SEMINAR “DEVELOPMENT OF MARINE BIODIVERSITY INDICATORS”

ABSTRACTS OF SEMINAR PRESENTATIONS

SEMINAR "DEVELOPMENT OF MARINE BIODIVERSITY INDICATORS"

ABSTRACTS OF SEMINAR PRESENTATIONS

Disclaimer

The publication is produced in the frame of the LIFE+ Nature & Biodiversity project "Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea" (Project acronym -MARMONI). The content of this publication is the sole responsibility of the Baltic Environmental Forum and can in no way be taken to reflect the views of the European Union.

Prepared with a contribution from the LIFE financial instrument of the European Community, Latvian Environmental Protection Fund and Estonian Environmental Investment Centre.

2-3 November 2011

Contents

1 Indicator-based evaluation of the ecological status of the Central Baltic Sea: the IndiSeas experience on comparative studies of exploited marine ecosystems

Henn Ojaveer, Estonian Marine Institute (University of Tartu, Estonia), Marta Coll (Institute of Marine Science, Spain), Lynne Shannon (University of Cape Town, South Africa), Martin Lindegren (National Institute of Aquatic Resources, Technical University of Denmark, Denmark)

One of the challenges faced by the scientific community with regard the ecosystem approach to marine management is to develop and propose a suite of ecological indicators, which would accurately reflect the effects of climate and different human activities on marine ecosystems. These indicators should facilitate communication with different stakeholders and support sound management practices. The IndiSeas initiative is aiming to develop methods to provide indicators-based assessments of the status of exploited marine ecosystems in a comparative framework. The network encompasses now close to 40 different ecosystems and seas/sea areas globally. Here, we present the main outputs of the first phase of the project by describing and analysing the performance of Central Baltic Sea ecosystem in relation to other seas, and present the first results of the most recently developed indicators related to climate change and biodiversity.

The following criteria were used for indicator selection:

(i) Data availability and measurability – availability of data estimated on a routine basis;

(ii) Ecological meaning – to reflect ecological processes occurring under fishing pressure and based on strong scientific and theoretical knowledge;

(iii) Sensitivity to fishing - to track ecosystem changes due to fishing, so there was a high correlation between trends in the indicator and in fishing pressure;

(iv) Public awareness - meaning and link of indicators with fishing widely and intuitively understood to avoid abstract ecological feature;

(v) Ecological objectives

  i. conservation of biodiversity (CB)

  ii. maintenance of ecosystem stability and resistance to perturbation (SR)

  iii. maintenance of ecosystem structure and functioning (EF)

  iv. maintenance of resource potential (RP)

The following indicators were applied in IndiSeas phase I (with corresponding management objective): Mean length (EF), trophic level of landings (EF), proportion of under/moderately exploited stocks (CB), proportion of predatory fish (CB), mean lifespan (SR), 1/CV of total biomass (SR), total biomass of surveyed species (RP) and 1/(landings/biomass) (RP).

2 Temporal changes of the phytobenthic plant and animal communities in the Northern Baltic Sea

Hans Kautsky (Dept. Systems Ecology, Stockholm University, Sweden)

The plant species number changes little in the whole Baltic Sea gradient, but the composition goes from algal to higher plants dominated systems. Using SCUBA divers estimates of species depth distribution and coverage the trends over time can be followed. In the Åland Sea, at the Mats Waern localities from the 1940s, a major decrease in the attached bladder wrack (*Fucus vesiculosus*) depth distribution could be seen during a revisit in the 1980s. This was attributed to the overall Baltic Sea eutrophication and the decrease in light penetration (Secchi depth). Revisits in the 1990s and mid 2000s show a steady increase in depth distribution of *Fucus* and today it is at the same level as in the 1940s. The same increase in *Fucus* depth distribution occurs in the Askö area (found ca 1 m deeper since 1993). This indicates a decrease in eutrophication and thus an increase in light penetration along our coast. Quantitative samples taken within the Swedish monitoring programme (SEPA) since 1993 enable us to follow each species development at six sites. Fusing the species into functional groups, we expect that, if the trend of decreased eutrophication should hold, the filter feeders and detritivores should decrease due to decreased pelagic primary production. The all dominating filter feeder the blue mussel (*Mytilus edulis*) decreases in the Askö area, well in accordance with the hypothesis. The filamentous alga, which benefit from higher nutrient contents, on the other hand, increase as well as the herbivores- a little bit contradicting if the amount of filamentous should be dependent on grazing. It should be pointed out that the epiphytic filamentous algae have never been dominating in the area except during their expected season. This year (2011) filamentous algae that usually are in high abundance were almost lacking in the Askö area and elsewhere, which I have never seen before. There is an increase in filter feeding animals excluding Mytilus also, but this is due to the increase of the coggle (*Cerastoderma glaucum*), a species which had a population bloom since the extremely warm summers in the mid-2000s.

