OSPAR COMMISSION

Human Activities
Thematic Assessment

OSPAR

QUALITY STATUS REPORT 2023

2022

OSPAR's Quality Status Report 2023

Human Activities Thematic Assessment

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

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Contents

Executive summary

This thematic assessment summarises information on human activities affecting the marine environment of the North-East Atlantic.

The main activities described are those covered in the feeder reports on extraction of aggregates and other minerals; agriculture; aquaculture; fisheries; production and consumption of plastics; renewable energy development; shipping; tourism and recreation; and management of waste water; and in the thematic assessment on oil and gas extraction.

The assessment also describes, in the Impact section, the ongoing OSPAR work on ecosystem services and natural capital, and how it is used in the overall QSR 2023 assessment of the state of the marine environment. OSPAR's general approach to cumulative impacts assessment is described in the section on bow-tie analysis. There is no attempt to construct a bow-tie analysis for all human activities.

Q1. Identify the problems? Are they the same in all OSPAR Regions?

The marine environment of the North-East Atlantic continues to experience multiple pressures from a wide range of human activities. These are particularly intense in parts of the Greater North Sea, Celtic Seas, and the Bay of Biscay and Iberian Coast. While levels of activity are lower in Arctic Waters and the Wider Atlantic, increases in some activities are likely to pose greater risks in future in those OSPAR Regions.

All activities covered in the assessment exert pressures on the marine environment. For example, agriculture is a significant source of nutrients contributing to eutrophication; fisheries influence ecosystems through removal of target and non-target species, and through disturbance of the seabed; multiple activities are sources of contaminants and litter, or routes for the introduction and spread of non-indigenous species; shipping noise is a significant pressure in some areas, such as the Greater North Sea; and new or increasing activities, such as offshore renewable energy or deep seabed mining, bring additional pressures. Additional stress from the pressure of climate change processes compounds the impacts from these activities and may further weaken ecosystem resilience.

The underlying societal drivers of activities in the North-East Atlantic – such as economic development, demand for energy, food security, housing and infrastructure, and societal wellbeing – remain strong. The scale of future activities will be influenced by factors such as the level of economic growth, including the recovery from the COVID-19 pandemic, the extent of globalisation, rates of technological change, and public perception and policy. For example, major expansion of offshore renewable energy is being driven by improved technology combined with political commitment to reduce greenhouse gas emissions. Drivers are affected by economic shocks, such as the financial crisis of 2008, but the impacts of shocks may be temporary rather than fundamentally altering the long-term intensity of activities in the North-East Atlantic.

Among the key trends in activities in the OSPAR Maritime Area since the QSR 2010, and potential future trends:

- marine fisheries landings were relatively stable, with the majority of stocks now fished at levels considered sustainable from a fish stock management perspective. Landings to 2030 are projected to remain approximately unchanged, but uncertainties remain;

- overall levels of shipping freight and passenger traffic were little changed; future levels are uncertain. There may be increases in some areas, for example in Arctic Waters, although the scale and timing are uncertain;
- aquaculture production, notably in Norway, has risen somewhat. Norway and some other countries have ambitions for future expansion, including in offshore environments and using shore-based systems;
- production of hydrocarbons decreased by 28% from 2009 to 2019, while the number of installations with emissions and discharges reported was the same. Drilling activity increased over the period, mostly for development wells. Pressures from offshore oil and gas activities are greatest in the Greater North Sea, followed by Arctic Waters and the Celtic Seas. In the Bay of Biscay and Iberian Coast and the Wider Atlantic, the number of installations is low, and the pressures in these OSPAR Regions are considered to be relatively low;
- offshore wind energy capacity increased approximately tenfold, predominantly in the Greater North Sea and Irish Sea. Further major growth is planned up to 2030 (fourfold or more from 2019 levels) and beyond (e.g., 300 GW in European Union (EU) waters by 2050 compared with 12 GW now);
- aggregate (sand and gravel) extraction varied between years. Additional requirements for sea defences are anticipated in future. Deep seabed mining for minerals may be a new pressure in the North-East Atlantic in the coming years;
- tourism has grown across OSPAR Regions since 2010, including cruise tourism and expedition tourism in potentially sensitive habitats, with further growth anticipated in the future.

Q2. What has been done?

Examples of measures taken by OSPAR and other organisations to reduce the environmental pressures from activities include:

- controls on fisheries put in place by the EU, national governments, and the North-East Atlantic Fisheries Commission;
- controls on pressures from shipping, including on nitrogen and sulphur emissions, oil pollution, release of ballast water and biofouling;
- improved understanding and implementation of measures to mitigate the environmental pressures from aquaculture, including better modelling of impacts, and standards to limit escapes of farmed fish and sea lice infestation;
- planned reforms to agricultural policy in the EU and United Kingdom would build on existing measures and may provide incentives to further reduce pressures, such as the release of nutrients and pesticides;
- measures have been introduced to reduce plastic waste, including restrictions on single-use plastic items and fishing gear, new provisions for port reception facilities, and measures to tackle pollution from microplastics;

- environmental assessment and permitting of offshore wind installations consider issues such as the siting of turbines (e.g., in relation to bird displacement and collision risk) and controls on construction noise.

Measures specifically taken by OSPAR are referred to in the assessment.

Q3. Did it work?

Management measures and knowledge of how to implement them have increased since QSR 2010. OSPAR measures have delivered improvements: for example, there has been a significant decrease in litter on beaches in most OSPAR Regions. Other examples of the impacts of measures are: an increasingly large proportion of commercial fish stocks is fished at levels consistent with Maximum Sustainable Yield (MSY); air pollution from shipping has decreased (although with increased discharges to water through exhaust gas cleaning systems as a result), as have incidents of oil pollution. For some activities (e.g., extraction of sand and gravel, management of aquaculture) management measures are well established, although gaps in knowledge remain.

At the same time, these measures have not sufficiently reduced all significant pressures. For example, nitrate and phosphorous inputs from agriculture and waste water remain a cause of eutrophication in some areas; some aspects of the ecosystem, including threatened and declining species of marine animals and fish, are negatively affected by fisheries, including non-targeted species impacted through incidental by-catch, and there are pressures from bottom trawling on benthic communities. Also, guidance from the International Maritime Organization (IMO) on reduction of shipping noise has not had a significant effect on noise levels to date.

In some cases, as for the large projected increase in offshore renewable energy, development of management measures and assessment of their success, as well as analysis of cumulative impacts, is relatively new. Judging the effectiveness (in terms of reducing environmental pressures and in terms of cost-effectiveness) of management measures requires assessment over many years and a well-balanced approach to cumulative assessment, and this will remain an important area in which to develop OSPAR capacity in the future.

The QSR 2023 status assessments include details of management measures taken in response to key pressures on particular species or habitats.

Management measures are well established for aquaculture, although gaps in knowledge remain. © Shutterstock

Q4. How does this field affect the overall quality status?

This thematic assessment encompasses a broad range of human activities in the North-East Atlantic. These activities have multiple effects on the marine environment. Information on quality status can be found in other QSR assessments.

Q5. What do we do next?

OSPAR is committed, in line with the North-East Atlantic Environment Strategy (NEAES) 2030 operational objectives, to addressing the following existing, expanding or only partly understood pressures, and as a priority to implementing measures to manage the activities sustainably:

- addressing the environmental impacts of the major expansion of offshore renewable energy, in particular of offshore wind. This includes regional guidance on offshore wind energy and work on large-scale cumulative assessment of developments;
- agreeing a Regional Action Plan on underwater noise. This would include ways to manage the impact of continuous noise, especially from shipping, as well as of impulsive noise, making the best use of the modelling tools now available;

- reducing, together with other competent authorities, pressures from human activities causing physical loss and disturbance to seabed habitats, including pressures from fishing and deep seabed mining;
- implementing a second Regional Action Plan for Marine Litter (RAP ML 2) to address litter from relevant land- and sea-based human activities, and making use of updated indicator assessments to evaluate progress against OSPAR's reduction targets;
- limiting inputs of nutrients and organic matter into the marine environment, including inputs from agriculture, waste water discharges, and aquaculture;
- reducing and eliminating inputs of hazardous substances, including contaminants of emerging concern, from sources including waste water discharges, agriculture, shipping, oil and gas operations, and aquaculture;
- developing a management approach to minimise the number of non-indigenous species introduced via human activity, including from shipping, recreational boating, and aquaculture;
- working to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles, and fish;
- reviewing the risks from new, emerging and increasing pressures on the marine environment, as identified in this assessment, and prioritising them for action and the adoption of measures;
- developing methods for the analysis of cumulative effects in the marine ecosystems of the North-East Atlantic.

Future climate change impact assessments of the OSPAR Maritime Area and its uses should review how climate change is affecting human activities and how they are adapting.

These, and other potential areas where OSPAR will consider action, are described further in the main body of this thematic assessment. This includes further work to update and take account of scenarios of trends and developments in human activities affecting the North-East Atlantic.

D - Drivers

Drivers of human activities in the North-East Atlantic

The extent of the human activities affecting the North-East Atlantic, and the pressures that they impose on the marine environment, are affected by multiple factors (drivers). Some of these will be specific to the activity concerned. Others are more general drivers of societal need: for example, economic development, demand for energy and food security, housing and infrastructure, societal wellbeing (such as health, culture, or recreation), and national security. In turn, these are affected by underlying drivers such as the level of **economic growth** (affecting demand and the ability to invest); the **extent of globalisation** and international trade; levels of **technical innovation**; **societal values**, including the priority given to environmental protection; **population growth**; and **systemic shocks** such as the COVID-19 pandemic.

In past decades, such drivers have affected the scale and nature of human activities in the OSPAR Maritime Area. For example, the economic downturn of 2008 depressed shipping freight; technological innovation has facilitated the expansion of offshore wind; high levels of aggregate extraction were associated with major infrastructure projects in the Netherlands.

OSPAR has produced a standard set of high-level drivers which influence how society uses, values, and manages the North-East Atlantic. These drivers are applied in the DAPSIR framework across all thematic assessments for QSR 2023.

To explore these issues further, a scenario analysis was produced for OSPAR (Bekhuis, 2021) looking at possible future trends and developments (and uncertainties around them), which may influence economic activities in and around the North-East Atlantic. This was done by presenting four future scenarios characterised by different levels of economic growth and environmental awareness.

