity to prove that their product or activity is safe or acceptable. This may be achieved, for example, through application of an environmental impact assessment (EIA) and strategic environmental impact assessment (SEA) in the European Union.

The principle that the costs of environmental damage or resource depletion should be borne by polluters or users – the **Polluter- Pays Principle** (PPP) - was elaborated as an economic principle in the 1970s and is embedded in the 1987 European Community (EC) Treaty. The principle requires producers or resource users to meet the cost of implementing environmental standards or technical regulations, or by introducing liability regimes making producers liable for causing environmental damage (Coffey and Newcombe, 2000).

4.1.1 Sustaining ecological goods and services – actions and measures to support policy

Healthy ecosystems perform a diverse array of essential functions that provide both goods and services to humanity, in which '***goods***' refers to items given monetary value in the market place and '***services***' from ecosystems are valued but rarely bought and sold (Lubchenco, 1994; Nilsen *et al.,* 2002). For example, goods are food, medicinal materials, raw materials and wild genes, while services include maintaining the hydrological cycles and composition of the atmosphere, regulating climate, storing and cycling essential nutrients, absorbing and detoxifying pollutants, sustaining food webs and habitats, generating and maintaining sediments and reefs, and providing sites for tourism, recreation and research. The sustainability concept depends on two aspects: sustainability of use (sustainable use) and sustainability of ecological resources and their associated ecosystem. These aspects are tightly connected as sustainable use of ecological resources can only be achieved if these resources themselves are sustainable. Thus, the ecosystem approach to management involves, *inter alia*, a paradigm shift from managing commodities towards sustaining the production potential for both ecosystem goods and services ('natural capital') (Costanza *et al.,* 1997).

The ***ecosystem approach*** (CBD, 1992) is a synonym for an integrated or holistic approach to ecosystem management, recognizing the need to manage the impacts of human activities on ecosystems in order to achieve sustainable use of '*ecosystem goods and services*' and maintenance of *ecosystem integrity* (ICES, 2000). This definition points to the need for a comprehensive and holistic approach to understanding and anticipating ecological change, assessing the full range of consequences and developing appropriate scientific and regulatory responses.

Humans are an integral part of ecosystems and socioeconomic systems constantly interact with other physical and biological parts of the system. It is important to emphasize that implementing an ecosystem approach is a process and should be considered as a tool to help comprehensively and systemically redress the root causes human induced problems (Hopkins, 2004). Among the human activities that impact coastal and marine ecosystems, being the root causes of environmental problems, are:

- agriculture and forestry;
- human settlements and coastal industries;
- mariculture;
- fisheries;
- recreation and tourism;
- oil and gas exploration and exploitation;
- coastal engineering and land reclamation;
- power generation;
- shipping;
- dredging and dumping of wastes and litter;
- mineral and aggregate extraction.

To achieve successful marine and coastal management, we must:

a) **Develop a Vision and implement integrated Policies, Strategies and Objectives, supported by Actions** at the appropriate spatial scales (e.g., regional, local) involving long-term perspectives – applying the precautionary principle and the ecosystem approach;
b) **Identify and rank the root causes of the problems** (harmful activities and practices) causing deterioration and degradation and **prioritize targeted management actions** (e.g., regulatory measures) aimed at **redressing the root causes** in a concerted manner for conservation and restoration purposes within the framework of the policy.

A convincing and coherent **policy** (e.g., the European Marine Strategy) incorporating a clear overarching **vision** (e.g., from the European Marine Strategy ‘*we and future generations can enjoy and benefit from biologically diverse and dynamic oceans and seas that are safe, clean, healthy and productive*’) must elaborate in meaningful terms what it is we want to achieve and why (i.e. justification), which is translatable into tangible **goals/objectives** supported by agreed **actions/measures** (e.g., a workplan comprising a ‘toolbox’ of activities and regulatory measures) for implementation. An illustration of some of the components involved in such a process and their possible relationships is provided in Figure 4.1.1.1. Similar schemes being established in other marine protection conventions.

Achieving marine policy visions requires developing effective and relevant **targets and limits for environmental/ecological quality**, including the development of **indicators** that allow us to measure/track progress with respect to ‘**reference points**’. This feedback scheme allows assessing the current ecosystem status and determining how we are approaching a ‘destination’. Operational objectives, indicators, targets and limits involved have to be region specific (based on Ecoregions), but the general approach, defining visions, strategic goals, and ecological objectives is applicable to marine ecosystem management in general.

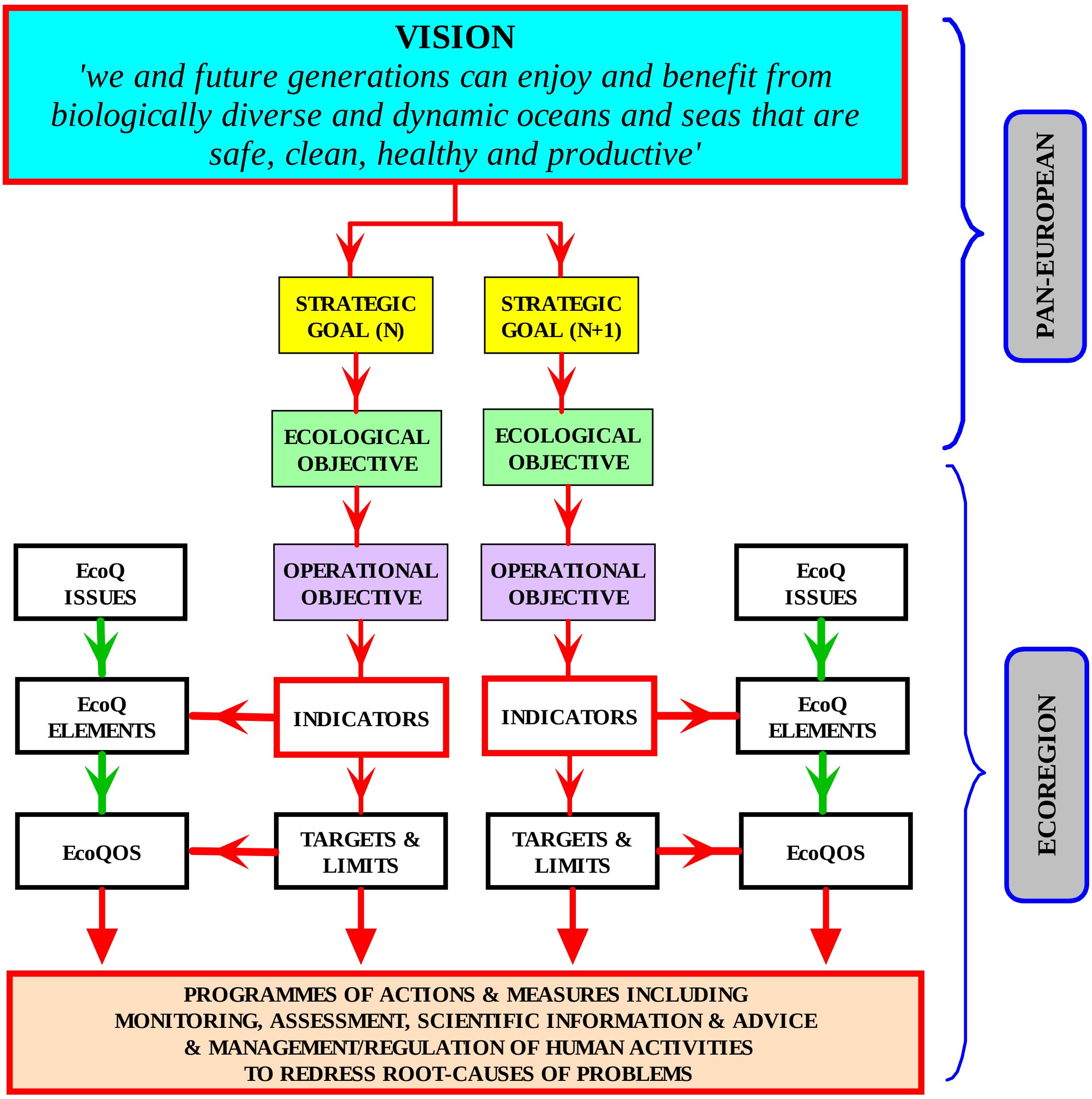

Figure 4.1.1.1: Organogram illustrating the process linking steps in the European Marine Strategy to indicators of ecological quality (Hopkins, 2005).

In the framework of this management scheme, the precautionary principle presents a reference point to management that should not be transgressed, because it represents the outer envelope of safe biological limits for the ecosystem. This reference point also marks the boarder between sustainable and unsustainable ecosystem exploitation. The precautionary limit should correspond to the boundary between moderate and poor ecological status in the EU Water Framework Directive (WFD), in order to prevent irreversible ecosystem damage. The precautionary limit has to be distinguished form the management goal, which for example in case of the EU WFD is good ecological status.

Discussion

Jacqeline McGlade (EEA) agreed that more emphasis should be put on the precautionary reference point. Often countries implementing the WFD regard poor ecological status as a status from which recovery is possible, a belief that may not be true. As many systems are already in a bad state, the scientific community should emphasize that ecosystem dynamics might be non-continuous, leading to irreversible changes after exceeding limit points. Chris Hopkins pointed out, that the precautionary principle is centrally recognized in the Conventions of many marine environmental protection Commissions. Andris Andrushaitis added that the threshold between good and moderate ecological status – rather than between moderate and poor status – expresses the precautionary principle in the WFD, as management action is required when reaching the boundary between good and moderate status. Chris Hopkins again emphasized the need to set and adhere to precautionary levels in addition to setting target and limit levels, keeping in mind the socioeconomic benefits of keeping within the precautionary levels.

References

CBD. 1992. Convention on Biological Diversity. 5 June 1992, Rio de Janeiro (Brasil).

Coffey, C, and Newcombe J. 2000. The polluter pays principle and fisheries: the role of taxes and charges. UK Joint Nature Conservation Council (JNCC) http://www.jncc.gov.uk/pdf/thepollute2.pdf

Costanza, R., d'Arge, R., de Groot, R., Farber. S., Grasso, M., Hannon, B, Naeem, S., Limburg, K., Paruelo, J., O'Neill, R.V., Raskin, R., Sutton, P., and van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. Nature, 387: 253–260.

Hopkins, C.C.E. 2004. Biodiversity Assessment and Threats Analysis for the WWF Global 2000 EcoRegion 'North-East Atlantic Shelf'. WWF Germany, Frankfurt am Main. 108 pp.

Hopkins, C.C.E. 2005. The Concept of Ecosystem Health and Association with the Ecosystem Approach to Management and Other Initiatives. AquaMarine Advisers, Sweden. Invited Keynote Paper for ICES BSRP/HELCOM UNEP Regional Seas Workshop on Baltic Sea Ecosystem Health Indicators. 29 March–2 April 2005, Sopot, Poland. 14 pp.

ICES. 2000. Report of the Study Group on Ecosystem Assessment and Monitoring. ICES C.M. 2000/E:09.

Lubchenco, J. 1994. The Scientific Basis of Ecosystem Management: Framing the Context, Language and Goals. Pp 33-39, In: Committee on Environment and Public Works, United States Senate, Ecosystem Management: Status and Potential. Proceedings of a Workshop by the Congressional Research Service, March 24–25 1994. 103rd Congress, 2nd Session. Washington. U.S. Government Printing Office.

Nilsen, H.-G., Aarefjord, H., Øverland, S., and Rukke, J. 2002. Progress Report. Fifth International Conference on the Protection of the North Sea, 20-21 March 2002. Bergen Norway. Norwegian Ministry of the Environment. ISBN – 82-457-0353-2.

4.2 Jan Thulin (BSRP) and Ken Sherman (US-NOAA): The Large Marine Ecosystem concept

The Large Marine Ecosystem approach has been developed by US NOAA (e.g., Sherman and Skjoldal, 2002) and currently 10 LMEs are used to delineate the coastal regions of the US. These Large Marine Ecosystems are being used to form a basis for US ocean policy. The differences among these 10 LMEs are based largely on differences in bathymetry, hydrography, trophodynamics, and productivity.

Globally, 95 % of the World's fish catch are produced within 64 large marine ecosystems that are mainly located on the coastal shelves. The Global Environmental Facility (GEF) currently funds 10 Large Marine Ecosystem projects involving 72 countries, providing funding of USD 650 million as of January 2004. Additional 52 countries (representing 8 LMEs) are preparing assessment and management projects in Africa, Asia, Latin America and Eastern Europe.

GEF-funded LME projects comprise global efforts to:

- **REDUCE** coastal pollution;
- **RESTORE** damaged habitats (e.g., coral reefs, mangroves, sea grasses);
- **RECOVER** depleted fishery stocks.

GEF funded LME projects are initiated according to the GEF International Waters Operational Strategy using **Transboundary Diagnostic Analysis (TDA)** and drafting of a **Strategic Action Program (SAP).** TDA provides consensus priorities from analysis and ranking of water-related resources issues, their environmental and socioeconomic impacts, immediate and root causes and possible remedies. SAP provides national and regional commitments to policy, legal and institutional reforms, and investments to remedy root causes of priority transboundary issues identified in TDA.

A paradigm shift in marine ecosystem management is currently occurring which represents a move from a focus on individual species to a focus on ecosystems. This paradigm shift requires working on multiple scales rather than small scales and increasing the time period associated with assessment and management. Central to this paradigm shift is the acceptance of humans as an integral part of ecosystems, and management is shifting towards adaptive management interacting with current research in order to sustain production potential for goods and services, vs. the earlier approach focusing on managing commodities (Figure 4.1.1.1).

The LME approach focuses on five modules to determine an appropriate suite of indicators to be used in an assessment of ecosystem health. (Figure 4.2.1) These five modules include:

- Productivity;
- Fish and Fisheries;
- Pollution and Ecosystem Health;
- Socioeconomic;
- Governance.

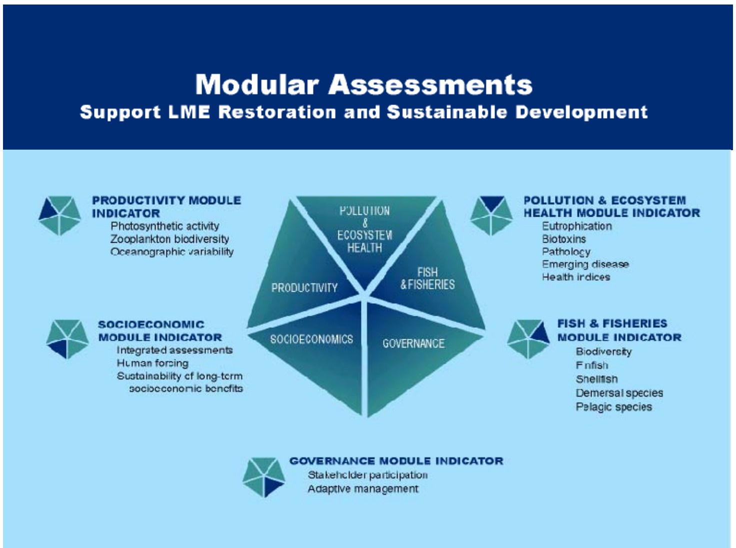

Figure 4.2.1: LME Approach and associated modules and indicators.

Physical and biological drivers for the US Northeast Shelf ecosystem are:

- circulation;
- primary production along the coast;
- zooplankton biomass (annual average);
- temperature.

With relation to the five LME modules, the appropriate indicators for the Northeast Shelf are given in Table 4.2.1.

Table 4.2.1: Indicators used in the Northeast Shelf LME.

MODULE	INDICATORS
Productivity	• Primary productivity; • Chlorophyll *a*; • SST; water column temperature; • Photosynthetically active radiation (PAR); • Nitrogen; • Zooplankton biomass; • Zooplankton abundance;.
Fish and fisheries	• Demersal species surveys, • Pelagic species surveys, • Ichthyoplankton surveys, • Invertebrate surveys (clams, scallops, shrimp, lobster, squid), • Essential fish habitat, • Marine protected areas.
Pollution and ecosystem health indicators	• Water Clarity; • Dissolved Oxygen; • Coastal Wetland Loss; • Eutrophic Condition; • Sediment Contamination; • Benthic Index; • Fish Tissue Contaminants; • Multiple Marine Ecological Disturbances.

Pollution and ecosystem health indicators used in joint US EPA and NOAA assessments of coastal zone condition include:

1) Water Quality;
2) Sediment Quality;
3) Habitat Quality;
4) Biodiversity (using benthic communities);
5) Fish Tissue Contaminants.

These indices are based on tens to hundreds of individual measurements that are combined in order to communicate overall health or condition to environmental managers. This allows a straightforward assessment of good, fair and poor condition (described in stoplight format as green, yellow and red) that is easily conveyed to multiple audiences. The EEA is using a similar type of reporting to communicate coastal conditions.

Additional information regarding the LME approach for marine ecosystems can be found at www.lme.noaa.gov.

Discussion

Gedas Vaitkus asked, whether the indicators used for managing the Northeast Shelf LME are mapable and cautioned that some data, e.g., fish landings, might have only weak spatial connections. In the Northeast Shelf LME, most in-shore indicators can be linked to individual stations, but problems might exit with spatial inter- and extrapolation. Off-shore indicators are usually collected along transects (e.g., trawling, zooplankton/ichthyoplankton net samples) and characterize a larger area that can be thought of as a latitude-longitude box. Other off-shore indicators, e.g., sediment data, however, come from specific locations.

4.3 Hein Rune Skjoldal (Norway): Development of Ecological Quality Objectives (EcoQOs) in OSPAR: history, status and lessons learnt

In OSPAR the EcoQO approach was initiated in 1990 when the Ministers at the 3rd International Conference on the Protection of the North Sea in den Haag, requested that a method for setting ecological objectives should be elaborated. Figure 4.3.1 depicts major milestones in the further development of EcoQOs and its relationship to the development of the ecosystem approach to management of the North Sea. A summary of this history was also presented at the ICES Dialogue Meeting in Dublin in April 2004 (Report of the Thirteenth ICES Dialogue Meeting: Advancing scientific advice for an ecosystem approach to management: collaboration amongst managers, scientists, and other stakeholders. ICES Cooperative Research Report No. 267; http://www.ices.dk/pubs/crr/crr267/crr267.pdf).

During three workshops (Bristol 1992, Geilo 1993, Ulvik 1995), the concept, feasibility, terminology, criteria for selection of information, and test application to the case of eutrophication, were elaborated. This resulted in 1997 in a general methodology for setting Ecological Quality Objectives (EcoQOs) (Skjoldal, H.R. 1999. Overview report on Ecological Quality (EcoQ) and Ecological Quality Objectives (EcoQOs). Institute of Marine Research, Bergen, 20 p. ISBN 82-7461-050-4). At this stage, it was agreed within OSPAR to develop specific EcoQOs for the North Sea as a test case.

The following definitions were agreed at the first workshop in Bristol in 1992, and these were copied with slight amendments from early preparatory work to what subsequently became the EU Water Framework Directive.

