Towards a joint monitoring programme for the North Sea and Celtic Sea

Project outcomes and next steps

European Commission

JMP NS/CS

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BOX 1

Project goal and background

The Marine Strategy Framework Directive (MSFD, 2008/56/EC; European Commission 2008) aims to achieve Good Environmental Status (GES) in European seas by 2020. The MSFD uses ecosystem indicators to assess GES at the scale of international marine subregions, e.g. the Greater North Sea and Celtic Sea. Article 11.1 requires Member States (MS) to establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of their marine waters by July 2014.

The route down from assessment to monitoring leads via indicators and parameters, meaning that an assessment can incorporate multiple indicators, and indicators may need data on more than one parameter, derived from monitoring. In this project, we use 'assessment framework' for the combination of steps between monitoring and assessment.

Current monitoring in the North Sea and Celtic Sea tends to be conducted by Member States (MS) generally working within their own waters. Member States often employ differing sampling methodologies, analytical methods and/or data analysis. This independent approach does not supply adequate data support for all MSFD indicators, and complicates state assessments for subregions that cross national boundaries. In response, Article 11.2 states that MS sharing a subregion should ensure that monitoring methods are consistent and results comparable. This cooperation is to be achieved through the Regional Seas Conventions. At present, coordination is only mandatory for monitoring funded by the EU Data Collection Framework (DCF), and typically takes place in ICES survey planning groups. Environmental monitoring and assessment is coordinated at different geographical levels and most sampling designs are focused on national waters, even when assessments cover much larger areas (eg. hazardous substances in the OSPAR area).

This project demonstrates that joint monitoring (multiple purpose and/or internationally coordinated) is achievable and desirable for the MSFD and will enhance single-purpose or national monitoring. This conclusion is based on the inventory of multi-party and multi-discipline collaboration, perspectives for improved coordination, and optimisation and cost estimation tools developed within this project. The project also brings together a variety of disciplines and institutes, enabling exchange of experiences and strengthening the ambition to aim for future collaboration.

The deadline for submitting final national monitoring plans for the MSFD occurred during the project time frame. Furthermore, development of common indicators is ongoing. As a result, the project case-studies and some project activities were based on best available information.

The project is supported by the EU and runs in parallel with two related EU projects in the Baltic Sea (BALSAM) and the Mediterranean and Black Sea (IRIS-SES).

Although the project originally focuses on the MSFD, the outcomes are also applicable in a wider environmental perspective. In addition, the tools and approaches can be beneficial for other sea regions. This was initially explored in a joint conference (24 April 2015, Brussels) with the two related projects (Box 8).

Partners in the JMP NS/CS project

1.	MI	10.	TI
2.	MSS	11.	BSH*
3.	JNCC	12.	BfN*
4.	CEFAS	13.	DTU Aqua
5.	Ifremer	14.	AU DCE
6.	ILVO	15.	IMR*
7.	RBINS	16.	SwAM*
8.	RWS	17.	SMHI
9.	Imares	18.	SLU

* non funded partner

Note for Readers:
This document presents the main outcomes and findings of the EU project 'Towards a joint monitoring programme for the North Sea and Celtic Sea'. Throughout the text there are hyperlinks to the project main deliverables and underlying documents for further reading and details. These links are indicated by underlined text or the following button: . All deliverables are available at the project's dedicated website. Additionally, links to other key websites and relevant initiatives are provided as footnotes.

Joint monitoring:

Definition, benefits and options

Definition of a Monitoring Programme

The measurement of one or more metrics describing an aspect, or aspects, of the marine ecosystem in a specified region and which is performed at one or more locations in space, but repeated in time.

The measurements are performed following a specified method which does not change with time without an analysis being performed on the quantitative effect of any change.

Definition of a Joint Monitoring Programme

A monitoring programme performed by more than one organisation

- Activities Expected in a JPM
- Operational Objectives of a JPM

Activities Expected in a JPM

- shared platforms
- shared equipment
- joint training programmes
- joint planning meetings
- joint programme management
- inter-organisation personnel exchange
- inter-organisation calibration studies
- shared data infastructure (e.g. databases)
- shared assessment procedures
- joint assessment
- joint reporting
- joint funding mechanisms
- joint resource allocation

Possible Operational Obejectives of a JMP

- to extend the spatial or temporal extent of measurements using the same resource allocation among JMP members
- to increase the number of metrics measured using the same resource allocation among JMP members
- to increase the precision of a metric using the same resource allocation among JMP members
- to reduce the resources needed by JMP members to measure an existing set of metrics

BOX 2

Example of internationally coordinated fisheries independent survey

The North Sea herring acoustic survey is coordinated through the International Council for Exploration of the Sea (ICES). This survey uses vessels from 6 countries. Effort in this survey (see map) is allocated in space and time to provide the best, most accurate and precise, abundance estimate of the herring resource. The survey is fully standardised in design and methodology. Data are analysed by a joint working group of scientists from all participating countries that use all the same tools to produce the final product - a stock size estimate. A single report is presented annually for the whole exercise. While the product is limited to two species of fish at most, it allows straightforward EU level management based on a single agreed deliverable report. Many other ICES coordinated fisheries surveys are set up in a similar manner.

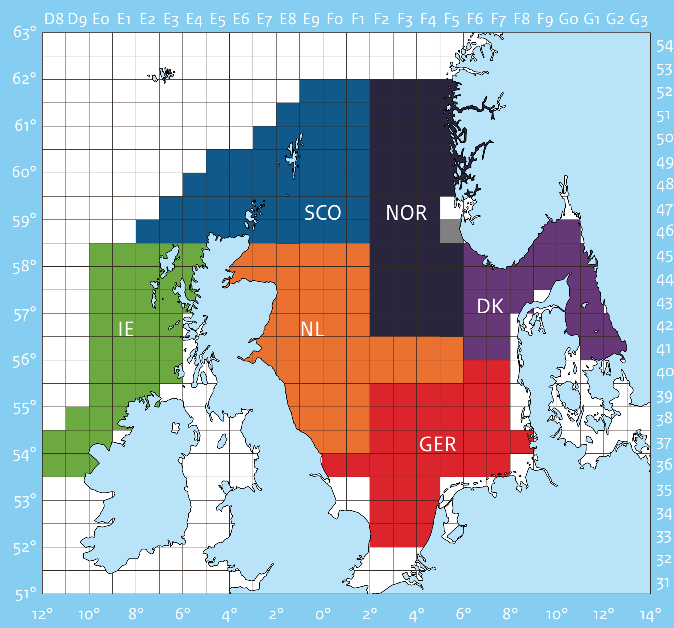

Figure 2. Joint design for monitoring herring stocks

Joint monitoring has value for all parties involved. It can provide clear benefits for optimising the planning of monitoring and the assessment of the marine environment. Joint monitoring can be considered in two ways:

- Multi-discipline: Monitoring of multiple aspects of the marine environment in an integrated design, e.g. collection of water quality data on a fisheries survey.
- Multi-party: Combined monitoring by multiple organisations for a series of objectives.

It is possible and desirable to advance in both directions. It does not necessarily imply a single overarching programme, but a series of collaborations (multi-party and/or multi-discipline) built up over time and maintained. This document shows, based on the outcomes of the project Joint Monitoring Programme North Sea and Celtic Sea (JMP NS/CS) - October 2013–March 2015, which benefits can be gained from joint monitoring, and how.

Tangible benefits from joint monitoring

- **Cost Effectiveness** – When monitoring multiple aspects of the ecosystem, the principle costs are those related to the deployment and operation of the platform (e.g. vessel, plane, mooring etc.). In most cases the addition of data collection systems will not substantially increase the costs of the deployment - costs associated with additional equipment, personnel and analysis resources[1] will be at least an order of magnitude less per day than for activating a new platform.
  Cost benefits from multi-party collaboration will be mostly associated with the avoidance of redundancy (e.g. survey or sampling overlaps in time and space) and the sharing of the additional costs associated with analytical equipment, and possibly personnel, as well as data archiving. A good current example is the North Sea International Bottom Trawl Survey (IBTS[2]). If two or more organisations were to coordinate their monitoring they might do so with common equipment and personnel.
- **Allocation of monitoring resources to assessment needs** – For data collected during a monitoring programme meant to be used in an assessment framework, it is important to estimate the statistical power needed to detect change before setting up any, including joint, monitoring. This will limit the number of data types that can be collected without losing precision and accuracy, and is key to producing data that are fit for purpose. It informs the selection of precision levels, sampling frequency, sampling design and stratification of the monitoring. If possible, the design of sampling should account for the variance in underlying ecological processes, both in time and space. Depending on the geographic extent of national waters, national monitoring may only cover part of the ecologically appropriate regional scale, while multi-party monitoring can optimise sampling across ecoregions.
- **Monitoring at the appropriate regional scale** – Marine ecosystem variables do not respect political borders. Hence, monitoring only within such borders, of a country for example, may miss the full range of values for a given variable. This may lead to misinterpretation of signals, or different national baselines and thresholds in the assessment framework. Ultimately, this can lead to a mismatch between mitigation/management measures in the assessed region. Joint international reporting facilitates agreement on data quality/adequacy and assessment conclusions.