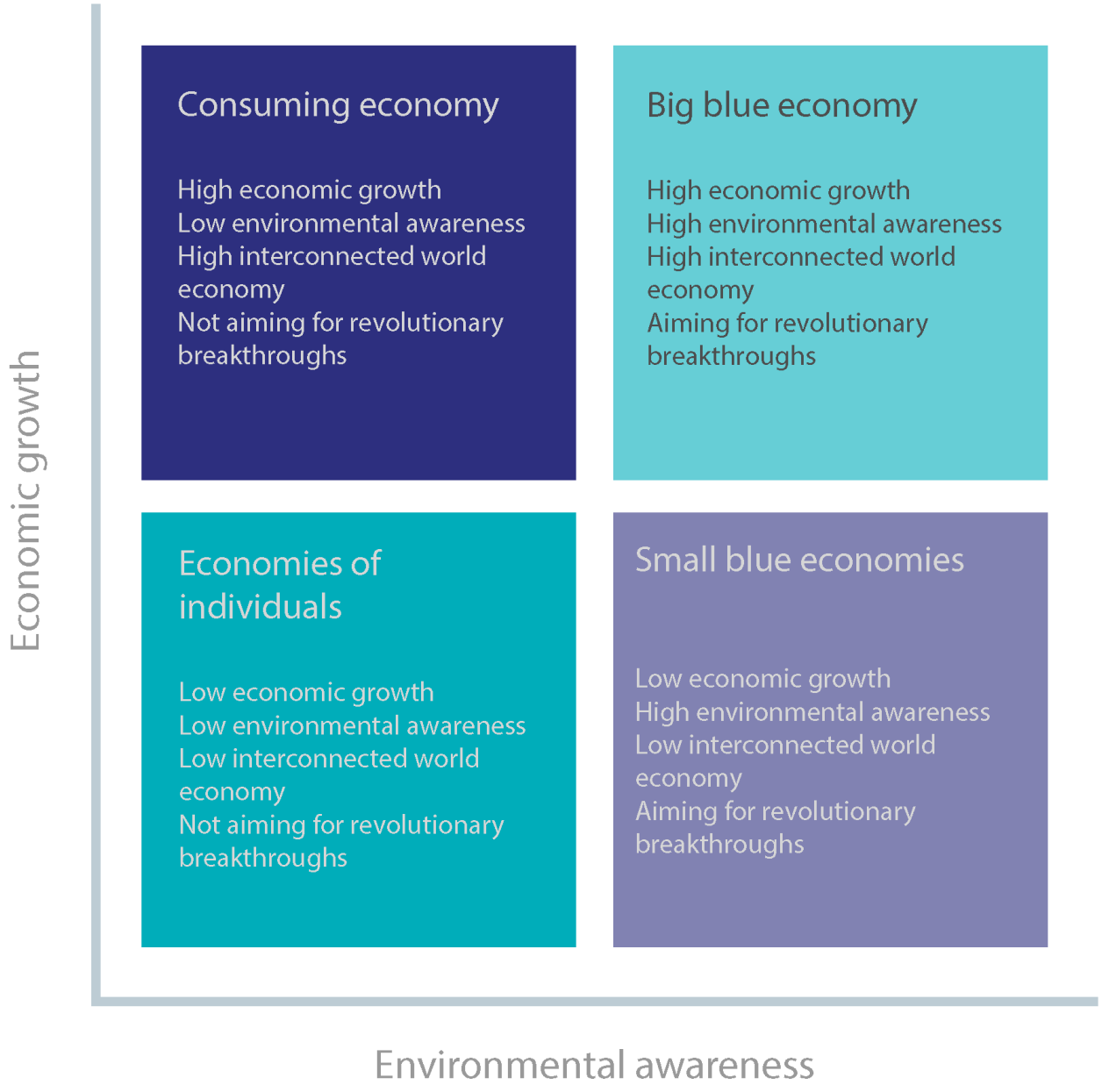


Figure D.1: Four quadrant model used in scenario analysis of human activities

These scenarios are alternative storylines on what could happen. They are not the only way of describing potential futures, nor predictions of what will happen, but help to illustrate some of the most important uncertainties in the driving forces underlying the economic activities in the OSPAR area. For example:

- how will public awareness of environmental issues influence activities, for example through policy choices or consumption patterns? Will public concern be influenced by COVID-19 and / or greater awareness of climate change impacts? Might there be a move towards more localism?
- what scenarios might drive the uptake of more efficient and environmentally better technologies, and more circularity in resource use? What changing technologies and / or consumption patterns might increase pressure on the marine environment (for example, deep seabed mining for key minerals)?
- how will globalisation develop? It is plausible that free trade policies will continue to be extended by European countries, but at the same time global issues including protectionism, political tensions or rethinking of production chains could limit moves towards a more interconnected world economy;
- population growth is less uncertain than other underlying drivers. A global increase is projected between 2019 and 2030, from 7,7 billion to 8,5 billion; lower growth rates and an aging population are projected for OSPAR countries;
- the consequences of COVID-19. For example, the pandemic led to changes in consumption of single-use plastics (including littering from protective equipment), and short-term impacts in sectors such as tourism, fisheries, and aquaculture. Longer-term impacts may also persist: for example, potential effects on patterns of shipping and trade. However, the size and duration of the consequences of the COVID-19 pandemic, for both individual activities and society at large, are still largely uncertain. (More analysis is in the QSR third party assessment on 'COVID-19 impact on marine and aquatic environment and the economic dimension')

In some countries and OSPAR Regions, significant potential expansion is expected in the coming decades in certain activities, such as aquaculture, renewable energy production, production and consumption of plastics, or deep seabed mining. The scale of the developments in these and other activities will be sensitive to uncertainties related to the drivers described above.

Future priorities for OSPAR

In looking at how human activities may affect the marine environment in future years, OSPAR needs to recognise that the future is uncertain. OSPAR should therefore cooperate to periodically assess how key human activities, including emerging activities, and underlying drivers are changing over time, both in the past and in the future, and to help prepare OSPAR for possible alternative future developments in both the society and the environment.

The scenarios work could be a reference point to help OSPAR explore to what extent its objectives will be met in the future - for example, whether certain scenarios pose particular threats, and how OSPAR could respond to different scenarios.

References

Bekhuis, K. (2021). Exploring the future together: a scenario analysis for the OSPAR Region. Available at: https://www.noordzeeloket.nl/publish/pages/189058/exploring-the-future-together-a-scenario-analysis-for-the-ospar-region.pdf

A - Activities

Major human activities and associated pressures

Human activities are distributed widely across the North-East Atlantic, but the intensity of activities and of the pressures they impose on the marine environment vary greatly between OSPAR Regions and sub-divisions. Some sea areas are affected by multiple activities; in others, only a few may be significant. The table below gives a high-level summary of the intensity and trends of selected activities across the OSPAR Regions, based on analysis in the feeder reports.

Table A.1: Intensity and trends of selected human activities in OSPAR Regions

Cell entries represent intensity (high, medium, low), trend since QSR 2010, and forecast trend to 2030. The symbol ↔ is used where there has been little change in intensity since QSR 2010; the symbol ? is used where future trends are uncertain.

Main activities	Arctic Waters	Greater North Sea	Celtic Seas	Bay of Biscay and Iberian Coast	Wider Atlantic
Aggregates extraction					
Intensity	L	H	M	M	L
Trend since QSR2010	↔	↓	↔	↑	↔
Trend to 2030	?	?	?	?	?
Agriculture					
Intensity	L	H	M	M	L
Trend since QSR2010	↔	↔	↔	↔	↔
Trend to 2030	↔	↔	↔	↔	↔
Aquaculture					
Intensity	H	H	M	M	L
Trend since QSR2010	↑	↑	↔	↑	↑
Trend to 2030	↑	↑	↑	↑	↑
Fisheries					
Intensity	H	H	H	M	L
Trend since QSR2010	↓	↑	↑	↔	↔
Trend to 2030	?	?	?	?	?
Oil/gas production					
Intensity	M	H	M	L	L
Trend since QSR2010	↔	↔	↔	↔	↔
Trend to 2030	↔	↔	↔	↔	↔
Renewable energy					
Intensity	L	H	M	L	L
Trend since QSR2010	↑	↑	↑	↑	↔
Trend to 2030	↑	↑	↑	↑	↔
Shipping					
Intensity	M	H	H	H	L
Trend since QSR2010	↔	↔	↔	↔	↔
Trend to 2030	?	?	?	?	?
Tourism					

Intensity	L	H	M	H	L
Trend since QSR2010	↑	↑	↔	↑	↑
Trend to 2030	↑	↑	↔	↑	↑

Key issues for each OSPAR Region are summarised below; further information is in the feeder reports and in the ICES series of ecosystem overviews.

Arctic Waters

Fishing occurs across the Arctic Waters Region, although pressure from bottom trawling is lower than in most other OSPAR Regions. Major oil and gas extraction occurs in the Norwegian Sea. Finfish aquaculture is important, notably in Norway, with expansion planned for future years, including into offshore environments. Increased shipping and oil and gas activity, for example in the Barents Sea, may bring further pressures in the coming decade. Deep seabed mining in the Region is also a possibility. A growth in tourism activity may increase pressure on sensitive habitats.

Greater North Sea

The Greater North Sea is an area of intense activity, influenced by major population centres, intensive agricultural land use, coastal development, and tourism and recreation activity, particularly in southern areas. The presence of major ports in the area results in high pressure from shipping, and fishing takes place across the Region, with mobile bottom trawls deployed over 73% of the ICES ecoregion in 2018. Salmon aquaculture is a significant industry on the Norwegian coast. The greater part of aggregates extraction in the North-East Atlantic occurs in the Southern North Sea and English Channel.

Oil and gas production is widespread in the Northern North Sea, and gas production in the Southern North Sea. In the past decade, offshore wind developments have increased substantially in the Southern North Sea and at a lower rate in the Skagerrak and Kattegat, and major expansion of offshore wind energy will be a key issue for the Region in the coming decade.

