OSPAR COMMISSION

*Protecting and conserving the North-East Atlantic and its resources*

# OSPAR Science Agenda 2018 Update


Monitoring and Assessment Series

2019

**OSPAR Convention**

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

**Convention OSPAR**

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

# 2018 OSPAR Science Agenda for marine environment assessments

This OSPAR Science Agenda (OSA) updates the first version that was published in 2015. The current OSA contains a prioritised list of 44 knowledge gaps, aiming at improving future OSPAR assessments, notably the OSPAR's next Quality Status Report (QSR) due in 2023, and contains suggestions for increasing OSPAR's knowledge base. Whilst OSPAR recognises there are gaps in knowledge in many strands of work, this update is based on knowledge gaps identified in OSPAR's 2017 Intermediate Assessment (IA2017).

The OSA is organised in two parts:

PART I

Section 1 includes the brief introduction below, sets the objectives and the role of the OSA and summarises the main science needs. The entire list of priority science needs is in Annex I.

Section 2 describes the approach adopted for the identification and prioritisation of knowledge gaps and who was involved. A more detailed description is in Annex II.

Section 3 contains suggestions for focused action to close the knowledge gaps and to make better use of new scientific knowledge gained.

PART II

This part contains the entire list of knowledge gaps identified in IA2017, sorted by indicator or thematic assessment. Knowledge gaps selected for the prioritised list often relate to other relevant knowledge gaps. For each knowledge gap, information on geographic scope, importance for assessments, relevance for policy measures and an indication of costs is given.

## PART I

### *Background*

In 2015, OSPAR developed the OSPAR Science Agenda (OSA2015) in order to identify gaps in knowledge that hamper progress towards achieving the aims of OSPAR's thematic strategies and to set out a procedure to ensure that science needs are well defined and based on common understanding of knowledge needs. The OSA2015 was based on the 2010 Quality Status Report of the marine environment of the North-East Atlantic (QSR2010) and successive thematic assessments. The identification of science needs was done by individual OSPAR committees and their subsidiary bodies, assisted by the Secretariat and the OSPAR Science Agenda Task Group (OSA TG), during the 2012-2013 and 2013-2014 meeting cycles. Priority Marine Strategy Framework Directive (MSFD) knowledge gaps, identified in the European Union's STAGES project[1], were also included.

The publication of the OSA2015 coincided with the first of a series of EU EMFF[2] calls aiming at supporting the implementation of the MSFD by Member States through collaboration in Regional

[1] www.stagesproject.eu

[2] European Maritime and Fisheries Fund

Sea Conventions. Consortia of national institutions active in OSPAR successfully applied for EU funding which resulted in projects contributing to the development of the assessments of IA2017.

In 2017, OSPAR finalised the IA2017 to provide a common basis for the 2018 reporting under the MSFD, using a set of agreed common indicators. The scope of IA2017 differs from that of the QSR2010, and therefore the OSA2015. Whereas the OSA2015 knowledge gaps cover all steps in the OSPAR process, i.e. from monitoring up to assessment of the effectiveness of measures, knowledge gaps of the IA2017 are focused on monitoring and assessment of status and impacts due to the nature of the assessment. Furthermore, the IA2017 knowledge gaps are limited to the topics of the OSPAR common indicators and a set of thematic assessments.

The major impetus for the current update is the need to support the preparation of QSR2023.The 'Knowledge Gaps' identified in the 42 indicator assessments, 5 thematic assessments on OSPAR strategies and three other thematic assessments in the IA2017 provided the basis for the update.

At its meeting in May 2016, OSPAR's Coordination Group (CoG) agreed that a reiteration of OSA2015 would be reconsidered at CoG(2) 2017. Continued work in the meeting cycle 2017/2018, involving all thematic committees and their subsidiary groups, led to this 2018 OSPAR Science Agenda for marine environment assessment containing a list of 44 prioritised science needs considered to be the core of the OSA.

This update of the OSA is a living document, to be reviewed and updated on a regular basis, for instance after the QSR2023.

### *Section 1 Priority science needs for OSPAR's assessments*

The main objectives of the OSA 2018 update are to:

- prioritise the knowledge gaps identified in the IA2017 in a transparent and objective manner to support achieving the aims of the OSPAR strategies;
- set out a procedure to ensure that science needs are well defined and based on common understanding of knowledge needs among both policy makers and experts within OSPAR.

The role of OSA 2018 is to:

- highlight the priority science needs for future assessments, especially for QSR2023;
- inspire marine scientists to direct their research towards defined management needs and avoid duplication;
- promote development of joint research projects and sharing knowledge/scientific results by Contracting Parties;
- provide a focus for EU and other joint funding programmes;
- strengthen cooperation between OSPAR and its partner organisations such as International Council for the Exploration of the Sea (ICES).

This update is important not only as a product but also as a process. As a process, it has been very useful to initiate dialogue and increase understanding of current knowledge gaps and future science needs among policy makers and experts working within different OSPAR committees and groups.

The scope of the OSA follows the scope of the IA2017, i.e. monitoring and assessment of status and impacts.