[1] http://www.ices.dk/community/Documents/Expert Groups/WGISUR/additional task table_WGISUR2012.xlsx The document can be assessed without password

[2] http://www.ices.dk/sites/pub/Publication Reports/ICES Survey Protocols %28SISP%29/SISP1-IBTSVIII.pdf

- **Integrated ecosystem understanding from integrated monitoring** – Collecting a wide range of ecosystem data in a single integrated programme with agreed methods substantially increases the ability to understand ecosystem functioning and inter-relationships. Doing so removes many of the problems of spatio-temporal confusion inherent in analysing relationships. For example, much of the variability in abundance and biology of a fish stock can at least partly be explained by ecosystem functioning (e.g. availability of food or habitat). This connection may create scope for modelling approaches that combine direct monitoring (e.g. fish survey catch) with environmental data to increase accuracy and precision in population estimates.
- **Data sharing** – Sharing of data in a common database will facilitate comparison of data across borders and will provide a basis for easier reporting at international geographic scales such as EU or the Regional Sea Conventions.

How close to joint monitoring are we?

Multi-party joint monitoring: depends on monitoring type

Current marine monitoring strategies in European marine waters can generally be divided into environmental monitoring and the fisheries independent surveys. A gradient of international coordination and standardisation can be distinguished, where fisheries monitoring sits at the higher end: 92 Europe-wide surveys, of which 21 in North Sea or Celtic Sea regions; example in text box. Environmental monitoring and assessment is coordinated at different geographical levels, ranging from primarily national (eg. benthos) to (sub)regional: seabirds around the British Isles (SMP[3]), mammals in the entire North Sea (SCANS[4]) and hazardous substances in the OSPAR area (CEMP). International monitoring guidelines typically allow for further specification at national level, since most sampling designs are focused on national waters, even when assessments cover much larger areas (eg. hazardous substances).

Multi-discipline joint monitoring: in progress

There are few examples of "single parameter monitoring", as most monitoring activities will collect at least information on two environmental variables such as salinity and temperature, but many monitoring programmes do have a limited number of primary objectives. Conversely, there are a number of "integrated ecosystem" surveys[5] that collect a suite of ecological data. These are typically based on fisheries surveys, but modified to accommodate multiple objectives. Examples include the pelagic ecosystem surveys in the Bay of Biscay, the Barents Sea ecosystem surveys, and the Western Channel beam trawl survey. One of the critical issues with these 'modified' surveys is that their design, e.g. stations or transects, reflects the objectives of the original fishery survey. Other data are now collected, but the design is not typically optimised for this additional sampling; a purpose-built sampling programme might look very different. In practice, modified surveys produce primary data streams (appropriate survey design), and secondary data streams (less appropriate design but likely still useful).

Multi-party and multi-discipline joint monitoring: room for improvement

There are some examples of surveys comprising multi-party as well as multi-discipline joint monitoring - the ecosystem surveys described above involve two countries at most. The

All Partners Meeting in Edinburgh

ideal might be a multi-disciplinary monitoring programme (such as the Barents Sea survey[6]) across the appropriate regional scale (such as the herring acoustic surveys). Vessels would be deployed in time and space according to an optimized survey design and having the appropriate resources on board for defined tasks. This type of joint monitoring in the Celtic Sea is being developed by Ireland, France and the UK (TIME project[7]) and is a step ahead of current North Sea joint monitoring, mainly because the primary monitoring objectives could be re-defined, and the procedure allows a new integrated survey to be designed from scratch. The TIME concept will include different vessels covering different areas and times with different sampling tools for fish monitoring. It will include additional monitoring for seabirds, marine mammals and litter, and also potentially include data collection for other indicators e.g. plankton, hydrography, contaminants and nutrients. It will be spatially stratified on an ecosystem basis, using hydromorphological characteristics, rather than simply by fish abundance. It will also incorporate an ecosystem process analysis to provide the theoretical context for joint monitoring at an ecosystem scale.

3 Seabird Monitoring Programme (DEFRA, UK)

4 Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)

5 More information available in the ICES Report of the Workshop on Evaluation of Ecosystem Surveys (WKECES) (non-ICES users can ignore the login window by clicking cancel)

6 Survey Report from the Joint Norwegian/Russian Ecosystem Survey in the Barents Sea

7 The TIME project is funded by the Strategic Evidence Partnership Fund, UK.

Achieving joint monitoring from a policy perspective

Sampling of plankton

There is an imperative under the EU Marine Strategy Framework Directive (MSFD) to develop monitoring at the geographic scale of regions or sub-regions. However, the detail of how 'coordinated' or 'consistent' monitoring programmes should be is not prescribed, although the Regional Sea Conventions have a formal role to facilitate cooperation between Member States and other Contracting Parties. The Article 12 assessment[8] concluded that the initial implementation of the MSFD in the North East Atlantic is not sufficiently coordinated and Member States need to significantly improve this situation. There are considerable benefits to be gained from developing joint monitoring and assessment from a policy perspective. Policy makers and scientists must continue to work closely together to disseminate scientific findings and to define acceptable uncertainty limits for the detection of change in environmental state. Such collaboration will ensure that management thresholds and policy decisions reflect scientific evidence.

Benefits of developing joint monitoring

- Integration of monitoring effort and assessment across policy drivers increases monitoring efficiency: One data collection programme may serve multiple policy drivers, e.g. Habitats Directive, MSFD, Birds Directive, Water Framework Directive, OSPAR, and national requirements.
- Sharing expertise and capacity for monitoring and research leads to more coherence in methods across and within countries and improved comparability of assessments.
- Integration of monitoring on the appropriate regional scale will lead to:
  - Better scientific evidence to support management decisions, more scientific rigour through shared expertise, and better ability to detect change. Consequently this will support appropriate targeted management of marine activities;
  - Reduction or removal of redundant data collection within or between institutes or countries;
  - A basis for data sharing and establishment of improved and partly automated EU reporting facilities.

Challenges and opportunities in developing joint monitoring

Within this project we have identified existing examples of joint monitoring between institutes as well as between scientific disciplines, and have described some of the scientific and organisational challenges encountered. Building on these examples, the following section presents a selection of policy actions that could be developed over a short term to facilitate development of joint monitoring:

[8] COMMISSION STAFF WORKING DOCUMENT Annex Accompanying the document Commission Report to the Council and the European Parliament The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC) - The European Commission's assessment and guidance /* SWD/2014/049 final */

Challenges	Opportunities
There are numerous separate international groups (e.g. under ICES, OSPAR, European Commission) set up to advise on strategic direction or determine monitoring needs, but very few groups coordinate (multi-party/multi-discipline) operational programming of monitoring	Improve interaction between the policy/science needs and the operational programming, by: • Letting overarching multi-party coordination groups (cf. Dogger Bank Steering Group monitoring sub-group, Irish Sea), of scientists, policy makers, stakeholders, develop, implement and maintain long term plans for monitoring (incl. data storage, data sharing, analysis and assessment) • Use the ICES Survey Working Group model to bring scientists together to develop and refine monitoring and assessment methods, taking into account policy interests
Different national remits, funding mechanisms and priorities in marine monitoring might lead to competition between monitoring institutes rather than joint monitoring	Focus initially on areas of monitoring where greatest gain can be obtained (e.g. seas where a number of countries are involved, e.g. benthos in the North Sea) Arrange long term solutions such as a central funding source across countries with incentive to cooperate (e.g. EU Data Collection Framework method of funding collaborative data collection) Organise multi-party vessel/monitoring platform groups to facilitate sharing of vessels/platforms between scientific disciplines and/or countries. Eurofleets might provide a framework for this, although it may not fit all needs
Processes to obtain permits to sample in other national waters varies with country and needs to be planned well in advance of the actual sample/data collection	Standardise, simplify and speed up the current international permit process for such cross-border sampling across EU Member states Provide clear protocols for each Member State on regulations concerning monitoring by foreign vessels and crews