Celtic Seas

Pressures associated with fishing, shipping, coastal development, tourism and recreation, and agriculture are widespread in the Celtic Seas. Mobile bottom trawls were deployed over almost 45% of the ICES ecoregion in 2018. Finfish and / or shellfish aquaculture is important in the United Kingdom, Ireland, and France. Energy production (fossil fuel and renewable energy) takes place in the Region, and significant future expansion of offshore wind energy is projected, notably in the Irish Sea.

Bay of Biscay and Iberian Coast

Fishing, shipping, tourism and recreation, land-based industry, and agriculture are the source of the most important pressures in this Region. Mobile bottom trawls were deployed over 19% of the ICES ecoregion in 2018. There is no clear trend in nitrate inputs in this Region, in contrast to the decreasing trends in other EU waters. Important shipping routes exist across the Bay of Biscay and off the western Iberian Coast. Shellfish aquaculture takes place in Spain and France.

Wider Atlantic

The only human settlements within the Wider Atlantic Region are in the Azores, so pressures from human activities are generally low. Nevertheless, some OSPAR threatened or declining species remain vulnerable

to fisheries pressure, even though fisheries catches in this Region are relatively small. There is increasing interest in exploring options for harvesting mesopelagic fish and plankton. Low-frequency noise from shipping is likely to affect much of the Region. Litter and contaminants from shipping, or introduced from outside the Region, also occur. This Region also contains potential mining areas for deep seabed minerals.

Information on specific activities

Extraction of mineral resources: aggregates

See: OSPAR Feeder Report 2021 – Extraction of non-living resources

What has happened since Quality Status Report (QSR) 2010

Sand and gravel extraction in the North-East Atlantic has increased substantially from the early 1970s to the current levels of tens of millions of m^3 annually. Annual extraction varies, but was lower and relatively stable in the second half of the 2010s – 61 million m^3 in the OSPAR and HELCOM Maritime Areas combined in 2019. This compared with 174 million m^3 and 162 million m^3 in 2009 and 2010, when large amounts of aggregates were used for major infrastructure projects in the Netherlands. Aside from those large projects, extraction of aggregates before QSR 2010 was comparable to more recent levels.

The majority of aggregates extraction is in the Southern North Sea and English Channel near the coasts of the Netherlands, Denmark, Belgium, the United Kingdom, and northern France, with smaller amounts elsewhere in the OSPAR Maritime Area. The economic value of activities supported by marine aggregates extraction can be high; for example, the major port infrastructure in the Netherlands and construction activity in London and south-east England.

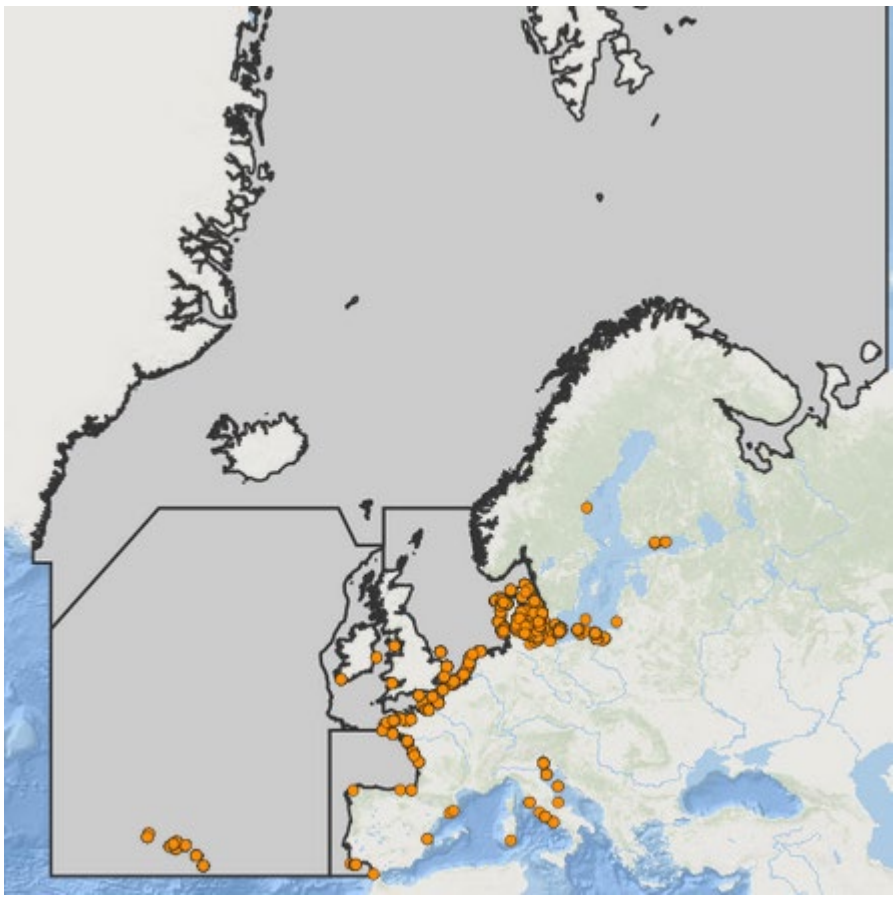


Figure A.1: Aggregates extraction in the North-East Atlantic. Available at: https://odims.ospar.org/en/maps/?layers=ospar_regions_2017_01_002,ospar_aggregate_extraction_2020_11_001

Future developments

Substantial reserves of aggregates remain in some areas of the North-East Atlantic, but future trends are uncertain. Extraction will depend on factors such as the impact of economic conditions on demand, the availability of land-based resources and recycled aggregates, and the material intensity of construction. In future decades, an expansion of aggregates use may be required for coastal defence purposes due to sea-level rise.

Pressures from aggregates extraction

The pressures of aggregates extraction include:

- *physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)* - associated with the removal and translocation of rock, ores, gravel, sand, and shell;
- *physical disturbance to the seabed (temporary or reversible)* - associated with dredging operations, including mobilisation, suspension and settling of sediment plumes. Topographical changes can last just a few months in mobile sand areas, and years or decades where sediments are more stable;
- *input of anthropogenic sound (impulsive, continuous).*

Management of aggregates extraction to reduce pressures

Sand and gravel extraction can be managed in ways that minimise impacts and allow recovery of the benthic fauna. Restoration of species diversity and biomass in gravel habitats can take 10 years or more; in dynamic sandy habitats recovery is faster. OSPAR has adopted, through OSPAR Agreement 2003-15 on sand and gravel extraction, the International Council for the Exploration of the Sea (ICES) guidelines for management of extraction. An ICES review in 2016 considered these fit for purpose, but they are being reviewed.

Future priorities for OSPAR

OSPAR will engage with ICES in future assessments of impacts of sand and gravel extraction. OSPAR will need to assure itself that any major expansion of aggregates extraction does not have, or contribute to, an adverse effect on the marine environment. To support this, OSPAR Contracting Parties will need to improve access to data on the location of extraction sites and keep informed about future trends in extraction. (Relates to North-East Atlantic Environment Strategy (NEAES) 2030 Operational Objective S9.O1)

Extraction of mineral resources: deep seabed mining

(see: OSPAR technical report on deep sea mining)

What has happened since QSR 2010

Areas of the North-East Atlantic that contain known and predicted seabed minerals have been identified, but further work would be needed to estimate reserves. All potential deep seabed mining areas are in Arctic Waters and the Wider Atlantic. To date, there have been no deep seabed mining projects in the OSPAR Maritime Area, or globally. Some OSPAR countries are in the process of opening areas for exploration on the continental shelf; for example, in 2020 the Norwegian Government initiated an opening process for offshore mineral activity.

Future developments

Deep seabed mining of seafloor mineral resources, such as massive sulphides, cobalt-rich ferromanganese crusts and polymetallic nodules, has potential for development, although the scale of any such development is uncertain. Increasing demand for secure supplies of minerals, including the growing transition to renewable energy (associated with increased energy storage requirements), is a key driver of increased demand for resources such as copper, cobalt, nickel, lithium, silver, rare earth elements and critical metals.

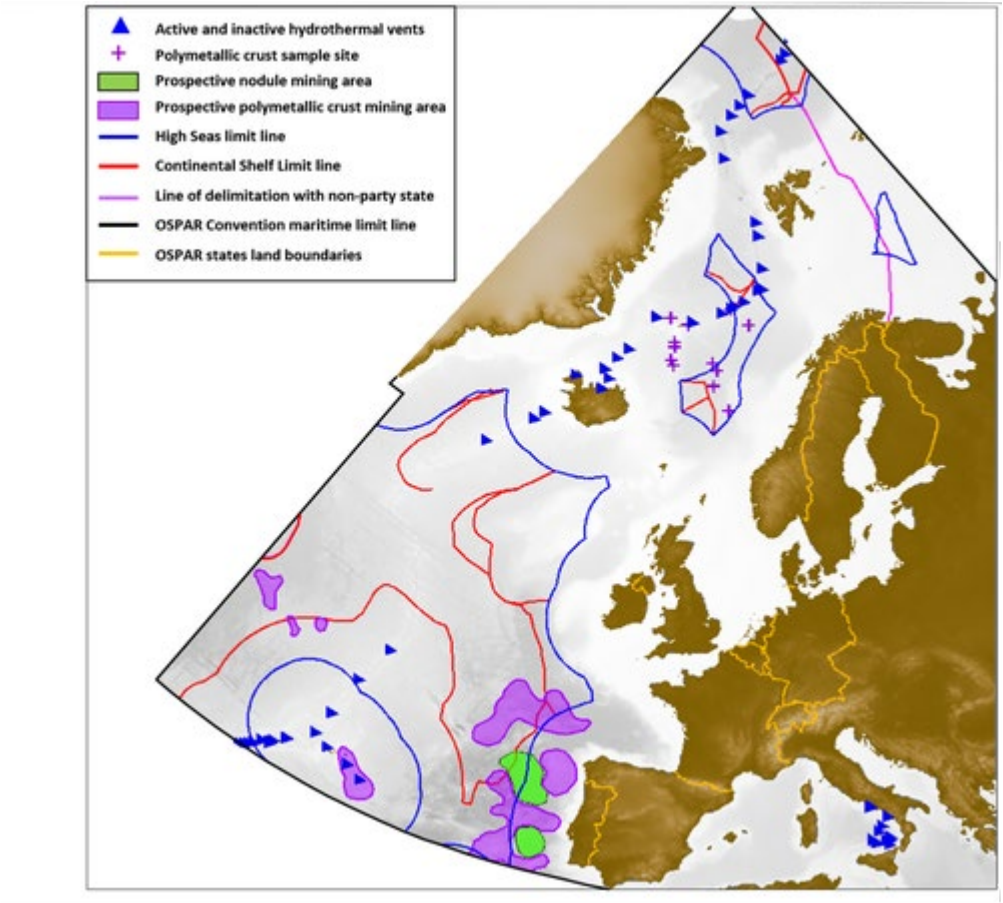


Figure A.2: Compilation of confirmed and potential metallic deep sea mineral deposits within the OSPAR Maritime Area