ECOLOGICAL QUALITY – EcoQ *is an overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities.*

ECOLOGICAL QUALITY OBJECTIVE- EcoQO is the *desired level of ecological quality relative to a reference level.*

An Intermediate Ministerial Meeting on Integration of Fisheries and Environmental Issues in Bergen in 1997 (IMM-97) agreed that an ecosystem approach should be developed as a guiding principle for further integration of fisheries and environmental measures. A workshop in Oslo in 1998 elaborated a framework for an ecosystem approach and suggested that the ongoing work on EcoQOs in OSPAR could be seen as an integral component of such an approach.

The framework for the ecosystem approach consists of ecosystem objectives, monitoring and research, integrated assessment, scientific advice, and adaptive management. Ecosystem objectives reflect the desired state of the marine ecosystem, i.e., the goals for management actions. Integrated assessment is a comprehensive evaluation of the ecosystem conditions and status, including the degree of human impact on that status. Scientific advice should provide clear recommendations that are understandable to decision-makers, from the inherently noisy environmental information. Management has to be responsive and adaptive to the changing ecological status, meaning that management is flexible and can be tuned to meeting the set ecosystem objectives.

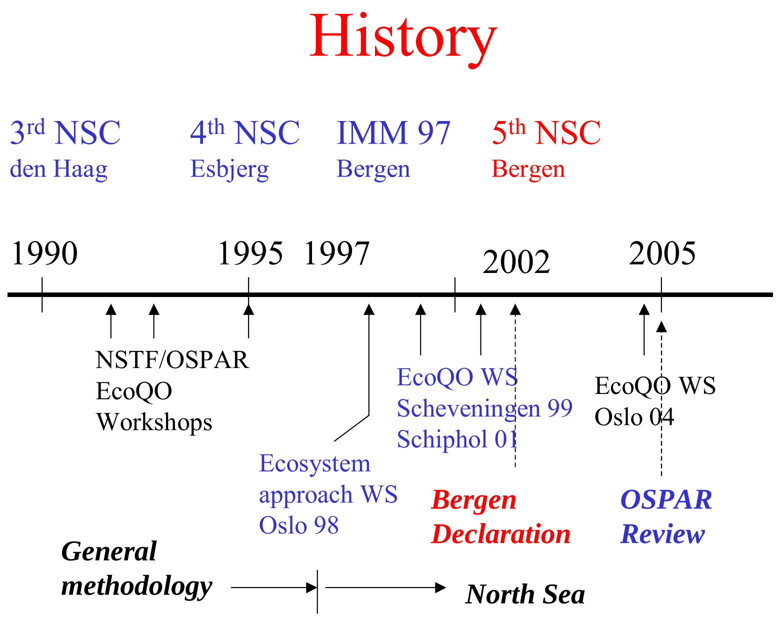

Figure 4.3.1: An overview with milestones of the development of Ecological Quality Objectives (EcoQOs) and Ecosystem Approach to the management of the North Sea.

EcoQOs should reflect and balance ecosystem properties on the one hand and human activities that impact the ecosystem on the other. This was the general criteria as the core of the general methodology for setting EcoQOs. This work was taken forward by two workshops (Scheveningen, 1999; Schiphol, 2001) that elaborated a range of general issues and specific ecological quality elements to which quantitative objectives (EcoQOs) could be set.

ICES provided substantial scientific input and advice to this process through the Advisory Committee on Ecosystems (ACE), building on the work of many ICES working groups (WGECO, WGMME, WGSE, WGFE, MCWG, BEWG, SGEUT). The ICES advice is contained in the ACE Reports for 2001, 2002, 2003 and 2004 (http://www.ices.dk/products/cooperative.asp). ICES developed the following criteria for good EcoQOs:

- Relatively easy to understand;
- Sensitive to a manageable human activity;
- Easily and accurately measured;
- Responsive primarily to a human activity;
- Measurable over a large proportion of area;
- Based on existing body or time series of data;
- Ecological importance.

The OSPAR Biodiversity Committee (BDC) managed the work on developing the EcoQOs with The Netherlands and Norway as co-lead countries. The Eutrophication Committee (EUT) within OSPAR provided input to the development of EcoQOs in relation to eutrophication. Based on the workshops, advice from ICES and the work within BDC and EUT, OSPAR presented a document with EcoQOs proposals to the 5th International Conference on the Protection of the North Sea in 2002.

The Fifth North Sea Conference in Bergen in 2002 agreed to adopt the EcoQO approach. The Ministers in the Bergen Declaration agreed to a list of 21 ecological quality elements and to specific EcoQOs for 10 of them to be applied in a pilot project. For the remaining 11 elements, the Ministers requested that further work to set EcoQOs for them should continue with the aim to be completed by 2004. The Ministers requested that OSPAR in collaboration with ICES, should review progress in the development of EcoQOs in 2005 with the aim of adopting a comprehensive and consistent scheme of EcoQOs. The list of 21 EcoQ elements from Annex 3 to the Bergen Declaration is given in the Table 4.3.1 where the 10 elements for which EcoQOs are set, are shown with red or green (related to eutrophication) colours.

Table 4.3.1: The list of 21 EcoQ elements from Annex 3 to the Bergen Declaration.

REFERENCE POINTS FOR COMMERCIAL FISH SPECIES	SPAWNING STOCK BIOMASS
Threatened or declining species	Presence and extent
Sea mammals	Seal population trends Utilization seal breeding sites By-catch of harbor porpoises
Sea birds	Proportion oiled guillemots Hg seabird eggs and feathers Organochlorines seabird eggs Plastic particles stomachs Sand-eel availability and kittiwakes Seabird population trends
Fish communities	Proportion of large fish
Benthic communities	Changes/kills – eutrophication Imposex in dog whelk Density of sensitive species Density of opportunistic species
Plankton communities	Chlorophyll *a* Indicator species for eutrophication
Habitats	Habitat quality
Nutrient budgets and production	Winter nutrient concentrations
Oxygen consumption	Oxygen concentration

The requirement to base EcoQOs on existing data time series presents an inherent problem, as EcoQOs will always be linked to what has been measured in the past. If data are not available, the desired level of an ecological quality element is difficult to define based on reference conditions.

The set of EcoQ elements with EcoQOs sets represent a range of different aspects or situations with regard to the North Sea ecosystem. Some of them reflect more the overall conditions in the ecosystem, for instance reflected in the trends in seabird populations. Similarly, the EcoQO for seal populations (decline in population level should not exceed 10% over a time period <10 years) serve as a warning signal and trigger for investigations to determine whether the decline is natural or due to anthropogenic effects. Other EcoQOs serve more as performance indicators for specific issues. For example, the proportion of oiled common guillemots serves as an indicator of oil spill frequency in the North Sea. Similarly, concentrations of mercury and organochlorines in seabird eggs indicate trends in these contaminants in the North Sea foodwebs.

Ecological quality is defined as an overall expression of the structure and function of the marine ecosystem. Therefore, in evaluating the status of EcoQOs development, the holistic nature of EcoQ needs to be kept in mind. A number of questions can be raised and addressed from three different perspectives:

- a scientific perspective;
- a management perspective; and
- a societal/political perspective.

From the **scientific** perspective, there are questions such as:

- What types of objectives are EcoQOs? Are they limit- or target-based, or both?
- Which ecological features does the set of EcoQOs reflect?
- Is the set of EcoQOs coherent and integrated and is it comprehensive and consistent?
- Is the set complete or are there gaps?

From the **management** perspective, there are questions like:

- Should all objectives related to management of marine environment and resources be called EcoQOs?
- If not, what are the other types of management objectives?
- Should the term EcoQO be limited to objectives related to ecological state?
- Should EcoQOs be general objectives or specific operational objectives, or both?
- Within what time frames should EcoQOs be used (annual, long-term)?
- What are the relationships between EcoQOs and assessments?

From the **societal/political** perspective, there are questions like:

- How can the EcoQOs help achieve the integration which are the core of an ecosystem approach?
- And more specifically, how can they contribute to integration of fisheries and environmental policies and measures?
- What is the institutional framework for applying the EcoQOs?
- Who should apply them?
- How should they be applied?
- What are the consequences for non-compliance?

These questions are raised for consideration and it is not the intent to provide detailed analysis here. In terms of targets or limits, the set of EcoQOs could together define an inner target area for the state of the ecosystem, which should be met, or an outer boundary of limits, beyond which the state of the ecosystem should not exceed. Target area and boundary limits may, however, change over time, e.g., depending on climate and natural variability. Climate variability and change convey major forcing of ecosystem dynamics, affecting also fish stock dynamics and contaminant pathways.

In order to express the structure and function of the marine ecosystem in the sense of ecological quality, a set of ecological features should be covered. Important among such features could be productivity, diversity, trophic structure, stability, and resilience. In the case of the North Sea EcoQOs, they cover fairly well the components of fish populations, mammals, and seabirds, while other features, notably benthic communities, habitats, and threatened/declining species, are captured less well and may represent gaps to be filled in the further development. With the current state of development, none of the North Sea EcoQOs provides an aggregated index of the ecological features of the ecosystem in general.

OSPAR is currently evaluating the scheme of EcoQOs. A workshop was held in Oslo in December 2004 to review a draft report on the North Sea Pilot Project on Ecological Quality Objectives. With views from the workshop incorporated, the draft report was further considered at the BDC meeting in February 2005. Following a round of written comments by Contracting Parties, the document will be finalized and presented for adoption at the OSPAR Commission meeting in Ireland in late June 2005. A preliminary conclusion contained in the draft report is that OSPAR regards the North Sea EcoQOs as a workable and scientifically valid system. The system is, however, not yet comprehensive, and OSPAR sees the need for adjustments and additional steps for successful implementation and completion. The whole set of EcoQOs is seen as periodically being used as part of the Joint Assessment and Monitoring Programme (JAMP). OSPAR has also noted obvious links with the emerging ideas of the thematic European Marine Strategy, and the possible need for harmonization in the further developments.

Discussion

Elzbieta Lysiak-Pastuszak inquired about the organizational principles of seabird monitoring in the North Sea, i.e. whether it is institutionalized or based on voluntary actions? Hein Rune Skjoldal pointed out, that in prioritizing issues to be included into the EcoQOs, also activity and awareness of scientific groups play a role. Chris Hopkins emphasized, that the requirement that EcoQOs should be sensitive to manageable activities inherently poses the problem of defining which and to what extent activities are manageable. Hein Rune Skjoldal stressed that cause and effect relationships, based on the DPSIR (**D**rivers, **P**ressure, **S**tate, **I**mpact, **R**esponses) framework, may be used to link EcoQOs to relevant management activities. However, causal relationships often form networks rather then simple chains, and in developing EcoQOs one has to strike a balance between being practical/operational and safeguarding the biota against unknown, unclear, and/or multiple impacts. Consequently, biological status should be monitored in general, supplemented by investigative monitoring to detect the causes of emerging ecological issues.

Jesper Andersen added, that HELCOM MONAS demands causal relationships to be documented for all proposed EcoQOs .

4.4 Hermanni Backer (HELCOM): Draft HELCOM Strategic goals, Ecological Objectives and supporting key indicators for Eutrophication, Hazardous substances, and Biodiversity

HELCOM strategic goals, ecological objectives and indicators are assessment tools that measure progress towards the vision adopted by HELCOM 25/2004:

Healthy Baltic Sea environment with diverse biological components functioning in balance, resulting in a good ecological status and supporting a wide range of sustainable human economic and social activities.

The draft EU Marine Strategy (EC DG Environment 2004) has the vision that *" We and future generations can enjoy and benefit from biologically diverse and dynamic oceans and seas that are safe, clean, healthy and productive"*

The full assessment chain for making these visions operational requires general strategic goals (based on identified concern areas), management- and ecological objectives, indicators and corresponding target values to show how these objectives are met and finally data for the selected indicators. For identifying the different links of this chain HELCOM uses the terminology of the European Marine Strategy (Figure 4.4.1).

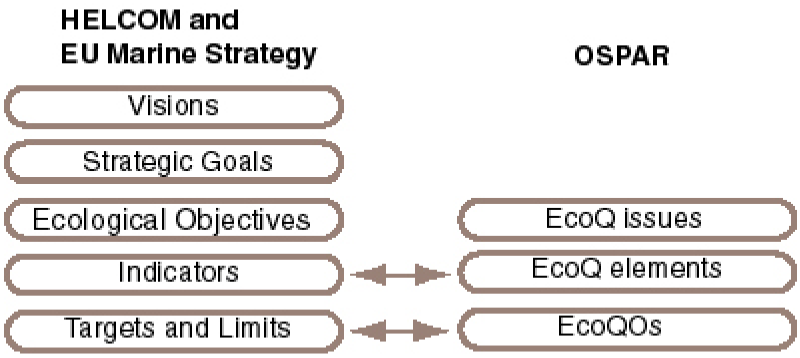

Figure 4.4.1: The path from visions to actions and translation between European Marine Strategy and HELCOM Ecosystem Approach terminology (left) and OSPAR terminology (right).

The HELCOM EcoQO Project sees the elements of this assessment chain narrowing in their geographical specificity from widely applicable Ecological Objectives to local target levels and limits. The presented Ecological Objectives are meant to be common for the whole Baltic Sea. In defining indicators the project has aimed at Baltic-wide applicability but in several cases the indicators have to be selected or modified according to the Baltic sub-basins (e.g., concerning relevant species). Depending on the indicator the target levels can be even more local in their applicability.

Note that the elements of this assessment cycle are tightly linked to the HELCOM monitoring and assessment activities. A system of strategic goals, ecological objectives, and indicators incorporating efforts from various HELCOM Groups and projects will be submitted to HELCOM Commission meeting in 2006 and provide elements for classifying the ecological status of the Baltic Sea harmonised with the parallel developments at Pan-European level.

The HELCOM ECOQO Project has defined a set of Ecological Objectives and drafted indicators for making them operational. This work has been carried out using the knowledge already available at ICES and OSPAR, taking into account the developing European Marine Strategy and implementation of the EU WFD in close cooperation with the BSRP, and the HELCOM Groups.

The Ecological Objectives and indicators are divided into three groups of *Eutrophication, Hazardous substances* and *Biodiversity and nature conservation*. All the remaining identified concerns of HELCOM, such as environmental impacts of fishing and maritime safety, have been taken into account within these three topics.

The HELCOM Ecological Objectives and indicators should be considered as an interconnected *system* of indicators, not as a collection of single indicators. To be worthy its place in the HELCOM work this developing system of Ecological Objectives has to be both pragmatic and complete as well as cover the whole ecosystem with minimum bias to any specific topic or area.

Target levels for the indicators are not proposed as such by the HELCOM EcoQO project. Such developments will be the task of separate HELCOM activities partly initiated with the HELCOM EUTRO Project (January 2005-November 2005) for eutrophication indicators. Long–term anthropogenic influences such as climate change are outside the timespan considered in the draft system; therefore a separate report on Baltic Sea effects of the global climate change is being planned for 2006.

Discussion: Hein Ruhne Skjoldal asked, whether the HELCOM EcoQO system also included quality objectives for fish. However, HELCOM efforts are focused on coastal fish, or commercially non-assessed species. Gedas Vaitkus inquired, which land elements are included into the HELCOM monitoring system and suggested to include land cover into the monitoring and assessment system. Currently HLECOM collects data on land-based inputs and atmospheric deposition, but reporting is not completely linked to marine assessment yet. With respect to land cover data, it should be kept in mind that HELCOM focuses mainly on marine areas.

4.5 Jacqueline McGlade (EEA/EC): Thematic Strategy for the protection and conservation of the marine environment

Pressures on marine ecosystems – overfishing, oil spills, shipping, oil and gas exploration, pollutant discharges – together with current warning signs – decreasing biodiversity, destroyed habitats, declining capacity to provide food for human consumption – call for an integrated approach to managing human activities in the marine environment that is focused on the benefits of maintaining a healthy marine ecosystem. Currently, there is a lack of coordination of marine management at international, EU and national level.

At **international level** many regional and global strategies, recommendations, binding agreements, guidelines etc. have been designed, but articulation between them is missing. In parallel, many institutions, bodies, conventions and agreements exist that are inadequately coordinated. At **EU level** a number of policies affect the marine environment, for example the common fisheries policy (CFP), marine transport policy, chemicals policy, common agricultural policy (CAP), air policy, and water policy. However, no policy is specifically designed to protect the marine environment and no concerted policy for the protection of the marine environment exists.

The 6th EU Environmental Action Programme consequently identified marine protection as one of the seven Thematic Strategies in need of concerted policy action. EU Council Conclusions in 2003 gave a clear mandate for the design of a European Marine Strategy. The geographical region addressed by the strategy includes both EU as well as non-EU countries bordering the European Seas and encompasses relevant international organisations.

The Marine Strategy will aim to protect the European Seas and to ensure that human activities are carried out in a sustainable manner using **common principles for problems shared by the different regions.** The EU covers parts of all regional seas around Europe, therefore many problems are shared in these seas and many threats and human activities have a transboundary nature. Instead of a sectoral approach, a **regionalised approach based on eco-regions** will be used to capture specific problems, providing coherence and integration, and using as much as possible existing legal and regional institutional instruments. The strategy should also explicitly address the EU footprint, i.e. effects of EU policies on adjacent ecosystems.

Cost-benefit analysis and strategic impact assessment of policy options will be an essential part of the strategy. The periodic assessment of the state of the European Seas will be based on streamlined monitoring and assessment activities. A 5-year cycle is currently envisioned as the minimum period for pan-European marine assessments. The assessment results will not only have implications for the managing human activities in the marine ecosystems, but they will also provide important feedback on the success of land-based environmental policies.

Status of the development of marine and coastal indicators in the EEA/EC

With respect to marine environment protection, the central task of the European Environmental Agency (EEA) is to link incoming data and information to marine strategy design and policy making. For that purpose, the EEA has adopted a set of indicators, covering the entire DPSIR – **d**rivers, **p**ressure, **s**tate, **i**mpact, **r**esponses - cycle.

Key issues threatening the European Seas are eutrophication and land based nutrient loads, climate change, change of storm tracks and frequency, as well as coastal flooding. Coastal flood risk management is of importance for habitat protection, and special attention has to be given to restauration of habitats when flooded areas have been restored.

Eutrophication is linked to land based nutrient loads. Currently European rivers show both upward and downward trends of nitrogen loads.

Indicators that the EEA applies on EU scale as well as the proposed regional indicators must:

- be policy relevant;
- monitor progress towards the targets/thresholds;
- be based on routinely collected data (reporting obligations, specified time scale, reasonable cost-benefit ratio);
- be consistent in space coverage;
- have sufficient time coverage;
- be primarily collected on national scale;
- be simple and understandable;
- be conceptually and methodologically well founded;
- be relevant to EU priority areas;
- be available in a timely manner; and
- be well documented and of known quality.

The EEA has designed a core set of 37 indicators, covering air pollution and ozone depletion, biodiversity, climate change, terrestrial environment, waste, water, agriculture, energy, fisheries and transport. Several indicators from this set relate directly to the marine environment, for example winter nutrient concentrations in coastal waters, bathing water quality, summer chlorophyll *a* concentrations, fish stocks outside safe biological limits, aquaculture production and the European fishing fleet capacity.