Challenges	Opportunities
Information on national monitoring is not easily accessible, restricting spontaneous joint monitoring. Monitoring priorities often vary with time and political landscape, which makes integration and agreement of joint monitoring between countries difficult	Use the metadata database of EU Members States national monitoring programs developed in this project to find the national monitoring contact persons Develop mechanisms to maintain and update this metadata database Develop mechanisms to share forward planning for monitoring surveys over appropriate time-frame (several years), to facilitate vessel availability. Consider development of a real time survey vessel information system, cf. BALSAM Arrange long term solutions such as a central funding source across EU Member S tates with incentive to cooperate (cf. EU Data Collection Framework method of funding collaborative data collection)
It is both a scientific and a political challenge to get agreement on the appropriate common monitoring methods to use. For example, organisations may be unwilling to change their methods to accommodate the needs of another country or scientists may be unwilling to adapt their existing methods which might disrupt long time-series of data	Consider improved multi-party integration from the start, preferably during the planning of work Develop mechanisms to share forward planning for monitoring surveys over appropriate time-frames Develop a portal for shared monitoring protocols, including periodic inter-calibration exercises Establish conversion factors to maintain time-series despite changes in methods
Reporting under many European Directives is a Member State responsibility, there is a will to cooperate, but not a very strong driver to force regional cooperation	Clear guidance on assessment and reporting, taking account of regional differences, in line with the set priorities of the Directive Further explore costs and benefits of joint monitoring compared to business as usual

BOX 3

Assessing level of cooperation in North Sea and Celtic Sea monitoring

The JMP NS/CS project assessed the opportunities for joint planning and joint monitoring across member states during two workshops in London (September and November, 2014). We performed a polling exercise involving policy makers, monitoring managers and scientists. Expertise ranged from fisheries to environmental monitoring. The main aim of the exercise was to assess the level of current cooperation in MSFD monitoring and the potential for cooperation.

The project developed a scale of international collaboration (Figure 3a). The positions of the current IBTS (North Sea wide demersal fish survey) and CSEMP (coordinated environmental monitoring in UK waters) were considered somewhere half way on this scale. For a fully harmonized, integrated and internationally operated monitoring programme we used the term 'North Sea Institute'.

The results from this exercise are summarised in Figure 3b (upper panel: workshop 1; lower panel: workshop 2) and interpreted below:

Question 1: What level of 'Joint Monitoring' would be politically acceptable?
All groups (scientists, policy makers and managers) agreed that a level of 'Joint monitoring' close to the current IBTS would be politically acceptable.

Question 2: What level of 'Joint Monitoring' would be the cheapest?
There strong agreement across all groups that a level of co-ordination close to a 'North Sea Institute' would be the cheapest option for marine monitoring but at present this is non-existent.

Question 3: What level of 'Joint Monitoring' would be scientifically most robust?
The majority of colleagues agree that a more centralised and better co-ordinated North Sea Institute type of joint monitoring would improve the quality of the results. There would be more agreement on monitoring protocols and better integration of data. However, a remark was made that scientific robustness also requires a healthy debate between independent experts.

Question 4: Where on the scale is MSFD monitoring in the North Sea/Celtic Sea today?
Overall this clearly was the question with the lowest scores. There is limited to no cross-border co-ordination in MFSD monitoring in the North Sea and Celtic Sea today.

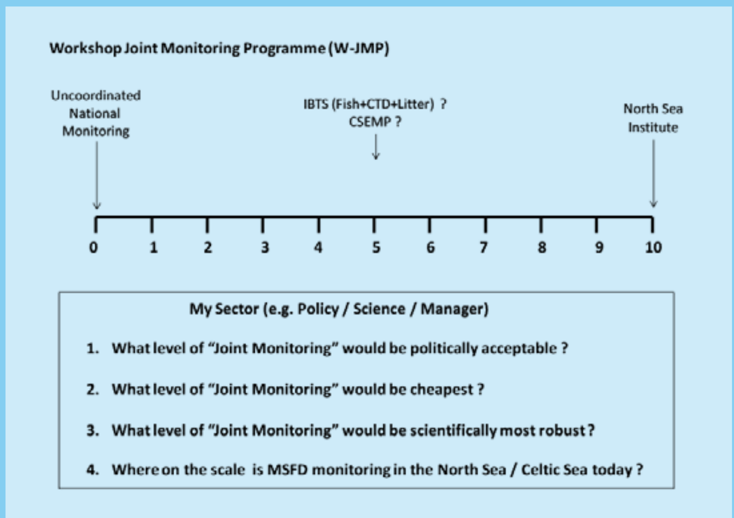

Figure 3a. Scale of international collaboration ranging from national coordination to a joint North Sea wide Institute. The box contains questions that were raised in the polling exercise.

Figure 3b. summary of results from the questions 1-4 on the level of monitoring required in two JMP NS/CS workshops. Values on Y-axis are: 0= national coordination only; 5=CSEMP/IBTS and 10= North Sea Institute.

BOX 4

Information platform

The development of appropriate information and communication platforms is important in the setup of successful joint monitoring. In order to get an overview of existing (MSFD) national monitoring programmes in the North Sea and Celtic Sea, a searchable meta-database was developed.

The database integrates metadata on marine monitoring (e.g. element and parameter measured, sampling frequency, start dates etc.), as well as the complete list of indicators and environmental targets reported to the European Commission by Member States (MS) in July 2012. Key features of monitoring at Member State or ecoregion scales are made available to support visualisation tools for assessment and communication purposes.

Furthermore, the database contains a list of contact persons per country responsible for the different types of monitoring.

The database can be searched according to the following criteria: Purpose, Spatial zone, MSFD programme, Member state, QA/QC, INSPIRE. The chosen sub-programmes can then be exported in different formats (XLS, CSV, XML). Figure 4 shows an example of how information in the database can be visualized.

We advice to further improve the usefulness of the information held in the database by adding GIS-maps, eg. as has been developed by the companion [project IRIS-SES](). Correspondingly, in order to foster synergy and avoid duplication of efforts, the conditions should be created to establish a link with the data base of research vessels used in HELCOM monitoring programmes developed by the other companion [project BALSAM]()

The [JMP NS/CS database]() is hosted by the Belgian Marine Data Centre on a server at OD Nature (RBINS) and is accessible at http://jmp.bmdc.be (username: jmpguest – password: jmpguest).

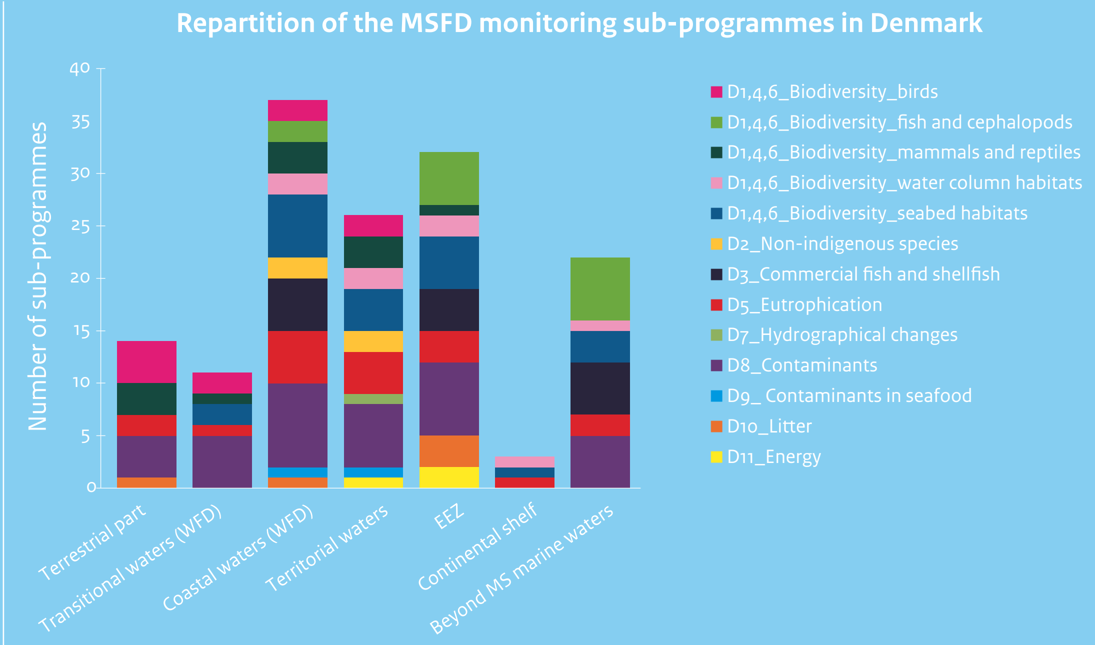

Figure 4. Example of selecting information available in the database

Achieving joint monitoring from a scientific perspective

Maximise the compatibility within the assessment framework

The need to maximise the compatibility of the assessment framework, ranging from monitoring and the development of a suitable indicator to assessment and standardisation of current practices, is considered indispensable to achieving joint monitoring. Standardisation across institutional and state boundaries is a key scientific challenge.
Standardisation contains two aspects: inter-calibration and harmonisation. Harmonisation is considered especially useful at the level of indicator selection and development, monitoring programme design and execution, and ecosystem health assessment, as it strives towards reaching consensus in the approaches to be applied. Inter-calibration helps compare the results derived from different approaches, and improve the data quality/comparability of results derived from the same approaches.

