



# Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea

LIFE09 NAT/LV/000238

Executive Summary  
2015



**Project “Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea” (acronym – MARMONI) was implemented from 01.10.2010-31.03.2015.**

The **main aim of MARMONI** was to develop innovative and ecosystem-based monitoring and assessment approaches based on a set of indicators for assessment of good environmental status and conservation status of marine biodiversity. These assessment approaches were supposed to be integrated into national (Estonian, Latvian, Finnish and Swedish) management and be based on marine biodiversity monitoring programmes. With its work MARMONI was aiming to contribute to the implementation of the Marine Strategy Framework Directive (MSFD) as well as the Birds and Habitats Directives and the HELCOM Baltic Sea Action Plan with regard to the assessment and monitoring of the state of marine biodiversity. Partly, the indicators may also contribute to the implementation of the Water Framework Directive.

**MARMONI** has achieved **outputs** on the following issues:

1. Developing a set of true marine biodiversity indicators;
2. Testing the indicators and survey methods in the field (in four study areas) and proposing a few for wider application e.g. at Baltic Sea level;
3. Assessing cost and time effectiveness of these methods and trying to estimate costs related to monitoring of separate indicators; applying the indicators for biodiversity assessment according to Good Environmental Status (GES) of the MSFD. Assessment of Favourable Conservation Status (FCS) of species and habitats according to the Habitats Directive was also performed ;
4. Demonstrating marine spatial management in Sweden based on maps of the same ecosystem components as the indicators and using the same survey methods linking biodiversity assessment to the planning processes;
5. Accompanying and impacting implementation of the MSFD in the four target countries and contributing to indicator-based marine biodiversity assessment and monitoring at the Baltic Sea scale;
6. Providing recommendations and forwarding lessons learned on indicator development, assessment of marine biodiversity and future marine monitoring programmes to competent authorities and policy makers;
7. Informing stakeholders on marine biodiversity and its regulating policy frame as well as involving them in monitoring and supervision activities;
8. Promoting MARMONI results at international conferences and seminars;
9. Providing scientific backstopping for future monitoring methods and indicators by preparation and submission of a number of articles to scientific journals and preparing comprehensive publications under the MARMONI logo.

**MARMONI key deliverables:**

- “The MARMONI approach to marine biodiversity indicators”:
  - Volume I: Development of indicators for assessing the state of marine biodiversity in the Baltic Sea within the LIFE MARMONI project (ISBN 978-9985-4-0873-5, ISSN 1406-023X) (book);
  - Volume II: List of indicators for assessing the state of marine biodiversity in the Baltic Sea developed by the LIFE MARMONI project (PDF, ISBN 978-9985-4-0874-2) (data base);
  - MARMONI indicators database: available online:  
[http://www.sea.ee/marmoni/marmoni\\_pulk/start\\_indicator\\_database.html](http://www.sea.ee/marmoni/marmoni_pulk/start_indicator_database.html)

- “Field, Laboratory and Experimental Work Within the MARMONI Project - Report on Survey Results and Obtained Data” (PDF);
- “Biodiversity Assessment of MARMONI project areas” (PDF);
- “Report concerning marine mapping and management in the Swedish study area” (PDF);
- “Socio-Economic assessment of indicator based marine biodiversity monitoring programmes and methods” (PDF);
- “Proposals for amendments to the procedures on wind farm environmental impact assessment” (PDF);
- “Guidelines for the environmental impact studies on marine biodiversity for offshore wind farms projects in the Baltic Sea region” (PDF);
- “MARMONI recommendations to the national marine monitoring programmes of Latvia, Estonia, Finland and Sweden” (PDF);
- “MARMONI recommendations to the national marine protection policies of Latvia, Estonia, Finland and Sweden” (PDF);
- “Towards a resilient ecosystem of the Baltic Sea” (brochure);
- “MARMONI activities and results in brief” (brochure);
- 3 scientific articles published, 17 submitted/in preparation;
- A series of posters, info stands and brochures on marine nature values for laymen at strategic public places such as *Tallink* ferries, marine museums, info centres and harbours.

### **MARMONI locations**

All MARMONI work has been implemented in four demonstration areas: Irbe Strait and the Gulf of Riga (shared by Latvia and Estonia), Hanö Bight (Sweden), Coastal Area of South West Finland, and the Gulf of Finland (Finland and Estonia). The experts partly worked also in international teams at each other's' demonstration areas or tested proposals from the expert group of the partner country.

