



“Towards indicator based, cost effective and policy compliant monitoring and assessment of the marine biodiversity in the Baltic Sea (TotalBio)”

LIFE+ Biodiversity project “MARMONI – Innovative marine biodiversity indicators and monitoring and assessment of conservation status of nature values in the Baltic Sea” (Project no. LIFE09 NAT/LV/000238)

7- 8 May 2014

Tallink SPA & Conference hotel, Sadama 11a, Tallinn, Estonia

Report

Rapporteur: M. Kuris, BEF EE

<u>Participants:</u>	Institution	Country
1. Anders Galatius	<i>Aarhus University</i>	<i>Denmark</i>
2. Henrik Skov	<i>Water Environment Health (DHI)</i>	<i>Denmark</i>
3. Rasmus Due Nielsen	<i>Aarhus University</i>	<i>Denmark</i>
4. Agnes Villmann	<i>Ministry of the Environment</i>	<i>Estonia</i>
5. Agu Leivits	<i>Environmental Board</i>	<i>Estonia</i>
6. Aleksei Lotman	<i>Estonian Fund for Nature</i>	<i>Estonia</i>
7. Alvar Räägel	<i>Estonian Environment Agency</i>	<i>Estonia</i>
8. Andres Kuresoo	<i>Estonian University of Life Sciences</i>	<i>Estonia</i>
9. Eda Andresmaa	<i>Estonian Environment Agency</i>	<i>Estonia</i>
10. Georg Martin	<i>Estonian Marine Institute, University of Tartu</i>	<i>Estonia</i>
11. Kai Klein	<i>Baltic Environmental Forum Estonia</i>	<i>Estonia</i>
12. Kaire Torn	<i>Estonian Marine Institute, University of Tartu</i>	<i>Estonia</i>
13. Kait Antso	<i>Ministry of the Environment</i>	<i>Estonia</i>
14. Kaja Peterson	<i>SEI Tallinn</i>	<i>Estonia</i>
15. Katarina Oganjan	<i>Estonian Marine Institute, University of Tartu</i>	<i>Estonia</i>
16. Kristi Altoja	<i>Estonian Environment Agency</i>	<i>Estonia</i>
17. Kristina Tiivel	<i>Estonian Marine Institute, University of Tartu</i>	<i>Estonia</i>
18. Leho Luigujõe	<i>Estonian University of Life Sciences</i>	<i>Estonia</i>
19. Marek Nurmik	<i>Estonian Environmental Research Centre</i>	<i>Estonia</i>
20. Marilis Saul	<i>Estonian Environment Agency</i>	<i>Estonia</i>
21. Markus Vetemaa	<i>Estonian Marine Institute, University of Tartu</i>	<i>Estonia</i>
22. Merle Kuris	<i>Baltic Environmental Forum Estonia</i>	<i>Estonia</i>
23. Sandra Oisalu	<i>Baltic Environmental Forum Estonia</i>	<i>Estonia</i>
24. Urmas Lips	<i>Marine Systems Institute, Tallinn University of Technology</i>	<i>Estonia</i>
25. Heidi Hällfors	<i>Finnish Environment Institute</i>	<i>Finland</i>
26. Henrik Nygård	<i>Finnish Environment Institute</i>	<i>Finland</i>
27. Markus Ahola	<i>Finnish Game and Fisheries Research Institute</i>	<i>Finland</i>
28. Soile Oinonen	<i>Finnish Environment Institute</i>	<i>Finland</i>
29. Tamer Fawzy	<i>Baltic Environmental Forum Germany</i>	<i>Germany</i>
30. Volker Dierschke	<i>Gavia EcoResearch</i>	<i>Germany</i>
31. Johanna Karhu	<i>HELCOM</i>	<i>International</i>
32. Lena Avellan	<i>HELCOM</i>	<i>International</i>
33. Manuel Frias	<i>HELCOM</i>	<i>International</i>