The current emerging issues within the management of the marine environment are the increase of alien species and the lack of knowledge of the ecosystem dynamics. Ecosystems may possess thresholds embedded into their trophic dynamics, leading to greenlash, where a variety of gradual and unexpected ecological changes lead to the loss or severe decline of an ecosystem.

Improvement of the marine management on the European scale poses challenges to handling environmental information. “Ecoinformatics” technologies have to be developed to share monitoring data from multiple platforms. Assessment methods, tools and results, as well as current research have to be shared and discussed. A cross-sectoral approach in designing policy options and the ability to analyse the effectiveness of proposed management measures are essential.

European marine assessment and management are conducted under the umbrella of the 6th Environment Action Programme. Activities are closely integrated with ongoing research projects (e.g., GMES and FP6 projects MERSEA, TOPAZ), remote sensing activities (GEOS – ESA), climate reconstruction efforts (ECMWF – ERA 70), and GIS database development (COGI European Grid Reference System, CORINE Land Cover). Coordination has also been established with the EU Flood Management initiative.

Discussion

Bärbel Müller-Karulis asked whether the Marine Strategy will also contain legally binding instruments. According to Jacqueline McGlade, the type and extent of legal instruments in the Marine Strategy is not defined yet, however, the Marine Strategy will include some legal obligations, which are especially sought by fisheries management groups.

Further, Gedas Vaitkus raised the questions of cost reductions through the use of remote sensing for marine monitoring. According to EEA estimates, remote sensing costs approximately one third of the conventional monitoring, if the satellite launch is not included into the cost estimates. However, many European satellites in use today are scheduled to go out of service soon and the observation system must be renewed continuously. An intriguing approach to reducing monitoring costs is the SEAWATCH system of monitoring buoys currently deployed in some European marine waters. A unified system of buoys could potentially be deployed in all European Seas. Kevin Summers reported experiences from the USA on the increase in use of buoys and remote sensing, but pointed out that not all parameters can be monitored with those platforms. Hein Rune Skjoldal suggested that buoys should be considered in the context of all other monitoring platforms. Jacqueline McGlade welcomed this suggestion and called for more cooperation and shared resources among the countries involved in marine monitoring, for example a shared European research vessel. Jan Thulin pointed out that attempts are conducted within the BSRP to collect jointly fisheries and monitoring data, and that the BONUS project plans to establish a shared European research vessel for the Baltic Sea.

Jan Thulin also asked about the status of the MMED (multiple marine ecological disturbances) approach within the EEA. Here the EEA has suggested cooperation with ICES and the marine environment protection conventions. Kevin Summers pointed out that a "cultural difference" exists between scientists and politicians in the way they reach agreement on necessary components of monitoring and assessment programmes. In this regard the EEA sees its role as an integrating element. The EEA is funded by, and reports to, the European institutions, translating scientific knowledge and advice into recommendations to policy makers. Generally, the EEA is regarded as an objective, knowledge-based advisor, and the European Parliament is interested in the available policy options and is often also willing to take necessary, but unpopular decisions.

Jesper Andersen pointed out that the planned pan-European assessment cycle with a 5-year frequency should be matched with the assessment periods used in the WFD and OSPAR/JMP. Chris Hopkins commented that the planned pan-European assessments are needed as important milestones, but environmental information should also be available on a nearly real time basis and information should be continuously presented on the web.

4.6 Dag Daler (GIWA): GIWA – a presentation of the methodology and assessment results from the Baltic Sea region

GIWA – Global International Waters Assessment is a project implemented by the United Nations Environmental Programme (UNEP) on behalf of the Global Environmental Facility (GEF) conducting a global assessment of marine resources (see www.giwa.net). The overall objective of the GIWA is to develop a comprehensive strategic assessment that may be used by UNEP, GEF and its partners to identify priorities for remedial and mitigatory actions in international waters, designed to achieve significant environmental benefits.

GIWA Methodology for global assessment

GIWA's assessments are based on an ecosystem approach. They aim to identify anthropogenic environmental problems in international waters of transboundary nature, their severity in relation to human life and welfare, the human activities that are the root causes of the problems and policy options available for their mitigation (Figure 4.6.1).

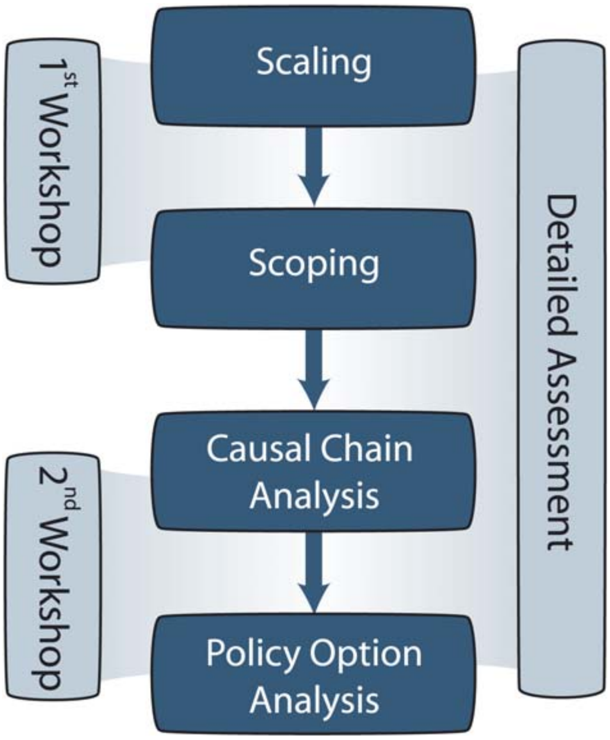

Figure 4.6.1: GIWA assessment flow chart.

The scope of GIWA's assessments are five environmental concerns that have been identified on a global scale, using a simple but globally applicable indicator system (Table 4.6.1):

Table 4.6.1: Global water concerns and assessment indicators.

Concern	Indicators
Freshwater shortage	Modification of streamflow Pollution of existing supplies Changes in the water table Economic impacts Health impacts Other social and community impact
Pollution	Microbial Eutrophication Chemical Suspended solids Solid waste Thermal Radionuclides Spills Economic impacts Health impacts Other social and community impact
Habitat and community modification	Loss of ecosystems or ecotones Modification of ecosystems or ecotones Economic impacts Health impacts Other social and community impacts
Unsustainable exploitation of fish	Overexploitation by fishery Excessive bycatch and discards Destructive fishing practices Decreased viability of stock Impact on biological and genetic diversity Economic impacts Health impacts Other social and community impacts
Global change	Changes in hydrological cycle Sea level change Increased UV-B radiation Changes in ocean CO2- source/sink function Economic impacts Health impacts Other social and community impacts

GIWA uses a global division of the world land surface and adjacent marine areas into 66 regions according to drainage basins and land boundaries. These 66 regions largely coincide with the delineation of Large Marine Ecosystems (Figure 4.6.3).

Socio-economic issues are a central component of the assessments, including

- **Economic impact** (Direct and indirect);
- **Health impact** (Seriousness of the health problem and number of people affected);
- **Other social and community impact** (Aesthetic values, life style values, etc.).

The severity of water management problems in the 66 areas was ranked on a scale from 0 (no impact) to 3 (severe impact) and trends in development were indicated (Figure 4.6.3).

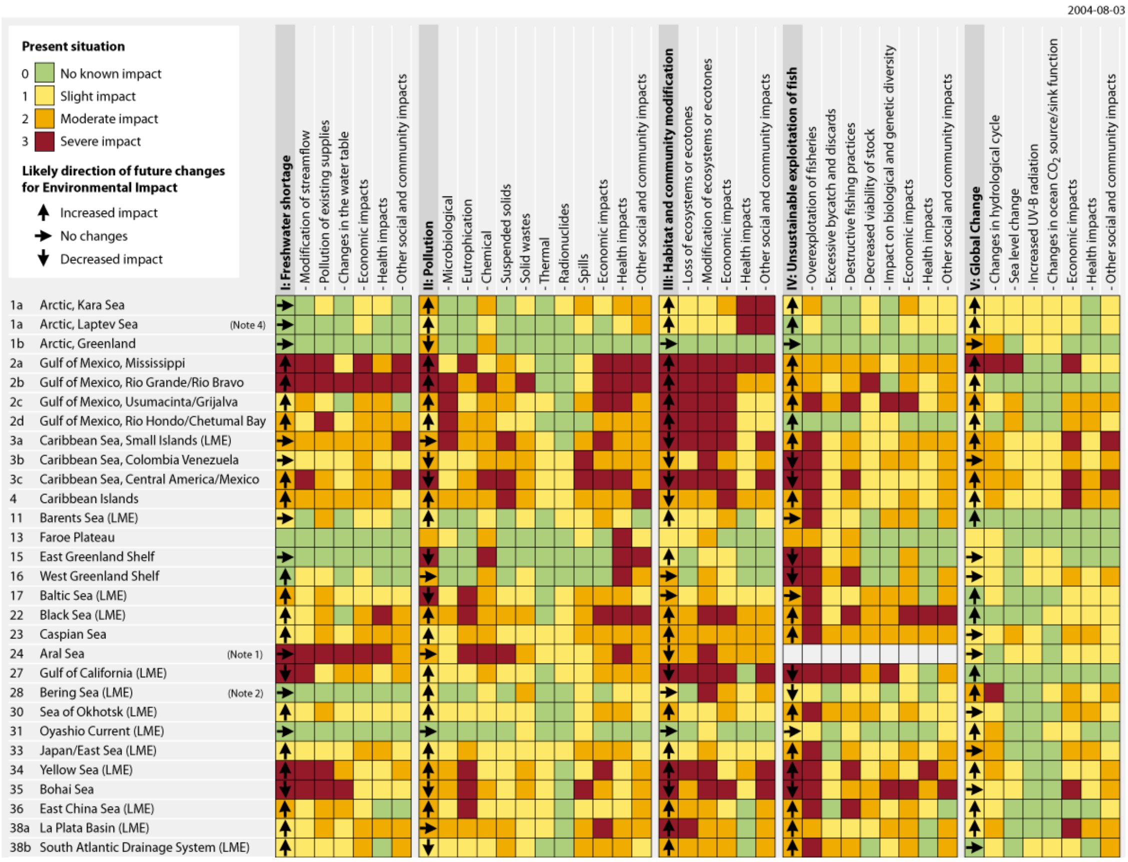

Figure 4.6.3: Environmental impacts in the 66 GIWA regions (Preliminary results).

Root cause analysis of the identified environmental impacts has proved one of the most important elements, but at the same time the most difficult component of environmental impact assessment. It was found out that population growth and high resource use by modern societies is the root cause of most water problems. In order to provide useful advice to governments and international development and donor organizations, GIWA's root cause analysis focuses on driving forces that can be influenced by improved governance.

Common root causes of water management problems:

- demography, population growth, urbanisation, migration patterns;
- shortcomings in governance and management, national water laws, international conventions and intergovernmental agreements, lack of institutional capacity;
- skewed economic incentives, subsidies failures, lack of real water pricing;
- market failures, global trade;
- demands for short-time economic profit takes priority over environmental sustainability.

Baltic Sea case study

GIWA has identified two major environmental problems in the Baltic Sea – eutrophication and overfishing. Also increasing shipping traffic threats the Baltic ecosystem (GIWA, 2005).

Baltic Sea eutrophication is associated with significant environmental impacts, like loss of commercially valuable fish, loss of benthic fauna, modifications of ecosystems and ecotones, toxic algal blooms and oxygen depletion. Socio-economic impacts due to loss of recreational values are linked to cost of drinking water treatment, infections, diseases and allergies.

Waterborne and airborne inputs are identified root causes.

Waterborne inputs:

- **Lack of governance**: lack to successfully integrate environmental policy into agricultural policy. Lack of adequate land use policies, and lack of regulations for land use conservation and use of water resources. Shortcomings in EU-CAP;
- **Intensive agriculture**: Excessive use of fertilizers and high livestock density;
- **Ineffective technology**; Poor implementation of modern agricultural technology;
- **Urbanisation and economy**: Low investment in waste water treatment facilities leading to increased discharges of municipal and industrial pollutants; High urbanisation rate.

Airborne inputs:

- **Governance**: ineffective laws and regulations to control emissions; lack of adequate transport policy; increased sea and road traffic.

Overexploitation of fish in the Baltic Sea leads to environmental impacts, marked by considerable changes in the structure and number of fish populations, decline in spawning stock size, and decrease in total landings of commercial species. Associated socio-economic impacts are loss of revenues from fishing, loss of livelihood and increased unemployment in the fishery sector, impacts in the fishing markets due to uncertainty and variability of fish landings.

Root causes behind fishery problems are

- **Governance and legal**: fishery management coordination, inadequate fishery control and lack of reliable fishery statistics. Deficiencies in the EU common fishery policy. Lack of cross sectorial coordination;
- **Economic**: fishing subsidies, market failure and economic reform failures;
- **Education**: knowledge, inappropriate assessment methods.

Overall, pollution impacts to the Baltic were classified as ‘severe’, fishery impacts were graded ‘moderate’.

GIWA recommended a suite of remedial policy options for Baltic Sea water management:

- To integrate environmental policies with agricultural policies by supporting co-operation networks and action programmes;
- To strengthen sustainable fisheries by means of increased co-operation in the field of control and enforcement as well as to integrate fishery policies with economic and environmental strategies;
- To implement the EU Water Framework Directive in all the EU countries situated in the catchment area of the Baltic Sea and to ensure similar actions in Russia.

Discussion

Hein Rune Skjoldal raised the question how GIWA assessments differ from other Baltic Sea assessments, conducted for example by HELCOM. In contrast to local conventions GIWA uses a more global approach, applying a set of indicators and criteria that are applicable world wide, focusing on major problems that are common to all world marine systems.

Henn Ojaveer objected to the GIWA notion that all Baltic fish stocks are overexploited and pointed out that some stocks are in good condition. Chris Hopkins pointed out that the latest ICES assessment shows that all assessed stocks, except the Gulf of Riga herring and most sprat stocks, are outside safe biological limits.

Kevin Summers asked for GIWA’s view on the future development of global ecosystem and their chances of improvements after good governance would be implemented. However, Dag Daler saw GIWA’s assessments as strategic documents and pointed out that more detailed analysis was needed to recommend specific policy measures. However, GIWA’s documents do provide a basis that makes it very well possible to identify the severity of problems and to define a global strategy for investments. Also Chris Hopkins agreed that meaningful assessments do not need "detailed" information.

References

GIWA. 2005. Regional Assessment 17, The Baltic Sea, UNEP 1005, ISBN-1651-940X, Kalmar University Press.

4.7 Kevin Summers (USA): Approaches and methodologies for the development of indices of coastal ecological condition – experiences from the USA

The US EPA has conducted an assessment of its coastal resources since 1990 and has conducted nation-wide surveys of coastal conditions since 2000. The basic goal of this program (National Coastal Assessment – NCA) was to build the scientific basis, and the local, state and tribal capacity to monitor for status and trends in conditions of coastal ecosystems. In order to achieve this goal, four basic guiding questions were posed that the surveys had to address. These included:

- What is the status, extent, and geographical distribution of ecological resources?
- What are the proportions of resources declining or improving? Where? Where are areas where additional efforts should be focused?
- What factors are likely to contribute to declining conditions?
- Are pollution control, reduction, mitigation and prevention programs achieving overall improvement of ecological conditions?

The combination of the answers to these questions can be used to assess whether the "environment is getting better or worse". In order to address these questions, NCA uses a variety of indicators to examine various elements of the environment and ecosystem, including:

- Exposure Indicators (nutrients, dissolved oxygen, suspended sediments, etc.);
- Response Indicators (e.g., benthic and fish communities, chlorophyll, fish tissue contaminants);
- Habitat Indicators (light transmittance, salinity, temperature).

These types of indicators represent a similar approach to that taken by the BSRP examining stressor, impact and response variables.

An approach for the development of guidance criteria for indicator selection was described that focused on a two step process whereby:

- Environmental values, apparent stressors, and assessment endpoints are identified; and
- A set of candidate indicators are determined that are linked to the identified endpoints and are expected to be responsive to stressors.

Mandatory criteria used for the acceptance of candidate indicators are:

1) Regionally responsive;
2) Unambiguously interpretable;
3) Simply quantifiable;
4) Stable throughout the index sampling period;
5) Described by relatively low year to year variation;
6) Related to environmental impacts.

Highly desirable criteria for indicator selection include:

- Stability of the sampling unit;
- Methods for collection and analysis are readily available;

- Some historical record exists;
- Retrospective nature of indicator;
- Indicator is anticipatory;
- Indicator is cost effective.

Indicators used by the National Coastal Assessment include **water quality indicators** (nitrogen, phosphorus, chlorophyll, dissolved oxygen, water clarity), **sediment quality** (bulk chemistry, toxicity, sediment total organic carbon), **changes in wetland acreage**, **community measurements** associated with benthic and pelagic ecosystems, and **tissue contaminant concentrations in fish**. It was necessary to develop conceptual models for each of these indicators to demonstrate the relationship of these indicators to environmental stressors and the response endpoints as well as environmental values.

Examples were provided of the development of an index of multiple physical indicators for water clarity (LICOR measurements, Secchi depths) and an index of benthic community based on various community benthic parameters.

Discussion: Jacqueline McGlade asked whether the reevaluation of indicators integrated into the National Coastal Assessment has led to the rejection of indicators, and which criteria would be used to evaluate indicators. So far no indicators have been rejected, but it is planned to reevaluate indicators, that do not change within a ten year period, as they might not provide new information. Jacqueline McGlade also wanted to know, whether the regional approach taken in the National Coastal Assessment is well understood by the public. Often, the US Federal Government is interested in information aggregated over large region, but most information is also available on state level and sometimes even for individual estuaries.

Elzbieta Lysiak-Pastuszak compared the one-out all-out approach implemented in the EU WFD to the US concept of weighting the response of several indicators into a final assessment. She inquired how the National Coastal Assessment concept handles situations, where a quality element might not be applicable, e.g., sediment contaminant content in areas without sedimentation. Here the approach acknowledges that distinct subpopulations exist within the respective area, e.g., deposition areas and areas without sedimentation. Then the relevant indicators are evaluated for each subpopulation. If the indicator approach is still not applicable, the underlying conceptual model of ecosystem state assessment should be revised.

Hermanni Backer asked, how continuity in assessments is assured, after changing the algorithms for calculating individual indicators. The National Coastal Assessment analyses the data based on both previous and new algorithm to analyse, how the changing calculation scheme impacted the assessment.

4.8 Jan Marcin Weslawski (Poland): Outcomes of European Community RTD Framework Programme related to biodiversity

A number of EU-funded networks and projects deal with marine biodiversity. These started from 5th FP Concerted Action BIOMARE, which developed into the 6th FP Coordinated Action MARBENA, and made basis for the extensive Network of Excellence MARBEF (www.marbef.org). Results of these research projects have now to be implemented into marine management.