Align assessment frameworks

A consensus selection of indicators, in line with the intention of the MSFD, would solve the current problems experienced with indicator comparability. However, the long-term use of indicators and the preference for locally developed indicators create a reluctance to deviate from the business-as-usual model. Breaching the long-term use of indicators may disrupt long-term databases, depending on whether or not the underlying parameters will continue to be used. Preference for locally developed indicators is often very strong. A persistent use of different indicators will however continue hampering cross-border comparison. Besides, a common understanding of an indicator, i.e. specification of the parameters and requirements of assessments against baseline and target levels, forms the starting point for designing an adequate monitoring program.

Different indicators may have the same environmental assessment purpose. In benthos, for example, various multi-metric indices are used to assess the overall level of human pressures onto the benthic ecosystem throughout Europe (Box 5). Similarly, different spectral ranges of chlorophyll concentrations are used to assess the impact of eutrophication (Box 7).

Agree on indicators to encourage joint monitoring

A shared set of well-defined indicators and associated baselines and thresholds will optimise cross-border comparison. This set can be complemented with a national, customised (set of) indicator(s). While major progress has been achieved with inter-calibration, these exercises seem to have reached their limits. Major progress is yet to be searched for in further specification of shared sets of indicators and harmonisation (i.e. agree on methodologies; see below). Regional Sea Conventions now pay attention to the development of common (OSPAR[9]) or core (HELCOM[10]) indicators.

Various lessons learnt can be taken from inter-calibrations carried out over the last few years. For example, for multi-metric benthos indicators and chlorophyll-based indicators long-standing statistical calibration exercises are being executed within different fora. Furthermore, the JPI Oceans[11] project studied monitoring of phytoplankton and benthos in coastal waters under the EU Water Framework Directive. Both have achieved moderate levels of success. The benthos calibration has now come to an end, with consensus agreements throughout Europe. For chlorophyll, pragmatic conversion factors were developed based on QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe) quality assurance schemes.

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[9] OSPAR
[10] HELCOM
[11] JPI Oceans

Turn ongoing (national) monitoring into joint monitoring

Ongoing monitoring often has a long tradition, which may lead to institutional and/or country specific reluctance (skills, expertise, and technology) to deviate from business as usual. Implementing a North Sea wide minimum sampling design for an assessment framework that is the responsibility of individual Member States, taking into account nationally designed programmes, should lead to better integrated monitoring (Box 5).

Every Member State has its own monitoring program covering similar environmental aspects, often characterised by different objectives and each with their own mix of strategies, sampling designs and protocols. For example, differences in sampling period, frequency and spatial design (i.e. fixed stations vs. random sampling) between countries hampers joint assessment of chlorophyll in adjacent areas, especially for offshore waters (Box 7).

Scientifically-sound ecosystem assessments can only be achieved based on data collected at the ecosystem component-specific spatial scale (relative to mobility/migration). For example, the relevance of harbour porpoise by-catch levels at national levels is irrelevant, as harbour porpoise migrate throughout the (southern) North Sea.

Aspire to compatible data collection

The two main pillars in data collection are on the one hand sample collection (amount, design), and on the other hand the analytical methods used to process the samples. Processing differences could result in separate data series even when the sampling method is identical (Box 7). Compatible sample collection and processing (i.e. harmonisation) will ultimately lead to compatible datasets feeding into the assessment framework. Harmonisation includes data handling/quality assurance, parameters/indicators and definitions. As for the MSFD, all Member States have to report on Good Environmental Status (GES), internationally agreed methodologies for data processing and reporting will help to integrate results over wider scales and to facilitate interpretation.

International agreement on methodologies facilitates joint monitoring and data interpretation. For some assessment frameworks like contaminants, sampling methods may already be similar across countries. In other cases, established monitoring may not be internationally agreed, and certain sampling techniques may not be acceptable in all countries. This variation is the main consideration when choosing consensus methodologies - technical developments may provide scope to enhance sampling without changing methodology.

Explore and use new cost effective and scientifically improved methods

Some aspects for improving monitoring still need some scientific development before they can be implemented. There is a lack ecological knowledge around the life-cycle characteristics and distribution of some highly mobile, endangered (low occurrence) species (e.g. Elasmobranchs). Novel techniques (e.g. tagging) can generate the required baseline knowledge (Box 6) and can allow a better allocation of sampling effort. Some parameters, like chlorophyll-a, need high-frequency field sampling (up to twice weekly) to measure temporal variability, which may be solved by moving from in situ sampling to (satellite) remote sensing (Box 7). This allows the development of a common dataset on a regional scale, but still needs to be correctly processed towards an assessment.

Science is needed to improve inter-calibration of sample collection, and especially processing, methodology. The consequences of differences in sampling or processing are mostly ignored (benthos, chlorophyll). Species-abundance data for benthos and elasmobranchs can be collected in various ways, but the methodology influences the assessment. Methodological differences are often ignored when policy advice is produced, while they decrease the value of the assessment.

Improved sampling design, especially when considered jointly, can also significantly enhance the quality of monitoring results and decrease costs. This project explored innovative statistical approaches for the geographic design of elasmobranch and benthos sampling.

BOX 5

Case study benthic habitat condition

Benthic habitat condition (species, habitat) is an aspect taken into account under various environmental directives, but there is no common indicator, assessment and monitoring protocol for the North Sea and Celtic Sea regions.

A broad scale benthic monitoring design for the North Sea is developed within this project, which can be aligned with the national programmes. The roadmap to such a scheme is to strengthen international cooperation by implementing a multi-party group that can work towards agreed benthos sampling protocols and align this broad scale monitoring with the national monitoring. Work in this context will create better value for the invested money.

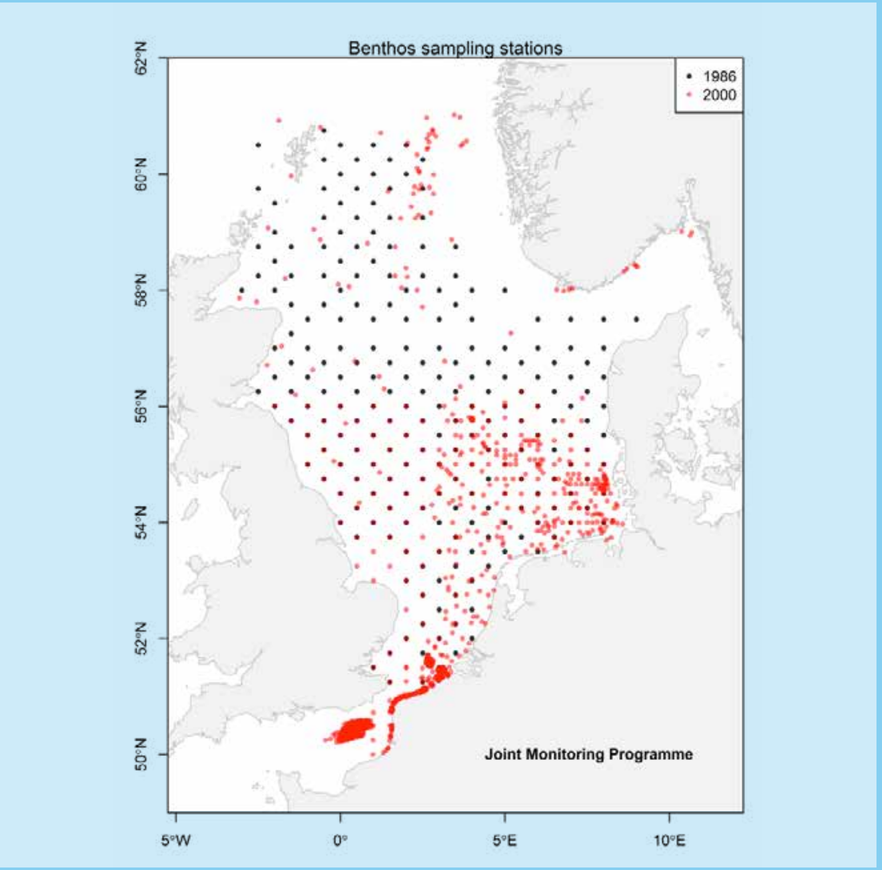


Figure 5a. Sampled stations of the North Sea Benthos Survey of 1986 and the North Sea Benthos Project of 2000.