The prioritised knowledge gaps are presented in Annex I. These have been identified as the most urgent needs to improve a next assessment of common indicators and themes. Moreover, they fall under the strategic priorities identified at the policy level.

A summarised list of prioritised knowledge gaps is below:

a. Further development of (common and candidate) indicators to fulfil the requirements of the (primary) criteria of the revised EU MSFD Commission Decision 2017, and to allow increased coverage of existing common indicators. Highest priorities are for pelagic and benthic habitats, seabirds and food webs (biodiversity); and marine litter, noise, eutrophication, non-indigenous species and the oil and gas industry (pressures);
b. Thresholds and reference values for common indicators. Highest priorities are for fish communities, marine mammals and food webs (biodiversity); and for contaminants (including in dredged material) and radioactive substances, as well as eutrophication and marine litter (pressure);
c. Ecologically meaningful assessment areas. Highest priority is for eutrophication, to solve incoherent assessment outcomes (pressure);
d. Cumulative effects and integration of indicators. Highest priorities are for integrated ecosystem assessments in general and eutrophication, and cumulative impacts of human activities on marine mammals and food webs;
e. Effectiveness of measures to reduce pressures. This is an overarching priority, including socio-economic assessments, and for the management of Marine Protected Areas.

It should be noted that improving OSPAR's assessments in many cases relies also on solving the knowledge gaps that have not been prioritised. The entire list of IA2017 knowledge gaps is in Part II.

## *Section 2 Identification of priority needs*

### 2.1 description of approach

As a first step, distinct knowledge gaps contained in the IA assessments were identified based on the criterion that a knowledge gap is *a lack of true understanding of a topic or method*. Another criterion is that scientific projects would be able to solve the knowledge gap. Thus, gaps relating to database management, data sharing, data flow, cooperation in monitoring etc. were excluded.

An effort was also made to link the IA2017 knowledge gaps to the priority science needs in the OSA 2015. This analysis showed that linking of the IA knowledge gaps to OSA science needs is not straightforward and the overlap was marginal. For example, of the 194 knowledge gaps identified, only 25 can be covered by the priority science needs identified in the OSA 2015.

Once all the knowledge gaps in the IA2017 were captured and reviewed by experts responsible for the IA2017 assessments, it became obvious that a shorter list of priority knowledge gaps needed to be developed. During the 2017-2018 meeting cycle, the OSA TG prepared guidance on how committees can contribute to identifying priority science needs and steered the process of prioritisation under the guidance of CoG. In order to ensure that the prioritisation of IA knowledge

gaps proceeded, as far as possible, in a transparent and objective manner, the OSA TG developed a set of criteria (ref. Annex II) to be used for prioritisation.

To make the process as inclusive as possible, the OSA TG sought the collaboration of the entire OSPAR family. Input of both policy makers at OSPAR committee level (BDC, HASEC, EIHA, RSC and OIC) and experts (ICG-COBAM, ICG-MPA, ICG-POSH, MIME, INPUT, ICG-Eut, ICG-EcoC, ICG-ML, ICG-Noise and ICG-MSFD) was obtained. Additionally, IA2017 indicator assessment authors were also consulted. This structured and inclusive process ensured that the prioritisation of the knowledge gaps identified in the IA2017, is based on the views held by the broader OSPAR community regarding the way forward for the future scientific research within OSPAR and priorities to support preparation of QSR2023.

2.2 Distribution of knowledge gaps among OSPAR working areas

This prioritisation led to the identification of 19 knowledge gaps on biodiversity issues and 25 knowledge gaps on pressures, out of in total 194.

**Table 1: Summarised overview of knowledge gaps per Committee**

| OSPAR Committee | Number of Assessments | Number of priority Knowledge Gaps | Total number of knowledge Gaps |
|---|---|---|---|
| BDC | 23 | 19 | 89 |
| EIHA | 7 | 11 | 32 |
| HASEC | 17 | 12 | 65 |
| OIC | 1 | 1 | 5 |
| RSC | 1 | 1 | 3 |
| **Total** | **49** | **44** | **194** |

OSPAR experts were requested to identify the most important one or two knowledge gaps for each assessment. Therefore, the prioritised list of knowledge gaps represents the most urgent needs for assessment. It should be noted however, that all the knowledge gaps identified and provided in Part II are also useful for improved assessment.

Once the priorities at the indicator level were defined, committees realised the need for a more strategic steer /approach across all OSPAR work areas. Thus, the priority knowledge gaps defined above were linked to higher level /strategic science needs. The following set of five high-level strategic priorities was proposed:

a. Further development of (common and candidate) indicators to fulfil the requirements of the criteria of the revised EU Commission Decision 2017, and to allow increased coverage of existing common indicators, noting the lack of coverage in Regions I, IV and V (BDC, EIHA);

b. Thresholds and reference values for common indicators (BDC, EIHA and HASEC);

c. Ecologically meaningful assessment areas (BDC, EIHA and HASEC);

d. Cumulative effects and integration of indicators (not necessarily the same: ecosystem understanding vs condensed reporting) (BDC, EIHA and HASEC);

e. Effectiveness of measures to reduce pressures (EIHA).