3 Marine bird abundance and distribution data derived by automated detection in aerial survey image data

Rasmus Due Nielsen, Geoff Groom, Ib Krag Petersen, Michael Stjernholm (Aarhus University, Bioscience Kalø, Denmark)

The increased use of marine areas for large scale constructions such as offshore wind farms, wave energy plants, bridges and oil and gas exploration has increased the importance of assessing these areas in terms of their significance for marine birds, and marine mammals. Many marine bird species in particular are migratory or use specific marine areas for breeding, wintering and moulting; cumulative changes in the conditions associated with such increased utilizations of the sea can affect the ecological status of specific species populations. Therefore knowledge of the spatial and temporal use of different marine areas by each population is vital in marine ecological management work, including for instance environmental impact assessments and post-construction monitoring. A key component of that knowledge is the abundance and distribution of the populations, i.e. data on the numbers of individuals present and their locations. Traditional surveys of the distribution and abundance of birds and mammals at sea have been conducted using instantaneous visual observations done from ships and/or aircrafts based on line transects. The quality of the results from these surveys is highly dependent on a key subjective factor, namely the judgment of those making the observations regarding the species identification and number estimation. Even with adoption of rigorous survey protocols such judgments vary between observers, and between survey conditions such as associated with the sea state and the numbers of animal individuals present. More fundamentally, these survey methods are intrinsically lossy in that the only permanent documentation of the instantaneous real world situation is the record (written or verbal) made by the observer, *i.e.* there is no basis for subsequent verification of the recorded data. Since the past ten years it has become increasingly possible to complement traditional marine bird and mammal survey work with the use of remote sensing methods that can record the animal individuals. Advances in aerial survey digital camera technology now enable collection of image data in which most bird and epipelagic mammal individuals can be visually identified to species group level. The images collected represent long term documentation, enabling verification of extracted information, and extraction of new information as required by subsequent applied needs. Moreover, geo-rectified images represent a basis for high geographical accuracy of the recorded individuals: with the traditional survey methods a group of 30 Long-tailed Ducks could be represented as a single point at an approximate position; with a geo-rectified image every single bird will be recorded as an individual point with a geographical accuracy of <10 m. Knowing the area of each image footprint and the number of individuals of a particular bird species within the images we can calculate bird species densities. With the traditional line transect method densities were estimated by fitting a detection function, implying some degree of uncertainty to a density estimate. The increased geographical accuracies possible with geo-rectified images improve our ability to make robust evaluations of potential changes in pre- and post-construction bird densities in relation to man-made marine environment changes. Visual information extraction represents one way of working with these image data, which can however be labour intensive and is also subject to judgment and competence factors. These short-comings can be reduced by enabling automated, or semi-automated image processing to extract the required information. Possibilities to use contextual (neighbourhood) patterns within images, as are part of object-based image analysis (OBIA) methods developed over the past ten years, are proving proficient for automated extraction of bird and mammal individual records. With respect to indicators, data produced via marine bird or mammal individual observations and subsequent spatial modelling of population densities represent expressions of State, and the items discussed above are focused upon the techniques that can be applied to meet the data needs of such an indicator. Use of specific techniques for indicator data acquisition has to have relevance to the conceptual and biological aspects of indicator selection as well as the possibility to provide the indicator with scientifically valid data.

We are grateful to DONG Energy who commissioned the project that has made possible developments and experiences expressed within this contribution to the Marmoni project.

4 On the possibility to use remote sensing in mapping of biodiversity in shallow water coastal environments

Tiit Kutser, Ele Vahtmäe, Jonne Kotta, Merli Pärnoja, Kaire Kaljurand, Lennart Lennuk (Estonian Marine Institute, University of Tartu, Estonia)

Remote sensing could be used in mapping biodiversity in phytoplankton community but in this presentation we concentrate on the possibility to map benthic habitat biodiversity in shallow coastal waters. For biodiversity studies it would be desirable to map benthic habitats in species level. However, in most cases this is not possible as several benthic species are optically too similar to each other and even thin layer of water above them makes their optical signatures even more similar. Another problem related to remote sensing mapping of benthic habitat is spectral and spatial resolution of the sensors. Benthic habitats may vary in the scales on tens of centimetres while spatial resolution of satellite sensors is in the range of 2 m. Another problem with high spatial resolution satellites is that they measure water leaving signal in 3-6 wavelengths which is often not sufficient to recognise different benthic species. Airborne sensors provide 1 m or less spatial resolution as well as high spectral resolution and should be better for benthic habitat mapping.