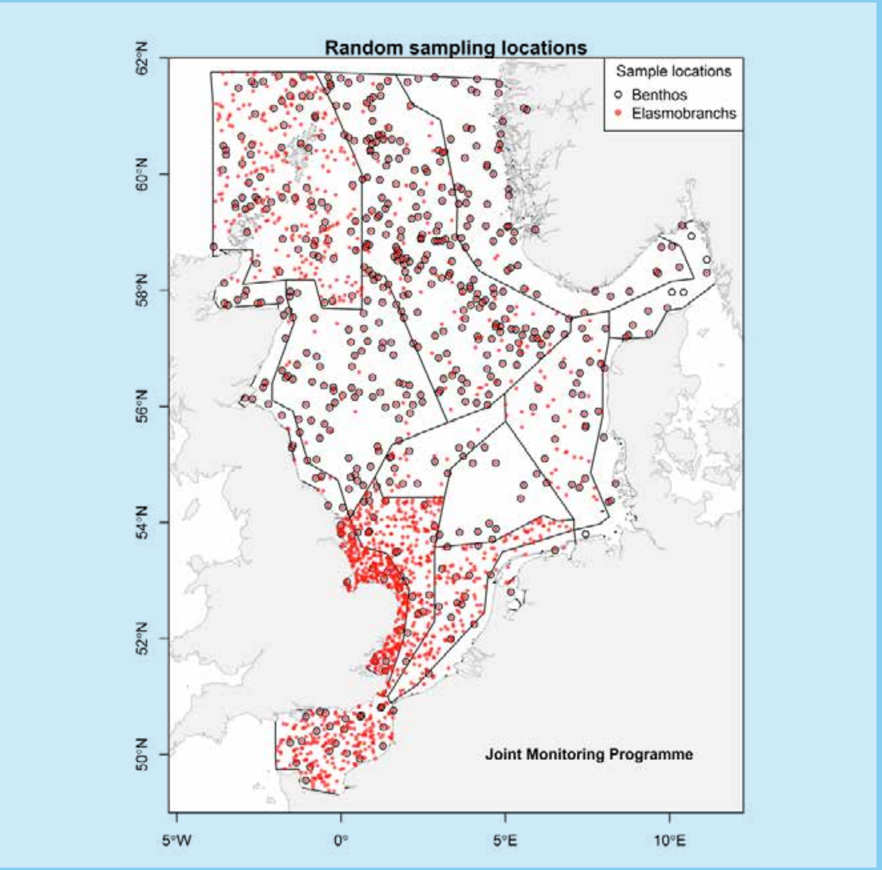


Figure 5b. Proposed Joint Monitoring Programme for the combined case studies in the North Sea. The selected scenario is composed of 1885 stations for elasmobranchs case study (red dots) and 777 stations for the benthos case study (black circles).

The differences in assessment are not an obstacle for internationally integrated monitoring, because benthic habitat indicators rely on species-abundance data, which can be collected in a standardised way using different devices. The Member States' monitoring for benthic habitat condition is currently based on national monitoring programmes, industrial monitoring for permits and environmental impact assessment (EIA) and some institutional engagements and can be found in the meta-database developed in this project. These different types of monitoring programs are characterized by different objectives and each has its own mix of strategies, sampling designs and protocols.

A compilation of such data (e.g. North Sea Benthos Survey of 1986 and the North Sea Benthos Project of 2000) allows for analyses of benthic characteristics at wider scale, but with survey gaps due to the irregular sampling pattern (focus on protection and/or human uses areas) (Figure 5a). Based on this data, the conditions (ecosystem stratification, Neyman sample allocation principle) for a more effective benthic monitoring design were determined. For example, a suitable sample effort (statistically defined) for evaluating the species richness within the North Sea area can be 777 samples. This effort needs to be distributed in such way that larger strata and strata characterized by a higher variance, get more samples (Figure 5b).

This benthic monitoring at broad scale can be implemented in a feasible way, by slightly adapting the national monitoring. These programmes need to collect habitat-stratified species-abundance data, seasonally fixed across all programmes, and all 'common' data needs to be collected and analysed based on agreed protocols (cf . ISO 16665 norm).

BOX 6

Case study sharks and rays

The North Sea provides habitat for a variety of sharks, skates and rays (elasmobranch fishes), where in a food-web context most of them are considered as top-predators. In general, these species have low growth rates, late maturation and low reproductive output, which make them highly vulnerable to over-exploitation. There are many examples of declining or even extirpated populations. Healthy elasmobranch populations will be required to achieve good environmental status under several MSFD descriptors, and so an appropriate monitoring programme is needed.

At present, elasmobranchs are sampled in discard observer programmes and in fisheries-independent surveys. These provide abundance data used in assessments of commercial stocks. Many species are considered data poor, and assessment comprises abundance trend analysis without historical reference points. Joint monitoring programmes have the potential to provide elasmobranch sampling that can robustly detect relative changes. A pragmatic route is to optimise existing fisheries surveys for elasmobranch data collection, with a focus on achieving required precision with minimal sampling effort. Analyses suggest that by adjusting survey design to account for ecological heterogeneity, i.e. by using jointly defined assessment areas, it may be possible to safely reduce the number of survey trawls to measure abundance of some assessed fish stocks. This process could enhance efficiency and free up ship-time and resources that could be allocated to dedicate elasmobranch sampling as a secondary goal. In future, surveys could be designed to integrate the sampling needs of several objectives.

In the case of elasmobranchs current survey programmes collect too few data for a reliable annual or even quarterly assessment (Figure 5a indicates the two surveys performed in 2013 in the IBTS). In order to find out how many hauls are needed to provide an acceptable level of confidence, a dataset was compiled consisting of all hauls (quarter 1 and 3) from 2000 to 2013, i.e. nearly 9000. As an example, stratification of the survey stations resulted in about an 80% reduction of stations needed for a comparable certainty of the abundance estimate of 8 selected target elasmobranchs species (Box 5, Figure 5b; 1885 stations). Thus, in order to obtain abundance estimates with the same certainty as derived from the full data set (2000-2013), the survey data of three years (ca. 600 per year) have to be pooled after the stratification and allocation process. Nevertheless, the corresponding stratified sampling design would already reduce the uncertainty by about 50%, even if the number of stations (ca. 600 per year) would stay the same as currently sampled in the IBTS in one year.

An elasmobranch joint monitoring programme could also synthesize additional sampling schemes such as an expanded commercial observer scheme, tagging programme and egg case sampling.