An analysis of the number of knowledge gaps that are also considered important at the indicator level (44 in total), under each of the strategic priorities, reveals that 19 are linked to *indicator development*. As expected, these knowledge gaps fall mostly within the scope of EIHA and BDC (Figure 1), since many new (common) indicators have been assessed for the first time, for instance pelagic and benthic habitats and their communities, and food webs. Cumulative effects and integration is another important area of research (7 priority knowledge gaps), notably for biodiversity.

Slightly fewer (14) priority knowledge gaps relate to development of thresholds and reference values, notably for HASEC and BDC assessments. This reflects the search for coherent assessment levels, including for existing indicators that have already been assessed in previous QSRs. Priority knowledge gaps related to *cumulative effects/indicator integration* are less numerous (7), but they reflect the importance of understanding ecosystem functioning as a whole. This number may increase once the revised MSFD Commission Decision, including its linkages between criteria or indicators, is further implemented. The development of *assessment areas* generally is considered a less urgent science need, although it will become important in more integrated assessments, such as the upcoming QSR2023. The QSR will also address the *effectiveness of measures,* which was outside of the scope of the IA2017 although still considered a priority in some indicator assessments.

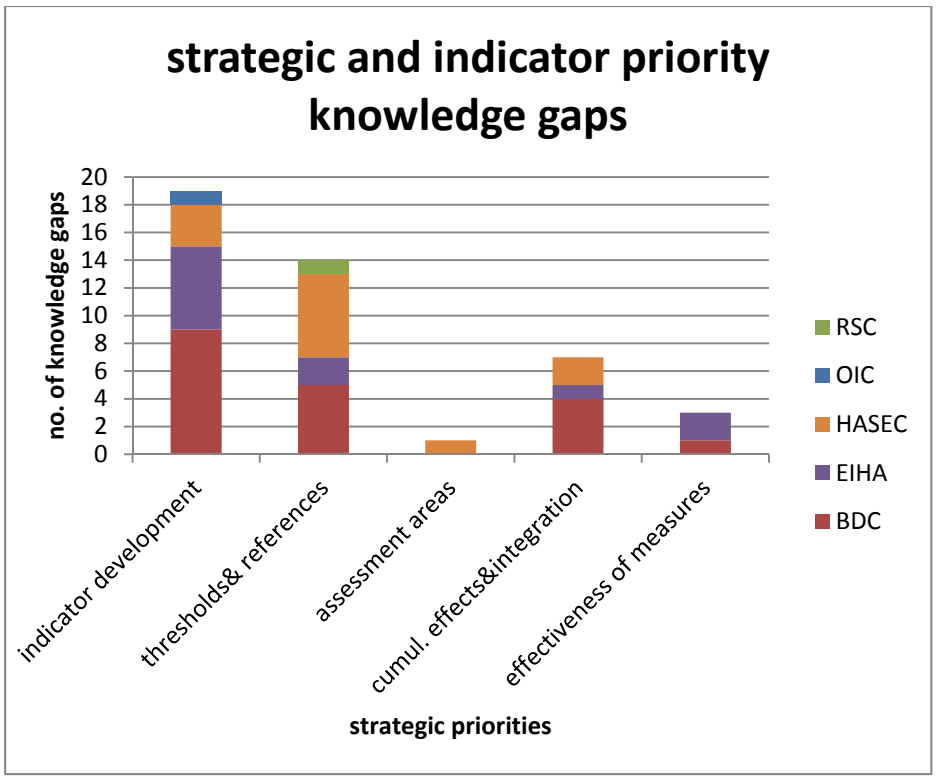


*Figure 1. distribution of knowledge gaps among strategic priorities as identified by Committees. These knowledge gaps are also selected as the main priorities from the perspective of indicator*

*assessments. The majority of knowledge gaps (of 44 in total) are linked to 'indicator development' and 'thresholds and references'.*

## *Section 3 Ensuring best use of science*

The main driver for advancing OSPAR's knowledge base is the commitment of Contracting Parties to contribute to the North-East Atlantic Environment Strategy. OSPAR is obliged to protect and conserve ecosystems and biodiversity through the management of human activities, guided by an ecosystem-based approach to management (EBM).

### 3.1 What has OSPAR done so far?

In the QSR2010, OSPAR assessed ten ecological quality objectives developed for the North Sea which focused mainly on the interactions between mobile species and human pressures. Since 2010, OSPAR scientists and policy makers have developed indicators that can help to assess pelagic and benthic habitats and their communities, and food webs. These indicators are assessed for the first time in IA2017. It is the gaps in knowledge that the IA2017 identified that have been the basis for this update of the OSPAR Science Agenda. As OSPAR continues to develop its approaches and assessment methods with each additional assessment cycle, understanding of natural and human-induced change in the complex and dynamic marine environment will further improve.

The North-East Atlantic Environment Strategy 2010-2020 to a great extent overlaps the requirements of the EU Marine Strategy Framework Directive and national marine policies for Contracting Parties that are not EU Member States. The requirements of assessment of Good Environmental Status under the MSFD have recently been further detailed in the 2017 EU Commission Decision[3]. This challenges the marine scientific community, within and outside of OSPAR, including international institutions providing ecosystem advice, such as ICES, JRC and EEA, as well as national institutes for marine research.