High benthic biodiversity is often reflected as highly variable bottom. Consequently, the heterogeneity of the bottom can most probably be used as a proxy of biodiversity. Studying bottom types with conventional methods (diving, underwater video, grab samples) is time consuming and expensive while airborne remote sensing can provide data over large areas with high spatial resolution. Spatial heterogeneity calculated from the imagery could be an indicator providing information about the biodiversity.

The aim of the MARMONI project is to develop new biodiversity indicators. Some of the indicators may be correlated with the optical signatures detectable by remote sensing instruments. This is a path worth of exploring while the indicators are developed in the frame of the project.

5 Phytoplankton-based indication system for eutrophication

Hendrik Schubert (Rostock University, Germany)

Due to its enormous high alpha (0)-diversity, phytoplankton rarely gets identified down to species level in monitoring programmes. Most often just biovolume is estimated by transfer of counting the 10 (or even less) most abundant species multiplied by conversion factors or, even more simplified, Chlorophyll a is taken as a proxy for phytoplankton biomass. This often results in acceptable good indication of eutrophication status of water bodies, but definitely does not exploit the full indication potential of phytoplankton, being the energetic basis of any open Sea pelagic ecosystem. On the other hand phytoplankton, being enclosed between bottom-up regulation by nutrients; light availability and temperature on one hand and top-down regulation by grazing pressure on the other hand is a challenging object for developing indication systems for a given factor. Phytoplankton is characterized by very short generation times and therefore it reacts with changes in its species composition already on short term events which are just tolerated by species of longevity. On the other hand, if not being eaten because of any kind of grazing resistance it might still survive for a while even when conditions are unfavourable. Moreover, because its generation times are that much shorter than of most of its grazers, examples of “inverse biomass pyramids” have demonstrated that the “most dominant” species does not must be the one supporting the higher trophic levels; tiny, fast reproducing species might be the basis of the food chain if conditions for their productivity are favourable, whereas a large bulk of “dominant phytoplankters” might still be in the system just because of their grazing resistance, but not contributing to productivity. However, these dominant species must have been productive once, because in boreal systems the phytoplankton gets a “reset” every winter due to energetic limitation.

Therefore the main task if constructing a phytoplankton-based indication system is to find a period in time where the community is responding predominantly to the respective factor and, at a second step, to define the limits within the respective factor is the “master factor”. In case of the Baltic Sea hydrological variability with its irregular changes of salinity has been found to be a crucial factor at least in the western part, where at a single station salinity may vary within a few days with an amplitude of >7. This problem could be solved by applying a “continuous typification”, where a sample is classified according to its salinity irrespective of its geographical origin. In case of indicating eutrophication, a short period between wintertime energetic limitation and onset of combined grazing pressure and nutrient limitation (either nitrogen or phosphorus) was found to be most sensitive. However, the timing of this period heavily depends on the weather conditions, making it hard to incorporate the approach into regular monitoring programmes. Moreover, “Zooplankton grazing” is a factor including so many different species of different feeding behaviour and seasonality that a thorough analysis would be required to reach fully satisfying results. Moreover, in shallow areas benthic filter feeders, mainly temperature-controlled in its activity are complicating the situation even more. Therefore the applicability of the indication system developed for the western Baltic is still being tested and already applying it on a second dataset from the same region, which was set aside during the development in order to have an independent proof for the “hypothesis” (indication system) developed showed that not all of the indicators were robust enough. On the other hand, the work showed that it is possible to use taxonomy-based phytoplankton parameters for indication purposes as well as “functional groups”, even in cases where taxonomic resolution is restricted. The success in these cases depends mainly from the length and frequency of the monitoring series because all attempts of “extrapolation” behind the limits of forcing conditions faced during the time series failed so far and will probably also fail in future until determination of productivity can be added to numerical counting.

6 Interrelations between concepts of favourable conservation status of species and habitats in marine environment as defined by the Habitats Directive and GES as defined by the Marine Strategy Framework Directive. Potential synergies and conflicts between the goals of the Habitats Directive and the Marine Strategy Framework Directive in the Baltic Sea – the role of eutrophication as a common denominator.