Pressures from deep seabed mining

Understanding of the extent and nature of impacts, and the effects on marine ecosystems, is uncertain, but the potential environmental impacts of deep seabed mining include:

- *physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)* - associated with the removal and translocation of rock, ores, gravel, sand, and shell;
- *physical disturbance to the seabed (temporary or reversible)* – changes to seabed integrity associated with dredging operations, including mobilisation, suspension and settling of operational and discharge plumes;
- *loss of / change to natural biological communities*;
- *input of other substances (e.g., synthetic substances, non-synthetic substances, radionuclides) from diffuse sources, point sources, atmospheric deposition, acute events* - associated with operational chemical plumes, release of sediment-bound or subsurface porewater toxic metals into the water column;
- *input of anthropogenic sound (impulsive, continuous)* - including vibration from mining activities;
- *input of other forms of energy (including electromagnetic fields, light, and heat)* - lighting associated with seabed mining vehicles.

Management of deep seabed mining to reduce pressures

Development of exploitation technology for deep seabed mining, including mitigation or restorative techniques, is at an early stage, and there remain substantial gaps in understanding of how pressures might be managed. Addressing these issues includes consideration of the precautionary principle and the need for elaborated Environmental Impact Assessments.

Future priorities for OSPAR

Further research and knowledge on the deep-sea environment and its sensitivity and resilience (e.g., impacts on fish and small benthic fauna; long term recovery of the seabed and impacts from plumes and ecotoxicology on the marine environment) are required in order to ensure that a move from exploration to use of deep seabed mineral resources avoids adverse impacts on the marine environment and its ecosystems.

Deep seabed mining for resources such as key metals may become an increasing area of interest for OSPAR, given its potential to grow in coming decades, particularly as understanding of the environmental impacts is as yet uncertain. OSPAR will need to consider how the knowledge gaps and uncertainties should be addressed. (Relates to NEAES 2030 Operational Objective S9.O1)

OSPAR should consider how it can maintain an overview of Contracting Parties' plans for exploitation within the OSPAR Maritime Area, and should develop a common understanding on the extent to which OSPAR measures can apply to deep seabed mining activities in the Area Beyond National Jurisdiction. (Relates to NEAES 2030 Operational Objective S9.O1)

Agriculture

What has happened since QSR 2010

Agriculture is the largest land use in the majority of OSPAR countries. OSPAR countries collectively are a major global producer of dairy products and cereals, and an important producer of livestock. In past decades, the general pattern of development in the agricultural sector in Europe has tended towards a greater concentration within fewer, larger farms. For livestock, there has been an increase in poultry, veal and pig production and a decrease in beef, sheep, and goat production. The output of the agricultural industry across all OSPAR countries was relatively steady from 2013 to 2018.

Future developments

EU analysis suggests a continued increase in the EU in areas of cereals, protein crops and maize, and a small decrease in areas of oilseeds and permanent pasture. Dairy production is expected to increase and intensify; beef production to decline; pig meat production to increase initially and then decline; and poultry to increase steadily. Increases in cereals, dairy, and poultry production could lead to increased nitrogen and phosphorus losses to water unless further measures are put in place.

A revised EU Common Agricultural Policy (CAP) is due to start in 2023. It is built around nine objectives, including climate change action, environmental care and preservation of landscapes and biodiversity. The EU has also published the Farm to Fork Strategy addressing the challenges of a fair, healthy and environmentally-friendly food system. Sustainability is an objective for agriculture in OSPAR countries outside the EU: for example, the United Kingdom is now developing its own policies, including moves away

from direct payments based on farmed areas and towards a system based on public money for public goods, including environmental improvement.

Pressures from agriculture

The pressures of agriculture include:

- *input of nutrients from diffuse sources, point sources, atmospheric deposition* - nitrogen and phosphorus losses from agriculture are a major cause of eutrophication. Across OSPAR countries, there was a decrease in the agricultural nitrogen surplus between 2000 and 2015, an indication of an improving trend. In general, the main decrease was between 2000 and 2010; after that, the balance was relatively constant or decreased only marginally. For phosphorus, the surplus in 2015 was less than half of the value in 2000 in most OSPAR countries. The Netherlands and Belgium had the highest phosphorus balances of all of the OSPAR countries in 2000, but these had declined to only 13% and 25% of their earlier value by 2015;

Table A.2: Gross Nitrogen Balance per hectare UAA (kg of nitrogen per ha) (Source: OSPAR 2021d)

	2000	2005	2010	2011	2012	2013	2014	2015
Belgium	189,9	145,7	142,0	143,2	143,1	137,9	131,7	132,0
Denmark	131,7	111,3	90,0	88,0	83,4	87,1	79,8	80,0
Finland	54,9	48,6	57,1	50,2	47,5	46,5	47,5	49,5
France	58,0	50,7	40,2	52,3	39,8	45,1	45,3	42,0
Germany (until 1990 former territory of the FRG)	110,0	85,2	77,7	88,6	75,1	78,9	65,9	81,8
Ireland	71,2	63,8	44,6	28,2	35,1	50,4	45,7	47,8
Luxembourg	156,6	129,5	126,8	138,3	124,9	127,3	128,7	129,0
Netherlands	254,3	203,7	171,7	172,3	169,3	170,6	161,8	191,5
Norway	85,3	96,3	82,9	97,1	90,2	102,3	89,2	86,8
Portugal	39,1	44,5	38,5	39,5	43,7	38,1	44,7	44,1
Spain	40,2	38,3	35,2	29,5	33,6	28,7	39,4	38,5
Sweden	54,6	44,7	38,2	42,2	31,2	34,5	30,7	31,7
Switzerland	67,3	66,2	71,5	61,4	64,4	69,9	68,8	68,4
United Kingdom	107,0	91,0	89,7	85,3	87,5	88,3	85,1	83,3

- *input of other substances (e.g., synthetic substances, non-synthetic substances) from diffuse sources, point sources, atmospheric deposition, acute events* - pesticides are routinely used in agriculture across OSPAR countries and quantities of pesticides are detected in aquatic systems as a result of run-off, particularly from arable land. While regulatory procedures are in place governing pesticides, and there have been successes in taking substances out of the market, some concerns remain. The specific impacts of pesticide run-off on marine ecosystems are not well documented, but studies have indicated potential effects;
- *input of litter (solid waste matter, including micro-sized litter)* - plastics used in agriculture can result in litter, including through fragmentation and degradation, or leaching as microplastics, including from sewage sludge applied to agricultural land.

Management of agriculture to reduce pressures

The implementation of the EU Nitrates Directive (Directive 91/676/EEC) and EU Water Framework Directive (Directive 2000/60/EC) has addressed inputs of nitrogen and phosphorus from agriculture. Improvements, such as in more sustainable manure management, have occurred as a result. Nevertheless, nitrate and phosphate pollution and eutrophication remain an issue in some areas (Eutrophication Thematic Assessment). Planned reforms to the EU CAP as well as national action, including a new regime in the United Kingdom, could provide incentives to reduce losses further.

Pesticide approval and authorisation in the EU involves approval of the active substance and of the plant protection product. The process involves assessment of risks to human and environmental health and a framework for sustainable pesticide use including integrated crop management and the use of alternatives to pesticides. The EU indicator for the quantity and risk of pesticides in use showed a decrease of 17% from the baseline period of 2011-2013 to 2018, although with an increase of 56% in the number of emergency authorisations for new and emerging crop health issues over the same period. The 2021 EU Zero Pollution Action Plan includes an aim to reduce the overall use and risk of pesticides by 50% by 2030 (Eutrophication Thematic Assessment).

Future priorities for OSPAR

OSPAR will further develop the evidence base and toolkits to identify and quantify sources of agricultural nitrogen and phosphorus losses, such as fertiliser usage and manure production, agree nutrient reduction needs for Contracting Parties to combat eutrophication, and ensure that sufficient measures are taken to achieve these reductions. (Relates to NEAES 2030 Operational Objectives S1.O1 - S1.O5)

OSPAR should consider encouraging Contracting Parties to take measures to reduce litter from agriculture, including re-using or recycling a higher proportion of agricultural plastics, taking a lead from the small number of Contracting Parties that currently have schemes in place. (Relates to NEAES 2030 Operational Objectives S4.O1, S4.O7)

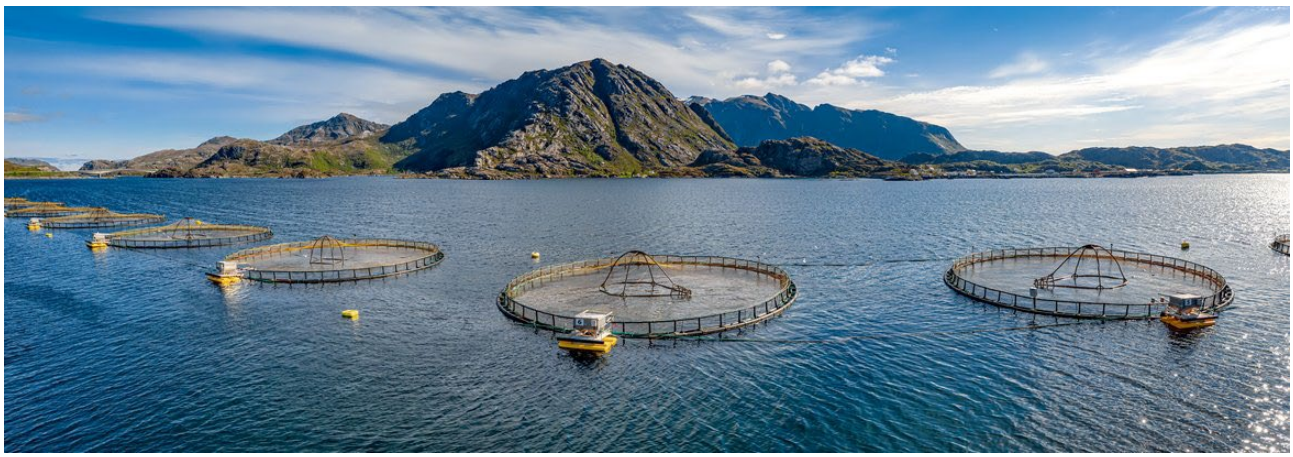
Aquaculture

What has happened since QSR 2010

Marine aquaculture production in the North-East Atlantic (including the Baltic) increased from around 1,5 Mt in 2008 to around 2,2 Mt in 2018, comprising approximately 1,68 Mt of finfish and 0,54 Mt of molluscs. Other marine aquaculture production (crustaceans and seaweeds) was small.