Three paradigms of biodiversity were coined in terrestrial ecology, where the field of biodiversity research first developed:

- more diverse ecosystems are more productive and more stable (e.g., Loreau et al., 2001);
- biodiversity contributes largely to goods and services of the ecosystem (Wilson, 1998);
- biodiversity is diminishing on the high rate due to man’s activity (Martin, 1984).

Following these assumptions, high-rank international agreements were accepted, e.g., the Convention on Biological Diversity (CBD Rio 1992, Johannesburg 2002), the Oslo-Paris Convention (OSPAR), and the EU Habitat directive. On the European scale, the EU pronounced to stop the biodiversity loss until 2010.

Basically, concerns about biodiversity loss are linked with the "concept of domino blocks" – i.e. the organisms in ecosystems are interlinked, and removal the key species might start an avalanche of effects (examples are Eider duck on Norwegian coast – balance between sea urchins and kelps, if top predator eider duck is removed, sea kelp is grazed down, causing coastal erosion, and species loss). In daily life, there are more than simple casual chain effects. Elements (species) may follow a bifurcated setup and ecosystems may switch between states. Quite frequently species in ecosystems are not dependant on each other, forming isolated states.

Compared to terrestrial systems, there are some specific problems with marine biodiversity:

- Most knowledge is based on terrestrial examples;
- In the sea, no experimental results on biodiversity and ecosystem performance are available;
- Marine biodiversity presents on higher taxonomic level compared to land different phyla;
- Marine biodiversity reservoirs are unknown and small taxa;
- Marine ecosystems are often physically controlled, not biologically controlled;
- Biodiversity concepts on land are based on long-living plants, plants are connected to 1 m of active soil layer, whereas in the sea: primary producers are short lived, and do not accumulate from year to year.

Among most often used and recommended metrics for biodiversity there are:

- number of species;
- number of functional groups;
- Shannon Wiener index;
- Taxonomic distinctness index (based on taxonomic distance between species in a sample).

In some cases, species counts do not form a reasonable basis for ecosystem comparison. For example, in the Puck Bay the following number of species occurs:

- sea grass beds - 32 species;
- sandy sublittoral - 12 species;
- stony outcrop – 21 species;
- algae washed ashore – 41 species – most of the drifted and dead species from other biota.

To avoid problems with biodiversity assessment as an indicator of ecosystem health, we shall consider the examination of existing functional links between ecosystem components.

Two types of biotopes should be distinguished for biodiversity assessments:

1) physically controlled systems;

- links between organisms are often only weakly established.

2) biologically controlled biotopes:

- resemble more the terrestrial biotopes, accumulation of organic matter, biological interlinks;
- unhealthy: annual specialists, no biological structures;
- healthy: long-lived species, burrowing animals.

New biodiversity indices could be based on functional links between species. Several types of links exist in marine ecosystems, e.g., symbiosis, predator-prey relations, commensalisms etc. Matrixes established by multi dimensional scaling can be used to show differences in species occurrence. Biodiversity is generally important in systems with many links. In systems with isolated entities the biodiversity will not adequately indicate the quality of the biota. It is generally assumed, that only in healthy environments biologically controlled biota will develop in full and the ecosystem will be saturated with the expected number of species.

Discussion: Sergej Olenin commented on the parallels between human health and healthy ecosystems. Similarly to differing concepts for "health" among human age groups (healthy child – healthy old man), a different concept of "health" is needed for marine ecosystems. Therefore the Baltic Sea requires a different health concept than, e.g., the North Sea. The Baltic "health" should be defined differently along regions of the salinity gradient.

Jacqueline McGlade pointed out, that the ecologist Robert Ulanowicz's works provided trophodynamic indexes that well reflected retention of carbon and biomass, as well as showing shifts in system biogeochemistry. Therefore the standing stock of biota should be linked to trophodynamic indices. At the same time, pelagic ecosystems are not entirely "transient". However, the transient nature has to be taken into account in data assessment, because differences in functional chain lengths exists, with regularly disturbed systems having long single chains, and seasonally disturbed systems often showing duplication of trophic pathways.

In this respect, Chris Hopkins pointed out, that pelagic habitats are currently weakly understood. For example, no consensus exists on defining habitats of mobile marine species. Nick Aladin added that differing time scales have to be taken into account. In this respect that Baltic Sea is a very recent entity. Therefore biodiversity of the Baltic Sea is not yet fully developed, and similarly to the Black Sea, the Baltic Sea has more lacustrine than marine properties. However, global marine ecosystems are the oldest ecosystems on Earth, being older than all terrestrial ecosystems.

References

Loreau, M., Naeem, S., Bengtsson, J., Grime, J.P., Hector, A., Hooper, D.U., Huston, M.A., Raffaelli, D., Schmid, B., Tilman, D., and Wardle. D.A. 2001. Biodiversity and ecosystem functioning: current knowledge and future challenges. Science, 294: 804-808.

4.9 Juha-Markku Leppänen (HELCOM): HELCOM Assessment and Monitoring Strategy

The 26th Meeting of Helsinki Commission adopted the HELCOM Monitoring and Assessment Strategy.

The new HELCOM Assessment and Monitoring Strategy sets out the basis for how the HELCOM Contracting States commit themselves to carry out their national monitoring programmes and work together to produce joint assessments.

4.9.1 Monitoring

The HELCOM monitoring system covers the whole Baltic Sea Area and its catchment area within the Contracting States, is targeted to identify concerns, and is scientifically sound and cost-effective. Monitoring in the catchment area utilizes national and international data collection and makes it comparable at the Baltic scale. In the open Baltic Sea, HELCOM monitoring programmes are the backbone while in coastal areas they will bring added value to activities required by other fora.

HELCOM monitoring should focus on parameters which are indicative of the ecological status and should be carried out in such a way that adequate confidence and precision is achieved.

The sampling should be designed to take into account the natural spatial and temporal variability in the marine environment in order to produce statistically reliable data.

Spatial and temporal frequency of sampling as well as the set of parameters to be monitored can differ between sub-regions, and they should be related to the level of compliance to the ecological objectives; most intensive monitoring in cases where ecological objectives have not been reached.

Monitoring should promote continuation of existing long-term data series and establishment of new ones for the future.

The HELCOM monitoring system consists of several manageable complementary programmes:

1) PLC-Air and PLC-Water to quantify emissions to the air, discharges and losses to inland surface waters and the resulting air and waterborne inputs to the sea;
2) COMBINE to quantify the state, impacts and changes in the various compartments (water, biota including coastal fish, and sediment) of the marine environment - it also includes the physical forcing;
3) MORS to quantify the sources and inputs of artificial radionuclides as well as the resulting state and changes in the various compartments (water, biota, sediment) of the marine environment;
4) HELCOM is also coordinating surveillance of deliberate illegal oil discharges as well as making an inventory of marine accidents and is annually assessing the number, distribution and amount of the spills.

HELCOM monitoring programmes cover eutrophication, hazardous substances and elements of biodiversity. Baltic Sea Protected Areas (BSPAs) provide building blocks for nature conservation assessments.

4.9.2 Assessment

HELCOM assessments, as well as the supporting monitoring, should be targeted at identified threats in the policy areas where HELCOM continues to act, i.e. eutrophication, hazardous substances (including artificial radionuclides), change of biodiversity and habitat degradation, and problems arising from shipping. In addition, HELCOM will continue to act on newly emerging issues with detrimental effects to the marine environment.

HELCOM assessments should be timely, scientifically sound, reliable, and approved in consensus. The assessments should make use of the guidance provided by the Driving force, Pressure, State, Impact, Response (DPSIR) scheme as well as use Quality Objectives and linked performance indicators as central tools.

While HELCOM assessments should be Baltic specific, the information content as well as their timing should be harmonized with other corresponding products, e.g., at the European level.

In order to gain synergy, HELCOM should make use of data and information that Contracting Parties are collecting and reporting to other organizations such as EU, IMO, OECD and UNEP. Research outside HELCOM should be used as the primary source for defining newly emerging concerns.

HELCOM's assessment products comprise of:

1. Indicator Fact Sheets which are updated annually to provide timely information on how the HELCOM objectives are met;
2. Thematic reports which cover various topical themes. Thematic reports covering inputs, eutrophication, hazardous substances (including radioactive substances) and biodiversity are to be produced periodically. The reports should consist of a technical/scientific (science for management) section and a policy implication section. Thematic reports may also be produced on other specific topics;
3. Holistic assessments which cover the DPSIR frame and link science and management as well as provide a basis for formulation of supplementary regional policies and measures.

Data from joint monitoring programmes as well as indicator and thematic reports form a continuous chain towards holistic assessments where modelling and scientific reports play an important role in explaining and linking pressures, state and impacts and providing guidance for future responses.

4.10 Sergej Olenin (Lithuania): The importance of biotopes, their mapping and classification for development of the ecosystem health concept

(Based on Olenin, S. and Ducrotoy, J-P. 2005. The concept of biotope in marine ecology and coastal management (submitted to Marine Pollution Bulletin))

Origin and evolution of the biotope concept

The term "biotope" was introduced by a German scientist, F. Dahl in 1908 as an addition to the concept of "biocenosis" earlier formulated by K. Möbius (1877). Initially it determined the physical-chemical conditions of existence of a biocenosis ("the biotope of a biocenosis"). Further, both biotope and biocenosis were considered as abiotic and biotic parts of an ecosystem, accordingly. This notion ("ecosystem = biotope + biocenosis") became accepted in German, French, Russian, Polish and other European "continental" ecological literature.

Up to the early 1990s, the notion "biotope" in the English literature was not applied widely. The term was "re-discovered", when the Joint Nature Conservation Committee of Great Britain, working on a classification of coastal marine environment, came with a new definition of the biotope (Connor, 1995; Hiscock, 1995): "Biotope = habitat + community".

The new biotope concept combines the physical environment (habitat) and its distinctive assemblage of conspicuous species. The habitat was defined according to geographical location, physiographic features and the physical and chemical environment (including salinity, wave exposure, strength of tidal fluxes, etc.), while the community was described as "a group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups" (MarLIN, 2003). The community was interpreted as a biotic element of a biotope.

The new meaning of the word "biotope" should be distinguished from the ecosystem definition, which also includes both the physical environment and community (e.g., Odum, 1975; Ramade, 1978). Strictly speaking (according to its original definition), the new concept of biotope does not take into consideration the energy and other ecosystem linkages between its abiotic and biotic components. The community (particularly one of its parts – the complex of the most distinctive, conspicuous species) is being mentioned only as one of the distinctive characteristics, which enables one to distinguish and classify the biotopes (Olenin *et al.*, 1996).

Thus, the new interpretation of biotope differs essentially from the traditional one. Nowadays, "the biotope concept is considered as a synonym of habitat in some legislative acts, directives and conventions for the convenience of interpretation" (MarLIN, 2003). Also, the new understanding of "biotope" now dominates in the international scientific and applied environmental literature (HELCOM, 1998; EUNIS, 2002; Connor *et al.*, 2004).

Biological features used for identification of biotopes

From a biological point of view, the biotope results from a balance between the regional pool of species and the local environmental conditions. The species composition will be dependent on their access to the habitat and on other biological requirements, such as recruitment of young stages, trophic relations, food availability, etc.

Not only living organisms themselves can be considered as biological features, but also the signs of their life activity (empty shells, sandy refuges, borrows, traces, faecal pellets, etc.). These signs give indications of the physico-chemical qualities of the substrate and how the vital activities of the bottom fauna affect them (McCall and Teversz, 1982; Bromley, 1996). Consequently, the qualities of biotopes themselves depend more or less on correlations between biological and physico-chemical processes. That is why the application of further biotic features in classification of biotopes is not only useful but also necessary from the methodological point of view.

In contemporary classifications, benthic biotopes are identified by brief descriptions of the physical environment and the Latin name of the conspicuous and/or dominant species (Dauvin *et al*., 1996; Olenin, 1997; Connor *et al.*, 2004).

Biotope approach to coastal typology

In the late 1980-1990s, with many European Directives being promulgated, law has become a driving force for ecology (Ducrotoy and Elliott, 1997; Elliott *et al.*, 1999).

A regional international classification of coastal biotopes and their complexes was developed for the Baltic Sea (HELCOM, 1998).

Recently, the notion of biotope was suggested for the development of a coastal typology meeting the requirements of the Water Framework Directive (Figure 1). In the regional case study, the coastal types were defined as complexes of biotopes (Olenin and Daunys, 2004). It was noted that the biotope notion integrates several, if not all, obligatory and optional factors (the tidal range, salinity, depth, current velocity, wave exposure, turbidity, etc.) listed in relevant WFD recommendations for coastal typology (Guidance document, 2003). Furthermore, the biotope classification procedure includes such a necessary step as the analysis of matching between physical and biological features used to characterize the biotopes. The next step, following the development of biotope classification system and its use for coastal mapping, includes identification of coastal types as the complexes of interrelated neighboring biotopes. This step gives the coastal typology a solid natural background and provides it with essential ecological relevance. The major argument to use biotopes for the coastal typology is that there are already several national and international biotope classification systems developed for the coastal zones of Europe (see above).

Biotope approach to the ecosystem health assessment

The application of an international classification system should offer an opportunity for monitoring changes in marine ecosystems. Following the 1992 Rio Earth Summit, the European Community passed the Habitats Directive (1992/EC192) (Bell, 1997) which places on member states a requirement to designate Special Areas of Conservation (SACs). The establishment of the Natura 2000 network is an integrated approach to the designation of protected habitats to represent Europe's environmental diversity, including SACs but also Special Protection Areas (SPAs) designated under the Birds Directive. The philosophy behind the directive is that if the habitat is protected, then the health of the biota will also be safeguarded. Once an area is assigned the SAC status, the Habitats Directive (Article 17) requires that the member state government reports at regular annual intervals on the conservation status of the habitats and species for which the site is designated. The information provided should include a broad scale assessment of the complete range of habitats and their associated communities and whether they meet conservation objectives for the site. Biotopes could be used in marine SACs, but it would then be necessary to further refine the classification to ensure it is accurate enough for monitoring changes.

However, biotope classifications were not devised as a monitoring tool per se and alternative and/or complementary methodologies will need to be introduced if certain designated sites need to be surveyed using such classifications.

References

Bell, S. 1997. Environmental Law, Ashford Colour Press, Gosport.

Bromley, R.G. 1996. Trace Fossils. Biology, taphonomy and applications. London, Chapman and Hall: 361 pp.

Connor, D. 1995. The development of a biotope classification in Great Britain and Ireland - principles and structure of classification. In: K. Hiscock (ed.) Classification of benthic marine biotopes of the north-east Atlantic. Proceedings of a BioMar-Life workshop held in Cambridge. 16–18 November 1994, Cambridge UK, Peterborough, Joint Nature Conservation Committee: 30–46.

Connor, D.W., Allen J.H., Golding, N., Howell K.L., Lieberknecht L.M., Northen K.O., and Reker, J.B. 2004. The Marine Habitat Classification for Britain and Ireland. Version 04.05 JNCC, Peterborough (internet version) www.jncc.gov.uk/MarineHabitatClassification (accessed 2005.03.10).

Dauvin, J.-C., Noël, P., Richard, D., and Maurin, H. 1996. Inventaire des ZNIEFF-Mer et des espèces marines: éléments indispensables à la connaissance et à l'aménagement des zones côtières. Journal de Recherche Océanographique, 21: 16–20.

Ducrotoy, J-P, and Elliott, M. 1997. Interrelation between Science and Policy-making: the North Sea Examples. Marine Pollution Bulletin, 34(9): 686–701.

Elliott, M., and Dewailly, F. 1995. The structure and components of European estuarine fish assemblages. Neth. J. Aquat. Ecol., 29: 397–417.

Guidance document No 5. 2003. Common implementation strategy for the water framework directive (2000/60/EC). Transitional and Coastal Waters – Typology, Reference Conditions and Classification Systems. Produced by WG 2.4. – COAST. Luxemburg: Office for Official Publications of the European Communities. 107 p.

HELCOM. 1998. Red list of Marine and Coastal Biotopes and Biotope Complexes of the Baltic Sea. Ed. by H.V. Nordheim and D. Boedeker. HELCOM. Baltic Sea Environment Proceedings, No.75: 115 pp.

Hiscock K. (ed.), 1995. Classification of benthic marine biotopes of the north-east Atlantic. Proceedings of a BioMar-Life workshop held in Cambridge, 16–18 November, 1994. Peterborough, UK, Joint Nature Conservation Committee: 105 pp.

MarLIN. 2003. Assessing the sensitivity of seabed biotopes to human activities and natural events. The Marine Life Information Network for Britain and Ireland. http://www.marlin.ac.uk/ (site visited 14/07/2003).

Odum J., 1975. Fundamentals of ecology. W.B. Saunders Company, Philadelphia.

Olenin, S., Daunys, D., and Labanauskas, V. 1996. Classification principles of the Lithuanian coastal biotopes. Annals of Geography (Vilnius), Vol. 29: 218–231, (in Lithuanian with English summary).

Olenin, S., and Daunys, D. 2004. Coastal typology based on benthic biotope and community data: the Lithuanian case study. Ed. by G. Schernewski and M. Wielgat. *In* Baltic Sea Typology. Coastline Reports, 4: 65-83.

Ramade, F. 1978. Éléments d'écologie appliquée. Action de l'homme sur la biosphère. Ediscience, Paris.

5 Results of subgroup work

Four subgroups:

- On Effects of Eutrophication;
- On Effects of Hazardous Substances;
- On Effects of Fishing Activities; and
- Loss of Biodiversity.

were established. These subgroups were requested to continue developments which started in Vilnius (SGEH, 2004):

- EcoQOs;
- Indicators; and
- Reference values.

5.1 Subgroup on Effects of Eutrophication: Georg Martin (Co-Chair), Jesper Andersen (Co-Chair), Baerbel Mueller-Karulis, Elzbieta Lysiak- Pastuszak, Piotr Margonski

Comments/presentation by Georg Martin

The Baltic Sea is a marine area with very large degree of natural variability in terms of environmental factors. A variety of environmental gradients create mixture of unique conditions in the basins and sub basins. Eutrophication is considered to be one of the major environmental concerns in the Baltic Sea. Assessment of the eutrophication is one of the main aims of the HELCOM MONAS activities similarly to EU WFD.

The ecological status of the coastal waters of the Baltic Sea deviates in many areas from the reference conditions (HELCOM, 2001). The impaired ecological status is to a large extent caused by five factors: i) fishing and hunting (top-down control), ii) pollution (nutrients, contaminants, radioactive substances etc.), iii) mechanical destruction of habitats (constructions, extraction of materials), iv) introduction of alien species, and v) global change, cf. Jackson *et al.* (2000).