### **MARMONI administration and partnership**

MARMONI has been funded by the LIFE Nature & Biodiversity Programme under the Biodiversity strand and implemented 18 actions at a total budget of ca 5.9 M€ between 01.10.2010 and 31.03.2015. 11 project partner institutions and six sub-contractors have been involved from four countries: Latvia, Estonia, Finland and Sweden. The consortium consisted of public authorities, research institutes and non-governmental institutions. The consortium was led by Baltic Environmental Forum Latvia. The leadership over the actions was distributed over the consortium members and the involved experts worked in cross-national teams – in total ca. 70 persons contributed to project success. Competent authorities in charge of marine biodiversity assessment, monitoring and policy from the four countries and international organisations were actively involved and are actually the direct beneficiaries of the project results.

### **The MARMONI indicator work**

MARMONI has analysed existing operational marine monitoring programmes and indicators in relation to marine biodiversity. It was found that most of the programmes were designed for the assessment of the effects of eutrophication or hazardous substances, although some components of marine biodiversity were included to describe and follow the impacts of the pressures. MARMONI, therefore, focussed on development of new true biodiversity indicators reflecting the state of a certain component of marine biodiversity.

In four and a half years, the MARMONI project developed and tested 49 marine biodiversity indicators (out of more than 100 initially proposed) covering four thematic groups – fish, birds, as

well as benthic and pelagic communities. Most of these indicators have already proven to be operational in the tested area(s) and only five still need to be developed further (and one was rejected). The MARMONI team was not aiming at developing a complete list of indicators covering all possible aspects of marine biodiversity and all assessment needs set by different policy instruments. Instead, the aim was to fill the knowledge gaps in indicators reflecting the state of marine biodiversity and to propose new innovative approaches to increase the cost-effectiveness of monitoring and assessment of marine biodiversity and in this way support modernization of national marine monitoring programmes.

The indicator development, as all project related work, took place in four MARMONI demonstration areas: Irbe Strait and the Gulf of Riga (shared by Latvia and Estonia), Hanö Bight (Sweden), Coastal Area of South West Finland, and the Gulf of Finland (Finland and Estonia). Most of the indicators were developed for one of the project areas, except most bird indicators, which were developed for the entire Baltic Sea due to high mobility of the species. Some of the indicators were later tested in one or several other project area(s). However, despite the limited geographical range of the demonstration areas, most of the indicators are applicable on a wider geographic scale and in different environmental settings.

### **Indicator and survey method testing and cost-effectiveness assessment**

During three years' field seasons, MARMONI tested special methods and equipment for monitoring and collected extensive data for the development of biodiversity indicators. All in all, 17 new, partially new, or modified existing monitoring methods were tested. Most (15) were methods for monitoring of benthos and plankton, and two for bird monitoring. In addition to those, several conventional monitoring methods were utilised to collect data needed for indicator development and testing. The methods were tested in the four project study areas and a comprehensive survey report has been elaborated.

Another goal for testing was to find options for data collection in a more **time- and cost-effective way** compared to conventional methods which often means a better spatial or temporal coverage or level of detail and not necessarily less costs in absolute terms. The main challenge in developing monitoring methods was maintaining a high quality and sufficient detail of the attained data. Many reliable conventional methods have been developed for collection of highly detailed information from each surveyed station – but these methods are often time-consuming and laborious, which strongly limits the number of samples and affects the spatial and temporal coverage.

One large cost position of marine biodiversity monitoring is the costs for vessels and the idea is prevailing to use the same vessel for different methods or combinations. However, this is limited due to the very different working methods (e.g. for bird counts, fishing and benthic habitat mapping) and this option needs to be evaluated in each individual case.

The other large cost position is labour costs. In order to decrease the costs of (traditional and new) monitoring activities, several new methods are automated alternatives to manual methods where parts of the processes are performed by machines or algorithms. Automated methods can also decrease subjectivity and eliminate biases caused by differences in expert knowledge. In MARMONI, methods for the automatic identification or measurements of benthic fauna, phytoplankton, zooplankton and birds were tested and evaluated to be applicable. However, many of these novel methods require further development to be fully operational, and some manual labour is still needed. In most cases the new automated methods should be used in combination with conventional methods for verification and calibration of the automated methods. MARMONI experts consider it unrealistic that biodiversity monitoring methods will ever be fully automated.