Articulation of research needs often proves difficult. The policy objectives of the EBM framework are mostly high-level and qualitative and not yet supported by agreed methods to perform ecosystem assessments and evaluate the effectiveness of management measures. Additionally, articulation of research that supports policy development requires regular and continued dialogue between policy makers and scientists. Involvement of and mutual understanding among scientists and policy makers are needed to ensure that scientific advice can be used in practice.

Such interaction is in principle supported by the organisation of OSPAR, where scientists and policy advisors collaborate in working groups and Intersessional Correspondence Groups. Their products are successively reviewed in the thematic committees and decided upon by the OSPAR Commission. Each step in this hierarchy provides an opportunity to articulate science needs and present new research to close knowledge gaps in an iterative manner. It also provides opportunities for the policy maker to explain the most important policy needs. The way OSPAR works, i.e. agreement of annual thematic work programmes and lead countries volunteering to advance the agreed products, ensures ownership and use of scientific results, at least for those countries that actively contribute.

The resources required to meet the challenges posed by EBM far exceed the available capacity and budget of Contracting Parties. Therefore, Contracting Parties increasingly use EU funding

[3] COMMISSION DECISION (EU) 2017/848

programmes to contribute to OSPAR products. They may use programmes that require projects to actively contribute to the work of Regional Sea Conventions (RSCs) (e.g. EMFF), or stimulate collaboration between neighbouring countries (e.g. INTERREG). Other programmes (e.g. H2020, including the upcoming BANOS CSA[4]) are also used, although transfer of scientific results to OSPAR's work often requires additional effort, both from scientists and policy makers. A recurring complaint from funding programme managers is that uptake of scientific results in policy and management is sub-optimal and should be enhanced.

### 3.2 What can OSPAR do to close the priority knowledge gaps?

OSPAR could be a proactive client of scientific projects in general. This could involve:

a. Actively seeking funding opportunities and supporting or coordinating proposals for projects. This can be done in the context of EU funding programmes and also by bringing together national research budgets, for instance through JPI Oceans pilot initiatives;

b. Contributing to relevant projects initiated outside of OSPAR, e.g. by participation in policy steering groups from the early stages of the project development. This is much appreciated by most consortia, since it enhances the visibility of the project and increases its potential impact on marine policy and management;

c. Inviting project coordinators to share their results in OSPAR groups, e.g. through presentations. This may require effort and time, both from the project and from the OSPAR group, to translate the project results to the science needs and vice versa. It also requires an open eye for scientific projects, both ongoing and completed;

d. Using OSPAR's scientific network, including organisations such as ICES, JRC and EEA, to invite expert groups therein to contribute to the priority science needs. ICES is increasingly sensitive to science needs in RSCs and MSFD and organises better involvement of the scientific expert groups in ecosystem advice. ICES also provides links to EBM knowledge and best practices in the US and Canada.

e. Last but not least: sharing the OSPAR science agenda with organisations responsible for funding programmes to inspire their calls for proposals, e.g. the European Commission and The Baltic and North Sea Coordination and Support Action (BANOS CSA) 'Towards a Baltic and North Sea research and innovation programme' BANOS CSA.

### 3.3 Limitations of the current update

During the development of the 2018 OSPAR Science Agenda for marine environment assessments a number of choices had to be made, related to the time available (one meeting cycle, hence limited iterations with OSPAR groups) and the scope and contents of the IA2017. It should therefore be noted that the following limitations apply:

a. the OSA update only addressed those knowledge gaps identified during 2016 in the production of the IA2017. However, knowledge gaps were reviewed and updated during the 2017/18 cycle;

[4] HORIZON 2020 coordination and support action "Towards the joint Baltic Sea and the North Sea research and innovation programme" (BANOS CSA)

b. b. identifying knowledge gaps was part of the process of producing indicator and thematic assessments for the IA2017. Some of these assessments referred to climate change knowledge gaps. However, the chapter on climate change itself did not identify other knowledge gaps;

c. the OSA TG could not do a review of the OSA 2015 to check how much has been achieved. Many of these science needs are still relevant.