Henrik Skov (DHI, Denmark)

The targets for environmental protection as well as for nature and habitats protection in the Marine Strategy Framework Directive (MSFD) and Habitats Directive/Birds Directive (HD/BD) are in principle the same, i.e. restoration, protection and improvement of ecosystem functioning. Accordingly, it is often suggested that good environmental status and favourable conservation status are interpreted and understood as synonyms. However, the suggested parallelism between the goals of MSFD and HD/BD is far from realistic when looking at higher trophic levels in terms of benthivores in the more exposed and nutrient-limited coastal waters of the Baltic Sea. A strong reduction in nutrient load would, probably with some time lag, lead to reduced primary production. Both empirical and model data indicate that as eutrophication control approaches oligotrophic conditions this will have great implications for the Baltic biomass of benthic invertebrates. Potentially, this may lead to a large reduction in the total populations of bivalve-feeding waterbirds, marine mammals and fish the system may support. Management solutions between the two (three) directives in the Baltic Sea are illustrated on the basis of conceptual models for benthivorous and carnivorous predators, and it is shown that potential synergies between overlapping areas of the two directives will be easily identified for areas with a dominance of herbivorous species, while synergies for areas with a dominance of carnivorous species may depend on the capacity of the area to change back into a mature stage and well organised ecosystem as well as the capacity of neighbouring regions to absorb affected predators. If a regime shift is unlikely to happen the synergy for the sub-region may be limited to the lowest possible level of eutrophication which still allows for a favourable conservation status of the key species.

7 Pelagic indicators

Laura Uusitalo, Vivi Fleming-Lehtinen, Maiju Lehtiniemi, Heidi Hällfors, Seija Hällfors (Finnish Environment Institute SYKE, Finland), in co-operation with Andres Jaanus, Lauri London, Jose A. Fernandes

Plankton biodiversity is very difficult to estimate. The plankton community hosts a large number of species, many present only in very small abundances, and many whose identification requires high expertise. Moreover, the life cycle of many of these species is fast, and the community reacts rapidly to changes in their environment, making the community structure ephemeral; a large number of samples is required to overcome this high natural variability. Yet maintaining biodiversity is one of the key issues in environmental protection, and assessment of success of the protection needs methods to measure that diversity, or at least track changes in it.

We propose and examine indicators to evaluate both taxonomic and functional diversity of phyto- and zooplankton, based on monitoring summer survey data from COMBINE monitoring programme and Algaline ship-of-opportunity samples. The aim is to propose biodiversity indicators based on established sampling campaigns and innovative, cost-efficient monitoring methods.

The taxonomic diversity of phytoplankton showed promising results: the various indicator candidates correlate with each other, showing that they "tell the same story". They also show expected response to eutrophic level: when the phytoplankton biomass is high, the diversity indicators are low, whereas on low biomasses all diversity values were seen, with the emphasis on the higher values. The zooplankton taxonomic diversity measures (Shannon's index, Simpson index, evenness) generally agreed with each other, but did not show significant trends over time (with the exception of decreasing trend in the Gulf of Finland surface water and increasing trend in the Baltic Proper below-thermocline water). The functionality-related indicators showed numerous consistent trends in time: decreasing mean size of zooplankters above the thermocline and increasing below the thermocline, and increasing biomass of both copepods and microphagous zooplankton.

Our future prospects include further analyses of the impacts of pressures on these indicators; considering the estimation of reference and target levels and/or baselines for them; developing indicators for the functional diversity of phytoplankton based on ship-of-opportunity data; investigating the possibilities of cost-efficient monitoring and analysis methods including the ships of opportunity sampling and semi-quantitative phytoplankton analysis; and developing a system for collecting zooplankton samples using a Continuous Plankton Recorder and analysing them automatically using a supervised classification image analysis, which would be a cost-efficient method to obtain higher frequency data for certain indices.

8 Phytoplankton community structure based indicators

Andres Jaanus (Estonian Marine Institute, University of Tartu, Estonia)

Based on a variety of available data sources, the Baltic Sea, incl. Kattegat, hosts altogether at least 1700 phytoplankton species. The number of taxa identifiable in monitoring samples is, however, much less – HELCOM PEG (Phytoplankton Expert Group) list consists of about 860 taxa. Some taxa, mainly dinoflagellates and nanoflagellates from different classes, cannot be identified to species or even genus level using routine methods.

It has been proposed that many recent changes in the phytoplankton could be related to climate variation, which influences directly and indirectly the water temperature, salinity, and loading from the catchment in the Baltic Sea area. The shifts in phytoplankton composition are typically not abrupt and the changes are rather small if the increases in nutrient levels are small or moderate. It remains still an open question whether more species are facilitated or excluded from communities by environmental fluctuations. Changes in biodiversity are almost impossible to prove and true indicators can be developed rather on the level of dominants and/or functional groups.