There is at present no single and globally accepted definition of marine eutrophication. Nixon (1995) defines marine eutrophication as "an increase in the supply of organic matter". The supply is not restricted to pelagic primary production, but also includes bacterial production, primary production of submerged aquatic vegetation, inputs of organic matter from land via rivers and point sources as well as the net advection from adjacent waters. The advantage of this definition is that it is short, simple and does not confuse causes and effects. The limitations of the definition are 2 fold. It does not take structural or qualitative changes due to nutrient enrichment into account, and it is difficult to make fully operational since the majority of existing marine monitoring programmes seldom include all the variables needed to estimate the total supply of organic matter to a given body of water. Gray (1992) focuses on the direct effects of nutrient enrichment on productivity, the secondary effects where the produced organic material is not consumed by grazers, and the extreme and ultimate effects, which includes the growth of macroalgae, oxygen depletion and mortality of benthic invertebrates and natural versus cultural caused eutrophication. Prudently, Richardson and Jørgensen point out that when we speak of eutrophication it is cultural eutrophication or that, which is caused by anthropogenic activities, which is of interest.

A number of EU Directives also define eutrophication. In the Urban Wastewater Treatment Directive eutrophication means: "The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce and undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned"(EU, 1991). The Nitrates Directives definition is almost identical, except that it is restricted to eutrophication from agriculture (EU, 1991).

The list of possible eutrophication EcoQOs and indicators have been discussed and agreed upon during the SGEH meeting in 2004 and could be found in the form of the table in SGEH report. The possibility of establishment the reference conditions was evaluated for most of the proposed indicators. During the present meeting the discussion of further development of the indicator list is planned.

Comments/presentation by Jesper Andersen

The objective of HELCOM EUTRO is to develop tools for a thematic eutrophication assessment for the Baltic Sea and to base the assessment on reference conditions.

It was as a cautionary note underlined that the results of targeted eutrophication monitoring activities are not only representing the effects of nutrient enrichment, but also other pressures as top-down control, contaminants, physical modification, alien species and global change.

HELCOM EUTRO is based on a step-wise approach:

- Step 1: Agreement on the definition of reference conditions;
- Step 2: Agreement on a list of assessment indicators;
- Step 3: Agreement on assessment metrics and principles (justify % deviation from reference conditions, but not exceeding 50%);
- Step 4: Production of national reports;
- Step 5: Compilation of national reports into a preliminary eutrophication assessment report, including description of objectives, principles and tools applied.

Deadline for submission of national report is 2 May 2005. A draft HELCOM-wide report (Interim Baltic Sea Eutrophication Status Report. Development of tools for a thematic assessment of eutrophication) will be presented and discussed at a workshop on 20–22 September 2005 in Stockholm – together with the "Baltic GIG" group. The final report (including tools and recommendations) is expected to be approved by HELCOM MONAS in late November 2005.

As a second warning note, it was emphasized that there is at present a strong focus on so-called functional relations, sometimes referred to as cause-effect relationships or dose-response relationships. But reality is often far more complicated, and there are strong indications that many shallow coastal systems are multi-stable ecosystems, where regime shift may occur when threshold/point-of-no-returns are passed. It is important to communicate to senior managers and politicians that management should focus on such thresholds, because changes in structure and functioning might be irreversible.

Status after SGEH 2004 meeting in Vilnius

EcoQOs and Indicators for biological effects of eutrophication, as compiled in Vilnius meeting, are given in Table 5.1.1. This table includes also a status of methods/data for establishing reference conditions.

Table 5.1.1: Preliminary proposal for EcoQOs, Indicators and Reference conditions for biological effects of eutrophication (ICES SGEH Report 2004).

General EcoQO/ Vision: **Reduce eutrophication in order to restore ecological balance around historical reference values within the Baltic Sea and to ensure functioning of marine ecosystem**

Specific EcoQO	EcoQElement/Indicator	Reference points /Reference conditions
Restore Water clarity levels to those of 50s of the 20th Century	Depth distribution of macroalgae – definition of depth conture parameters according to typology (sometimes irrelevant)	Available in historical data and in literature (e.g., CHARM)
Restore Water clarity levels to those of 50s of the 20th Century	Secchi depth – the only measure widely used, useful measure despite great variability (possible variants max, mean, seasonal mean etc.).	Available historical data
Restore Water clarity levels to those of 50s of the 20th Century	PAR measurements (not subjective, automated, well correlated with macrophyte production).	To be found out
Restore Water clarity levels to those of 50s ofthe 20th Century	Direct measurements of turbidity	To be found out
Restore Water clarity levels to those of 50s of the 20th Century	Chlorophyll *a*	To be found out
No oxygen depletion where it should not occur naturally	Frequency of hypoxia and annoxia	Historical data
No oxygen depletion where it should not occur naturally	Loss of sessile benthos	To be determined
No oxygen depletion where it should not occur naturally	Kills of invertebrates and fish (poor indicator)	Historical data
No oxygen depletion where it should not occur naturally	Presence/absence of laminated sediments	
Depth range of perennial vegetation returned to regionally defined historical levels	Type and species specific EQR (for reference conditions see CHARM report)	Literature (CHARM)
No massive algal blooms	Chlorophyll *a*	To be developed
No massive algal blooms	Frequency of harmful algal blooms (annual, decadal?)	To be developed
No massive algal blooms	DOC	Historical data
No massive algal blooms	Size structure of plankton community	Historical data and moddelling
No massive HAB (Harmful algal bloom) and presence of algal toxins in benthic organisms	Abundance of HAB species	.
No massive HAB (Harmful algal bloom) and presence of algal toxins in benthic organisms	Annual frequency of HABs	
No massive HAB (Harmful algal bloom) and presence of algal toxins in benthic organisms	Presence of hepatotoxins and DSP in shellfish and benthic fish liver	
To maintain the abundance of opportunistic species at regionally defined level	Proportion (biomass/cover) of opportunistic to perennial species	Literature (CHARM)
To maintain the abundance of opportunistic species at regionally defined level	Changes in size structure of zooplancton community	NIA, Hist, Modelling
To maintain the abundance of opportunistic species at regionally defined level	Increased abundance of species sensitive to TOC additions	Modelling, NIA
To maintain the abundance of opportunistic species at regionally defined level	Changes in dominance of taxonomic species of fish.	Historical data available

SPECIFIC ECOQO	ECOQELEMENT/INDICATOR	REFERENCE POINTS /REFERENCE CONDITIONS
To maintain the abundance of opportunistic species at regionally defined level	Frequency of macroalgal mats occurrence	Uncertain info available.
Restoring historic nutrient levels and ratios	Winter nutrient concentrations	Could be delivered from modelling
Restoring of historic nutrient levels and ratios	Winter N:P:Si ratios	Could be delivered from modelling
Loadings at historical levels	Land based inputs	Could be delivered from modelling
Loadings at historical levels	Atmospheric inputs	Could be delivered from modelling
Loadings at historical levels	Internal loading	Could be delivered from modelling

Further developments

The group recalled that the reference conditions describe the biological quality elements that exist, or would exist, at high status, that is, with no, or very minor disturbance from human activities and that the objective of setting reference conditions is to enable the assessment of ecological quality against these standards.

ToR 1. Review the concept of Ecosystem Health and its relationship to the Ecosystem Approach to Management and the aims of the European Marine Strategy

The group reviewed the concept of Ecosystem Health and its relationships to the Ecosystem Approach to Management and the aims of the European Marine Strategy. The group discussed the understanding of the term “Ecosystem health”. It was suggested that “Ecosystems health” should be interpreted as ‘ecological status’. Ecosystem health would be equal as a consequence to “an ecological structure, functioning and stability that deviates only slightly from reference conditions” and “that do not deviate moderately from reference conditions”.

The group was briefly introduced to the draft pan-European guidance document on the assessment of eutrophication in all European water policies. The group examined how the assessment of the Baltic Sea Ecosystem corresponds to the objectives and requirements of the EU Water Framework Directive and other directives directly or indirectly dealing with eutrophication.

<table>
<tr><td>Baltic Sea Ecosystem Health</td><td colspan="2">A healthy ecosystem</td><td colspan="3">An unhealthy ecosystem</td></tr>
<tr><td>HELCOM EUTRO</td><td colspan="2">NEW</td><td colspan="3">Eutrophicated waters</td></tr>
<tr><td>OSPAR Common Procedure</td><td colspan="2">NPA</td><td colspan="3">Problem Area</td></tr>
<tr><td>Water Framework Directive</td><td>High</td><td>Good</td><td>Moderate</td><td>Poor</td><td>Bad</td></tr>
<tr><td>Urban Wastewater Directive</td><td colspan="2">NSW</td><td colspan="3">Sensitive waters</td></tr>
<tr><td>Nitrates Directive</td><td colspan="2">NPW</td><td colspan="3">Polluted waters</td></tr>
<tr><td>Habitats Directive</td><td colspan="2">Favorable CS</td><td colspan="3">Unfavorable Conservation Status</td></tr>
</table>

EQO-eutro

Figure 5.1.1: Illustration of the correspondence between the understanding of the Baltic Sea Ecosystem Health and the management standard of HELCOM EUTRO, OSPAR Common Procedure, the EU Water Framework Directive, the EC Urban Wastewater Treatment Directive, the EC Nitrates Directive and the EC Habitats Directive. Based on Anon., 2005 and Andersen *et al.*, 2004.

ToR. Examine how the US EPA 'indices approach' can be used in the Baltic Sea;

The group examined how the US EPA 'indices approach' could support the development of the Baltic Sea specific indices. The US approach was considered scientifically sound and robust. Group pointed out that the specific strength of the approach lies in the integration of different quality elements (indicators) in a very "communicative" manner attractive to politicians and public. However, the assessed system was not based on reference conditions which was considered as a weakness of the approach making its direct application in the Baltic Sea area difficult.

ToR. Consider existing indicator developments by the EEA, FAO, HELCOM, OSPAR, ICES, IOC/SCOR and US EPA/NOAA;

The Group considered and reviewed briefly similar work carried out in different organisations and noted that at least EEA, HELCOM, OSPAR and ICES work is very well coordinated and harmonized. In general, the duplication of the work is not noticed but there is continuous need for communication between similar groups. For this purpose it is very important to make public the outcome of the BSRP EH meeting outcomes in the internet as soon as possible.

The Group discussed the progress of HELCOM EUTRO and recommended to change the categories of indicators used in the eutrophication assessment procedure to three quality elements mentioned in the WFD adding some categories with supporting indicators describing physical-chemical conditions.

The Group discussed the possibility to organize the demonstration project (case study) in the BSRP region to test the eutrophication assessment procedure with different scenario involving weighting of different indicators, application of different levels of acceptable deviation from reference conditions. It was decided that the Gulf of Riga could be the perfect test area for such exercise due to geomorphological conditions as well as data availability. The outcome of the work should be presented at a planned workshop on draft pan-European guidelines of assessment of eutrophication and included as case study in the developed Guidelines. The time-frame for the activities of the case study was proposed as following:

16 May:	HELCOM EUTRO meeting. First meeting of LL PB, LL ZP and CCPROD to set up the detailed workplan
20–22 September:	HELCOM EUTRO meeting. Powerpoint presentation prepared with preliminary results
October 2005:	Workshop on draft pan European guidelines for assessment of eutrophication. Presentation of the results of the assessment exercise.
November 2005:	SGEH meeting. Results of socioeconomic analyses presented.
December 2005:	paper submitted to scientific journal.

It was estimated that the activity will require altogether four man month of four man work time to complete, and it was discussed to ask the BSRP management to allocate the necessary resources.

A similar project will be carried out in Denmark in the Øresund area.

It was agreed that LL on phytobenthos monitoring will be the leader of the activity with participation from LL on Zooplankton and CC on Productivity. Jesper Anderson offered to be the facilitator of the project.

It was discussed that it is very important to present the outcome of the meeting at the next meeting of ICES Study Group to Review Ecological Quality Objectives for Eutrophication (SGEUT) and BSRP management will be asked to support the participation of the representative at the meeting.

ToR. Develop Ecosystem Health Indicators in relation to the effects of eutrophication, harmful substances, fishing activities, and the loss of biodiversity.

The subgroup realized that many activities in relation to assessment of eutrophication are ongoing, nationally, regionally (BSRP, HELCOM, OSPAR) and internationally (EU, EEA). Important drivers for these activities are the processes of implementation of (1) the EU Water Framework Directive, (2) strategies and recommendations of the marine conventions, as well as (3) a suite of RTD projects (BSRP, CHARM, HELCOM EUTRO) and (4) the development of the European Marine Strategy.

Taking in mind the above, the subgroup was of the opinion that coordination and exchange of information should be given high priority in order to target the ongoing work and avoid double work. The first step in this process would be to (1) make the outcome of this workshop available on the web, and (2) to present the work carried out by BSRP in relation to eutrophication at the joint Baltic GIG/HELCOM EUTRO workshop taking place 20–22 September in Stockholm. In a longer perspective, it is recommended to organize a workshop in June 2006 focusing on synergies and added value in convention-wide assessments of eutrophication status.

Recommendations for HELCOM EUTRO – stronger coordination with the EU WFD, move from categories (I, II, III) to quality elements and supporting factors. One out, all out to be applied on the quality element level.

The subgroup proposes to modify the list of HELCOM EUTRO assessment criteria for Category III:

Quality Element PHYTOPLANKTON:

1) changes in proportion of selected indicative zooplankton taxons (side specific);
2) zooplankton/phytoplankton biomass ratio (which is related to efficiency of energy transfer and ecosystem health).

Comments

- A lot of activities are going on and the coordination and communication is needed between those activities in order gain maximum benefit and avoid duplication of work.
- Indicator list developed by the SGEH is in complete accordance with pan european developments in the Eutrophication assessment guidelines.
- Close coordination exists between BSRP Eutrophication Indicator development and similar activities in HELCOM.
- US EPA "indices" approach could be applied in the Baltic Sea and will be considered in further development of eutrophication assessment tools.

Recommendations

- To carry out the demonstration project in the Gulf of Riga, including allocation of necessary resources, to evaluate the eutrophication assessment tools.
- To carry out the excercise on the results of demonstartion project to evaluate the consequences of restoring good ecological status on socioeconomic, biodiversity and fisheries aspects.

Recommendations for ToR, for SGEH November, 2005 meeting

1. To evaluate the eutrophication status of a demonstration area (Gulf of Riga) as one component of ecosystem health, based on indicators and assessment principles consistent with EU WFD and the upcoming guidance on pan-European assessment of eutrophication.
2. To estimate of the possible socioeconomic effects of restoring good ecological quality in the demonstration area, based on a) inputs from experince from BSRP CCs and LL as well as b) existing tools available via other projects and activities.
3. To develop socioeconomic indicators for eutrophication in the area of "direct" and "indirect" effects related to ecological goods and services.
4. To the extent possible, and in close colaboration with BSRP LL on Biodiversity and BSRP CC Fish, assess the possible consequences of achieving good ecological status on biodiversity and fisheries.

5.2 Subgroup on the Effects of Hazardous Substances (Kari K. Lehtonen (Co-Chair), Thomas Lang (Co-Chair), Galina Rodjuk (Co-Chair), Dorota Napierska, Justyna Kopecka)

Status of EcoQOs and Indicators development at SGEH, 2004 Vilnius meeting is given in Table 5.2.1.

Table 5.2.1. Preliminary proposal for EcoQOs and indicators for biological effects of hazardous substances (Report SGEH, 2004).

General EcoQO/Vision: **Concentrations of hazardous substances in the Baltic Sea near background values for naturally occurring substances and close to zero for man-made substances**

SPECIFIC ECOQOS	ECOQ ELEMENT/INDICATOR	REFERENCE POINT/REFERENCE CONDITIONS
	The "Inputs" of specified contaminants should not be included in this programme. The purpose of the planned marine monitoring programme includes the measurement of hazardous compounds in the environment and their biological effects. Concentrations of: PCBs, DDTs, Cd, Pb, Hg, PCDD/PCDF(dioxins), Brominated flame retardants, TBT compounds, Radionuclides) in water and/or sediments. Regional target levels need to be agreed upon	
	Addition of Cu to the list of measured contaminants. Motivation: Cu is widely used in new generation antifouling paints; elevated environmental concentrations are already seen in the North Sea. *Addition of PAHs to the list of measured contaminants. Motivation: increasing chronic exposure due to oil shipping and drilling; background data in case of major accidents	
	Distinction between the commonly assessed persistent organic pollutants and specific endocrine disruptors. (ED) compounds: addition of alkylphenols and phthalates monitoring in sediments.	
No illegal oil discharges	No oil slicks in aerial surveys	
No oiled birds	No oiled birds	
All fish caught in the Baltic Sea shall be suitable for human consumption.	Concentrations of: PCBs, DDTs, Cd, Pb, Hg, PCDD/PCDF(dioxins), Brominated flame retardants, TBT compounds, Radionuclides in herring and cod *Inclusion of benthic/demersal fish in the monitoring programme. Motivation: 1) directly in contact with sediment-bound contaminants, 2) commercial importance and quality of food.	
Toxic substances shall not cause sub-lethal nor intergenerational or transgenic effects to the health of marine organisms (e.g., reproductive disturbances).	Endocrine disruption (vitellogenin, Gonado-Somatic index) *Gonadosomatic index may not be regarded as a biomarker: gonad histology should be included as an indicator of endocrine disruption.	
Toxic substances shall not cause sub-lethal nor intergenerational or transgenic effects to the health of marine organisms (e.g., reproductive disturbances).	Biomarkers (AChE, EROD, lysosomal, PAH metabolites) from cod, herring and/or blue mussel * A proposed reorganisation of the monitoring strategy of hazardous substances is given below.	

SPECIFIC ECOQOS	ECOQ ELEMENT/INDICATOR	REFERENCE POINT/REFERENCE CONDITIONS
Attain pre-Chernobyl concentrations of manmade radioactivity in the Baltic Sea ecosystem causing risk neither to humans nor the Natural systems sustaining human, plant and wildlife populations	Annual radiation doses in selected fish (concentrations of radioactive isotopes)	
Other	Other Cod and herring stock *condition of the individuals might be affected by the contaminants	
	Parasites and disease in fish *the frequency of parasites is not necessarily related to the level of contamination	

Further developments were carried out during the EH Indicator Workshop in Vilnius (Table 5.2.2)

Table 5.2.2. EcoQOs, Indicators and Reference conditions as developed during the Workshop.