## Annex I: Priority knowledge gaps based on the OSPAR Intermediate Assessment 2017

| Theme | Strategic priority | Ecosystem component or human activity | Indicator (common or candidate) | Priority knowledge gap (short description) |
|---|---|---|---|---|
| **Human Activities** | 1. indicator development | Non-Indigenous Species | 1.1. Trends in New Records of Non-Indigenous Species Introduced by Human Activities | 8. Investigate and define optimised monitoring design for the European Union Marine Strategy Framework Directive, with potential applicability to other policy drivers. |
| | 1. indicator development | Marine Litter | 6.5 All marine Litter indicators | 1. There is still limited understanding of the harm caused by certain types of litter. |
| | 1. indicator development | Marine Litter | 6.1. Beach Litter - Abundance, Composition and Trends | 3. The present allocation of sources in Litter Analyst is not precise enough to be used to identify sources for the OSPAR assessment units. Identification of sources need to be improved to enable allocation of particular OSPAR litter items to given sources at sub-regional level. This should be done in line with recommendations of the MSFD TG on Marine litter. |
| | 1. indicator development | Marine Litter | 6.2. Composition and Spatial Distribution of Litter on the Seafloor | 1. Future litter assessments should include modelling to determine sources and pathways taking into account seasonal influences, weather patterns and changes in currents, all of which could affect the distribution of litter. |
| | 1. indicator development | Marine Litter | 6.4 Microplastics (candidate indicator) | 1. Effects of micro litter on biota and the marine environment |
| | 1. indicator development | Noise | 7.1. Distribution of Reported Impulsive Sounds | 2. Further development (and validation) of frameworks that can be used for larger scale assessment of impulsive sound impacts on populations and the ecosystem, including relation between direct responses and population consequences, spatial risk-assessment approaches and population modelling. |
| | 1. indicator development | Noise | 7.2 Continuous low frequency sound (candidate indicator) | 2. Develop knowledge on direct effects of elevated ambient noise levels on fish communication |
| | 1. indicator development | Eutrophication | 3.2. Winter Nutrient Concentrations in the Greater North Sea, Kattegat and Skagerrak | 2. Better informed models are required to estimate long-distance transports of nutrients and their regional effects |

| Theme | Strategic priority | Ecosystem component or human activity | Indicator (common or candidate) | Priority knowledge gap (short description) |
|---|---|---|---|---|
| | 1. indicator development | Eutrophication | 3.5. Concentrations of Dissolved Oxygen Near the Seafloor | 5. The methodology, developed over years and refined for this assessment, requires further development to address questions about the feasibility and practicalities of near-bed monitoring and assessment. |
| | 1. indicator development | Eutrophication | 3.1. Nutrient Inputs to the Greater North Sea and the Bay of Biscay and Iberian Coast | 4. Atmospheric phosphorus deposition is effectively unknown, with no observations over the sea, few observations over land and no operational modelling. |
| | 1. indicator development | Oil and Gas Industry | 12.1Trends in Discharges, Spills and Emissions from Offshore Oil and Gas Industry | 4. Improve understanding on the fraction of chemicals and oil discharged during offshore oil and gas activities and impacts on the receiving environment |
| | 2. thresholds& references | Marine Litter | 6.3. Plastic Particles in Fulmar Stomachs in the North Sea | 1. Dedicated experimental laboratory-based research to demonstrate harm to fulmars from specified levels and types of plastics and literature research and application of selected modelling methods to develop a No Effect Level (NEL) for plastics in fulmars. |
| | 2. thresholds & references | Radioactive Substances | 11.1 The Fourth Periodic Evaluation of Progress towards the Objective of the Radioactive Substances Strategy | 2. Determine additional activity concentrations in the marine environment resulting from discharges of naturally occurring radionuclides in produced water to the marine environment. |
| | 2. thresholds& references | Dredged Material | 5.1. Dumping and Placement of Dredged Material | 2. Identification and development of baseline levels for new contaminants having properties of persistence, bioaccumulation and toxicity that may accumulate in dredged material. |
| | 2. thresholds& references | Eutrophication | 3.6. Third OSPAR Integrated Report on the Eutrophication Status of the OSPAR Maritime Area, 2006-2014 | 1. Scientifically sound, area-specific assessment levels of the OSPAR's harmonised criteria used in the diagnoses of eutrophication in the Common Procedure are needed. |
| | 2. thresholds& references | Hazardous Substances | 2.10. Status and Trend for Heavy Metals (Cadmium, Mercury and Lead) in Sediment | 1. Lack of ecotoxicological data for developing new assessment criteria based on the EU WFD or OSPAR Environmental Assessment Criteria (EAC) principles, to replace the current Effects Range-Low (ERL) criteria |
| | 2. thresholds& references | Hazardous Substances | 2.3. Status and Trends of Polychlorinated Biphenyls (PCB) in Fish and Shellfish | 2. OSPAR should consider developing EAC for the purpose of protection against secondary poisoning. |