The project area includes an open sea in the central and western Gulf of Finland. The area is intensively used for shipping including international ferry lines. Three ferry lines crossing the area are equipped with automatic flow through observation and sampling systems (Ferryboxes) that can be utilized for testing the monitoring of pelagic indicators. Data will be collected from fixed stations at fixed depths with frequency enabling following the seasonal development of phytoplankton communities.

Although phytoplankton is often used in several environment assessment schemes it is a challenge to develop comprehensive indicators describing spatial and temporal variability in planktonic biodiversity. EU MSFD sets qualitative descriptors for determining good environmental status and according to that, the elements of the marine food webs should occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species. A shift in phytoplankton functional groups may affect ecosystem function in terms of the carbon available to higher trophic levels or settling to the sediments. Succession of functional groups can potentially provide an index that represents a healthy planktonic system, with a natural progression of dominant functional groups throughout the seasonal cycle. The development of the second potential indicator is based on assumption that there are distinct phytoplankton assemblages and generic lists of dominating phytoplankton taxa over seasons which could form the basis of a community assessment metric.

One aim of our work is to elaborate adequate sampling frequency in both time and space when collecting phytoplankton data for the evaluation of regional differences and long-term trends estimates. New methods for collecting data, such as ships-of-opportunity, provide additional information to the traditional shipboard sampling.

9 Present state of Finnish MARMONI macrophyte works

Ari Ruuskanen (Finnish Environment Institute SYKE, Finland)

Three indicators were studied in the field and in the lab in 2011.

1. Growth depth of perennial macroalgae species is an indicator of light availability which in turn is an indicator of eutrophication. At this moment, Finland has one Water Framework Directive macroalgae indicator, *Fucus vesiculosus* and more is needed. We tested the light requirements of *Furcellaria lumbricalis*, *Polysiphonia fucoides* and *Rhodomela confervoides* in the lab. This was done to find out compensation point which equals to the maximum growth depth. After that we surveyed their vertical and small scale geographical distribution in the field. We found that these species are suitable for indicators but their occurrence is strongly related to the location of the study site along the wave exposure gradient and the sea bottom structure as well.

2. Abundance of a seasonal species *Cladophora glomerata* is considered to be an indicator of the summer time nutrient concentration in surface waters. Field observations done from sea marks used in ship navigation revealed that a height of *C. glomerata* is bigger in more eutrophicated areas than in less eutrophicated areas. To study the relationship between the length of *C. glomerata* and nutrients in water, we cultivated *C. glomerata* in different concentrations of nitrate in the lab. We found that the growth rate was linear and it could be possible to use the length of *C. glomerata* as an indicator of water quality in harbours, for example.

3. A share of annual and perennial species is used as an indicator in some countries. This method is not in use in Finland so far. To test if this method is useful in Finnish coast line we measured proportions of annual and perennial species at one shore. Work is in process.

10 Benthic biodiversity indicators – data and progress so far – Hanö Bight study area

Nicklas Wijkmark (AquaBiota Water Research, Sweden)

AquaBiota has a spatial approach on benthic biodiversity indicators, working at the species, community and habitat levels of biodiversity. Spatial patterns of biodiversity and important anthropogenic pressure gradients are studied. Some first analyses of data on phytobenthic and zoobenthic communities in the study area indicate that some anthropogenic gradients have an impact on the zoobenthic community and that the highest diversity of both phyto- and zoobenthos is found in the phytobenthic zone. Anthropogenic pressures and interactions with natural gradients will be examined in the on-going indicator development focusing on habitat building species. The proposed new indicators will be linked to the relevant anthropogenic pressures. The indicators will be tested using the quality criteria from Rees et al. (2008) and NordBio (2010). The conclusions from action A1.1. will be used to ensure the compatibility of the indicators with relevant directives and policies. Interactions with birds, fish and plankton will be examined in a spatial context.