34. Ulla Li Zweifel	HELCOM	International
35. Wojciech Wawrzynski	International Council for the Exploration of the Sea	International
36. Ainārs Auniņš	Latvian Fund for Nature	Latvia
37. Anda Ruskule	Baltic Environmental Forum Latvia	Latvia
38. Edgars Bojārs	Baltic Environmental Forum Latvia	Latvia
39. Gunta Gabrāne	Nature Conservation Agency	Latvia
40. Heidrun Fammler	Baltic Environmental Forum Latvia	Latvia
41. Jānis Ušča	Ministry of Environmental Protection and Regional Development	Latvia
42. Juris Aigars	Latvian Institute of Aquatic Ecology	Latvia
43. Kristīna Veidemane	Baltic Environmental Forum Latvia	CB-Latvia (lead)
44. Kristine Pakalniete	Baltic Environmental Forum Latvia	CB-Latvia (lead)
45. Santa Mince	Nature Conservation Agency	
46. Solvita Strāķe	Latvian Institute of Aquatic Ecology	Latvia
47. Darius Daunys	Coastal Research and Planning Institute, Klaipeda University	Lithuania
48. Linas Lozys	Nature Research Centre	Lithuania
49. Martynas Bučas	Klaipeda University, Marine Science and Technology Center	Lithuania
50. Ralf van Hal	IMARES	The Netherlands
51. Angel Borja	AZTI-Tecnalia	Spain
52. Agnes Ytreberg	Swedish Agency for Marine and Water Management	Sweden
53. Leif Nilsson	Lund University	Sweden
54. Martin Isaeus	AquaBiota Water Research	Sweden
55. Mats Lindegart	Swedish Institute for the Marine Environment, University of Gothenburg	Sweden
56. Nicklas Wijkmark	AquaBiota Water Research	Sweden
57. Tobias Porsbring	Swedish Agency for Marine and Water Management	Sweden

Goals of the workshop:

- to present the ideas of the MARMONI project to an international expert audience, receive feedback and to discuss experience on integrated, indicator based marine biodiversity assessment schemes and tools;
- to examine the issue of cost implications of introducing new monitoring methods for building policy compliant national monitoring programmes for marine biodiversity assessment.

Opening: introduction to the MARMONI; objectives of the workshop, participants of the event, by Heidrun Fammler, Baltic Environmental Forum, MARMONI project manager

H. Fammler gave an overview of the MARMONI project and its achievements by now as well as introduced the goals and agenda of the event.

Review on the list of MARMONI indicators for assessment of marine biodiversity in the Baltic Sea, by Georg Martin, Estonian Marine Institute, University of Tartu

G. Martin explained the reasons why we need to assess the status of biodiversity and presented background information on the Marine Strategy Framework Directive (MSFD), Good Environmental Status (GES) and biodiversity indicators. He also gave an overview on development of indicators in the MARMONI project and introduced the preliminary results: the conclusions from the review of existing indicators and the new indicators developed in the project.

The main conclusion from the review of existing biodiversity indicators was that there was a lack of monitoring programmes targeting assessment of the status of biodiversity. Still, 13 truly biodiversity

indicators were identified that were mostly pressure indicators (fisheries, eutrophication). When developing new indicators in MARMONI project it was taken into account that they should be innovative, cost-effective, and easy to operate, it should be possible to establish reference conditions and GES levels/targets and the indicators should be suitable for integrating into biodiversity assessment schemes. The development of new indicators included also testing of indicators and field methods in one or more project areas.

Draft list of indicators developed in MARMONI was published in the beginning of 2013. During 2014 it was improved and indicator descriptions were amended. The list includes 16 bird indicators, 9 fish indicators, 16 benthic indicators and 10 pelagic indicators. The developed indicators together with the descriptions are available on the project web page: <http://marmoni.balticseaportal.net/wp/category/biodiversity-indicators/>.

The web-site contains also an active feedback form. Feedback has been already received and the project team is still interested in further feedback because it is still possible to make amendments. Some of the developed indicators have been presented in international conferences already.

Operationalization of HELCOM core indicators for biodiversity and hazardous substances CORESET II, by *Lena Avellan, HELCOM CORESET II project manager*

L. Avellan briefly introduced HELCOM and its activities for protection and assessment of the Baltic Sea (the Baltic Sea Action Plan, development of core indicators for assessment of the Baltic Sea). She gave an overview on the HELCOM CORESET II project activities and timeline as well as presented examples of HELCOM core, pre-core and candidate indicators.

HELCOM core indicators are commonly agreed by all Contracting Parties. Pre-core indicators are identified as needed indicators but they still need some development and are partly agreed. Candidate indicators are not yet agreed (a living non-endorced list). Supplementary indicators are optional regional indicators. Supporting parameters support core indicators in holistic assessments. All indicators are feeding into HELCOM monitoring and assessment strategy.

The aim of the CORESET II project (Sept 2013 – June 2015) is operationalization of HELCOM core indicators for hazardous substances and biodiversity. CORESET II is closely linked to other HELCOM projects: EUTRO-OPER, MORE, BALSAM, (HOLAS2 – the next holistic assessment). Currently the testing of core indicators is going on (to specify GES boundaries, to test applicability in different areas). It is planned to publish all core indicators by summer 2015.

Introduction to the approach to build an integrated and indicator based tool for assessment of biodiversity with regard to good environmental status, by *Martin Isaeus, AquaBiota Water Research, Sweden*

M. Isaeus introduced the MSFD marine biodiversity assessment tool developed by the MARMONI project team (under the lead of G. Martin, Estonian Marine Institute) and presented the results of testing the tool based on 2 MARMONI project areas – the Gulf of Riga and the Hanö Bight.