### **Biodiversity assessment**

The MARMONI indicator work also included an exercise to assess the marine biodiversity and test the applicability of the developed indicators. The project team developed and tested a web-based application "**MARMONI Biodiversity Assessment Tool**" with the aim to, in accordance with the

principles and requirements of the MSFD, facilitate biodiversity assessment for authorities and policy makers. The Tool is available online and ready to be used free-of-charge: <http://www.sea.ee/marmoni/index.php>

This indicator-based integrated assessment revealed potential obstacles and drawbacks of the indicators. These were mainly related to data quality and availability, but also to the structure and character of the indicators themselves. The main lessons learned are that a higher number of high quality indicators provide more robust assessment results with a higher confidence level; systematic data collection should be carried out in the assessment area in order to fulfil all requirements of the indicators; different indicators do have different operational geographical scales; and, further development of biodiversity indicators is necessary in order to gain better coverage and representation of all required biodiversity characteristics and elements.

### **Favourable Conservation Status (FCS) assessment**

Additionally, an assessment of the conservation status of species and habitats of community importance was carried out by the MARMONI project team following the assessment procedure described by the EU Habitats Directive. According to the Habitats Directive, the conservation status assessment has to be carried out nationally by the EU member states and then supra-nationally at EU level. MARMONI carried out the FCS assessment at a finer – the MARMONI project area - scale. The FCS assessment was carried out for each marine species and habitat type, on which the relevant country is obliged to report under the Birds and Habitats Directives and which regularly occurs in the particular project area. The results are summarised in 83 fact sheets giving proportions of favourable, inadequate, bad or unknown conservation status in each of the assessment categories (distribution, population size or habitat area, habitat for species, structures and functions): [http://marmoni.balticseaportal.net/wp/wp-content/uploads/2011/03/Biodiversity-assessment-report\\_24.03.2015.pdf](http://marmoni.balticseaportal.net/wp/wp-content/uploads/2011/03/Biodiversity-assessment-report_24.03.2015.pdf)

### **Demonstration of Marine Spatial Management in Sweden**

The Swedish MARMONI team focused on the spatial dimension in its demonstration area Hanö Bight using spatial modelling to demonstrate use of biodiversity data marine management to county administrations and municipalities.

The modelling resulted in over 70 full scale species distribution maps, which are freely available: <http://marmoni.balticseaportal.net/wp/category/marine-spatial-management/>

A series of ocean zoning tools for marine spatial planning were reviewed, and a full scale spatial management demonstration was performed in Hanö Bight. A spatial ecosystem model was developed; furthermore, conservation values were modelled and scenarios of effects on the ecosystem due to wind park construction and eutrophication (a decreased water transparency) were developed. These demonstrations provide excellent examples for (regional) planning authorities how to integrate the ecosystem approach into planning and consider optimum locations for economic activities and prioritise conservation actions for valuable habitats and species.

### **Policy impacts of MARMONI on national and regional monitoring programmes**

All in all, MARMONI has significantly contributed to supporting the implementation of the MSFD by providing cost-effective biodiversity monitoring methods and an overall improvement of the assessment capacity of the state of marine biodiversity in the Baltic Sea. In particular, the knowledge gained through indicator development, field works, modelling and data analysis on the status and distribution of species and habitats will help the state authorities to define appropriate management plans for particular areas, to assess their conservation status as well as their contribution to the state of biodiversity of the Baltic Sea.

MARMONI has had a direct impact on regional marine biodiversity monitoring programme development due to its input to the HELCOM CORESET indicator project and the HELCOM MORE

project aiming at harmonising marine monitoring at the Baltic Sea Region level. Consequently, MARMONI will also aid the national monitoring programme developments as they are being currently refined in line with the HELCOM proposals and MSFD implementation. Already more than half of MARMONI indicators have been included in the monitoring programmes of one or more of the project countries and almost the same amount are recommended for consideration in the future.

MARMONI experts have influenced discussions and decisions at HELCOM MORE and CORESET projects bringing the systemic approach for indicator development and biodiversity focus of MARMONI into it. The collaboration between MARMONI and the HELCOM CORESET projects have resulted in direct input to the list of CORESET indicators as well as in indirect impacts throughout the course of the Baltic Sea wide indicator development, e.g. sharing of learned lessons from the results of indicator testing as well as applied methods and interpretation. The CORESET project has partly taken up the indicators developed by MARMONI, assessed their applicability for all 10 HELCOM contracting parties and modified them, if necessary, to be suitable as Baltic Sea wide indicators. As a result, six MARMONI bird indicators, one fish indicator and one pelagic indicator have contributed to development of the relevant “core” indicators of the CORESET list, while two benthic indicators are currently included in the “pre-core list”. Furthermore two pelagic indicators are proposed as candidate indicators to CORESET and one to HELCOM EUTRO-OPER.