11 Testing the usage of benthic biodiversity indicators in the Estonian coastal sea: a spatial perspective

Jonne Kotta (Estonian Marine Institute, University of Tartu, Estonia)

In this presentation a number of the existing and novel spatial biodiversity indicators were presented spanning from simple numerical metrices to more complex multivariate measures. Among the indicators used by this pilot study were the ZKI index, the Chao non-parametric estimator for species richness, species-rank curves, number of biological traits, community wide synchronicity and scale-specific community homogeneity. The indices take into account the means and spatial variability of taxonomical and functional diversity as well as the community dominance structure. The most of these indicators are intuitively simple, attractive and easy to calculate. They are easy to measure in the field, have ecological meaning and are potentially sensitive to environmental changes. Tests of the applicability of the studied indicators in the pilot area demonstrated that the selection of the spatial and/or temporal scale has a strong impact on the index performance. Thus, in order to assess the intensity of local human pressures and/or global climate induces changes an appropriate spatial scale should be defined as different pressures operate at different spatial and/or temporal scales.

12 MARMONI-fish: Indicator development for coastal fish

Markus Vetemaa (Estonian Marine Institute, University of Tartu, Estonia)

The need for fish indicators

The most important driving force for the fish indicator development is the new Marine Strategy Framework Directive (MSFD), which obliges member countries to develop indicators to monitor the environmental status of the marine waters. The indicator development is guided by the COMMISSION DECISION (2010/477/EU), later in the text "COMDEC". The Water Framework Directive (WFD) has been implemented a few years ago and monitoring programmes targeted to several components of the ecosystem are running. On the contrary to the WFD, the MSFD requires that also fish and fish populations should be monitored and fishery is regarded as a pressure. Thus, the need for fish indicators in the Baltic Sea Region has emerged just very recently and the development of fish indicators is still almost in the starting point. In the Baltic Sea, however, the main commercial fish species have been monitored already for decades through rather well-funded programmes/projects and using sophisticated methods. There are a lot of data available concerning e.g. the internationally managed commercial species (herring, sprat, cod and salmon) compiled by the ICES working groups. ICES has also taken the responsibility to develop indicators for Baltic subpopulations of these species. However, much less data is available for the coastal fish species. Thus, the most urgent need now is to develop and test a set of adequate indicators for the coastal fish species which are important components of the coastal biodiversity and, in addition, several species are also important commercial species.

Main pressures for the Baltic coastal fish

The major pressures for coastal fish in the Baltic Sea appear to be fishery and eutrophication (and perhaps climate change which effects are at least to some extent connected to eutrophication). Indicators related directly to fish and fish populations are in decisive role when monitoring the effects of fishery on the marine environmental status, although fishery might have detectable effects on e.g. sea birds and mammals, too. The effects of nutrient enrichment are naturally easiest seen in water chemistry and primary production. However, we need sensitive indicators from higher ecosystem levels (such as fish), too, to monitor the effects of eutrophication on the entire marine ecosystem and biodiversity.

According to the COMDEC, monitoring programmes and the indicators could be mainly focused on the major pressures, vulnerable areas and on components which are sensitive to the pressures. Using sensitive indicators in vulnerable areas enables to detect effects or deviations from the good status in early phase and, on the other hand, makes it easy to conclude that effects (deviations from the good status) do not exist, if the sensitive indicators do not reveal anything alarming.

Basis for indicator development

The basis for indicator development is the evaluation of existing fish data and a comparison of data collected using different methods. New approaches and data collection are likely needed, too. So far the fish research has unfortunately been rather one-sided. Its main aim (at least while talking about internationally agreed data collection and monitoring schemes) has been to provide advice how to reach bigger catches and higher economic revenues. At the same time, monitoring related to other problems – like for example biodiversity issues, has lacked or been just a by-product. Based on that, the main aim of the MARMONI-fish is to:

- analyse relevance of existing monitoring schemes for the assessment of the state of fish biodiversity in the Baltic Sea,
- elaborate methods for better future monitoring,
- propose and test most relevant sets of fish-related indicators. The work has started in 2011 and here we present some examples of the on-going work of the MARMONI-fish.

13 Estonia: comparison of fish data from different sources and biodiversity

Markus Vetemaa and Kristiina Jürgens (Estonian Marine Institute, University of Tartu, Estonia)

During the first study year work has been carried out to answer two main research questions: 1) should the national monitoring provide additional raw data for some new and innovative indicators reflecting the status of fish biodiversity and fisheries pressure in a better and more cost-efficient way, and, 2) could the data collected now mainly by gill-netting (and forming the base for indicator approach related to coastal fish species) be also provided by some other method (e.g. trawling or more detailed analyse of commercial landings data)?

In order to answer these questions the following studies were initiated (will be continued in 2012):

- Analysis of the existing fish-related biodiversity indicators (HELCOM CORESET indicators etc.) calculated on the base of standardized coastal fish monitoring data collected in 5 Estonian fish monitoring areas (1993-2011) in the Gulf of Riga.
- Comparative analysis of trawling data and gill net data (2009-2011) collected in Pärnu Bay.
- Comparative analysis of landings data and gill net data (2006-2011) collected in Pärnu Bay.