Over 1,35 Mt of 2018 production was in Norway, mainly salmon. Norway also contributed the bulk of the increase from 2008. The United Kingdom and the Faroe Islands were the next largest salmon producers. Salmon is the largest single component of global trade in fish and fish products, driven by demand in developed and developing markets. Norwegian salmon production was worth over €6,7 billion in 2018.

The largest shellfish producers were Spain (mainly mussels) and France (predominantly oysters). Production has fluctuated in the past decade, but there have been recent increases in Spanish mussel production. Factors such as weather and disease have impacted oyster production.



Farmed salmon in Norway. © Andrei Armiagov

Future developments

Norway aims to increase aquaculture production severalfold by 2050, with some increase by 2030 (Input Other Assessment). Some other OSPAR countries with salmonid production have growth ambitions, and some increase in shellfish production may also occur. Growth will be subject to factors such as global economic conditions, trade issues, environmental conditions, and competition for space with other marine activities. Some other countries (e.g., Denmark), are not planning to expand marine cage-based aquaculture of finfish.

There are prospects for aquaculture expansions in new areas (aquaculture is already increasing along the coasts and in the fjords of northern Norway and Russia) and environments, notably offshore (e.g., for salmon, mussels and oysters), and involving different species (e.g., seaweed). Land-based facilities with recirculating water (RAS), currently a niche part of aquaculture in the North-East Atlantic, are also likely to grow.

Pressures from aquaculture

Pressures from marine finfish, RAS, and /or shellfish aquaculture can include:

- *input of nutrients from diffuse sources, point sources, atmospheric deposition* - nutrient enrichment from fish feeds;
- *input of genetically modified species and translocation of native species* - escaped or introduced fish;
- *input of microbial pathogens* - the transfer of parasites and diseases;
- *input or spread of non-indigenous species* - such as the sea squirt *Didemnum vexillum* (also known as sea vomit) or the Pacific oyster *Crassostrea gigas,* associated with shellfish aquaculture;
- *input of other substances (e.g., synthetic substances, non-synthetic substances) from diffuse sources, point sources, atmospheric deposition, acute events* - chemicals (including contaminants from fish feed and therapeutants);
- *input of organic matter from diffuse sources and point sources;*
- *loss of, or change to, natural biological communities due to cultivation of animal or plant species* - shellfish aquaculture may, in some circumstances, contribute positively to ecosystem services, but has potential pressures including removal of mussel seed;

- *input of litter (solid waste matter, including micro-sized litter)* - finfish and shellfish aquaculture can be a source of litter;
- *input of anthropogenic sound (impulsive, continuous)* - from devices to deter predators.

Further expansion of large-scale aquaculture may increase these pressures, while expansion of RAS systems might reduce some effects, although may lead to higher emissions of greenhouse gases if fossil energy sources are used.

Management of aquaculture to reduce pressures

The impact of pressures is strongly influenced by local environmental circumstances. For example, the trend towards more dispersive sites for finfish aquaculture should help mitigate the impacts from organic waste. Site-specific decisions on location and management of aquaculture, via assessment of projects under individual Contracting Parties' regulatory systems, are the primary measure for addressing impacts. The European Commission has produced guidance on sustainable aquaculture in the context of EU environmental directives.

Escapes of farmed fish have been addressed through technical standards for cages and monitoring of escape incidents. Chemical and biological treatments (cleaner fish such as lumpfish or wrasse) are used to combat sea lice; in Norway, expansion of aquaculture may be refused, or existing aquaculture cut back, in areas where sea lice prevalence is too high.

PARCOM Recommendation 94/6 covers the reduction of inputs from potentially toxic chemicals used in aquaculture. In 2006, OSPAR agreed that, for the time being, implementation reporting on this Recommendation could cease; however, in 2020 OSPAR decided to initiate a new reporting round on the Recommendation.

Overall, measures to mitigate environmental impacts, including modelling approaches, have moved forward in the last decade, although knowledge gaps remain. For example, ICES has highlighted the need for more understanding of pressures from open ocean installations; measures to reduce the impact of escapes; the impact of substances such as therapeutants; and various aspects of shellfish aquaculture. There will also be a need for more understanding and management of pressures from any expansion of RAS, such as effluents containing dissolved nutrients.

Future priorities for OSPAR

OSPAR should consider increasing its understanding of the potential impacts of future growth in aquaculture, including risks of a spread of non-indigenous species or parasites, or of contamination of the marine environment with hazardous substances, therapeutants, or nutrients. It should consider engagement with ICES on knowledge gaps of particular significance. Such work would include the implications of new or expanded forms of aquaculture including offshore aquaculture, growth in cultivation of new or currently minor species (such as seaweeds), and recirculating aquaculture systems. (Relates to NEAES 2030 Operational Objectives S1.O3, S2.O1, S2.O2, S7.O2)

OSPAR should consider strengthening its monitoring and assessment of measures taken by OSPAR Contracting Parties to manage pressures from aquaculture. (Relates to NEAES 2030 Operational Objectives S1.O4, S7.O2)

OSPAR will develop and implement measures and targets to substantially reduce marine litter from aquaculture gear. (Relates to NEAES 2030 Operational Objective S4.O8)

Fisheries

See: OSPAR Feeder Report 2021 - Fisheries

What has happened since QSR 2010

Over the past decade total marine fisheries landings in the North-East Atlantic have been relatively stable. The total in 2018 was 9,32 million tonnes. Since the peak of 13 million tonnes in 1976, landings fell, increased in the 1990s, and then stabilised. Over half of stocks, but not all, are now being fished at or approaching levels consistent with Maximum Sustainable Yield (MSY).

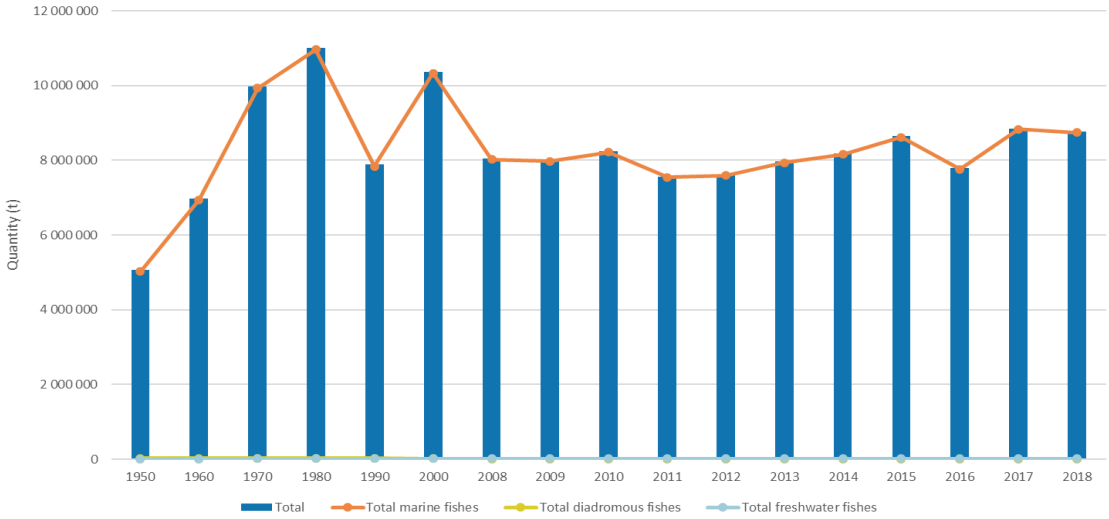


Figure A.3: Total capture production of fish in the North-East Atlantic, 1950-2018 (OSPAR, 2021b)

There are substantial fisheries in all OSPAR Regions. Trends since 2010 have varied. There have been some changes in fishing practice, for example, beam trawling in the Greater North Sea has been increasingly replaced by other methods. Nevertheless, mobile bottom trawls were still deployed in substantial areas – for example, in 73% of the ICES Greater North Sea ecoregion and 45% of the ICES Celtic Seas ecoregion.