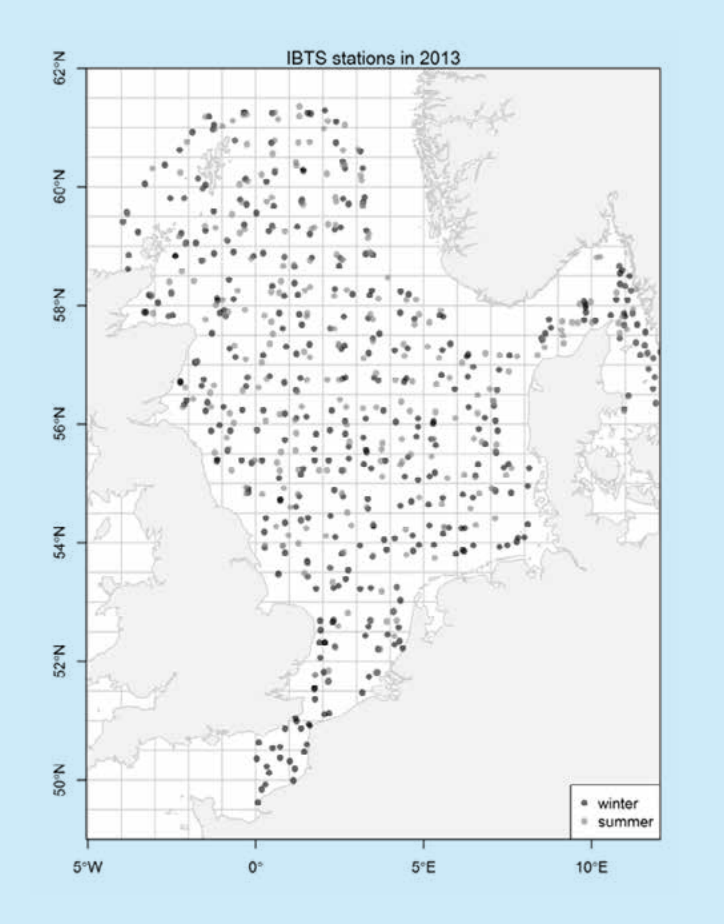


Figure 6. Stations sampled during the IBTS surveys within one year, quarter 1 and quarter 3 (here for 2013).

Case study chlorophyll(-a)

Chlorophyll-a is the MSFD key indicator for eutrophication (D5) as it shows up eutrophication problem areas. Additionally, it is an important input parameter for broader ecosystem understanding, such as food webs (D4). Chlorophyll therefore is an OSPAR common indicator for eutrophication assessment. OSPAR moves towards joint assessments of common indicators at scales that generally cover sea areas of several neighbouring countries. The project investigated to which extend this would be possible for North Sea countries and how this could be supported by a joint monitoring design.

We met serious obstacles that relate to the current ship-based monitoring design and the analysis of chlorophyll. All methods for the estimation of chlorophyll concentrations are well established, but importantly for joint monitoring, these all provide different information. Some measure one pigment (e.g. 'chlorophyll-a'), while

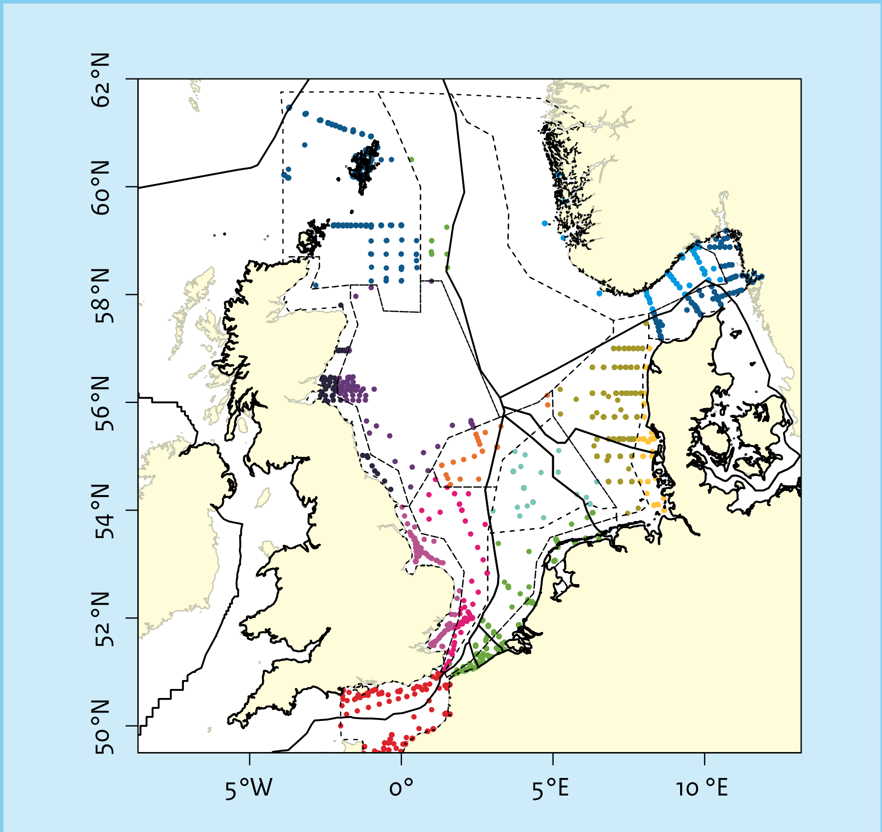
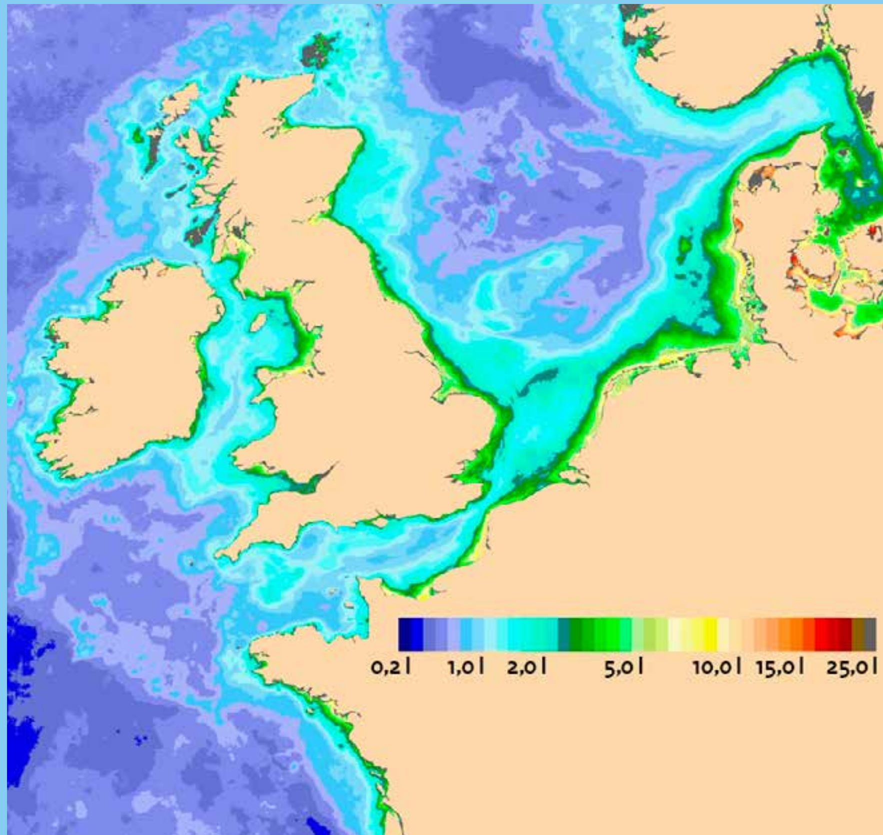


Figure 7a. Stations reported for chlorophyll monitoring in the ICES database. Year 2006. Dashed black lines and colour-coding of stations: boundaries of and measurements within strata that can be used as relatively homogeneous assessment units (Atlantis Stratification, see Annex I). Solid black lines: national borders.



Figures 7b. Mean of chlorophyll from March 1st to September 30th in 2006.

others measure a complex of pigments. In addition, North Sea countries make different choices for sampling design, 'background value', and for calculation of growing season value, although the latter are readily interchangeable.

The current monitoring data do not allow for a cross-border assessment and cannot provide information on spatial and temporal variability of the indicator that is needed to design an optimized joint monitoring programme. Creating subsets of data to increase comparability and trialing conversion factors between the different analytical methods is considered insufficient. One option to improve the situation is to harmonise monitoring design and the analysis of chlorophyll.

A second option is to gradually switch to remote sensing by satellites as the main source of chlorophyll data for the assessment of eutrophication. The high variability of this indicator in time and space calls for high sampling frequencies and dense sampling patterns, which is what satellite observation can deliver relatively easily (Figure 7b).

We estimated current monitoring effort using ships by the 'Travelling salesman approach' (see Tool 4 in section on Tools for designing a Joint Monitoring Programme and Figure 7a). The distance covered to visit all stations appeared to be comparable to one of the main demersal fish surveys (IBTS): approx. 165.000 nm and 157.000 nm respectively. We expect that using satellite information can significantly reduce the costs of chlorophyll monitoring.