The tool with the description documentation is available at <http://www.sea.ee/marmoni/index.php>. This tool is meant as a decision support system **enabling aggregation** of information from many different indicators used to assess marine biodiversity. The tool is based on MSFD and Commission Decision hierarchical system of Criteria and Indicators. The final assessment result is between 0 (if all indicators do not meet the GES values) and 100 (if all indicators are in GES). Everybody can use the tool for assessment by registering a work group and creating an assessment project. Instructions are included in the description documentation.

M. Isaeus presented the results of testing the assessment tool in two project pilot areas – Gulf of Riga (EE, LV) and Hanö Bight (SE).

The preliminary conclusions from the testing were the following:

- The assessment is sensitive to indicators used, therefore it is important to use the same indicators for each assessment.
- There are several indicator gaps (e.g. no data for some species groups in Hanö Bight). Also GES levels are not set for several indicators.
- Most important is to have a proper set of indicators for each group. Weighting is an option.
- It is not determined how many indicators would be needed for a proper assessment, however assessment is more robust when several indicators are used.
- Probably the most cost-effective way for making a proper assessment is to create many indicators based on each monitoring data set.
- The decision which assessment score corresponds to GES for an area should be made based on assessments done in several study areas.

Questions & discussion:

- The tool enables to use different indicators and targets: Reference Conditions with Acceptable Deviation (fixed value or percentage), trend, interval, fixed GES level or expert judgment.
- HELCOM is planning to start the 2nd holistic assessment in the end of 2014 where this tool could be used/tested.
- There are discussions ongoing in HELCOM working groups suggesting that it is not sufficient to have only two status classes (GES/non-GES) because it would be necessary to measure distance towards GES.
- The main idea of the tool is to be able to aggregate a big set of indicators. The tool enables to see the gaps, see which indicators drive to a certain result, what kind of monitoring would be needed etc.

Development of innovative tools for understanding marine biodiversity and assessing good environmental status within the Marine Strategy Framework Directive: an overview of approaches and criteria developed in the project DEVOTES, by Angel Borja, Coordinator of DEVOTES project, AZTI-Tecnalia, Spain

A. Borja gave a brief overview on the DEVOTES project (2012-2016) and introduced the DEVOTES software Tool (the DEVOTool) to select indicators for the MSFD. He also informed about activities of the DEVOTES project related to innovative modelling tools and monitoring techniques as well as development of an integrated biodiversity assessment tool.

The DEVOTool is available at <http://www.devotes-project.eu/devotool/>. It is a catalogue of indicators that currently includes 557 marine biodiversity indicators. A. Borja proposed that also MARMONI indicators could be inserted into DEVOTool.

The deliverables of the DEVOTES project can be found at <http://www.devotes-project.eu/deliverables-and-milestones/>.

Innovative monitoring techniques developed by the project include for example genomic analysis and using DNA meta-barcoding for assessment of environmental status.

The work package dealing with integrated assessment is developing an integrated biodiversity assessment tool based on existing examples (e.g. marine biological valuation mapping of the Basque continental shelf, Nature Index used in Norway, Ocean Health Index (USA, based more on human pressures), Baltic Sea

assessment by Henn Ojaveer et al., Danish marine strategy (assessment based on Helcom BEAT) and considering the current limitations of MSFD.

A. Borja concluded that as DEVOTES and MARMONI are doing similar work then there is a room for collaboration e.g. MARMONI can feed DEVOTool and use it to select indicators; DEVOTES can take these new inputs into account when selecting indicators; DEVOTES and MARMONI can work together in developing a common approach for biodiversity assessment and testing it in pilot sites from both projects (*DEVOTES has 8 pilot areas across Europe*).

Questions & discussion:

- The number of marine biodiversity indicators in DEVOTool is so big because information was collected from different countries and some indicators are quite similar (just having different names). Now the project is working on selecting most promising indicators and testing them. For the Baltic Sea only few indicators are tested, some of them are very local indicators.
- The criteria for selecting most promising indicators include for example targets, response to human pressures, response to management actions, etc.

Biodiversity Assessment Tool (BEAT 2.0), by Samuli Korpinen, SYKE, Finland

S. Korpinen introduced the HELCOM biodiversity assessment tool BEAT and its development.

The first biodiversity assessment tool was developed in 2008-2009, the next version of the BEAT in Harmony project in 2012. In the new version the confidence assessment was included (for reference conditions, acceptable deviation and for observation data). In 2014 the DEVOTES project has been testing the BEAT 3.0 version and the manuscript has been submitted.

The future of the BEAT tool: the next HELCOM holistic assessment has to be ready by 2017. The assessment tool for that has not been selected yet. It is also not clear yet whether one holistic or several assessment tools will be used. With using one holistic tool some information could be lost.