HELCOM STRATEGIC GOAL, ECOLOGICAL OBJECTIVES AND INDICATORS OF HAZARDOUS SUBSTANCES STRATEGIC GOAL: TOXIC SUBSTANCES SHALL NOT AFFECT THE HEALTH OF THE BALTIC SEA ECOSYSTEM.			
	Ecological Objectives	**Indicators**	**Relevant literature** (remark: this list is far from being complete)
Causative factors (P)	Relevant management objectives as defined by HELCOM and others	Emissions to air, waterborne discharges/ losses to inland surface waters (relevant priority hazardous substances) Waterborne inputs of relevant priority substances Atmospheric deposition of relevant hazardous substances to the sea	(HELCOM, 2004)
	Reduce concentrations of hazardous substances to near background values for naturally occurring substances and close to zero for man-made substances	Concentrations of relevant priority substances in sediments, water or biota depending on their properties, effects, extent of use, including persistent substances no longer in use. Regular monitoring of a limited number of substances combined with a less-frequent screening-type measurement of a wider range of substances.	(Cato and Kjellin, 2004) (Bignert *et al.*, 2004)
	All fish caught in the Baltic Sea should be suitable for human consumption. *Related objective as proposed by HELCOM/BSRP Coastal Fish Workshop 2005 (MON-PRO 2/2005 doc 3/3):* *Restore and maintain healthy fish (individuals) causing no harm neither to marine biota nor human population and ensure healthy fish populations*	Concentrations of dioxins, PCB and Hg in edible fish species, e.g., herring (*Clupea harengus*), salmon (*Salmo salar*), cod (*Gadus morhua*), perch (*Perca fluviatilis*), flounder (*Platichthys flesus*), sprat (*Sprattus sprattus*)	(Bignert *et al.*, 2004)
	Restore pre-Chernobyl concentrations of man-made radioactivity in the Baltic Sea	Radionucleids in herring tissue and sediments, e.g., Strontium-90, Caesium-137	(HELCOM, 2003)
	No illegal or accidental oil discharges shall occur	Oil slicks from aerial surveys Number of oil slicks observed	(HELCOM, 2003)

HELCOM Strategic Goal, Ecological Objectives and Indicators of Hazardous substances Strategic Goal: Toxic substances shall not affect the health of the Baltic Sea ecosystem.			
	Ecological Objectives	**Indicators**	**Relevant literature** (remark: this list is far from being complete)
Direct effects (S)	Hazardous substances shall not cause lethal or sublethal effects on the health of marine organisms	Proposed biomarkers to be used as a battery, measured in relevant target species (levels should not exceed agreed threshold values): Biomarkers of general exposure and effects: Lysosomal stability (general stress) Macrophage activity (immunotoxicity) Micronuclei (genotoxicity) Catalase (oxidative stress) Detoxification enzymes (EROD, GST) Contaminant-specific biomarkers: Acetylcholinesterase inhibition (neurotoxicity, exposure to organosphosphates) EROD (biotransformation of organic compounds, e.g., PAH, dioxin-like compounds) PAH metabolites in bile (exposure to PAH) DNA adducts (exposure to PAHs) Ala-D (exposure to lead) MT (exposure to heavy metals) Externally visible diseases and parasites in fish According to ICES/OSPAR/BEQUALM Guidelines Histopathology in liver (fish), soft body (bivalves) and intestinal tract (seals) For fish: according to ICES/OSPAR/BEQUALM Guidelines Supporting parameters: Length, Weight, Age, Condition factor Somatic indices (gonad, liver) Stage of gonadal maturation Population structure	(Lehtonen, 2005) (Bucke *et al.* 1996, Ericson *et al.* 1998; Bogovski *et al.* 1999; Lang *et al.* 1999, Feist *et al.* 2004)
	Hazardous substances shall not cause reproductive disturbances to any marine organisms as well as birds and humans	Imposex/intersex in gastropods Embryonal development in benthic amphipods Gonad histopathology in fish and shellfish M74 syndrome in salmon Vitellogenin levels in male fish Reproductive success of eelpout (*Zoarces viviparus*) Shell thickness of guillemot (*Uria aalge*) eggs White tailed eagle (*Haliaeetus albicilla*) breeding success/brood size Seal histopathology (intestine lesions, reproductive organs)	(Helander *et al.* 1999; HELCOM 2002)
Indirect effects (I)	Hazardous substances shall not cause changes at population and community levels	Biodiversity indices Fish stock assessment data (e.g., cod, herring, flounder, salmon) White tailed eagle population Seal species stocks	(Rappe and Soler, 1999; HELCOM, 2002)

In order to further develop EcoQOs and ecosystem health indicators, there is a need for collaboration between SGEH and various expert groups and organizations, some of which are listed in Table 5.2.3 together with information on their potential contribution. Planned collaborative BSRP workshops are also included.

Table 5.2.3: Collaborative actions towards progress in the development and application of ecosystem health indicators related to hazardous substances and their biological effects on the Baltic Sea Ecosystem.

Collaboration	Actions	Time frame	Remarks
BSRP Demonstration Project on Assessment of Biomarkers Response in Selected Coastal Areas of the Eastern Baltic Sea (BIODEMO)	Measurement of biomarker (AChE, GST, CAT, NRR, MN) and supporting parameters at contaminated and reference sites in 3 coastal areas (Latvia, Lithuania, Poland) with the aims of capacity building, intercalibration, training and provision of baseline data.	Scheduled for summer 2005	3 participating labs from Latvia (Institute of Aquatic Ecology), Lithuania (Institute of Ecology, Vilnius Univ.) and Poland (Sea Fisheries Institute). A meeting will be organised prior to the sampling campaign.
ICES/BSRP Sea-going Workshop on Fish Disease Monitoring in the Baltic Sea	Training workshop for Baltic Sea countries on methodologies to be applied in studies on fish diseases, parasites and liver histopathology	10–14 days in Dec. 2005	The workshop will be held on board the German RV 'Walther Herwig III' and will be attended by training experts (methodologies, externally visible fish diseases/parasites, histopathology, data assessments, BEQUALM) and trainees from the Baltic Sea countries.
ICES Advisory Committee on the Marine Environment (ACME)	Review progress made in relation to the BSRP ecosystem health component	June 2006	ACME may provide relevant advice
ICES Advisory Committee on Marine Ecosystems (ACE)	Review progress made in relation to the BSRP ecosystem health component	June 2006 (?)	ACE may provide relevant advice
ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO)	Review progress made in relation to the BSRP fish disease monitoring component; Review and endorse plans for a ICES BSRP Sea-going Workshop on Fish Diseases in the Baltic Sea in Dec. 2005 Discuss the development and applicability of health/diseases indices that could be of use for ecosystem health assessment in the Baltic Sea	8–12 March 2005	5 scientists from Estonia, Latvia, Lithuania, Poland and Russia funded by BSRP attended the WGPDMO meeting
ICES Working Group on Biological Effects of Contaminants (WGBEC)	Review progress made in relation to the BSRP biological effects monitoring component; Review plans for a BSRP Demonstration Project on Biomarker measurements in Baltic coastal areas.	18–22 April 2005	2 scientists from Lithuania and Poland funded by BSRP will attend the WGBEC meeting
ICES Marine Chemistry Working Group (MCWG)	Chemicals to be monitored in biota the Baltic Sea as part of an integrated monitoring programme		Exchange of information, WG should be approached in order to provide advice as appropriate
ICES Working Group on Marine Sediments (WGMS)	Chemicals to be monitored in Baltic Sea sediments as part of an integrated monitoring programme		Exchange of information, WG should be approached in order to provide advice

COLLABORATION	ACTIONS	TIME FRAME	REMARKS
			as appropriate
ICES Benthos Ecology Working Group (BEWG)	Measurement of biomarkers in benthic invertebrates		Exchange of information, WG should be approached in order to provide advice as appropriate
ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (SGQAC)	Quality assurance of chemical measurements		Exchange of information, SG should be approached in order to provide advice as appropriate
ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB)	Quality assurance of biological measurements, incl. biomarker measurements		Exchange of information, SG should be approached in order to provide advice as appropriate
HELCOM MONAS	Review progress made in relation to the BSRP ecosystem health component	November 2006 (?)	HELCOM MONAS may provide relevant advice
HELCOM MON-PRO	A background document was submitted, providing an outline for an integrated chemical and biological effects monitoring in the Baltic Sea based on the results of the Baltic Sea component of the EU-funded BEEP project.	February 2005	Lehtonen (2005)
HELCOM network on coastal fish monitoring	Exchange information in relation to the monitoring of fish diseases; Explore possibilities to design a joint sampling scheme	HELCOM network meeting early 2006 in Helsinki	In the reports of the network meetings, the monitoring of fish diseases is being mentioned in the context of EcoQOs/Indicators. Since this issue is also being considered by SGEH and as part of the Indicator Workshop, contacts should be established.
Biological Effects Quality Assurance in Monitoring Programmes (BEQUALM)	QA related to the measurement of biological effects of contaminants	Ongoing programme	It is essential that labs in Baltic Sea countries carrying out a coordinated integrated monitoring programme participate in BEQUALM. Funding for recipient Baltic countries should be made available through BSRP.
Quality Assurance of Information for Marine Environmental Monitoring in Europe (QUASIMEME)	QA related to the measurement of contaminants	Ongoing programme	It is essential that labs in Baltic Sea countries carrying out a coordinated integrated monitoring programme participate in QUASIMEME. Funding for recipient Baltic countries should be made available through BSRP.

Developing an integrated index for the pollution by hazardous substances and their effects

The approach of the US National Coastal Monitoring Program was taken advantage of in formulating a proposal for developing a Pollution Index (PI) to be applied in the Baltic Sea. The index would consist of 5 elements, each consisting of separate indicators, are as follows:

1) Concentrations of selected contaminants;
2) Battery of biomarkers of exposure and effects;
3) Histopathology;
4) External fish diseases;
5) Reproductive disorders.

The elements involved in the proposed PI clearly represent the different levels of detection of pollution and its effects in the marine environment. The calculation procedure for the PI (including the weighting of the different elements according to their "importance" or "severity" in the final result) is a matter of examination. One possibility to test the method would be to take advantage of feasible parts of the existing BEEP Baltic Sea database.

In relation to developing "health indices", the ICES Working Group of Pathology and Diseases in Marine Organisms discussed the issue of health indices at its last meeting in 2005 and decided to carry out a pilot study aiming at the development of health/disease indices to be used for environmental assessments. The pilot study will be based on data generated within the fish disease monitoring programme in the North Sea. It is envisaged that the results of the pilot study will be of use for the development of ecosystem health indicators for the Baltic Sea.

General conclusions

Efforts to harmonize the monitoring of hazardous substances and their effects within the integrated biological-chemical monitoring programme under development in OSPAR is a feasible goal. The strategy involves parallel measurements of effects of contaminants at different biological levels in integrated fashion. This enables us to study the links between effects at higher levels (population, community) to those observed in biomarker responses (molecular, biochemical, cellular, histopathological levels) and concentrations of selected hazardous substances. The choice of biomarkers applied can be adapted according to the regional pollution situations, e.g., in case of known pollution (e.g., point sources) contaminant-specific biomarkers can be included. However, the biological monitoring should always be based on the application of a battery of general stress biomarkers.

Recommendations

- Demonstration Project BIODEMO (Annex 3) will be carried out in summer and autumn 2005, including:
    - sampling of fish and bivalves at the three regional study areas, comprising of polluted and reference sites;
    - measurements of biomarkers and supporting parameters;
    - evaluation of data (including the pollution index approach);
    - practical workshops, intercalibration and other networking activities.
- An ICES/BSRP Sea-going Workshop on Fish Disease Monitoring in the Baltic Sea co-convened by T. Lang (Germany) and G. Rodjuk (Russia) shall be held in December 2005 on board the German RV 'Walther Herwig III'. Its objectives are to
    - provide training and intercalibration related to methodologies applied in fish disease monitoring in the Baltic Sea;
    - further develop and assess health indicators and indices appropriate for monitoring and assessment purposes;
    - establish a closer collaboration between institutes involved in fish disease monitoring in the Baltic Sea;
    - build the basis for incorporation of fish disease surveys into the revised HELCOM monitoring programme.

Terms of Reference for the next ICES SGEH meeting in November 2005, Kaliningrad, Russia

- finalize plans for the ICES/BSRP Sea-going Workshop on Fish Disease Monitoring in the Baltic Sea, to be held in December 2005 on board the German RV 'Walther Herwig III'
- review the progress in regard to the BIODEMO project
- review the products of the HELCOM MON-PRO project with regard to hazardous substances
- review the progress in regard to developing the Pollution Index
- develop socioeconomic indicators for hazardous substances in the area of "direct" and "indirect" effects related to ecological goods and services; examining the following scenarios:
    - direct toxic effects on growth, reproduction and survival of fish stocks: reduction of commercial fish stocks;
    - effects on immune system leading to higher susceptibility to pathogens and to increased disease prevalence: lowered quality of commercial fish species;
    - habitat destruction caused by oil spills: loss of fish habitats, effects on tourism, fisheries, clean-up costs, changes in the infrastructure of human communities.

5.3 Subgroup on Effects of fishing activites: Henn Ojaveer (Co-Chair), Maris Plikshs (Co-Chair, contributed by correspondence), Chris Hopkins, Hein-Rune Skjoldal, Ewa Wlodarczyk, Szymon Bzoma

Status after SGEH, 2004 meeting in Vilnius

During the 2004 BSRP/SGEH meeting in Vilnius, General EcoQO/Vision was formulated: *'To achieve sustainable fisheries in sustainable ecosystems'* (Table 5.3.1). It was also stressed that EcoQO/indicator elements should reflect real population (stock) units (cf. ICES ACFM advice on using population or area-based management units).

Table 5.3.1 Preliminary proposal for EcoQOs and EcoQ Elements for sustainable fishery (SGEH, 2004).

General EcoQO/Vision: **To achieve sustainable fisheries in sustainable ecosystems**

SPECIFIC ECOQO	ECOQELEMENT/INDICATOR	DATA REQUIREMENTS
Reduce fishing effort	Fishing effort of different Fleets.	Vessels, time fished and gear type per fleet.
Reduce fleet capacity	Fleet capacity.	Vessels registered and gear type per fleet.
Increase/maintain fish landings of commercially valuable species by area	Fish landings by major species by area.	Total landings by major species per fleet per year.
Increase/maintain spawning stock biomass of key retained species above a pre-defined limit	Spawning stock biomass of key retained species (or suitable proxy such as standardized cpue).	Length and/or age composition of major retained species.
Decrease/maintain the level of fishing mortality for key retained species below a predefined limit	Level of fishing mortality for key retained species.	Length and/or age of the discarded component of the target species catch.
Other ecological concerns		
Reduce discards to the extent practical	Total amount of discards.	Total catches of by-catch species (or species groups/indicator species), per fleet per year.
Reduce discards of high- risk species	Amount of discards of high-risk	Length and/or age of high-risk by-

SPECIFIC ECOQO	ECOQELEMENT/INDICATOR	DATA REQUIREMENTS
(or species groups) to predefined level	species (or species groups).	catch species
Reduce number of deaths of vulnerable and/or protected species to predefined level	Number of deaths of vulnerable and/or protected species	Catch of vulnerable and/or protected species Catch of non-fishery material (critical habitat)
Decrease/maintain same area of the fishery impacted by gear	Area of the fishery impacted by gear	Area fished by each fleet
Increase amount of habitat protected by MPAs to predefined level	Amount of habitat protected by MPAs	Area under MPAs by habitats
Increase ratio of large fish in the community	Size spectrum of fish community	Length of fish in a representative sample of community
Minimize the impact of other activities on fish resources and habitats	Area of fish nursery habitat degraded	Area of habitat, e.g., seagrass beds, mangroves and coral reefs
Maintain ecological balance	Mean trophic level of catch	Species composition from sample catches
Economic		
Increase the contribution of fishing to the national economy	Net economic return for fishery	Revenue from fishing per fleet per year. Costs per fishing unit per
Increase/maintain profit of the harvesting sector to that of similar industries	Profit to harvesting sector	
Increase exports	Export value	Destination of landings from each fleet
Maintain or increase economic contribution to community		
Social		
Health benefits/Increase fish consumption per capita	Fish consumption per capita	Fish consumption from representative sample
Ensure seafood quality meets food safety requirements	Number of food compliance reports	Food safety compliance reports
Increase/maintain employment in the harvesting and processing sector by fleet	Employment in the harvesting sector by fleet	Total number of fishermen employed in each fleet Total number of people employed in fishery-associated activities (e.g., processing)
Maintain or improve lifestyle value	Life-style value	Social surveys
Maintain or improve cultural values	Cultural value	Cultural sites and values
Maintain/increase level of activity of indigenous community	Number of indigenous fishers	Dependence of local community on fishing as a source of income and/or food.
Reduce the dependence of community on fishing	Dependence of community on fishing	Other income or livelihoods of the fishermen
Management activity: have well-developed management plans, including indicators and reference points and evaluation procedure in place for all fisheries	Number of fisheries with welldeveloped management plans, including indicators and reference points	Number of fisheries with a well developed management plan, including operational objectives, indicators and reference points

Further developments

It was agreed to suggest changing the two relevant HELCOM EcoQO's for fisheries. These read:

1) Management of all fish resources (i.e. assessed commercial fish stocks, non-assessed commercial and non-commercial fish stocks) should be based on natural (stock) units and guarantee healthy and viable fish communities to ensure the optimum justifiable long-term socioeconomic benefit. The major precondition for success, regarding both target and non-target species, is the management of excessive fishing effort.

2) The associated ecosystem impacts of fishing activities should be minimized, thereby facilitating recovery of vulnerable and declining species and habitats.

The subgroup proposed several indicators (according to the PSR scheme) of the IBSFC type (i.e., for the internationally assessed and managed species) and additional indicators (which are applicable both for internationally and nationally managed fish).

Intersessional activity included, most importantly, helding the BSRP/HELCOM second workshop on coastal fish, where further developments were made for identifying indicators for coastal fish according to the agreed EcoQOs: (1) Restore and maintain structure and functioning of coastal fish communities (healthy communities); (2) Restore and maintain species and genetic diversity of coastal fish including non-commercial species and (3) Restore and maintain healthy fish (individuals) causing harm neither to marine biota nor human population and ensure healthy fish populations. The meeting identified sevral indicators under each of these EcoQOs at species and community levels by indicating for each of the suggested indicator the following information: data availability, need for additional sampling efforts; concern/issue of the indicator and focal species for which the indicator could be tested. When identifying/developing the indicators, outcome of the 2004 BSRP/SGEH meeting indicators list was used. It was emphasised that for developing the the eco-physiological indicators (EcoQO 3) additional input from respective scientists are needed.

Two publised sources were further used to describe estuarine fish indices (Coates *et al.* 2003, Whitfield and Elliott, 2002). Coates *et al.* (2003) used for development of the estuarine fish community index fourteen indicators categorised into four groups: (1) species diversity and composition, (2) species abundance, (3) nursery function and (4) trophic integrity. A simple estuarine classification system was developed for migratory and resident fish components by Whitfield and Elliott (2002). They also reviewed several fish community indices (like estuarine community degradation index CDI; biological health index BHI; estuarine fish health index FHI; estuarine Biotic integrity index EBI and estuarine fish recruitment index FRI). Information in both of these papers should be considered when developing fish indicators in the Baltic Sea.

Report on work in the subgroup on the effects of fishing activities

The group started to develop socioeconomic indicators and stressed that significant additional input and consequently further development is needed.

Table 5.3.2. IBSFC type indicators (for internationally assessed and managed species: cod, herring, and sprat).