The project compared an assessment of chlorophyll based on 5 years of RS observation, using existing OSPAR assessments areas and area-specific assessment levels, as in the OSPAR Comprehensive Procedure. The outcomes were in most cases comparable to the 'real' COMPP assessment. The main differences occur in coastal areas of the south-eastern North Sea, caused by turbidity, which masks chlorophyll.

We suggest that continuation of parallel assessments will deliver better understanding of differences and similarities between the two methods. Furthermore, the Copernicus programme is expected to deliver high quality satellite data suitable for work with algal blooms from 2016 onwards. In situ sampling will be needed for calibration of RS, but less intensive than the current monitoring. It is important that such calibration surveys deploy the same sampling and analytical techniques and follow a joint sampling design. We expect that calibration algorithms will be area specific, for instance taking into account turbidity in coastal areas.

It should be noted that determination of toxic algae blooms still requires intensive in situ monitoring for early warning in some areas and during some periods of the year.

The need for regional assessments brings a real opportunity to internationally evaluate the current methods in relation to the assessment, and to develop joint approaches or ways to optimise the current comparison across areas. This could best be done by bringing together a mixed group in which the full assessment process (reaching from field sampling to the final assessment) as well as all countries in the region are represented. The project liaised with OSPAR's ICG-EUT for this purpose.

Tools for designing a Joint Monitoring Programme

Designing scenarios for joint monitoring (Activity E workshop, Hamburg).

The project developed a suite of tools to aid the planning of a joint monitoring programme. A general explanation if given in this section. Application is further elaborated in the text boxes on benthic habitat condition and Elasmobranchs (Boxes 5 and 6).

Joint stratification for multi-purpose monitoring

Moving towards integrated monitoring we need spatial subunits for the sampling (so-called strata) that would be applicable for a whole range of indicators at the same time. The project applied a stratification scheme, which was developed in the EU project VECTORS[12], recently finalized. This scheme will be used in a North Sea-wide ecosystem model 'Atlantis' and is based on a combination of physical and ecological parameters in subsections of the survey region, which remain rather constant over time.

Tool 1: Methods for the allocation of stations

Both the size of the strata and the variability of the indicator in each stratum determines the number of sampling stations needed to assess trends. The project compared different options for determining where stations should be allocated in the strata. The so-called Neyman allocation most effectively reduces the variance of the observations. It should be noted that this type of allocation best performs if sampling stations are chosen at random. However, we do realize that monitoring in marine protected areas or in the vicinity of human activities may require fixed stations and more sampling than monitoring for the purpose of assessing the quality of the marine ecosystem at the scale of the North Sea.

[12] EU project VECTORS

Tool 2: Changepoint analysis and optimal number of stations

We developed an approach to determine the minimum number of samples that are needed for a reliable assessment of an indicator (eg. abundance of sharks and rays) against its target. This is a compromise between precision and monitoring costs. A changepoint detection was performed, that shows how the variance decreases with increasing number of samples in different sampling designs. It turned out that the Atlantis design performs best, ie. less samples are needed for a reliable assessment compared to the current monitoring design.

Tool 3: combining stations for multiple indicators

As an example the project designed a spatial sampling strategy for two distinct ecosystem indicators (sharks and rays and benthos) and taking into account the minimum number of stations needed for an assessment. In order to achieve maximum efficiency, sampling was combined in as many stations as possible within each stratum (Box 5, Figure 5b). Realistically, a joint monitoring programme would best be created when as many as possible MSFD indicators are defined and operationalized. Then, it would be most effective to decide – based on the requirements of each indicator with respect to its temporal and spatial resolution – which parameters would be monitored together during one cruise. Useful combinations may differ between seasons.

Tool 4: Analysis of survey efficiency

The added value of joint monitoring in terms of costs is difficult to assess. The project used a proxy for sampling effort, ie. number of stations visited and distance travelled by ship, using a “traveling salesman approach”. The combined sampling of benthos and Elasmobranchs requires no additional sampling effort compared to Elasmobranch sampling alone. The project shows that improved sampling design can greatly enhance the confidence of the assessment, with a sampling effort similar to the current IBTS. However, it should be noted that the grid-based design of IBTS is not the best solution for decreasing the variance of the measurements. For parameters with high seasonal and/or annual variability, such as chlorophyll, more intensive sampling is required during the relevant season. Current annual effort of chlorophyll sampling in terms of distance travelled is comparable to the IBTS surveys.

Concluding remarks on tools

- A most efficient joint monitoring programme may select the best option for the monitoring, which could involve several joint assessments for the indicators, for which the benefit of joint sampling is highest.
- Different combinations could be useful for different seasons or even years, depending on the required frequency of the individual assessments.
- The JMP NS/CS project provides the tools to optimize a future REAL Joint Monitoring Programme.

Routes to collaboration

Encourage the multi-use of platforms

The operation of sampling platforms, such as ships and planes, is expensive. As such, it is worth using platforms as efficiently as possible. Many ship-based surveys could, and do, undertake additional data collection during downtime, e.g. at night on surveys performed during daylight hours, or use the time that a ship is on one position for multiple sampling types (e.g. water and benthic sampling). For instance, seafloor litter is currently being monitored in IBTS surveys. Space for staff or hardware may also be available within logistical limits, for example using ferrybox-type sampling. It is important to have sufficient insight about the staff, storage and equipment requirement when adding additional data collection to existing monitoring programmes, and to realise that primary objectives (often defined by the funding source) take priority. Flexibility in the planning of existing monitoring programmes may also facilitate secondary data collection, and so lead to joint monitoring. It is nonetheless important to make realistic and appropriate assessments of resource needs (e.g. staff, funding) when considering the addition of tasks on existing surveys/platforms.

Optimise coordination

A key issue is robust coordination of joint monitoring. Regular and active co-ordination can address challenges in sampling protocols, data analysis and reporting. For example, for both chlorophyll and benthos sampling, it is recommended that national coordination groups increase integration at the EU scale. For benthic monitoring the ICES Benthos Ecology Working Group (BEWG), agreed on a Standard Operating Procedure on how data are collected, analysed and reported.

International staff exchange promotes personal relationships and shared perspectives, potentially leading to the re-evaluation of procedures.

Optimise data sharing

Data exchange, exploration and sharing are crucial in joint monitoring. An overview of the monitoring taking place facilitates collaboration and data sharing. Within this project, a database containing metadata of participating EU Member States' national monitoring programmes has been created (Box 4). As many monitoring activities collect secondary data, a lot more information is available than might be concluded from specified monitoring goals. In some cases, multi-party data exchange is already well established with collaborative data repositories including ICES, EMODNET, and could serve as an example to optimise data sharing.

Although sharing raw and high-resolution data is not always feasible due to legal ownership, downstream data products may be more freely shared and sufficient for many users.

Report once, use many times

The metadatabase developed in this project offers Member States the possibility to enter the data needed for Art. 11 reporting, in a user-friendly manner and at the same time allows Member States to easily extract the data needed for reporting in the required xml format. The database has for example, already been used by Belgium when reporting on its monitoring programmes to the EC. This tool can hence be used also by other Member States in the next reporting phases. This would allow a more simplified and harmonised procedure for reporting and improve the comparability of assessments, which perfectly suits the "report once, use many times" concept. Our tool must be seen as complementary to the Eionet repository, being two-way compatible (export to Eionet and import from Eionet) and offering extensible data query and analysis functionalities. It is also possible to think of expanding the database to similar policy instruments such as the Water Framework Directive.

Combine data for assessments

Joint evaluation and better integration of existing datasets within the assessment framework may be a relatively easy way to extend indicator time series, or may support decision making if additional data collection or alternative data are needed for the assessment framework. Historic and long-term data sets may help to illustrate change, variability or the resilience of the ecosystem. Internationally agreed methodologies for data processing and reporting facilitate integration and interpretation of results over wider scales.

Currently, data from different countries tend to be collated on a fairly ad hoc basis, although international bodies such as ICES provide support in some fields. Pan-European virtual platforms could serve as mechanisms for data collation and exchange, and might also highlight data gaps. For some assessment frameworks, it may not be possible to pool monitoring data. Instead, decision rules could guide integration at a higher level.