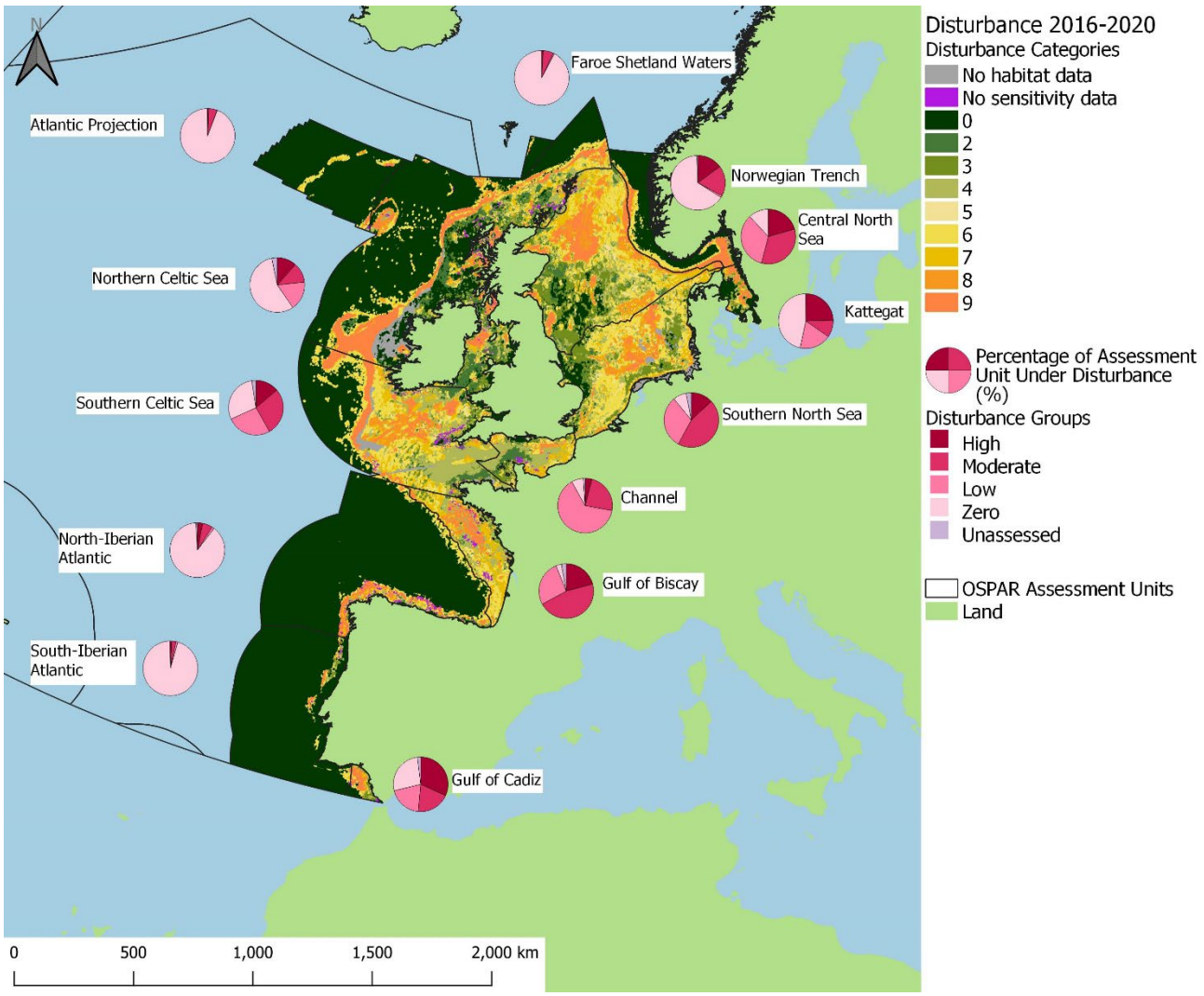


Figure A.4: Spatial distribution of aggregated disturbance using the 2016 to 2020 assessment period. Pie chart plots show the percentage of the assessment unit area under each disturbance group: 'Zero' = disturbance category 0; 'Low' = disturbance categories 1-4; 'Moderate' = disturbance categories 5-7; 'High' = disturbance categories 8 and 9; 'Unassessed Disturbance' = area where fishing pressure was present, but disturbance could not be assessed due to i) no habitat data, or ii) no sensitivity assessments for underlying habitat. (Matear et al., 2023)

Profits from European capture fisheries have generally risen in recent years, while the capacity of fishing fleets has generally decreased. The large-scale fleet accounts for most of the weight and value of catches, but the small-scale fleet can be important to local economies.

Future developments

The 2020 report from the Food and Agriculture Organization of the United Nations (FAO) on the state of world fisheries and aquaculture projected that capture fisheries in OSPAR countries would remain approximately unchanged to 2030, but that this could be affected by many uncertainties including macroeconomic conditions, trade rules, environmental conditions (including climate change) and fisheries management measures.

Pressures from fisheries

Pressures resulting from fisheries include:

- *extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities) - the removal of target species which can cause changes to biodiversity, fish stocks and food webs;*
- *selective extraction of species, including non-target species - the removal of non-target species as incidental by-catch which can cause declines and changes in vulnerable and protected species (including fish, birds, and marine mammals);*
- *physical disturbance to the seabed (temporary or reversible) - associated with activities such as bottom trawling which can cause changes to vulnerable habitats, benthic symbiotic communities, or to sea floor integrity;*
- *input of litter (solid waste matter, including micro-sized litter) - from fishing activities, including abandoned, lost, and discarded fishing gear.*

Across the North-East Atlantic, several fish species affected by fishing pressure in the past are on the OSPAR List of Threatened and / or Declining Species and Habitats (Agreement 2008-06 §4). Depending on the OSPAR Region, these can include sharks, skates and rays and diadromous fish including salmon, and deep-sea species. Some remain vulnerable to fisheries, for example as incidental by-catch. Management of deep-sea fisheries requires particular care.

Management of fisheries to reduce pressures

Fisheries management regulations have resulted in the harvesting of more (but not all) fish stocks moving to levels considered sustainable (from a fish stock management perspective). There is now increased use of landing obligations (discard bans) by Contracting Parties within and outside the EU. Measures to protect vulnerable habitats and species have been introduced, but concerns remain, such as incidental by-catch of cetaceans, birds, and threatened fish species, 'ghost fishing' due to abandoned, lost, and discarded fishing gear, and seabed disturbance from bottom trawling. Since 2010, OSPAR has adopted Recommendations to promote fishing for litter schemes and education for fishers, and measures to prevent and reduce littering from fishing activities are being put in place across the OSPAR Maritime Area.

Future priorities for OSPAR

While stocks in the North-East Atlantic are increasingly being fished according to the reference level MSY, OSPAR should improve its understanding of how fishing at MSY influences other components of the ecosystem and ecosystem health overall, and its understanding of future trends. OSPAR will continue to identify which fishing activities need particular focus from fisheries management authorities as posing a threat to species, habitats, biodiversity and ecosystems, including pressures affecting sea floor integrity, and litter from fishing activities. (Relates to NEAES 2030 Operational Objectives S4.O8, S9.O1, SX.O2)

OSPAR's implementation of an operational objective on incidental by-catch will give increased attention to effects on marine mammals, birds, and protected fish species. (Relates to NEAES 2030 Operational Objective S7.O6)

OSPAR should consider working more closely with relevant management, certification and accreditation organisations to ensure awareness of OSPAR status and other assessments.

Oil and gas exploration and production

What has happened since QSR 2010

The production of hydrocarbons decreased by 28% from 2009 to 2019, though production increased from 2014 to 2016 by approximately 17%, before levelling off. The number of installations with emissions and discharges reported in the OSPAR Maritime Area was the same in 2019 as in 2009 (676), with a maximum of 766 in 2015, followed by a decline to 676 by 2019. The decline was largely due to increasing cessation of production and consequent decommissioning following the drop in the oil price in 2014.

Drilling activity, despite a downturn during 2013-2015, increased over the period from 382 wells drilled in 2011 to 443 drilled in 2019, with a peak of 490 in 2017. Most wells drilled are development wells rather than wells for exploration and appraisal wells. There has been a decline in drilling activity in Ireland, the Netherlands and Denmark, while activity in Norway and the United Kingdom has remained relatively stable over the period.

Pressure from offshore oil and gas activities is greatest in the Greater North Sea followed by Arctic Waters and the Celtic Seas. Exploration and production occur in Denmark, Germany, the Netherlands, Norway, and the United Kingdom. In the other OSPAR Regions, the number of installations is low.

Oil and gas central processing platform. © Shutterstock

Future developments

In Arctic Waters, from the start of petroleum activities in the southern part of the Barents Sea in 1980 and up to the end of 2020, 162 exploration and appraisal wells had been drilled, 101 of which were begun in 2005 or later. Approximately half of these wells have indicated the presence of hydrocarbon deposits. A

number of small and medium-sized discoveries have been made. New gas infrastructure has been established in the northern part of the Norwegian Sea: the Aasta Hansteen field, which started production in 2018. There are currently two fields in production in the Barents Sea, Snøhvit and Goliat, and a third, Johan Castberg, is under development and production will start in 2023. In Norwegian waters, the parts of the Barents Sea area opened for petroleum activity are on average ice-free all year with sea temperatures comparable to the Norwegian Sea.

Elsewhere, the declining trend in production is expected to continue, and as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade.

Reducing greenhouse gas emissions (decarbonisation) of oil and gas production is increasingly gaining focus and electrification of oil and gas installations from the onshore grid or from renewable sources is likely to gain traction.

Pressures from the oil and gas industry

The main pressures resulting from oil and gas activities are:

- *physical loss (due to permanent change of seabed substrate or morphology) – associated with the placement of oil and gas infrastructure;*
- *physical disturbance to the seabed (temporary or reversible) – changes to seabed integrity associated with oil and gas construction, operational and decommissioning activities;*
- *input of other substances (e.g., synthetic substances, non-synthetic substances, radionuclides) from diffuse sources, point sources, atmospheric deposition, acute events – associated with [routine discharges] and accidental events;*
- *input of litter (solid waste matter, including micro-sized litter);*
- *input of anthropogenic sound (impulsive, continuous) – from seismic surveys and installations;*
- *input of other forms of energy (including electromagnetic fields, light, and heat) - lighting associated with offshore installations;*
- *input or spread of non-indigenous species - associated with the foundations of structures providing a suitable substrate for organisms to establish.*

These pressures occur throughout the lifecycle of oil and gas activities, through exploration, production, and decommissioning. Exploration includes seismic surveys and the drilling of exploratory and appraisal wells. Production includes drilling of production and injection wells, and the construction, placement, and operation of infrastructure to produce oil and gas. Decommissioning involves activities such as the plugging of wells and removal of infrastructure. Incidents during the transportation of oil and gas by pipeline or tanker and accidental spills from installations can cause impacts outside the area of production.