PRESSURE INDICATORS	STATE INDICATORS	REGULATORY/RESPONSE INDICATORS
Number of fishing vessels per fish population/ sub-system/area. Landings of fish per population/sub-system/area Total/average engine power per population/sub-system/area: total kilowatts of the fleet divided by the number of vessels Effort measures like days-at-seas, horsepower days-at-sea, hours fished Number of full time fishers actively engaged in an area, by country	Total and spawning stock biomass Fishing mortality Recruitment Ratio between Yield and SSB	Regulation of landings: total allowable catches (TACs) per fish population/sub-system/area Technical measures: Number of different specified fishing gears employed and mesh-sizes allowed Spatial-temporal fishing closures Regulation of the number of licensed commercial fishers/fishing vessels reflecting the status (e.g., biomass) of the targeted stock

Table 5.3.3. Additional indicators (that can be applicable for both internationally and locally managed categories of fish).

PRESSURE INDICATORS	STATE INDICATORS	REGULATORY/RESPONSE INDICATORS
Number and length/surface of various nets/longlines used By-catch of benthos, fish, seabirds and marine mammals on an area and fishery basis. Location (area-based) and amounts of discards and offal of fish by species. Spatial/areal identification and mapping of fishing effort by different types of gear as proportion of total catch both for target and non-target species.	Slope of the size spectrum of fish communities and species. Average maximum length/age of an individual fish in the community. Relation of slope of the size spectrum to fishing intensity. Size/age distribution Average size (length/weight) in the fish community Age and size at first maturity Sex ratio Indices of advected (i.e. moved into the Baltic Sea by currents and/or climate change) living aquatic resources relative to indigenous species. Ratio of pelagic/demersal fish in catches or landings (e.g., Caddy ratio: J. Caddy 2000. ICES J. Mar. Sci. 57: 628-640). Ratio between scientific advice and management implementation. For example, proportion of commercial stocks outside of safe biological limits (i.e. F > Fpa and SSB < SSBpa): resources fished above scientific target levels and other comparable measures. Ratio between occurrence of fishing sensitive and fishing insensitive species. Ratio between catch and effort. Frequency with which an area is trawled Area fished by bottom trawls (total fished area or proportion of total bottom area, degree of repeated trawling, etc).	Management of fishing effort (total time fished, number/size of fishing vessels, gear types and their selectivity). Develop performance measures to minimize accidental catch of target and non-target species. Incidence of Marine Protected Areas (MPAs), NATURA 2000 areas and no-take zones.

PRESSURE INDICATORS	STATE INDICATORS	REGULATORY/RESPONSE INDICATORS
	Frequency and persistence of trawl tracks (e.g., use of side scan sonar and ROV investigations). Average trophic level of the catch Relative abundance of a set of populations/species that are not regularly assessed (incl., e.g., rare, sensitive and declining species) Ratio between cyprinids and percids Proportion (abundance or biomass) of piscivorous fish in fish community Trends in abundance of sensitive benthos species Area coverage and location of highly sensitive habitats Indicator(s) for the impact of bottom trawling on benthic environment	

Indicators of Driving Forces

Economic indicators

- Types of gear used in various time-periods;
- Ups and downs of various stocks;
- Total economic value of the catch (by species);
- Proportion of catch used for human consumption;
- Fisheries contribution to GDP;
- Fisheries relative export value;
- Relative income of fishers;
- Fish trading;
- Historical fish taxes;
- Fisheries and marine mammals interactions (mammals as an example).

Social indicators

- Employment;
- Demography;
- Literacy /education;
- Fishing traditions and culture;
- Gender distribution is decision making;
- Stewardship;
- Ownership/motivation: rights and responsibilities.

Recommendations for further steps

Intersessional work is planned to carry out mainly in cooperation with relevant ICES Expert Groups and the HELCOM coastal fish specialists' network with the responsibility of the ICES BSRP SGBFFI Co-Chairs (M. Plikshs and H. Ojaveer):

1) Testing the indicator of 'Slope of the size spectra' in the Baltic Sea (as indicated in the SGEH 2004 report) (during 2005);

2) To contact ICES WG on Application of genetics to fisheries and mariculture for the advice on development of genetic indicators;

3) Develop socio-economic indicators in the area of 'direct' and 'indirect' effects related to ecological goods and services:

- For achieving this, to contact BSRP CC on Socioeconomy and the respective ICES WG for the advice;

4) Present the biological/ecological indicator list at the ICES/BSRP SGBFFI meeting for a review (to be held in June 2005);

5) Input to the ICES WGECO meeting (to be held in April 2005);

6) Organise the BSRP/HELCOM third coastal fish monitoring workshop (early 2006) with input by specialists from the subgroup on 'Effects of harmful substances' for development of indicators for the HELCOM coastal fish EcoQO 3.

The group considered available published papers/reports and amended the indicator list compiled during the ICES BSRP SGEH 2004 meeting. The source material consulted was the following:

1) Coates S.A., Colclough S.R., Harrison T.D., and Robson M. 2003. Development of an estuarine classification scheme for the Water Framework Directive: Fish Component. Environment Agency. UK, Peterborough

2) EC. 2004. Developing a system of indicators of environmental integration for the Common Fisheries Policy. Commission staff working paper. SEC (2004) 892. Comm.

3) HELCOM 2005. Minutes of the second meeting of BSRP/HELCOM coastal fish monitoring workshop. BSRP/HELCOM Coastal Fish Monitoring Workshop, Second Meeting. Helsinki, Finland, 31. January – 3. February 2005. The Baltic Sea Regional Project/Helsinki Commission. 39 pp.

4) ICES. 2005. Report of the Study group on Baltic Ecosystem Health Issues in support of BSRP, 2–5 November 2004, Vilnius, Lithuania. 48 pp.

5) INDECO. 2005. Approach towards comprehensive suite of indicators WP 2,3 (and 4?). Working paper. First draft. 47 pp.

6) Whitfield A.K. and Elliott M. 2002. Fishes as indicators of environmental and ecological changes within estuaries: a review of progress and some suggestions for the future. Journal for Fish Biology 61 (Suppl. A): 229-250.

7) FAO Technical Guidelines for responsible Fisheries. 1999. No. 8. Rome, FAO. 68 pp.

5.4 Subgroup on Loss of Biodiversity (including destruction of habitats and xenodiversity) : Jan Marcin Węsławski (Co-Chair), Sergei Olenin (Co-Chair), Juha Markku-Leppanen, Elmira Boikova, Elena Ezhova, Gedas Vaitkus, Hermanni Backer, Katarzyna Roszkowska, Andrzej Osowiecki, Kevin Summers

Status

The outcome of Vilnius meeting in November 2004 is given in Table 5.4.1

Table 5.4.1 Preliminary proposal for EcoQO, Indicators and Reference conditions for biodiversity (ICES SGEH Report 2004).

General EcoQO/Vision: **A Baltic Sea marine environment with maintained natural biodiversity at all levels, strengthening its natural integrity**

EcoQOs	EcoQElement/Indicator	Reference point/Reference condition
A sufficient number, size and network of coastal and marine BSPA, to ensure the preservation of natural coastal landscapes within the Baltic Sea	Percent of BSPA that have met this criterion	
A sufficient number, size and network of coastal and marine BSPA, to ensure the preservation of natural coastal landscapes within the Baltic Sea	Percent of shorelines habitats damaged	
A sufficient number, size and network of coastal and marine BSPA, to ensure the preservation of natural coastal landscapes within the Baltic Sea	Percent of coastal habitats restored	
A sufficient number, size and network of coastal and marine BSPA, to ensure the preservation of natural ecosystems and processes ensuring longterm interconnectedness between areas	Percent of bird nesting and resting areas disturbed	
A sufficient number, size and network of coastal and marine BSPA, to ensure the protection of declining/endangered species.	Percent of man induced key habitats loss.	
Restore species supporting climax communities in areas where they have disappeared, especially: **- Eel grass meadows (*Zostera*);** **- Bladder wrack beds (*Fucus*);** **- Mussel beds (*Mytilus edulis*);** **- Baltic Sea relict species.**	Percent of biotopes that host proper communities/biocenoses based on the best scientific expertise	
Restore species supporting climax communities in areas where they have disappeared, especially: **- Eel grass meadows (*Zostera*);** **- Bladder wrack beds (*Fucus*);** **- Mussel beds (*Mytilus edulis*);** **- Baltic Sea relict species.**	Percent of the specific habitat area that received restoration treatment	
Restore species supporting climax communities in areas where they have disappeared, especially: **- Eel grass meadows (*Zostera*);** **- Bladder wrack beds (*Fucus*);** **- Mussel beds (*Mytilus edulis*);** **- Baltic Sea relict species.**	Percent of the area of specific habitat that is protected.	
Maintain the integrity of habitats and their key functions that allow existence of healthy and viable populations of top-predators: mammals, seabirds, fish (salmon, trout, cod).	Food web diversity and integrity	
Maintain the integrity of habitats and their key functions that allow existence of healthy and viable populations of top-predators: mammals, seabirds, fish (salmon, trout, cod).	Trend in change of trophic group share	

EcoQOs	EcoQElement/Indicator	Reference point/Reference condition
Maintain the integrity of habitats and their key functions that allow existence of healthy and viable populations of top-predators: mammals, seabirds, fish (salmon, trout, cod).	Reduction of functional groups diversity.	
Minimize the man-induced introduction of nonnative species, especially from ballast water and aquaculture activity, through the full treatment of ballast water and sediment.	Percent of alien species, in local communities (and their share in biomass)	
Minimize the man-induced introduction of nonnative species, especially from ballast water and aquaculture activity, through the full treatment of ballast water and sediment.	Ratio between native and alien key stone species	
Minimize the man-induced introduction of nonnative species, especially from ballast water and aquaculture activity, through the full treatment of ballast water and sediment.	Percent of ships and harbours with facilities for ballast load treatment.	

Further developments

Biodiversity per se is not good or bad, it is just a feature of the system and its level is case specific. Species are not equal – some are more important than others.

For the indicator of biodiversity and the ecosystem health we propose to select organisms that are:

- Species that are well known and a bulk of information on their occurrence exists;
- Species that are routinely collected or observed.

For the specific areas (coastal waters, open deep sea, pelagic domain) the Subgroup proposes:

- The four main habitat builders, species that create habitat for number of others (*Mytilus*, *Fucus*, *Zostera*, *Furcellaria*). NB. *Zostera* in the Northern Baltic will be replaced by respective Angiosperm species (e.g., Rupia);
- For mobile non vegetated sands we propose a pollution sensitive crustacean *Bathyporeia*;
- For open seabed we propose a large bioturbators (*Scoloplos, Astarte*)
- For pelagic domain we propose a top predator representative – e.g., cod larvae, salmon, little gull ...?

As the proposed action the Subgroup foresee the following activities:

- Describe each indicator species with its own range of optimal and extreme physical properties;
- Provide set of maps presenting the geographic distribution of above mentioned values;
- Present a map of present distribution of habitat-builders;
- Present a map of deviation from expected distribution in the scale of (0–25%, 25–50....).

All the data needed to perform the recommended activities are available, the software and competence is also there.

The group reviewed the existing international documents - HELCOM recommendations, WFD, HD, EU Marine Policy. The planned (not always established) network of Marine Protected Areas and NATURA 2000 covers well the coastal waters with its most valuable resources, while the open Baltic Sea and the pelagic domain received less recognition.

The socioeconomic issue of the proposed indicators was addressed and divided into "Goods and Services" and was based on the methodology and concepts used in EU ELME project and NoE MARBEF socioeconomic groups.

Ecosystem Goods – directly and indirectly provided by recommended indicators:

- Nursery and spawning grounds for commercial fish;
- healthy products from higher plants (Zostera, Phragmites);
- macrophytes/macroalgae for agriculture, food;
- macrophytes/macroalgae for pharmaceutics.

Evaluation – measure deviation from expected value, e.g., *Furcellaria* exploitation in Poland was 200 k Euro/annually (in 1960s), now is 0.

Ecosystem services:

- recreational space (e.g., bird watching, SCUBA);
- natural filtration - improvement of water quality;
- ecosystem integrity – through food web, nursery and spawning grounds;
- enrichment value – brand, cultural identification;
- gas regulation (e.g., oxygen production?);
- potential for bioprospecting, genetics;
- sediment stabilisation and erosion control.

Evaluation according to current practice (TCM, HPM, DCA, etc.):

- *Fucus* – pharmaceutics, agriculture, habitat provision, sediment stability, spawning ground, recreational space, recreational fishery ground, DMS emission;
- *Furcellaria* - pharmaceutics, agriculture, habitat provision, sediment stability, spawning ground, recreational space, recreational fishery ground, DMS emission;
- *Zostera* and *Angiosperms* – as above plus C burial, sediment stabilisation;
- *Mytilus* – habitat provision, natural filtration, food web integrity.

A price tag may be placed on every indicator species according to the recommended measures in non market valuation (the price will be always case specific).

Recommendation on a standard plain Coordinate Reference System of the Baltic Sea drainage basin

It was also announced by Gedas Vaitkus, LPM of the GIS/Data CC that, after a careful analysis of recent documents provided by J.McGlade (EEA), it was decided that an official plain Coordinate Reference System to be further used by GIS CC and other BSRP partners for production of GIS and remote sensing datasets and spatial data analysis will be the European GRID CRS, based on Lambert Cylindrical Equal Area projection and ETRS89 datum, which was discussed an approved for the practical use by EEA.

Furthermore, the HIRIS statistical database, planned for implementation by GIS CC during the BSRP, will be based on the European GRIS CRS, and it will be used for testing of the statistical GIS grid information technology on integrated environmental datasets covering the entire Baltic Sea drainage area alongside with the other regional databases currently used for testing by EEA.

Data available:

- Gather and collate existing data on biodiversity indicators' physical limitations, from all Baltic partners;
- Present for each indicator species the GIS map of the areas of potential occurrence.

Data needed:

There is a need for groundtruthing in carefully selected sites with remote techniques (ROV, aerial, hydroacoustics). Consider both the area of indicator occurrence (presence) and its quality (based on density)

The need for socioeconomic focus on indicators:

The workshop recognized and emphasized the need for a greater focus in the BSRP on socioeconomic indicators.

It was noted that such focus will provide input to BSRP that is necessary to meet the needs of the BSRP Project Implementation Plan (PIP). Up to now, the four subgroups of the SGEH have worked primarily on exploring the biological, chemical and physical aspects of indicator selection. However, the work of the subgroups has now progressed sufficiently for greater emphasis to be placed on socioeconomic aspects of indicators. It was underlined that strengthening the socioeconomic work focus of the individual subgroups will result in greater interactions between the various subgroups (e.g., eutrophication and fisheries, fisheries and biodiversity, harmful substances and fisheries, etc.). In concluding the discussion on this topic, it was agreed to add an obligatory term of reference, emphasizing the socioeconomic aspect of indicators, for all subgroups concerning intercessional work to be conducted before the proposed 2–4 November 2005 SGEH meeting to be held in Kaliningrad, Russia. For this ToR, attention was called for the need for collaboration with, and participation of, socioeconomists - especially the BSRP Socioeconomic Lead Laboratory (Estonia). The Co-Chairs of the subgroups agreed to identify appropriate socioeconomists or socioeconomic working groups in ICES for consultation and collaboration.

6 Overall conclusions and comments

Conclusions and comments on ToR 1

Review the concept of Ecosystem Health and its relationship to the Ecosystem Approach to Management and the aims of the European Marine Strategy

Several invited speakers (see item 4) discussed Ecosystem Health issues and its relationship to the European Marine Strategy (EMS).

The ecosystem health, as found within the definition of the ecosystem approach to management, is an explicit element of the European Marine Strategy (EMS). The EMS document: “towards a strategy to protect and conserve the marine environment” (COM(2002) 539 final) recognizes that diverse human activities pose major threats that impact the marine environment and its associated ecosystems (EC, 2002). The European Marine Strategy should *inter alia* cover all the actions needed to ensure that all human activities with an impact upon the oceans and seas are managed so that marine biological diversity and critical habitats are conserved and human use of them is sustainable. It is agreed that the development of the EMS should be focused on the concept of an integrated ecosystem approach to management which is defined as:

“the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity" (Joint HELCOM/OSPAR Ministerial Meeting in 2003, (JMM, 2003)).

The Ecosystem Approach to management of human activities, adopted by the JMM 2003, obliges HELCOM to assess the pressures as well as the resulting state and impacts on the marine environment and to use this as the foundation for identifying priority actions.

References

EC. 2002. Communication from the Commission to the Council and the European Parliament: Towards a strategy to protect and conserve the marine environment. COM(2002) 539 final.

JMM 2003. Statement on the ecosystem approach to the management of human activities: Towards and ecosystem approach to the management of human activities. Annex 5. First Joint Meeting of the Helsinki and OSPAR Commissions (JMM). Bremen, 25–26 June 2003.

Conclusions and comments on ToR 2

Examine how the HELCOM assessment of the Baltic Sea ecosystem corresponds with the objectives and requirements of the EC Water Framework Directive

The main objective of the HELCOM environmental assessment work is to provide policy relevant information for targeted users at national and Baltic-wide level as well as to provide input to Pan-European and global fora (EU, UNEP, IMO). This is necessary in order to make sound decisions to restore the Baltic Sea ecosystem, to reach good ecological status, and to support the implementation of the HELCOM objectives and actions. An essential objective is to raise general public awareness of the Baltic Sea and HELCOM actions. For the assessment purposes, HELCOM coordinates national monitoring programmes. In the open Baltic Sea HELCOM monitoring programmes are the backbone while in coastal areas they will bring added value to activities required by other fora, including the Water Framework Directive.

The overall objectives of the HELCOM Monitoring and Assessment Strategy (adopted by HELCOM 26/2005) are:

- to facilitate the implementation of the ecosystem approach covering the whole Baltic Sea, including coastal and open waters;
- to show the inter-linkage and interdependence of activities in land, in coastal areas and at sea;
- to coordinate monitoring activities for Baltic specific issues of concern;
- to set out the structure and time frame for the production of regional specific assessment;
- to produce targeted environmental assessments for regional specific management purposes by also making use of data and information produced by Contracting Parties for other fora.

Reference

HELCOM Monitoring and Assessment Strategy, HELCOM 26/2005

Conclusions and comments on ToR 3

Examine how the US EPA 'indices approach' can be used in the Baltic Sea

The Workshop participants expressed deep interest in the US EPA "indices approach". The integration of specific indicator information into indices for selected areas was endorsed by the SGEH, although the specific formulations of the US indices may or may not be directly applicable to the Baltic Sea. The Eutrophication and Harmful Substances Subgroups will be examining the development of Eutrophication Index and a Pollution Index, respectively, based on their component indicators.

The Workshop welcomed proposal by US EPA representative to carry out Baltic exercise on "benthic index". US EPA will work with SGEH biologists/ecologists to determine whether benthic index development approaches developed by US EPA can be successfully applied to existing Baltic Sea data sets.

Conclusions and comments on ToR 4

Consider existing indicator developments by the EEA, FAO, HELCOM, OSPAR, ICES, IOC/SCOR and US EPA/NOAA

Indicator developments were considered in various keynote presentations (see item 4) except FAO and IOC/SCOR developments, due to the lack of representatives. However, these developments were partly covered by Chris Hopkins presentations.