MSFD sets certain frames for the tool (descriptors to be included etc.). S. Korpinen expressed personal opinion that integrated biodiversity assessment should include all descriptors related to biodiversity. The tool should reflect HELCOM ecological objectives, be flexible and have automated export function (the number of assessment units will be very high and cannot therefore be managed manually).

Questions and discussion:

- The prototype version BEAT 3.0 has been released and is currently tested in DEVOTES pilot areas (in the Gulf of Finland in the Baltic Sea and also pilot areas in the other parts of EU). It can be tested also in other areas.
- Estonian Marine Institute is interested to test the new BEAT version and compare it with the tool developed in MARMONI project.
- It was agreed that testing and comparison of biodiversity assessment tools could be done by the MARMONI final conference (27-28 January 2015).

Assessment of Conservation Status of species and habitats in the pilot areas of the MARMONI project, by Ainars Aunins, Latvian Fund for Nature

A. Ainars explained the methodology for assessment of the conservation status of selected species and habitats in the MARMONI project areas and presented the preliminary results.

The assessment methodology is based on reporting for Habitats Directive (HD) Art 17 and Birds Directive (BD) Art 12 reporting principles. The data collection sheets used are based on HD reporting sheets but modified a little bit. The Birds Directive does not mention the term Favourable Conservation Status (FCS) but to have a common logic Favourable Reference Values (FRV) were introduced also for birds' reporting sheets. The assessment was done separately for each project area and the reporting sheets were filled by relevant experts in each country. HD Annex I habitats and regularly occurring HD Annex II species and regularly occurring birds species were included in the assessment.

Two types of measurements were used for analysis: Percentage of elements with known conservation status and the score: percentage of points achieved among elements with known conservation status (0% if all have bad status and 100% if all have FCS).

Concerning overall assessment of the conservation status, the Gulf of Finland pilot area achieved the best score but it has the lowest confidence level because the percentage of elements with known conservation status is very low. In general there is no big difference in results for MARMONI project areas (between FCS and unfavourable-inadequate).

Conclusions:

- Assessment is applicable for different scales, however there are difficulties with wide ranging species and for setting FRVs;
- Cross-border assessment – „no data“ on one side of the border turn corresponding fields of joint assessment into „no data“, too;
- Assessment is based on HD annex species and birds, which leaves out many components of the ecosystem.

Discussion:

Opinions on possibilities for interrelation of conservation status assessment to GES assessment:

- Conservation status assessment cannot be directly used for GES assessment although many of the components are the same. However, the results of both assessments can be similar. It will be analysed in MARMONI A4.1 action report.
- HD assessment can be used for MSFD purposes although the approach is different. On the EC web pages different directives are compared. FCS can be comparable with GES. It is not necessarily indicator based assessment for the MSFD.
- MSFD and HD require totally different approaches - HD focuses on certain lists of species and habitats defined based on importance (a limited part of the environment); GES assessment should cover the whole ecosystem. Results of both assessments can show the same direction but cannot substitute each other.
- MSFD covers the whole environment but has also similar aspects with WFD covering certain aspects. Assessment of the whole environment is done based on assessment of certain components.

Work groups: towards a joint approach for assessment of biodiversity

The main conclusions from work groups were the following:

Difficulties in drawing the boundary for GES and defining reference conditions

- A limitation for defining a reference condition of GES lies in the wide variety of data and the available time series.
- For some species (e.g. birds) it is difficult/impossible to define reference conditions because we do not know the natural conditions

- From available data a mean index can be calculated and deviation from the mean level can be set (30% for example) that is considered to be acceptable. Populations below, and also above this boundary highlight a need to look deeper into the case.
- The reference level should equal to minimum safe level of population.
- For migratory species (e.g. birds, grey seals) GES must be assessed on the overall Baltic Sea scale.
- GES concept and numeric boundaries will be a changing concept depending on the new knowledge and natural changes in the marine environment.

Assessment of GES

- In order to have comparable GES among countries/regions, the same concept and methods must be used.
- It is impossible to reach GES at same time for different species and in all sites. So GES is not only scientific but also political issue.
- Marine environment is «dynamic» (changing distribution of species and habitats) which is leading to difficulties in interpretation of results and setting GES values.
- GES/non GES is not enough; there should be intermediate classes/targets, to measure the progress (to look at trends, if moving towards GES).
- Natural variability also needs to be considered when looking at trends. A lot of data are needed to know the natural variability. It is difficult to differentiate the human impact and natural processes.
- In assessments, individual interpretation (expert judgement) must be avoided, as this usually is very subjective.
- There is no easily understandable answer for policy people/layman on GES/ non-GES => interpretation of the indicator based assessment by scientists is still needed.
- An ecosystem approach for defining GES targets would be needed; following the definition of the MSFD => it is a difficult task since it is not always clear what we mean with productive and resilient ecosystem.