| Theme | Strategic priority | Ecosystem component or human activity | Indicator (common or candidate) | Priority knowledge gap (short description) |
|---|---|---|---|---|
| | 2. thresholds& references | Hazardous Substances | 2.5. Trends in Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Fish and Shellfish | 2. Assessment values applicable to OSPAR monitoring for temporal trends and the status of polybrominated diphenyl ethers (PBDEs) in biota need to be developed. |
| | 2. thresholds& references | Hazardous Substances | 2.6. Trends in Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Sediments | 2. Background Assessment Concentrations (BACs) and Environmental Assessment Criteria (EACs) need to be developed for PBDE concentrations in sediment. |
| | 2. thresholds& references | Hazardous Substances | 2.9. Status and Trend for Heavy Metals (Mercury, Cadmium, and Lead) in Fish and Shellfish | 1. Re-examine environmental quality criteria for mercury in fish which were derived by the EU which are lower than background concentrations |
| | 3. assessment areas | Eutrophication | 3.3. Concentrations of Chlorophyll-a in the Greater North Sea and Celtic Seas | 4. Options for aligning the assessment scales between the various indicators for phytoplankton (for ex. PH2 – Changes in Plankton Biomass and Abundance for chlorophyll-a) need to be studied. |
| | 4. cumulative effects & integration | Ecosystem assessment outlook | 8.1. Ecosystem assessment outlook | 3. Quantification of relationships / connections between indicators (cause-effects) within BTA ecosystem model, e.g. we can implicitly make connections between indicators such as contaminants in sediments with contaminants in biota with seabird breeding success and seabird abundance & distribution but how 'strong' are these relationships and how confident are we in the links |
| | 4. Cumulative effects & integration | Eutrophication | 3.4. Trends in Blooms of the Nuisance Phytoplankton Species Phaeocystis in Belgian, Dutch and German Waters | 5. Research on causes for population dynamics of Phaeocystis and other phytoplankton indicator species, including nutrients, food web interactions and climate change |
| | 4. cumulative effects & integration | Eutrophication | 3.7. Overarching eutrophication-related issues | 1. Developing a better understanding of the connections between the MSFD descriptors D5 eutrophication, D1 pelagic habitats and D4 food webs to obtain a consistent assessment of these aspects under the MSFD |
| | 5. effectiveness of measures | Overarching | 10.1 effectiveness of measures | 1. Develop a methodology for the assessment of the effectiveness of measures in reducing pressures |

| Theme | Strategic priority | Ecosystem component or human activity | Indicator (common or candidate) | Priority knowledge gap (short description) |
|---|---|---|---|---|
| | 5. effectiveness of measures | Socioeconomics | 9.1 Socioeconomics of the OSPAR Maritime Area | 2. Lack of socio-economic evidence of trade-offs between economic activities and environmental pressures and how to support decisions able to deliver the highest benefits to society |

| Theme | 2. Strategic priority | 3. Ecosystem component or human activity | 4. Indicator (common or candidate) | 5. Priority knowledge gap (short description) |
|---|---|---|---|---|
| **Biodiversity** | 1. indicator development | Pelagic Habitats | 2.1. Changes in Phytoplankton and Zooplankton Communities | 1. Further scientific research to examine the magnitude and direction of change in the Plankton Index with respect to each lifeform pair, as well as the ecological consequences of such change, for each lifeform pair in each ecohydrodynamic zone |
| | 1. indicator development | Pelagic Habitats | 2.2. Changes in Phytoplankton Biomass and Zooplankton Abundance | 5. Future research & monitoring studies should address various gaps in monitoring data coverage, particularly at the large scale, in order to further develop this indicator |
| | 1. indicator development | Pelagic Habitats | 2.3. Pilot assessment of Changes in Plankton Diversity | 2. Conventional sampling protocols should be supplemented with state-of -the -art methods such as flow-cytometry, image analysis and molecular approaches to permit higher spatial and temporal resolution, increase speed, accuracy and resolution of species identification and to allow for monitoring the whole size range of the phytoplankton community. |
| | 1. indicator development | Benthic Habitat Communities | 3.0 Benthic Habitat Expert Group Multiyear Work Plan (See doc) | 2. Lack of an agreed OSPAR/ EU scale monitoring method and program: Develop guidance on monitoring requirement, including sampling design, methods, frequencies and protocols |
| | 1. indicator development | Benthic Habitat Communities | 3.0 Benthic Habitat Expert Group Multiyear Work Plan (See doc) | 4. Limited availability of spatial data on benthic species and communities to undertake accurate predictive mapping and assess the state of the habitat. Lack of an agreed classification at the OSPAR level |

| Theme | 2. Strategic priority | 3. Ecosystem component or human activity | 4. Indicator (common or candidate) | 5. Priority knowledge gap (short description) |
|---|---|---|---|---|
| | 1. indicator development | Food Webs | 5.1. Pilot Assessment of Production of Phytoplankton | 4. Need for a consistent regional monitoring strategy for phytoplankton primary production within OSPAR needs that takes into account the techniques available and the best temporal frequency that can be applied to primary production assessments |
| | 1. indicator development | Marine Birds | 7.1. Marine Bird Abundance | 2. This indicator assessment could be expanded to include more data on seabirds and water birds collected at sea in order to obtain reliable results on trends in species that occur in substantial numbers offshore |
| | 1. indicator development | Marine Birds | 7.2. Marine Bird Breeding Success / Failure | 1. Gaps in data available for the assessment is significant and is a major drawback for the wider application of this assessment |
| | 2. thresholds & references | Food Webs | 5.2. Proportion of Large Fish (Large Fish Index) | 1. the lack of empirical data (including historical data) or appropriate models to inform Large Fish Index (LFI) assessment value setting |
| | 2. thresholds & references | Fish communities | 6.2. Size Composition in Fish Communities | 1. Appropriate baselines and assessment values for this indicator needs to be identified preferably through multi-species modelling |
| | 2. thresholds & references | Fish Communities | 6.3. Pilot Assessment of Mean Maximum Length of Fish | 2. Reference levels representing a pristine or sustainably exploited state and that would allow a formal assessment, are not yet available |
| | 2. thresholds & references | Fish communities | 6.1. Recovery in the Population Abundance of Sensitive Fish Species | 1. Non- availability of suitable population dynamics models to support the setting of absolute abundance assessment values for sensitive fish species |
| | 2. thresholds & references | Marine Mammals | 4.2. Grey Seal Pup Production | 4. Further demographic studies could help predict the natural carrying capacity for the number of grey seals in the North-East Atlantic and provide an indication of likely future trends in pup production, with and without impacts from human pressures |
| | 4. cumulative effects & integration | Marine Mammals | 4.4. Pilot Assessment on Abundance and Distribution of Killer Whales | 3. Further study of the relationship between human activities (e.g. disturbance, pollution, fishing, habitat alteration) and their impact on killer whale populations is required. |
| | 4. cumulative effects & integration | Marine Mammals | 4.3. Abundance and Distribution of Coastal Bottlenose Dolphins | 5. Further study of the relationship between human activities (e.g. disturbance, pollutant loads, overfishing, habitat alteration) and their impact on bottlenose dolphin populations is required. Priority 2. |