Management of oil and gas exploration and production to reduce pressures

OSPAR has put in place a significant number of measures aimed at reducing emissions and discharges from the oil and gas industry within the OSPAR Maritime Area. As of 2020, there were 15 OSPAR Decisions and Recommendations[1] relating to offshore oil and gas industry and a further 21 other Agreements[2]. The vast

[1] Not including Decisions and Recommendations amending the original text or those that have been set aside

[2] Not including Agreements that have been set aside

majority of these have been made since 2000 (most of which have since been updated) and aim to reduce the environmental impacts of the industry on the marine environment. Measures introduced by OSPAR have reduced the oil in produced water discharges and the discharge of hazardous chemicals and drilling fluids. OSPAR has, with a few exceptions, effectively prohibited the disposal of disused offshore installations at sea. Since the ban on dumping of disused offshore installations came into force in 1999, 170 offshore installations have been brought ashore for disposal and ten derogations have been issued by Contracting Parties for structures to be left in place, with a further four under consideration.

Future priorities for OSPAR

Since QSR 2010, and because of the implementation of OSPAR measures by Contracting Parties and industry, the oil and gas industry has made measurable progress and improvements in reducing its environmental impact. However, there are areas where it may be possible to further reduce the potential impacts. Specifically:

While progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, the challenge remains to phase out the discharges of substitution chemicals. OSPAR has set out operational objectives in S2.O3 of NEAES 2030.

Continuous improvement remains a challenge, with hydrocarbon production at different stages in different OSPAR Regions and new developments continuing in Region I and II. OSPAR has set out a number of operational objectives in relation to hazardous substances and marine litter in NEAES 2030 (S2.O3, S2.O4, S4.O5 and S4.O6).

Good practice guidelines for geophysical surveys and use of explosives need to be developed. (Relates to NEAES 2030 Operational Objective S8.O1)

On decommissioning, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. While there have been developments in advancing the technical capabilities, such as an increase in lift capabilities to remove topsides and steel jacket installations, there have been no technology developments that would support a reduction in the categories eligible for derogation from OSPAR Decision 98/3. OSPAR has set out Operational Objectives in S9.O2 and S9.O3 of NEAES 2030.

There are only two full-scale projects with CO_2 storage in the OSPAR Maritime Area (see Table 3). Due to this very limited number, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken. OSPAR has set out Operational Objectives in S12.O3 of NEAES 2030.

Production and use of plastics[3]

What has happened since QSR 2010

Plastics production in Europe[4] and demand from converters (manufacturers of plastic products) rose slightly between 2010 and 2019, to 58 Mt and 50,7 Mt respectively. Around 40% of demand was for packaging, 20% for construction, and 10% for automotive uses. Production facilities are widespread across

[3] This analysis deals with overall production and consumption of plastics; measures specifically addressing litter, including OSPAR's Regional Action Plan for Marine Litter, are addressed in the thematic assessment on litter

[4] Figures from PlasticsEurope; coverage is EU member states (including the UK), Norway and Switzerland

OSPAR countries, with the greatest number in Germany. The proportions used of different types of plastic were similar to those in 2010. The vast majority of plastics are derived from oil and gas. Globally, plastics production increased from 265 Mt in 2010 to 368 Mt in 2019.

Pre-production plastic pellets, otherwise known as nurdles. © Tomas Eriksson

Annual per capita plastic consumption has reached 100 kg in western Europe, and amounts of plastic waste have also increased. Of the 29,2 Mt of post-consumer plastic waste collected in the EU28, Norway and Switzerland in 2018, 7,2 Mt went to landfill (12 Mt in 2006); 12,4 Mt to energy recovery (7 Mt in 2006); and 9,4 Mt to recycling (4,7 Mt in 2006). Recycling rates varied between OSPAR countries; the highest in 2018 (over 40%) were in Norway and Spain.

Packaging is the largest component of post-consumer plastic waste, rising from 14,9 Mt in 2006 to 17,8 Mt in 2018. Of that, 3,3 Mt in 2018 went to landfill (7,2 Mt in 2006); 7 Mt to energy recovery (3,8 Mt in 2006) and 7,5 Mt to recycling (3,9 Mt in 2006). Recycling rates for this waste ranged from 26% to approximately 50% in OSPAR countries.

Microplastics have been an area of increasing interest. Primary microplastics (manufactured to be of small size) include microbeads in cosmetic products, industrial 'scrubbers', rubber granules in artificial grass pitches, and pellets used in plastics manufacture. Secondary microplastics are created through wear and tear of items including tyres and roads, paint, and textiles, as well as breakdown of plastic litter items.

Future developments

Global annual plastics production is expected to reach up to 1,2 billion tonnes by 2050. In the short term, as well as changes in consumption patterns (see Drivers section above), COVID-19 led to a sharp drop in primary plastics production in Europe. The speed of recovery depends on demand in industries such as automotive manufacture and construction.

The European Strategy for Plastics in a Circular Economy seeks a 'new plastics economy' involving greater durability, re-use and high-quality recycling. It aims for all plastic packaging in the EU by 2030 to be either re-usable or easily recyclable, and for more than half of plastic waste to be recycled. It seeks to encourage alternative feedstocks and innovative materials for plastics production.

Pressures from plastics production and consumption

- *input of litter (solid waste matter, including micro-sized litter)*

Around 0,15 – 0,5 Mt of plastic waste is thought to have entered EU seas in 2015. Estimated annual emissions of microplastics into OSPAR catchments averaged over 0,3 Mt, the largest sources being tyre wear and degradation of land-based litter.

Management of production and use of plastics to reduce pressures

OSPAR's 2014 Regional Action Plan for Marine Litter (RAP ML) included commitments to highlight waste prevention and management practices that impact significantly on marine litter; encourage recyclability and re-use of plastic products; assess instruments to reduce single-use items; and reduce inputs of microplastics.

EU actions have included legislation to reduce use of lightweight plastic bags; a recycling target for plastic packaging waste of 55% by 2030; a ban on certain single-use products; collection targets and design requirements for plastic bottles; measures on extended producer responsibility and labelling; and measures to reduce microplastic use (e.g., in products) and emissions. Measures have also been taken on port reception facilities and in relation to fishing gear. OSPAR Contracting Parties have also taken initiatives including plastic bag charges; the use of fees to finance recovery of packaging waste; voluntary agreements with industry; and information instruments.

The EU's Circular Economy action Plan anticipates future actions such as a review of packaging legislation; requirements for recycled content and waste reduction measures for packaging, construction materials, and vehicles; and a policy framework on use of bio-based plastics. In 2021, the European Commission launched a new initiative to address the unintentional release of microplastics into the environment. The 2021 EU Zero Pollution Action Plan also includes objectives on plastics.

Future priorities for OSPAR

OSPAR will continue to address sea- and land-based sources of litter in its new Regional Action Plan for Marine Litter (RAP ML 2) being developed for adoption in 2022. It should consider how to maximise synergies between its own measures (including on microplastics) and actions under the EU strategy for

Plastics in a Circular Economy, the EU Circular Economy Action Plan, and the EU Zero Pollution Action Plan. There may be scope to enhance cooperation with initiatives to reduce plastic inputs, such as the New Plastics Economy Global Commitment, Operation Clean Sweep, and the Arctic Council's regional action plan on marine litter. In their 2021 Cascais Declaration, OSPAR Ministers committed themselves to reducing plastic marine litter under the United Nations Environment Assembly process. (Relates to NEAES 2030 Operational Objectives S4.O1, S4.O7)

OSPAR should consider how it can maintain its awareness of any significant changes in plastics production (e.g., alternative new feedstocks or innovative materials) and their implications for the marine environment. It will improve data on inputs of plastics into the marine environment, and their impacts, including whether specific sources/types of plastic waste are of particular concern. (Relates to NEAES 2030 Operational Objective S4.O2)

Renewable energy

(see: OSPAR Feeder Report 2021 - Offshore Renewable Energy Generation)

What has happened since QSR 2010

In 2009, almost 1,9 GW of fixed offshore wind capacity, involving 713 turbines, was operational or under construction in the North-East Atlantic. By the end of 2019, the amount installed in European seas had grown to over 22 GW and over 5 000 turbines. Of this capacity, 77% was in the North Sea and 13% in the Irish Sea. Offshore wind installation in other OSPAR Regions is very small in comparison.

Offshore wind turbines off the North-East Coast of the United Kingdom. © Colin Ward

Table A.3: Grid-connected offshore wind projects at the end of 2019

	Number of wind farms connected	Number of turbines connected	Cumulative capacity (MW)
United Kingdom	40	2 225	9 945
Germany	28	1 469	7 445
Denmark	14	559	1 703
Belgium	8	318	1 556
Netherlands	6	365	1 118
Sweden	5	80	192
Ireland	1	7	25,2
Spain	2	2	5
Portugal	1	1	8,4
Norway	1	1	2,3
France	1	1	2

The size of turbines, the size of wind farms, the distance to shore, and the water depth have all increased. Costs have also fallen, from over €200/MWh in 2014 to a range of 45-79 €/MWh at the end of 2019. In global terms, OSPAR countries are leaders in offshore renewable technologies and industries, based on first-mover status for offshore wind turbines and a strong home market.

Compared to offshore wind, there has been much slower development of other forms of renewable energy installation - floating offshore wind, tidal and wave energy – with very limited operational capacity by 2020, and these technologies are largely at an early and experimental stage.

Future developments

The North Sea has high potential for continued growth, and the North-East Atlantic Ocean has a high natural potential for both bottom-fixed and floating offshore wind energy. In 2020, the European Commission envisaged an expansion in offshore wind in the EU27 from 12 GW to at least 60 GW by 2030 and 300 GW by 2050, and the United Kingdom Government set out plans for a fourfold increase to 40 GW by 2030. Under a maximum scenario developed by the wind industry, 212 GW could be installed in the North Sea by 2050, with 85 GW in the Atlantic and Irish Sea off France, Ireland, and the United Kingdom. Initially, most new capacity will be bottom-fixed installations, but floating offshore wind is also expected to develop further. Major investment is associated with these future expansion ambitions: estimates are for up to €800 billion to meet European Commission objectives for the EU as a whole by 2050, and £20 billion associated with the United Kingdom's plans for the next decade.

Some increase in tidal, wave and floating solar energy installations is also expected. The European Commission aims for at least 1 GW of ocean energy capacity in European waters by 2030, with a view to 40 GW by 2050. At present, there is no dominant technology for tidal and wave energy, and significant cost reductions would be needed for them to play a significant role in the energy mix.