Limitations for the indicator based approach

- There are lots of good indicators, but mechanically pulling them together into one assessment does not give interpretable answers.
- A system for integrated assessment of the status of biodiversity should be developed, using functionally interrelated indicators.
- For the policy making purpose the focus shall be on pressure indicators or biodiversity indicators that have a clear relation to pressures.

Assessment-procedure: One or several tools - which tool/tools to use in the Baltic Sea?

- If different tools cannot be compared, they are not ready products for policy makers to use.

→ *We need to highlight the characteristics and pros/cons of our assessment tools to facilitate comparison and the choosing of tool(s).*

Comparability of assessment results

- To achieve comparable assessment results in different assessment areas, it is essential to:
 - use the same tool/tools for all (=the different actors in the different assessment areas, i.e. countries/sub-basins etc.);
 - use the same assessment method (how to determine overall GES); i.e. the tool(s) need to be used in the same way by all;
 - the tool(s) need to be transparent concerning e.g. confidence ratings to facilitate an evaluation of the assessment results.
- Next circle of the MSFD should be more coordinated in relation to applied methods and interpretation of the data.

- HELCOM is a good facilitator for policy makers in countries to reach common agreements.
- Informal expert meeting among countries is the best way to get to common approach and interpretation of the results for GES values.

Using the same indicators for all assessment areas vs. the use of all available data?

- Using the same indicators for all areas is a conservative approach – a more flexible approach facilitates a more comprehensive assessment.
- A flexible tool is free of limitations regarding which indicators to use as input in which areas; it aggregates info from different areas and time periods.
- This flexibility allows us to include new indicators when available and re-run past assessments based on new indicators (providing the data has been collected).
- However, using the same set of indicators in all areas facilitates a coherent assessment of the status of the different areas (although based only on this limited set of indicators)
- Conclusion: in making assessments, the use of both such common-for-all core indicators and all other available indicators is necessary, the approaches complement each other.

→ *Something common needs to be adopted, a strategy or method, if not indicators – otherwise comparison of results is impossible.*

We can utilize several tools, but we need a common assessment of the whole Baltic Sea

- Spatial scale of indicators, pressures, and measures varies – assessment area needs to be flexible accordingly.

→ *Solution – multilayered assessment tools (procedures), where some indicators (pressures, measures) are assessed locally (per assessment area), others are assessed for larger areas (the whole Baltic Sea), and the layers are combined to form the overall assessment.*

Conclusion: Further assessment tool research & development still called for before it is realistic to attain a durable joint approach for the assessment of biodiversity in the Baltic Sea.

Towards coherent biodiversity monitoring programme for the Baltic Sea: contribution of the MORE project, by Manuel Frias, HELCOM MORE project coordinator

M. Frias gave an overview on history of HELCOM monitoring and introduced the activities of the MORE project.

HELCOM has been monitoring the Baltic Sea since 1970ties. In 2005 HELCOM Monitoring and Assessment Strategy was adopted and in 2007 the Baltic Sea Action Plan. After adoption of MSFD in 2008, it was decided that HELCOM monitoring programme has to be revised and therefore HELCOM MORE project was started in 2012. The main activities of the MORE project include compiling overview of the marine environmental monitoring in the Baltic Sea (published in 2013), updating monitoring and assessment strategy and developing the Monitoring Manual.

The aim of the Monitoring Manual is to gather all HELCOM monitoring procedures together in one place to achieve better coordination and regional cooperation for the MSFD. It will be an online system where all countries report monitoring information. The first version of the Monitoring Manual should be available for Contracting Parties by July and online by the 1st of October 2014.

The North Sea a jigsaw of ongoing monitoring: challenges to lay that jigsaw into a cost-effective joint multi-disciplinary monitoring programme, by Ralf van Hal, IMARES, Institute for Marine Research and Ecosystem Studies, IJmuiden, The Netherlands

R. van Hal introduced two projects developing monitoring in the North Sea: the Joint Monitoring Project and the JPI oceans pilot project.

The aim of the project „**Towards a Joint Monitoring Programme for the North Sea and Celtic Sea**” (JMP NS/CS, Oct 2013 - March 2015) is to create a joint, cost-efficient multi-disciplinary monitoring programme for the North and Celtic Sea. It will be based on an analysis of all ongoing monitoring in these subregions and the requirements of the MSFD, taking account of other legal frameworks and agreements.

The situation in the North Sea is similar as in the Baltic Sea: OSPAR is developing core indicators for 7 EU countries + Norway and there are numerous national monitoring programmes.

Four case studies were selected for the project (D1 fish: Distribution+abundance of a suite of species: elasmobranchs; D5 Eutrophication: Chlorophyll A in the growing season; Multi-Metric Benthos indicator and Marine litter) for which the options for data collection and the related costs will be analysed.