| Theme | 2. Strategic priority | 3. Ecosystem component or human activity | 4. Indicator (common or candidate) | 5. Priority knowledge gap (short description) |
|---|---|---|---|---|
| | 4. cumulative effects & integration | Marine Mammals | 4.1. Seal Abundance and Distribution | 5. More research is needed to establish direct links between population and human activities |
| | 4. cumulative effects & integration | Food webs | 5.3. Change in Average Trophic Level of Marine Predators in the Bay of Biscay | 2. Further improvement of the assessment of the state of the food web, requires incorporation of additional datasets on biological compartments that are not currently included (e.g. benthos, mammals, or birds), investigation of the influence of various anthropogenic pressures, investigation of finer geographic scales and further definition of assessment values. |
| | 5. effectiveness of measures | Marine Protected Areas | 1.1. Summary Status of the OSPAR Network of Marine Protected Areas (2016) | 3. Improved information on the management status of all OSPAR MPAs and development of method to assess management effectiveness |

## Annex II: Identification of IA2017 Knowledge Gaps

As a follow-up to the finalisation of the Intermediate Assessment (IA) 2017 and CoG Programme of Work, Product 5, the OSPAR Science Agenda Task Group (OSA TG) led by the Netherlands, examined the feasibility of developing an update of the 2015 OSA beginning summer 2017. The major impetus for this was the need to support the preparation of QSR2023 and the basis for the update was the 'Knowledge Gaps' sections in the Indicator Assessment sheets in the IA2017.

The knowledge gaps (Brief and Extended) described in each of the IA2017 assessment sheets were reviewed. In total the IA2017 contain 42 indicator assessments, 5 thematic assessments on OSPAR strategies and three other thematic assessments in the IA201742. These sections generally contain running text, often without a clear distinction among knowledge gaps. This arose due to lack of adequate emphasis and guidance on drafting knowledge gaps during the IA2017 formulation process.

In this process, distinct Knowledge gaps were selected based on the criterion that a knowledge gap is "a lack of true understanding of a topic or method". Thus, gaps relating to database management, data sharing, data flow, cooperation in monitoring etc. were excluded. The main reason for this exclusion is that data collection and management for OSPAR and MSFD assessment purposes often is a continuous effort organised through national monitoring programmes and as such less suitable for scientific projects. Selected knowledge gaps were reformulated where necessary, to bring out distinctly the science need. The purpose of this analysis was to identify all the knowledge gaps identified in the IA2017 Indicator Assessment sheets, provide a short description of each gap and make an overview.

An effort was also made to link the IA2017 knowledge gaps to the priority science needs in the OSPAR Science Needs Agenda (OSA) 2015. This analysis showed that Linking of the IA knowledge gaps to OSA science needs is not straightforward and the overlap was marginal. For example, of the 193 knowledge gaps identified, only 25 can be covered by OSA 2015. In this analysis, OSA Task Group was assisted by consultants from WaterPlanet Earth and Coastal and Marine Environment Management.

### *Who were involved*

As mentioned in the main document, this update of the OSA is important both as a product and as a process. As a process, it has been very useful to initiate dialogue and increase understanding of current knowledge gaps and future science needs among policy makers and experts working within different OSPAR Committees and Working Groups. CoG(1) 2017 initiated the update of the OSA, asking for a quick process to stimulate closing or reducing the main knowledge gaps in time for the QRS 2023.