Conclusions and comments on ToR 5

Develop Ecosystem Health Indicators in relation to the effects of eutrophication, harmful substances, fishing activities, and the loss of biodiversity

Main Baltic concerns: eutrophication, contamination, overfishing and loss of biodiversity were selected for developments of EcoQOs, Indicators and Reference levels. For this reason four Subgroups were established which concentrated on developments of EcoQOs and Ecosystem Health Indicators (see Section 5). Developments of Reference levels, which require work on data basis, are not satisfactory and may require ICES/BSRP special attention and decision on special Workshop.

It is worth noticing some difficulties in cooperation with western experts which arise from to the lack of financial support for western countries as well as low level of intercessional activity. The next SGEH meeting should aim to completing EcoQOs and Indicators in form structrised/prioritised list which can be offered to relevant bodies as "deliverables".

7 Closing and acknowledgements

The Workshop was closed on 1 April at 5 p.m. The Chair, Eugeniusz Andrulewicz, thanked the participants and special thanks were extended to the participants not funded by the BSRP. In particular, the Chair thanked Thomas Lang, Kari Lehtonen, and Kevin Summers for their valuable initiatives and involvement in relation to the Baltic ecosystem health assessment process. The Chair expressed his appreciation to Co-Chair Hein Rune Skjoldal for his contribution to the Workshop. He also thanked Chris Hopkins for having assisted in the planning of the Workshop.

The Chair also expressed his thanks to MARBENA (5th EU) for financial support offered to the Workshop, to the Director of the Institute of Oceanology, Stanislaw Massel, for offering splendid working facilities as well as to the local host, Jan Marcin Weslawski, for his effort to make this workshop run smoothly and efficiently.

Annex 1: Workshop agenda and timetable

DAY 1: Wednesday 30 March 2005		**TIME**	**Minutes**
Registration		08.30-09.00	30
Opening and Keynote Presentations			
Welcome and start-up	Chairs: Hein Rune Skjoldal (Norway); Eugeniusz Andrulewicz (Poland) Rapporteur: Gedas Vaitkus (Lithuania)		
Representatives of Co-Sponsors, Co-Conveners, Organizer and Local Host		09.00-09.30	30
Keynote speakers	Chair: Andris Andrushaitis (ICES BSRP) Rapporteur: Bärbel Müller-Karulis (Latvia)		
Chris Hopkins (Sweden): *The concept of Ecosystem Health and association with the Ecosystem Approach to Management and related initiatives*	20 min. plus 10 min. discussion	09.30-10.00	30
Jan Thulin (BSRP) and Ken Sherman (US-NOAA): *The Large Marine Ecosystem concept*	20 min. plus 10 min. discussion	10.00-10.30	30
Hein Rune Skjoldal (Norway): *Development of ecological quality indices in OSPAR, relations to international instruments such as the Water Framework Directive, and lessons learnt*	30 min. plus 10 min. discussion	10.30-11.10	40
Coffee		11.10-11.40	30
Hermanni Backer (HELCOM): *Status of the development of marine and coastal indicators in HELCOM*	30 min. plus 10 min. discussion	11.40-12.10	40
Jacqueline McGlade: (EEA/EC): S*tatus of the development of marine and coastal indicators in the EEA/EC*	30 min. plus 10 min. discussion	12.10 – 12.50	40
Lunch		13.00-14.00	60

Dag Daler (GIWA): *GIWA – a presentation of the methodology and assessment results from the Baltic Sea region*	30 min. plus 10 min. discussion	14.00 – 14.40	40
Kevin Summers (USA): *Approaches and methodologies for the development of indices of coastal ecological condition – experiences from the USA*	30 min. plus 10 min. discussion	14.40 – 15.10	40
Coffee		15.10-15.40	30
Jan Marcin Weslawski (Poland): *Outcomes of European Community RTD Framework Programme related to biodiversity*	30 min. plus 10 min. discussion	15.40 – 16.10	40
Summaries by Co-Chairs of Subgroups: *Conclusions from 2004 BSRP/SGEH meeting, reporting on follow-up intersessional work tasks, and specific Terms of Reference and strategy for each Subgroup at this workshop*	Chairs: Hein Rune Skjoldal (Norway) and Kevin Summers (USA EPA) Rapporteur: Chris Hopkins (Sweden)		
a) Georg Martin (Estonia)/Jesper Andersen (Denmark): *Subgroup on effects of eutrophication*	20 min plus 10 min discussion	16.10 – 16.40	30
b) Kari Lehtonen (Finland)/Thomas Lang (Germany)/Galina Rodjuk (Russia): *Subgroup on effects of harmful substances*	20 min plus 10 min discussion	16.40 – 17.10	30
c) Henn Ojaveer (Estonia)/Maris Plikshs (Latvia): *Subgroup on effects of fishing activities*	20 min plus 10 min discussion	17.10 – 17.40	30
d) Jan Marcin Weslawski (Poland)/Sergei Olenin (Lithuania): *Subgroup on loss of biodiversity*	20 min plus 10 min discussion	17.40 – 18.10	30
Hein Rune Skjoldal and Eugene Andrulewicz: *Wrap-up Day 1 and Review of Tasks for Day 2*		18.10 – 18.20	10
Welcome party hosted by the Director of the Institute of Oceanology, Polish Academy of Sciences		18.30 -	

DAY 2: Thursday 31 March 2005		**TIME**	**Minutes**
Work in Subgroups: Addressing Terms of Reference for respective groups (Effects of eutrophication; Effects of harmful substances; Effects of fishing activities; Loss of biodiversity)	Supervisors: Hein Rune Skjoldal (Norway) and Eugeniusz Andrulewicz (Poland) Chairs: Subgroup Chairs		
Morning session: (Coffee provided at 11.00)		09.00 - 13.00	240
Lunch		13.00 – 14.00	60
Afternoon session: (Coffee provided at 15.00)		14.00 – 16.00	180
Plenary Session: Presenting and critiquing results from Subgroup work. Drafting conclusions and recommendations	Chairs: Hein Rune Skjoldal (Norway) and Eugeniusz Andrulewicz (Poland) Rapporteurs: Subgroup Chairs		
a) Georg Martin (Estonia)/Jesper Andersen (Denmark): *Subgroup on effects of eutrophication*	20 min. plus 10 min. discussion	16.00 – 16.30	30
b) Kari Lehtonen (Finland)/Thomas Lang (Germany)/Galina Rodjuk (Russia): *Subgroup on effects of harmful substances*	20 min. plus 10 min. discussion	16.30 – 17.00	30
c) Henn Ojaveer (Estonia)/Maris Plikshs (Latvia): *Subgroup on effects of fishing activities*	20 min. plus 10 min. discussion	17.00 – 17.30	30
d) Jan Marcin Weslawski (Poland)/Sergei Olenin (Lithuania): *Subgroup on loss of biodiversity*	20 min. plus 10 min. discussion	17.30 – 18.00	30
Hein Rune Skjoldal and Eugene Andrulewicz: *Wrap-up Day 2 and Review of Tasks for Day 3*	10 min.	18.00 – 18.10	10

DAY 3: Friday 1 April 2005		**TIME**	**Minutes**
Round-table review of workshop conclusions	Chairs: Hein Rune Skjoldal (Norway) and Eugeniusz Andrulewicz (Poland) Rapporteur: Gedas Vaitkus (Lithuania)		
Jacqueline McGlade (EEA) and Juha-Markku Leppänen (HELCOM): Special *Ad Hoc* presentations and discussion forum	20 min. each plus 20 min. discussions	09.00 - 10.00	60
Coffee		10.00 – 10.30	30
Presentation of workshop conclusions, including final consideration of ToRs 1 – 5 and adoption of recommendations for future actions		10.30 – 13.00	150
Lunch		13.00 – 14.00	60
Completion of draft Workshop Report and closing of the workshop	Chair: Eugeniusz Andrulewicz (Poland) and Chris Hopkins (Sweden) Rapporteurs: Gedas Vaitkus (Lithuania) and Subgroup Chairs		
Work in Groups/Subgroups: Completion of draft Report		14.00 – 16.00	120
Coffee		16.00 – 16.30	30
Work in Groups/Subgroups: Completion of draft Report		16.30 – 17.30	60
Final Remarks and Closing of the Workshop		17.30-17-45	15

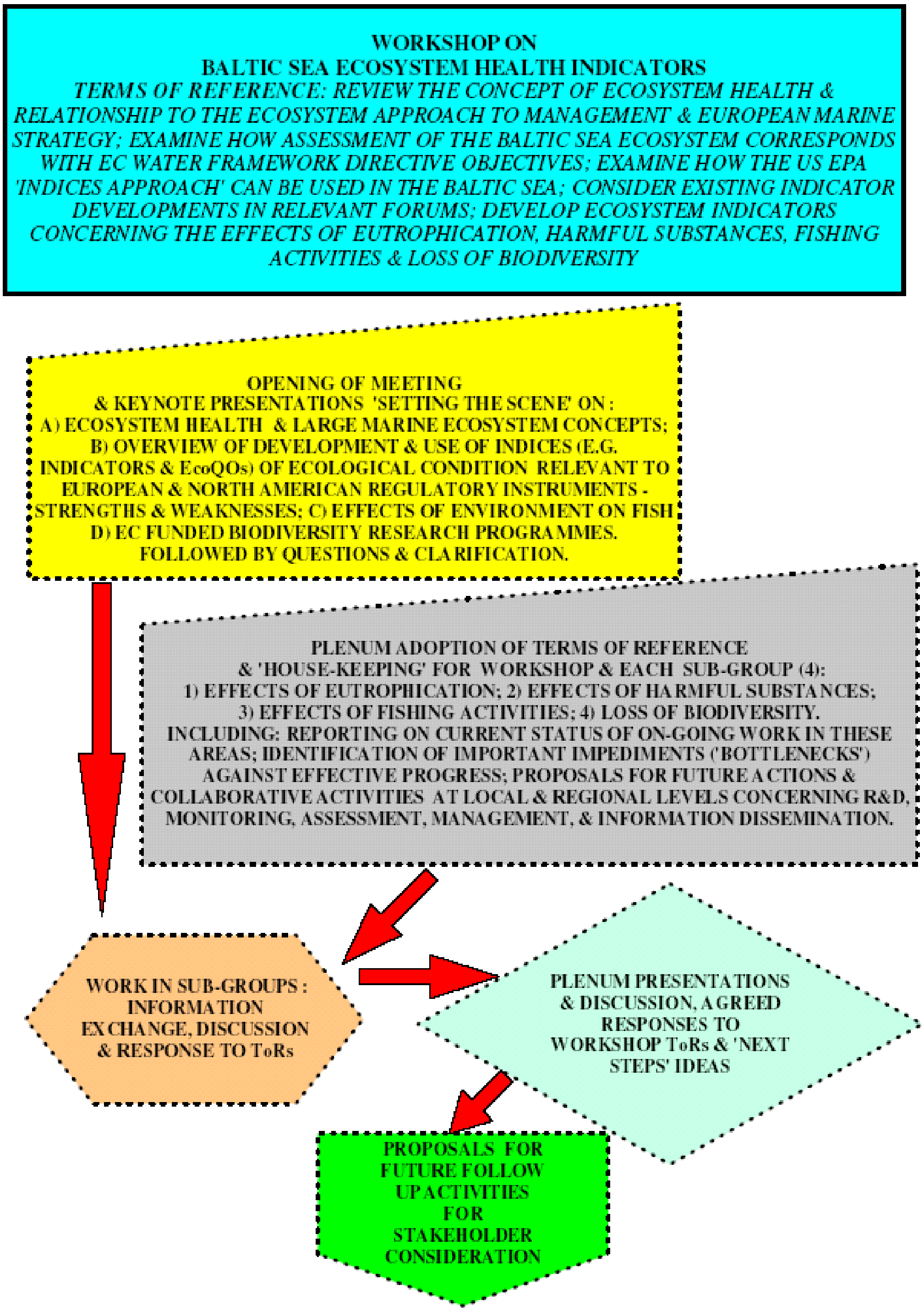

Figure A1.1. Sketch illustrating the concept for the workshop.

Annex 2: List of participants

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Annex 3: Proposal for a Demonstration Project (biolological effect monitoring exercise at coastal sites of Poland, Lithuania and Latvia): BIODEMO (by Kari Lehtonen)

The BSRP is a project related to management of the Baltic Sea marine ecosystem. Moreover, the SGEH should further develop the Baltic ecosystem health concept in relation to hazardous substances. The approach of studying biological effects of pollutants under natural conditions is probably the only realistic way to get evidence of environmentally dangerous levels of contaminants.

The role of the biomarker component in the BSRP has been considerably reduced compared to the original PIP of the project, which assumed that Ecological Effects component is present in the project structure. This shift in priorities happened primarily due to a drastic reduction of funding in regard to the original budget drafted for the project.

However, during the BSRP Workshop in Vilnius (11/2004) it was agreed feasible to carry out a small-scale Demonstration Project devoted to biomarker response assessment. The project has been prepared on the basis of already existing capacities and experience available at the Institute of Ecology of Vilnius University (Vilnius, Lithuania) and Sea Fisheries Institute (Gdynia, Poland) in order to examine possibilities to participate the Ecological Effects component in the BSRP (Phase 2). The "BIODEMO" project structure is presented briefly below.

Participants of the BSRP Biological Effects Demonstration Project

Latvia: Institute of Aquatic Ecology, University of Latvia. Responsible person: Irina Kulikova. Lithuania: Institute of Ecology of Vilnius University. Responsible person: Janina Baršienė. Poland: Sea Fisheries Institute, Gdynia. Responsible person: Dorota Napierska

Definition of the three regional study areas (comprising of polluted and reference sites)

Latvia – Gulf of Riga: Saulkrasti (anthropogenic influence from three rivers); Mersrags (reference site). Lithuania – Eastern Baltic Sea Proper: Klaipeda-Butinge area (mixed anthropogenic pollution); Palanga (reference site). Poland – Gulf of Gdansk: Vistula River mouth (mixed anthropogenic pollution, including strong agricultural influence; Leba (off-shore reference site).

Target species (defined on regional feasibility)

Flounder (*Platichthys flesus*); blue mussel (*Mytilus* spp.); Baltic clam (*Macoma balthica*). All species are common at all the study areas.

Definition of the time of sampling

The sampling will be synchronized in regard to water temperature and reproductive stage of the target species. All species will be sampled at the same time and from the same study locations. Previous experience in the EU BEEP project suggests the feasibility of early summer (May–June) and early autumn (September) for sampling in all the three regions.

Biomarkers employed

Acetylcholinesterase inhibition (AChE): exposure to neurotoxic contaminants; affected by various groups of pollutants, thus also potential indicator of general pollution stress. Glutathione-S-transferase activity (GST): exposure to organic xenobiotics; phase II biotransformation capacity; oxidative stress (by, e.g., heavy metals). Catalase activity (CAT): defence against reactive oxygen species (oxidative stress). Lysosomal membrane stability (using the Neutral Red retention test, NRR): index of cellular damage; predictor of pathology; indicator of general stress. Micronuclei frequency (MN): index of cytogenetic damage caused by genotoxic compounds; predictor of pathology.

Supporting parameters

Basic hydrography (temperature, salinity, oxygen): recorded at each sampling occasion. Morphometric indices (gonadal/somatic index): indications on health, physiological and reproductive status of individuals.

Protocols

Standard operation procedures (SOPs) will be elaborated before the sampling surveys. The SOPs will include instructions on sampling, maintenance conditions before dissection, size ranges of individuals, collection of tissue samples for biomarker analysis, biomarker analyses, and data management.

Capacity building

Equipment and materials for the execution of the BSRP Demonstration Project the partner institutes is expected to be partly financed by the BSRP. This will also increase the technical capability of the partner institutes to carry out biological effects studies and monitoring in the Baltic Sea area. Approximate costs: € 33,300.

Practical workshops, intercalibration, and other networking activities

Activities scheduled for 2005: (1) Internal exchange of methods and experiences. (2) Training run by local experts: five-days training on enzyme activity measurements (AChE, GST, CAT) at the Sea Fisheries Institute in Gdynia (proposed time: June 2005); 10-d training workshop on NRR and MN analyses at the Institute of Ecology of Vilnius University. (3) Intercalibration of biomarkers analyses: internal exchange of samples to ensure the comparability of data. (4) Participation of two representatives from eastern Baltic Sea countries in the ICES WGBEC (Working Group on Biological Effects of Contaminants) meeting (Reykjavík, Iceland; 18-22 April 2005). Costs expected to be covered mainly by the BSRP. Approximate costs: € 9,000

Meeting for practical arrangements

Spring 2005, in connection with the BSRP SGEH Workshop on Indicators (Sopot, Poland)

Annex 4: Preliminary plans for the ICES/BSRP Sea-going Workshop on Fish Disease Monitoring in the Baltic Sea (by Thomas Lang)

The workshop will be held for 10–14 days in December 2005 on board the German RV 'Walther Herwig III'. It will be organised and co-convened by T. Lang (Fed. Res. Centre for Fisheries, Inst. of Fishery Ecology, Cuxhaven, Germany) and G. Rodjuk (BSRP LL for fish diseases, parasites, histopathology, AtlantNIRO, Kaliningrad, Russia). The ICES Study Group on Baltic Ecosystem Health Issues in support of BSRP (SGEH) and the ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) will be involved in the programme planning.

The major objectives of the workshop are to:

- provide training and intercalibration related to methodologies applied in fish disease monitoring in the Baltic Sea;
- further develop and assess health indicators and indices appropriate for monitoring and assessment purposes;
- establish a closer collaboration between institutes involved in fish disease monitoring in the Baltic Sea;
- build the basis for incorporation of fish disease surveys into the revised HELCOM monitoring programme.

According to the present planning, the workshop will start in Kiel, Germany, and will end in a port in the eastern Baltic Sea yet to be decided.

Twelve scientists will participate, including training experts (on methodologies for fish disease surveys in the Baltic Sea, externally visible diseases/parasites, liver histopathology, data assessments, quality assurance) and trainees from Baltic Sea countries, with priority given to eastern BSRP countries.

The major target fish species will be flounder (*Platichthys flesus*), herring (*Clupea harengus*), sprat (*Sprattus sprattus*) and cod (*Gadus morhua*). These species will be sampled on a transect with selected sites representing different environmental conditions. If appropriate, samples can be taken for subsequent lab-based measurements, e.g., on biomarker responses (e.g., as part of the panned BSRP BIODEMO Project on biological effects of contaminants).

The final plans for the workshop will be presented at the next ICES SGEH meeting in November 2005 in Kaliningrad, Russia, at the Meeting of the ICES Advisory Committee on the Marine Environment (ACME) in Copenhagen, June 2005, as well as at the ICES ASC/Statutory Meeting in September 2005, Aberdeen, UK.

Cost implications for BSRP: funding (travel and per diem) will be required for scientists from the eastern recipient countries. Funding will also be needed for a representative from the BEQUALM lead laboratory on fish diseases and liver histopathology at CEFAS, Weymouth, UK, whose participation **is essential** in order to guarantee compliance with the BEQUALM quality assurance activities. Ship time, accommodation and food on board, the use of equipment as well as time allocation by western experts constitute a significant in-kind contribution by western countries.