JPI oceans is carrying out a pilot project on **Multi-use of Infrastructure for Monitoring in the North Sea**. The overall approach of the pilot action is directed towards the following three components: (1) setting up integrated monitoring surveys, (2) enhancing integration of monitoring efforts and (3) promoting data sharing and integrated information systems. More information: http://www.jpi-oceans.eu/prognett-jpi-oceans/Multiuse_of_infrastructure/1253990736864.

Questions & discussion

- Monitoring methods for jellyfish? – Hydroacoustics is a possible method (lead by French), also fishing of larvae.

The development of monitoring programmes for the MSFD in Sweden: precision and design of monitoring of benthic fauna and related cost implications, by Mats Lindegarth, Swedish Institute for the Marine Environment, University of Gothenburg

M. Lindegarth introduced the methodology and main conclusions of the assessment of precision and uncertainty of current and future monitoring of benthic fauna on the Swedish West Coast done in the frame of the WATERS project (“Waterbody Assessment Tools for Ecological Reference conditions and status in Sweden”, www.waters.gu.se).

The assessment was done using the methodology developed earlier in the project „WATERS” and its WP2.2 dealing with assessment of uncertainty in status assessment of water bodies for the Water Framework Directive.

The final aim of the project is to look at different scenarios of monitoring programme - varying the number of samples, testing alternative sampling designs – and find out how to achieve the needed precision/confidence with least efforts/costs.

The main conclusions:

1. The suggested methodology can be used to model precision and to address dimensioning and therefore costs of monitor monitoring programmes for the MSFD;
2. Precision of monitoring should be assessed at aggregated spatial and temporal scales relevant to the directives;
3. All analyses underline the importance of spatial variability and that maximising the number of spatial units (“stations”) determines precision;

4. Given the importance of "static" spatial patterns observed for analysed indicators, a nested design (sampling in new stations each time) would substantially improve precision at the scale of water body types and periods at a constant sampling effort.

Questions & discussion

- Will the assessment results be used for Swedish MSFD monitoring programme? – SwAM is discussing this right now but not reached the decision yet. Similar study is done in the Swedish Baltic Sea, their results will be considered as well.
- The sampling frequency was discussed - whether to sample each year or once in 6 years.
 - It depends on patterns of variability. When selecting new stations, the possibility to assess trend in each station will be lost. If the patterns are stable then yearly sampling is not needed. It also depends on what is measured. The conclusions of the Baltic Sea project are quite similar that it is not necessary to sample every year.

Developing cost-effective marine monitoring: challenges in data collection, by Soile Oinonen, DEVOTES project, SYKE, Finland

S. Oinonen introduced the work being done, methodology used and challenges faced in the WP2 on socio-economic implications for achieving GES of the DEVOTES project.

The aim of the WP2 is to identify cost-effective MSFD monitoring system. WP2 is assessing costs of monitoring programmes and new monitoring tools focusing on biodiversity indicators (descriptors D1, D2, D4, D6). The assessment is done in 2 pilot areas: Gulf of Finland and Bay of Biscay.

DEVOTES WP2 is collecting data on cost per sample (focusing on pilot area indicators and 4 descriptors). However, it is hard to find info on monitoring costs. Data is collected by economists who are not experts in monitoring – therefore the flow charts describing the process of sampling were created.

It is important to carefully define the monitoring system boundaries because there are additional costs related to biodiversity assessment, e.g. collection of supporting information, calculating indicators, assessing GES.

S. Oinonen stressed that cost-efficient monitoring means that the cost of taking one more sample equals the benefit from taking one more sample. To account for potential benefits from the monitoring Multi-Criteria-Decision-Analysis (MCDA) will be applied (set of criteria and their weights will be selected and defined in workshops/interviews). The aim of the assessment is to show the tradeoffs between monitoring costs and confidence.

S. Oinonen proposed that DEVOTES and MARMONI projects could collaborate to test the assessment tools in the Gulf of Finland and Bay of Biscay.

Questions & discussion

- Counting monitoring costs per sample was considered to be a dead end. When a ship is out at sea then man days are calculated, not samples. The opinion was that the costs are not depending on the number of samples. Therefore costs of the whole cruise should be considered, including the work done later in laboratory.
- It was proposed to look at the costs on monitoring programme level. However, on programme level it is not possible to do sound economic analysis.

Introduction to the concept and results of an economic analysis of the indicator based biodiversity monitoring programmes (MARMONI), by Kristina Veidemane & Kristine Pakalniete, Baltic Environmental Forum

K. Veidemane and K. Pakalniete introduced the concept, methodology and preliminary results of the economic analysis of indicator-based biodiversity monitoring programmes carried out in the MARMONI project.