Once the all the knowledge gaps in the IA2017 were captured and reviewed by experts responsible for the IA2017 assessments, they had to be prioritised. During the 2017-2018 meeting cycle, the OSA TG prepared guidance on how Committees and Working Groups can contribute to identifying priority science needs and steered the process of prioritisation under the guidance of the CoG. In order to make the process as inclusive, as possible, OSA TG sought the collaboration and input of both policy makers, and experts/scientists including IA2017 indicator assessment authors. OSA TG presented updates and guidance to policy makers for discussion at OSPAR Committee level i.e. BDC,

HASEC, EIHA, RSC and OIC as well as, experts within underlying working groups, i.e. ICG-COBAM, ICG-MPA, MIME, INPUT, ICG-Eut, ICG-EcoC, ICG-ML, ICG-Noise and ICG-MSFD. Further The OSA TG presented updates on the process to CoG(2) 2017 and CoG(1) 2018. This structured and inclusive process ensured that the prioritisation of the knowledge gaps identified in the IA2017, is based on the views held by the broader OSPAR community regarding the way forward for the future scientific research within OSPAR and priorities to support preparation of QSR2023.

### *Prioritisation Of Knowledge Gaps*

At the indicator level:

At the very early stage, OSA TG realised that the 193 IA knowledge gaps identified is far too many and prioritisation was inevitable.

In order to ensure that the prioritisation of IA Knowledge Gaps proceed, as far as possible, in a transparent and objective manner, OSA TG developed a set of criteria to be used for prioritisation. The need for effective measures to reduce impact of human activities and to make optimal use of limited funding opportunities available for research was taken into consideration.

These criteria and related classes for quantification and prioritisation are:

a. **Policy deadline**: the research question should relate to a concrete OSPAR deadline, notably the QSR2023 or next MSFD assessment in 2024:

   i. 2018-2024 (high priority) ii. 2025-2030 iii. 2030 and later

b. **Sub Regional**: the research need is generic and needs to be used by several Contracting Parties and responsibility should not be with single Contracting Party; the research question should be applicable at the region or sub-region level:

   i. Sub region ii. Region (high priority) iii. EU (high priority) iv. Global (high priority)

c. **Severity/impact:** the research question should be related to a human activity or a potential measure that has the potential to have an impact at the ecosystem level or at habitat/species level and/or support a potential measure. *Relates to pressure science needs, hence* difficult to apply for biodiversity knowledge gaps.

   i. High (high priority) ii. Medium iii. Low

d. **Likelihood of success**: answering the research question should be possible and, in combination with solving other identified research questions, be sufficient to fulfil a policy need:

   i. High (high priority) ii. Medium iii. Low

e. **Decrease in uncertainty**: i.e. by increasing our confidence in an assessment of impact on the environment, OSPAR can be more confident of taking appropriate measures – policy makers want to know whether to spend money (proposed by ICG-MSFD):

   i. High (high priority) ii. Medium iii. Low

f. **Approximate cost** of addressing the knowledge gap and possible financing options:

   i. < 100 k€ (high priority) ii. 100 - <5 00 k€ (high priority) iii. 500 - <1M k€iv >= 1 M€

Based on the above criteria for prioritisation, completed by using drop down menus in the excel Table (CoG(2) 18/3/4 Add.1) and taking into account any explanation in the column "comments", Committees and WGs identified the main knowledge gap or gaps for each IA2017 indicator and thematic assessment. Some originally selected knowledge gaps were deleted or reworded and some new knowledge gaps inserted by the expert groups.

The **green** cells in the overview Table indicate 'high' scores and the highest number of green cells simply identifies the priority knowledge gaps for each indicator (column N), unless the expert group or indicator lead stated differently in the 'Comments' column M.

This process resulted in a total of 43 knowledge gaps (BDC 18 priorities, EIHA 13 priorities and HASEC 12 priorities). OIC and RSC have two priority knowledge gaps each.

<u>At the Strategic level</u>

Further deliberations at BDC and at a later stage at EIHA and HASEC emerged the view that prioritisation at the indicator level alone is insufficient for the development of a meaningful and concise list of OSPAR science needs that is aligned with the OSPAR mandate. This requires a more strategic steer at the level of OSPAR Committees and across the OSPAR work areas. BDC 2018 trialled a 'nested approach' to link higher level/strategic science needs with the more concrete knowledge gaps of the IA2017. In collaboration with BDC, HASEC and EIHA participants these strategic priorities were linked to the prioritised IA2017 knowledge gaps. This analysis of the prioritised knowledge gaps at the indicator level, falling under each of the strategic priorities, reveals that most are linked to four strategic priorities viz. *indicator development*, *thresholds and reference levels, Ecologically meaningful assessment areas* and *cumulative effects/indicator integration* (Figure 2). Two other strategic priorities, *effectiveness of measures* and *emerging issues related to human activities* were underrepresented, owing to the limited scope of the IA2017. Therefore, it was decided not to further develop knowledge gaps within these priorities scope during the current OSA update.

The following set of strategic priorities was used for further prioritisation:

a. Further development of (common and candidate) indicators to fulfil the requirements of the criteria of the revised EU Commission Decision 2017, and to allow increased coverage of existing common indicators, noting the lack of coverage in Regions I, IV and V (BDC, EIHA);

b. Thresholds and reference values for common indicators (BDC, EIHA and HASEC);

c. Ecologically meaningful assessment areas (BDC, EIHA and HASEC);

d. Cumulative effects and integration of indicators (not necessarily the same: ecosystem understanding vs condensed reporting) (BDC, EIHA and HASEC).

e. Effectiveness of measures to reduce pressures (EIHA).

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