14 Finland: Biodiversity and fish reproduction areas

Antti Lappalainen (Finnish Game and Fisheries Research Institute, Finland)

The species distribution (1.1.) and distributional range (1.1.1) are suggested biodiversity indicator types in the COMDEC. For large-size fish species (and especially for commercial species) it is relevant to focus just only on the distribution of reproduction areas. In the Finnish coast, several fish species are living at the edge of their distribution areas and the distribution (and productivity) of their reproduction areas could be sensitive to changes in environmental variables caused e.g. by eutrophication and climate change. For example, the reproduction areas of flounder and turbot are found only in the SW-coast of Finland, where the salinity is high enough. The juveniles are found in the autumn only in some shallow sandy bottoms, and this habitat might be sensitive to effects of eutrophication (e.g. increased filamentous algae or organic matter). In a survey carried out in autumn 2011, juvenile flounder were found in 14 out of 42 areas in SW Finland. Similarly, sea spawning whitefish is a northern species and it is likely that the distribution of its reproduction areas has already shrunken from the SW-coast. The larvae of the sea-spawning whitefish are also found in shallow sandy bottoms, but during the spring. There is, however, some old "baseline data" on the abundance of both flounder juveniles and whitefish larvae in Finland and data on juvenile flounders should be available from several other countries, too. The distribution and productivity of fish reproduction areas could offer reasonable – and easily understood - indicators for the effects of environmental changes on fish biodiversity. A prerequisite is that a link between the environmental change and indicator is clarified. The further work with these candidate indicators is going on in MARMONI-fish during 2012-2013.

15 Latvia: Comparison of fish data from different sources and biodiversity

Atis Minde (Latvian Institute of Aquatic Ecology, Latvia)

The main activities were scheduled for 2012 and will address the following questions: 1) can the Nordic multimesh gillnets be used in offshore areas instead of bottom trawling, 2) development and use of fish-related biodiversity indicators for offshore fish community (main focus on fish communities not on internationally assessed fish species).

The following studies will be carried out (2012):

- Development and testing of fish community based biodiversity indicators on the basis of trawl survey data from Gulf of Riga and Irbe Strait.
- Field testing of Nordic multimesh gillnets in offshore areas on soft and hard bottom.

16 Sweden: studies of fish in the Hanö Bight

Tomas Didrikas (AquaBiota Water Research, Sweden)

Data available from previous years YOY (young-of-the-year) and juvenile fish sampling using small blast method in coastal areas of the Hanö Bight together with other physical parameters (temperature, depth, wave exposure, proximity to contaminated areas, etc.) were used in canonical correspondence analysis (CCA). Preliminary results after 2011 field work season did not show clear relationships between these factors. Spatial analysis and modelling will be continued in 2012 and will possibly result in development of integrated spatial indicators for YOY and juvenile fish.

The pelagic fish hydro-acoustic survey planned for 2011 has been postponed to 2012 in order to increase the spatial coverage by decreasing the temporal resolution. This is unlikely to impact other actions or deliverables negatively, but is expected to give positive synergy effects in the development of new integrated indicators. This will allow a spatial overlap of bird, benthos and fish inventories to a larger degree. The overlapping data is planned to be used for the development of a combined indicator which integrates information from several organism groups.

17 Proposal of bird indicators for the Baltic Sea

Ainars Aunins (Latvian Fund for Nature, Latvia), Leif Nilsson (University of Lund, Sweden), Antra Stipniece (Latvian Ornithological Society, Latvia)

There are good reasons to use birds as indicators for wider marine environment. They are near the end of the food chains and thus sensitive to environmental change. Although there are new advances in improving sampling design and detection probability, the well-established methods of bird monitoring exist that provide reliable data and several countries have time series covering decades. However, as birds operate on a relatively large spatial scale, they most usually are not enough specialised to use them as fine-scale indicators and due to their mobility and impressive seasonal movements birds can accumulate impacts of very different areas.

We identified bird indicators that are relevant for reporting requirements of the Birds Directive (Favourable Conservation Status), Habitats Directive (status/condition of typical species of Annex I habitats) and Marine Strategy Framework Directive (Descriptor 1 and Descriptor 4 of Good Environmental Status). We consider the following groups of indicators:

1. Indicators showing the status of marine birds should include all species and seasons that are relevant for particular country. The group contains both single species and multi species indicators. Typical parameters include abundance/abundance index, age ratio and distribution (spatially explicit abundance/abundance index). Multi-species indicators are expressed in a form of geometric mean of single species abundance indices.