The aim of the assessment is to evaluate and demonstrate cost implications of building policy compliant national monitoring programmes, including the introduction of new monitoring methods for the marine biodiversity monitoring. The cost-effectiveness means the least cost way for reaching the predefined target, which includes two aspects: compliance with policy requirements and confidence of the assessment.

Monitoring methods and indicators differ in terms of info provided, therefore they are not really equal alternatives, which makes the assessment more complicate.

Economic analysis aims at comparing the costs, compliance and confidence of 3 scenarios: 1) marine biodiversity monitoring with the current indicators and monitoring methods; 2) marine biodiversity monitoring compliant with the policy (MSFD) needs (with new indicators) with the currently used methods; and 3) marine biodiversity monitoring compliant with the policy needs and with new monitoring methods.

Confidence level is assessed based on expert judgement.

The steps of the analysis include: 1) describing indicators-parameters-methods; 2) characterising monitoring design and resource needs; 3) calculating monitoring costs for indicators-parameters-methods; 4) building and assessing alternative monitoring scenarios.

So far the methodology has been applied on 2 selected cases in Latvia (zooplankton and wintering birds monitoring). The first findings show that there are various assessment indicators without additional costs and there is obvious difference between monitoring methods in terms of cost-efficiency. The assessment approach has proven to be robust and flexible.

However, more profound analysis would be still needed for defining the optimal monitoring intensity (frequency per year, number and location of stations).

Questions & discussion

- Costs vs confidence comparisons? - Confidence was estimated for each monitoring method used for analysis. Confidence for the new method (automatic image analysis) was lower than of the conventional method but since the costs of the new method are so much lower than the costs of the conventional method then the cost-efficiency of the new method is still very positive.

Work groups: cost implications of introducing new monitoring methods and indicators (*thematic groups: fish, benthic, pelagic, birds, seals, policy prospects*)

Questions for discussion: What kind of aspects need to be taken into account in monitoring design and when calculating cost effectiveness of monitoring methods/programmes? What indicators are relevant for each functional group?

Conclusions on MSFD indicators relevant for functional groups are presented in the Annex of the report (Overview on indicators by functional groups).

WG on monitoring of benthic species and habitats:

- When designing monitoring programmes for benthic species and habitats, the following aspects should be taken into account: the objectives to be covered; what are we going to focus on; if it was monitored before or not, and what the available budget is. It is very important to define the spatial area to be covered, indicators or elements to be studied and based on that to design a monitoring

programme, the surveys needed the frequencies and also what additional information is needed for the assessment.

- Automated methods make monitoring cheaper but the consequence can be losing the experts, which leads to outsourcing, which can mean lower quality (choosing cheaper offers) and loss of information. The experience shows that outsourcing is not cheaper (e.g. Finnish coastal monitoring). With low cost monitoring a lot of information on benthic species and habitats is lost.
- The basic criteria on what to base a cost estimate with regard to benthic features are accuracy and confidence criteria (what accuracy and confidence level is required).
- Problematic is that benthic habitat monitoring does not exist. Therefore calculation of costs needs a different approach - it cannot be done sample-based because there is lack of baseline knowledge on how to estimate the habitat extent. Therefore, instead of calculating the actual costs, MARMONI could develop a scenario/concept for estimating cost of benthic habitat monitoring.
- MSFD and Habitats Directive (HD) – partly there have been surveys on sandbanks and reefs according to HD but for GES assessment info on full diversity of habitats is needed. There is a little contradiction with HD and there is no official approved habitat classification. Monitoring programme for red list habitats is in the pipeline via HELCOM.
- With regard to monitoring of new indicators the following aspects need to be taken into account when estimating the costs - are the new indicators replacing the old ones (alternative indicators) or do we monitor new features, which have not been monitored earlier or are they complementary or do they provide additional or new information.
- It is important to demonstrate that habitat monitoring is needed and that the quality of biodiversity monitoring should be increased. It should be taken into account that there are a lot of additional costs beside mechanical monitoring actions and equipment, including building up/maintaining the skills and institutional capacity.
- The opinion of the group was that the final results of the MARMONI cost estimates should not be presented in cost values (euros by sample) because there is the fear that policy makers' conclusions on that might be wrong. It is important to estimate the costs of the whole monitoring programme and better to use relative costs instead of actual monetary costs.

WG on monitoring of mammals and fish (reported by Edgars Bojars)

- A monitoring programme must provide a clear message to policy makers/managers what questions does it answer.
- Adequate accuracy of monitoring methods is essential, although better accuracy also means higher costs.
- Optimal sampling design is essential, particularly in relation to sampling area and frequency (not too low and not too high, because more sampling often does not provide better data).
 - Fish populations fluctuate very much. Therefore annual frequency is needed to determine trends.
 - Also, annual seal monitoring is needed because the species are either protected (ringed seal) or managed (grey seal).
- For mammals and fish, most monitoring costs go for the performance of field work (in opposite to e.g. plankton, which is laboratory costly).
- New monitoring methods need time to get adapted. It means that the old methods are being used in parallel for at least several years to calibrate; it often means double costs.
- Fish and mammal monitoring methods are conservative; new methods are being applied for very special needs.
 - Camera based visual counts.
 - Acoustic techniques.
- Health status monitoring of marine mammals is not sufficiently covered by the requirements of the Marine Strategy Framework Directive.