Use supporting large-scale data

Additional data from independent platforms, such as satellites and buoys, as well as models could contribute to current or future monitoring in the North Sea. This easily accessible information may be used to refine or underline specific monitoring and assessment. Using data from external sources as supporting information might in the end lead to better use of costly platforms like planes and ships, or improve the sampling stratification. For example, large-scale sediment images might help the identification of sea-floor habitats which will lead to better stratification of in situ monitoring than using data from using grab samplers. Objectives and data quality are focal points when extending and combining existing monitoring data.

Establish a living network

One of the project outcomes is the creation of a living network of scientists, policy makers and managers of monitoring programmes to support monitoring activities and assessments. Members of this project, the policy liaison group and steering group can mutually provide assistance on several aspects of monitoring that will improve multi-party coordination between countries, for example by defining protocols and training, deciding on further direction and ensuring continuous communication. The living network can benefit from the metadata database of Member States' national monitoring programmes created during this project, as it provides an overview of the monitoring taking place as well as the contact persons.

A living marine monitoring network extending across stakeholders could include outsourcing of data collection. This may take many forms, e.g. the UK Marine Conservation Society volunteers currently carry out beach litter monitoring. Although this may raise ethical questions about an MSFD implementation that relies on voluntary or non-scientific groups, it may be justified by the growing profile of 'citizen science'. In all cases, training, including an explanation of why the monitoring is important, and well-defined sampling protocols are necessary to ensure data quality and continuity. An effective dissemination strategy is also important as this can motivate people to maintain sampling efforts not directly related to their job specification.

Ambition to work towards joint monitoring and overcome institutional barriers

In a final event the JMP NS/CS consortium shared the project outcomes and lessons learnt. Environmental monitoring experts learned from the way fisheries monitoring and assessment is organized, including EU-funding, cross-border monitoring, international assessment groups and a clear distinction between scientific advice and policy decision making. There is a common understanding on what joint monitoring can include and examples of how this could improve the quality of MSFD assessments and increase the effectiveness of marine monitoring. We investigated barriers, that are partly scientific, but mainly institutional. We also realized that intensive collaboration would bring along major changes to current tasks and positions of the institutes and their staff. For instance, sharing ship time could lead to institutes giving up research vessels. Specialization among North Sea and Celtic Sea institutes could lead to loss of expertise in some. Would a UK policy maker trust the advice of a Dutch benthos expert? Would national flexibility be compromised?

Transparency, accountability and confidence are key to such changes. Joint actions involving two or more countries will create better mutual understanding. The consortium experienced momentum to work towards joint monitoring

Using statistical tools to create effective samplings designs (Hamburg).

and explored the concept of installing a joint monitoring working group in cooperation with OSPAR and ICES, or even a 'North Sea virtual Marine Institute' involving most partners of the JMP NS/CS consortium. It is important to start with concrete pilot projects that can deliver short term successes. The project's case studies and multi-use of monitoring platforms are considered good candidates for further development, using joint funding and where possible EU programmes. For new themes joint monitoring should be the point of departure.

BOX 8

Dissemination of project results and exchange with MSFD implementation framework

Region-specific: exchange with OSPAR
Regarding coordination of the MSFD implementation process the intersessional correspondence group (ICG) on MSFD acted as the project's policy liaison group. Representatives of ICG-MSFD participated in the workshops on policy perspective and the final event. ICG-MSFD also supported the inventory of monitoring programmes for the project's metadatabase. Links can be established with the OSPAR Data and Information Management System.

OSPAR thematic Committees and working groups were involved:

a. Biodiversity Committee/ICG-COBAM: several presentations of the project's progress in COBAM meetings and supporting the organisation of dedicated 'monitoring day' related to development and implementation of biodiversity indicators during the October 2015 meeting of ICG-COBAM;
b. Hazardous Substances and Eutrophication Committee/ ICG-EUT: presentation in HASEC 2015 and ICG-EUT meetings. Further work is conducted to compare chlorophyll assessments in North Sea areas based on ship surveys with Remote Sensing information and to evaluate the ability to detect trends with both methods;
c. Environmental Impacts of Human Activities Committee:
   - ICG-ML: the integration of marine litter monitoring with fish surveys provided a good example of joint monitoring;
   - ICG-Noise: although the JMP project did not address monitoring of underwater noise directly, the concept of joint monitoring has been leading for the development of a proposal for an ambient noise monitoring programme for the North Sea in 2015/2016.

Exchange at EU level

d. Exchange with MSFD CIS process PCG, WG DIKE, WG GES: coordinated presentations by the three New Knowledge Pilot projects JMP NS/CS, BALSAM and IRIS-SES were given in meetings of the Project Coordination Group and the Working Group on Good Environmental Status. The projects used the information and formats for member states' reporting of MSFD monitoring programmes developed by the Working Group on Data, Information and Knowledge Exchange to populate the metadatabases.
e. The outcomes of the JPI Oceans pilot project on Multi-use of infrastructure for monitoring was used for the development of scenarios for multi-use of platforms in this project. JPI Oceans expressed interest expanding the knowledge base with other policy relevant information, such as the actual costs of the monitoring programmes.
f. several ICES working groups contributed to the development of options for joint benthos monitoring (BEWG) and integrated surveys (WGISUR). In addition, the ICES database was used for information on current eutrophication monitoring. On request of OSPAR, BEWG will continue working on the optimisation of benthos sampling designs at the (sub)regional scale with emphasis on (1) sample station location, (2) fixed and/or random sampling design, and (3) defining minimal sampling effort for each ecostratum.
g. ICES Annual Science Conference 2015: An agreed proposal for a theme session: Ecosystem monitoring in practice. Several presentations on JMP NS/CS project outcomes have been accepted.
h. The New Knowledge Pilot projects JMP NS/CS, BALSAM and IRIS-SES organized a joint conference (Brussels, 24 April 2015) to share the project outcomes.

Main outcomes are:

- The projects helped to develop a common language and shared approaches to increase cost-efficiency in marine monitoring for MSFD;
- Political support at national and international level to resolve coordination issues is very important to move towards joint monitoring: the 3 pilot projects will develop a joint strategic paper containing the conclusions from this meeting and proposals on the way forward, to be discussed in MSCG and Marine Directors in Autumn 2015;
- See http://www.helcom.fi/helcom-at-work/projects/balsam/final-conference/ for joint statements and presentations. Links to BALSAM and IRIS-SES final reports: http://helcom.fi/helcom-at-work/projects/balsam/results/; http://iris-ses.eu/

Guidance on how to move towards joint monitoring

As joint monitoring can be seen as an iterative process and not a one-time fix, it depends on the status quo where the easiest benefits of joint monitoring can be achieved. The checklist below contains the crucial steps to move towards multi-party joint monitoring.

HOW TO ACHIEVE MULTI-PARTY JOINT MONITORING

To develop joint monitoring, initial joint workshops are needed involving scientist and policy makers or funders to agree on principles. These will need to be followed up by scientific workshops to develop detailed strategies and methods.

Phase	Activity or initiative to facilitate joint monitoring	Joint next steps
Objectives	Identify monitoring objectives of each party. Are there previously agreed monitoring objective(s)?	Agree on common objectives.
Indicators	Identify indicator(s) used by each party. Are there previously agreed indicators?	Agree on common indicator(s).
Parameters	Identify parameters measured by each party. Identify standards used.	Agree on common parameters to measure and which standards to use.
Sampling Method	Identify sampling methods used by each party, or for new surveys, identify common sampling method.	Agree standardized sampling method, or cross calibrate between methods if standardization cannot be agreed.
Sampling Platform	Identify suitable available sampling platforms in all countries.	Agree on sampling platforms to use.
Sampling Design	Identify sampling designs and strata used in each country.	Agree across country strata and combined sampling design (dependent on all others steps).
Analytical Method	Identify analytical methods and standards used by each country.	Agree standard methods to use, or cross calibrate if standardisation cannot be agreed.
Data Management	Identify common formats, standards and sharing protocols.	Agree on common formats and standards, or translation protocols if common formats cannot be agreed.
Assessment	Do the data collected contribute appropriately to the assessment methods (either common or separate assessment methods)?	Either amend data collected, or amend assessment method.
Report	Identify if reporting is to be separate by country, or combined.	Share data to ensure scientific conclusions are common (administrative or political conclusions may differ).
Funding	Arrange long term solutions such as a central funding source across countries with incentive to cooperate (e.g. EU Data Collection Framework).	Agree regional funding mechanisms.
Do Not Forget	Assess scientific and cost benefits of monitoring jointly against monitoring by individual countries.	Decision whether to sample jointly between countries may be affected by political considerations.

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