2. Indicators reflecting health of environment should include all true marine species and all ice-free seasons. The group contains multi-species indicators to level out any species-specific responses that do not reflect changes of ecosystem importance. Typical parameters include abundance/abundance index and distribution (spatially explicit abundance/abundance index) expressed in a form of geometric mean of single species abundance indices.
3. Indicators for food webs should include only species with well-established links to their food sources or their predators. The group contains single species based indicators allowing multi-species exceptions if food sources are similar. Typical parameters include distribution (spatially explicit abundance/abundance index), bird days, productivity, diet/feeding rate, chick growth rate. However, we admit that collection of data for some of these parameters is resource demanding and thus is unlikely to be included in sea wide monitoring programs.
4. Indicators of sea use impacts (such as pollution and disturbance) should include all species that are relevant for marine environment. The group contains multi-species indicators to level out any species-specific responses that do not reflect changes of ecosystem importance. Typical parameters include abundance/abundance index and distribution (spatially explicit abundance/abundance index).

18 Policy requirements for biodiversity indicators in the Baltic Sea marine environment: Coordination and recent developments in HELCOM

Samuli Korpinen (CORESET Project Manager, Helsinki Commission)

Assessments of the state of the marine environment have shifted from qualitative or semi-quantitative assessments to quantitative and integrated assessments. The Baltic Sea is in the forefront in this worldwide shift in environmental assessments and recent activities in the region promise that even better development can be expected in near future. HELCOM has been coordinating the state assessments of the Baltic Sea marine environment over decades and the recent thematic and holistic assessments have entirely relied on multimetric assessment tools and the hierarchical assessment structure which arises from the Baltic Sea Action Plan (BSAP). The BSAP is based on the vision of the healthy Baltic Sea, divided to four policy goals and several ecological objectives. This hierarchy ensures a structured approach for marine assessments, which has been implemented by the HELCOM assessment tools for eutrophication (HEAT), hazardous substances (CHASE), biodiversity (BEAT) and holistic assessment (HOLAS).

The BSAP and the EU Marine Strategy Framework Directive (MSFD) have very similar approaches for assessments of the state of the environment, which allows the use of same instruments for their implementation. However, while the biodiversity goal of the BSAP consists only of three ecological objectives, the MSFD gives a more detailed requirement for the biodiversity assessment of the Baltic Sea marine environment. There are four qualitative descriptors in the MSFD which directly describe the state of biodiversity: descriptor 1 (biodiversity), descriptor 3 (commercial fish stocks), descriptor 4 (food webs) and descriptor 6 (sea-floor integrity). Each of these descriptors is further divided to criteria, which must be addressed by the Member States.

The recent HELCOM thematic assessment of biodiversity – though being a thorough review of the current understanding of Baltic biodiversity – showed the general lack of harmonized indicators and targets to measure the state of biodiversity in the Baltic Sea. The HELCOM CORESET project was initiated to fill this gap and its objective is to serve both the BSAP and MSFD assessments by the Contracting Parties. The project started by identifying the indicator needs and then continued to develop the indicators which would be needed for a comprehensive biodiversity assessment. The project has concentrated on finding a common understanding of the required set of core indicators, although the resources to finalize all of them have been limited. Therefore the project has also welcomed parallel activities, such as the LIFE+ project MARMONI and the INTERREG IV A project GES-REG.

The HELCOM CORESET project has identified and partly developed 18 core indicators for biodiversity, which cover the majority of the assessment needs from the BSAP and MSFD. The project has also identified so-called candidate indicators, which would fill the remaining gaps but still require development work until they can be proposed to the HELCOM Contracting Parties. The objective of the CORESET work is to have regularly updated set of indicators, which are monitored by all Contracting Parties and placed on the HELCOM web site with all the data freely available.

The ambitious aim to have a common set of biodiversity core indicators adopted by all the HELCOM Contracting parties is within our reach in the Baltic Sea. Although environmental indicators are always simplifications of processes going on in the environment, such a common core set would form a firm basis for Baltic wide assessments and facilitate to understand the linkages of anthropogenic pressures and the state of the Baltic Sea.

LIFE+ Nature & Biodiversity project **"Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea"** (Project acronym - MARMONI).

Please visit the project website: http://marmoni.balticseaportal.net/

Project coordinating beneficiary: Baltic Environmental Forum – Latvia
Antonijas street 3-8, Rīga, LV -1010, Latvia
www.bef.lv