One of the **key findings** derived from the MARMONI project is that all member states (and international organisations) are striving for “cost-effective marine monitoring” - and this shall not be confused with “low costs for biodiversity monitoring” or “less amount of parameters monitored and/or experts needed due to better technologies/equipment”. The MARMONI work has clearly revealed that for proper assessment of the state of marine biodiversity a considerable amount of indicators, data and expertise is needed, otherwise the results will not be sufficiently reliable and robust. Innovative methods and harmonised approaches in field surveys and assessment, especially among countries sharing a regional sea basin, can contribute to cost-effective data collection, but the political will to reach harmonisation and intercalibration is still lacking due to longstanding traditions in marine monitoring; the changing of methodology risks breaks in several decades’ worth of long-term data series.

### **Stakeholder information on new EU maritime policy**

MARMONI wanted to inform stakeholders in the four target countries (and beyond) about the new EU marine and maritime policy and demonstrate its interlink with the existing legal framework. In the frame of the project, five international seminars have been held on the MSFD, marine biodiversity indicators, innovative approaches to marine biodiversity monitoring and assessment, new developments regarding off-shore wind parks and environmental impact studies, as well as maritime spatial planning and its interlink to the MSFD. More than 250 participants were present at these events and actively discussed policies and their implementation experience.

Furthermore, MARMONI also actively promoted its work and findings at events related to marine and maritime issues in Estonia, Latvia, Finland and Sweden and participated in more than 50 events (e.g. workshops, training activities, info days and conferences) with the goal in mind to facilitate stakeholders’ involvement in marine biodiversity monitoring, data and information sharing, and integration of marine biodiversity aspects into sectorial policies such as fisheries, maritime affairs and ocean energy.

### **Promotion of MARMONI work and results**

MARMONI experts have presented their work and results at a number of international conferences and other events in the Baltic Sea region, all over Europe and even in the USA, Australia and China. Altogether, MARMONI experts have participated in 29 events in 15 countries. The issues presented in oral presentations and posters were mostly particular indicators, the assessment tool and methods, as well as the MARMONI approach to biodiversity monitoring in search of the true

biodiversity indicators. The project gained considerable international recognition and received a large amount of invitations to present itself at events.

MARMONI also successfully brought its complex subject (i.e. the monitoring of marine biodiversity status based on true biodiversity indicators) to the wider public by participating in Maritime Days in the project countries and the Baltic Sea region and by distributing posters and flyers to people at different events. The ferry line *Tallink* became sponsor and cooperation partner in 2012. Each year eight of its ferries, which operate between Estonia, Finland, Sweden and Latvia, accommodate a set of MARMONI posters on various issues (marine nature values, monitoring methods, species, and biodiversity indicators).

### **Scientific backstopping**

MARMONI was a project targeted at implementing European environmental policy, it was not a research initiative. However, the key experts were scientists from various research institutions for a good reason. Biodiversity monitoring and survey methods need to be investigated and tested based on high quality standard methods and in accredited laboratories. Furthermore, to be used and quoted later on, these methods and indicators need a scientific basis, which usually is a peer-reviewed scientific publication. Therefore emphasis has been put on elaboration of a series of scientific articles and manuscripts (to date 3 articles have been published, 17 submitted/ under preparation) to backstop MARMONI work and give it authorisation for having used formally accepted research methods and techniques, producing results that can be used by monitoring institutions.

### **MARMONI conclusion**

MARMONI was implemented with a strong consortium and good cooperation, without major delays in its activities or constraints in implementation. The goals and objectives have been achieved by the consortium jointly, the budget was absorbed fully and was found sufficient for the tasks implemented. However, benchmarking with neighbouring initiatives and projects, which were/are far less equipped with funding, it became clear that only large financial resources can lead to regional cooperation in marine environmental monitoring and biodiversity assessments – the costs for operation are high also in the future and member states can afford only the minimum which they are explicitly obliged to. Thus regional cooperation must be intensively worked on and therefore it must be funded externally or it will not succeed.

*Prepared by project manager Heidrun Fammler  
heidrun.fammler@bef.lv*