WG on monitoring of birds:

- In cost estimates it needs to be taken into account that a lot of bird monitoring costs are saved due to voluntary work in ground counts. Volunteers are well equipped, which means also saving of equipment costs.
- At least some indicators mentioned in indicator lists as ready for monitoring are not really ready for monitoring. Some of them could be used for regional scale assessments but not as indicators for national monitoring programme. And some of indicators can be used only in countries where there are islands – so there are still some updates needed in descriptions of indicators on MARMONI web page to make clear for everyone what the potential for use of each indicator is.
- Information coming from consulting companies is different from information provided by ornithologists in terms of costs and needs for monitoring.

WG on monitoring of pelagic communities:

- When we look at the process of developing indicators we are still in the development phase. Therefore we should not focus monitoring only on existing indicators (we should monitor whole communities, not single indicators) – otherwise we will not have data series for future indicators.
- In terms of cost implications for monitoring we should not leave the costs of developing new indicators purely for research because a lot of field data are necessary for developing indicators and it cannot only be ensured by research projects. So regular monitoring costs should account for additional data collection also for developing new indicators not only fulfilling the current MSFD requirements for monitoring. Otherwise we would stay at the same level what we have today.
- The more indicators the more robust assessment. If indicators can be added without additional costs then this is a driver for developing new indicators.
- When estimating the monitoring costs, also the costs for maintaining the minimum or strategic level of infrastructure, institutional capacity, analytical capacity and expertise need to be taken into account.
- Monitoring costs depend considerably on how efficiently the monitoring system is organised in the country, e.g. how efficiently the monitoring infrastructure/equipment is used. A ship owned by an institution has some fixed costs during the whole year, not only during monitoring campaigns. Sometimes it is a political decision to maintain own infrastructure and institutional capacity although it is not cost-efficient.

Policy group:

Conclusions on national level:

- In all the countries, the available resources for monitoring are below the compliance scenario, also results from initial assessment and comments from EC show that. The countries have problems to implement the requirements of the MSFD.
- There is a need to agree on the level of precision and accuracy, on the level of our ambitions regarding monitoring and assessment.
- At the same time monitoring programme should be adaptive with regard to new developments.
- It is important to have high confidence of the assessment. Policy makers are not only interested in saving in costs but the quality of information is also very essential for making decisions.
- We need to focus on the purpose and fulfilment of aims of the MSFD when designing the monitoring programmes. Monitoring shall enable us to decide on measures, so it has to be pressure-related. But at the same time information on the status of biodiversity is needed for determining the GES.

Conclusions on the Baltic Sea level:

- A common agreement on the level of ambitions (precision, confidence level) and coordinated approach for monitoring programmes is needed. It could be coordinated by HELCOM or European Commission.

- It was concluded that current HELCOM projects are probably not sufficient for describing the optimum spatial and temporal design of monitoring programmes and there is a need for a new joint project on a Baltic Sea level to develop this.
- A more harmonised monitoring on a Baltic Sea level does not mean that it will be more cost efficient or cheaper (except in cases of using common ship or similar) but it is important for achieving the aims of the MSFD.

Cost efficiency of new methods:

- Remote sensing could be applied for mapping for reducing the costs but it cannot replace traditional sampling but should be applied in combination with that.
- Ecological modelling is another cost-efficient tool that can be used for planning purpose or for visualisation of monitoring results but it needs to be verified by field sampling.

Conclusions of the workshop:

- The workshop proved that exchange of information and cooperation between the projects dealing with similar topics (MARMONI, HELCOM MORE & BALSAM; DEVOTES, North Sea projects) is very important and mutually beneficial.
- Cooperation between MARMONI and DEVOTES project will be continued on testing the biodiversity assessment tools and cost estimates. MARMONI marine biodiversity assessment tool could be used in the next HELCOM holistic assessment of the Baltic Sea starting in the end of 2014.
- Next international events:
 - LITTORAL 2014 conference on 22-26 September 2014 in Klaipeda, Lithuania. DENOFLIT project leads the session on marine and coastal conservation. The main aim of the conference is to bring together managers and scientists. More information at balticlagoons.net/littoral2014.
 - Next MARMONI event on the 3rd week of October (20-24 Oct. 2014) in Latvia on interlinks of the MSFD and Maritime Spatial Planning.
 - Final MARMONI conference on 27-28 January 2015 in Jurmala, Latvia.