Pressures from renewable energy

Ecosystem components affected by offshore energy developments include benthic habitats, marine birds, migrating birds, fish, marine mammals, and migrating bats. Pressures include:

- *physical loss (due to permanent changes of seabed substrate or morphology and to extraction of seabed substrate);*

- *physical disturbance to the seabed (temporary or reversible);*
- *input of anthropogenic sound (impulsive, continuous) - from surveys, construction, operation, and decommissioning activities;*
- *death or injury by collision - with infrastructure;*
- *input of other forms of energy (including electromagnetic fields, light and heat);*
- *input of litter (solid waste matter, including microsized litter);*
- *input or spread of non-indigenous species - associated with the foundations of structures providing a suitable substrate for organisms to establish, or to act as stepping stones for their spread.*

The large-scale increase in offshore wind capacity in the southern North Sea by 2050 may also have fundamental impacts on local wind patterns, wave generation, tidal amplitudes, and sediment dynamics.

Tidal and wave devices have the potential to affect local and wider hydrodynamics, or make changes to the seabed and sediment transport, although this may only occur with large-scale installations. There may be impacts on marine life, such as on the local benthos.

Management of renewable energy to reduce pressures

Mitigation methods include appropriate siting of wind installations to avoid impacts on protected habitats and species, and the use of the least disturbing methods for activities such as cable installations. Methods for management of noise, in particular impulsive noise from pile driving, can include appropriate siting of developments, scheduling of activities to avoid sensitive periods, engineering (such as bubble curtains, isolation casings and hydro sound dampers), soft start, surveillance, and deterrents; licensing conditions can include noise thresholds. Design of infrastructure and temporary shutdown of turbines (e.g., during migration periods) can be used to reduce collision risk to birds. OSPAR has produced guidance on environmental considerations for offshore wind farm development (OSPAR agreement 2008-03).

Future priorities for OSPAR

The scale of offshore wind installation in the OSPAR Maritime Area is expected to increase greatly in the next decade and beyond, primarily in the Greater North Sea and Celtic Seas. While knowledge of ecological impacts has improved, evidence remains uncertain, and OSPAR will commission or engage with evidence programmes addressing gaps in understanding. OSPAR will develop common principles and guidance to promote and facilitate sustainable development and scaling-up of offshore renewable energy in a way that minimises cumulative environmental impacts. In order to strengthen its work, OSPAR has decided to set up a specialist group on offshore renewables. (Relates to NEAES 2030 Operational Objective S12.O4)

Management of underwater noise from the construction and operation of offshore renewable energy will form part of OSPAR's Regional Action Plan on Underwater Noise. (Relates to NEAES 2030 Operational Objective S8.O1)

Growth in tidal, wave, and floating solar energy in the next decade is likely to be small, but OSPAR will keep in touch with the work to increase understanding of potential environmental impacts and mitigation measures, and consider the need for guidance.

Shipping

see: OSPAR Feeder Report 2021 - Shipping and Ports

What has happened since QSR 2010

In 2018, the overall weight of goods handled in the ports of OSPAR countries and the passenger numbers in these ports were little changed from 2008. The amount of goods fell after 2008 due to the economic downturn, before recovering. Individual rates of change varied – for example, increases in freight in the Netherlands and Portugal, and decreases in the United Kingdom, Sweden, Denmark, and France.

The Greater North Sea, Celtic Seas, and the Bay of Biscay and Iberian Coast have a particularly high density of shipping, with the highest densities in the English Channel, Southern and Eastern North Sea, and the entrance to the Mediterranean. The OSPAR Maritime Area includes three of the twenty leading container ports globally, and ten of the twenty largest ports in Europe.

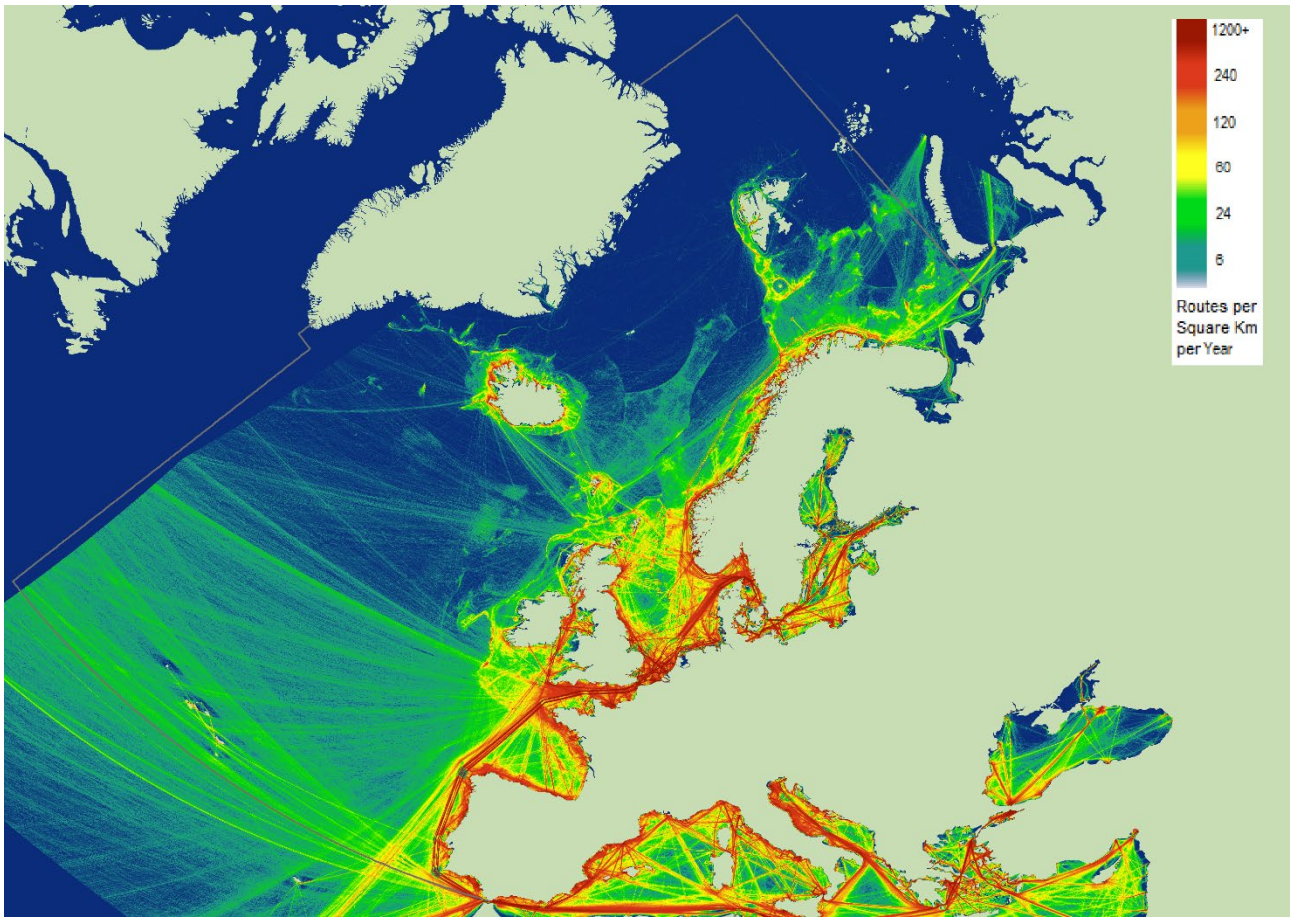


Figure A.5: EMSA route density map (EMODnet, 2019)

Maritime transport is critical to Europe's economy, estimated to represent between 75% and 90% of the EU's external trade and one third of intra-EU trade. For EU countries bordering the sea basins of the Atlantic and North Sea, maritime transport, port activities, and shipbuilding and repair had a gross value added of over €60 billion in 2017.

Future developments

Scenario analyses anticipate an increase in the amount of global shipping in future. However, growth could be limited by factors such as slower than anticipated economic growth, trade tensions, or shifts towards more regionalised trade flows. The extent of any change in volumes of shipping in the North-East Atlantic

therefore remains uncertain. There may also be increases in shipping in Arctic waters associated with trans-Arctic trade routes, natural resource extraction, and cruise tourism.

The composition of the fleet is likely to change over time, including a higher proportion of larger ships. Initiatives to reduce greenhouse gas emissions and air pollution will favour a move towards more efficient ships and, potentially, alternative fuels if these become viable.

Pressures from shipping

Shipping exerts multiple environmental pressures:

- input or spread of non-indigenous species - from ballast water exchange and transport on ships' hulls;
- input of other substances (e.g., synthetic substances, non-synthetic substances) from diffuse sources, point sources, atmospheric deposition, acute events) - shipping is a significant source of air pollution (24% of national NOx and SOx emissions from all sectors in the EU) and greenhouse gas emissions; other inputs include discharges from exhaust gas cleaning systems; discharges of contaminated water; pollution from oil or other noxious substances can arise from accidents, operational activities such as washing of cargo tanks, or antifouling paints;
- input of anthropogenic sound (impulsive, continuous) - continuous noise from shipping, primarily from propeller cavitation, is a major source of anthropogenic underwater noise;
- death or injury by collision - for example with marine mammals, but the effects on populations are difficult to assess as data is lacking;
- input of litter (solid waste matter, including micro-sized litter) - shipping remains a source of marine litter, including from losses of transported goods;
- input of microbial pathogens – from ballast water;
- physical loss (due to permanent change of seabed substrate or morphology) - restructuring of seabed morphology, including dredging and depositing of materials.

Management of shipping to reduce pressures

A range of measures have been taken to address the impacts of shipping, notably through conventions or guidance developed within the framework of the International Maritime Organization (IMO), reinforced or supplemented by action by OSPAR, the EU, and national authorities. Non-indigenous species are addressed through the Ballast Water Management Convention and IMO guidelines on biofouling; OSPAR and HELCOM have started work towards a harmonised management plan for biofouling on commercial vessels and recreational crafts. Airborne sulphur and nitrogen emissions have been reduced by measures under the MARPOL Convention, but actions to reduce airborne emissions have led to discharges to the marine environment from exhaust gas cleaning systems. Accidental or operational pollution has been reduced by measures under the MARPOL Convention, reinforced by cooperation through the Bonn Agreement. Shipping noise is covered by IMO guidelines on noise reduction, although these are not yet thought to have had an effect on overall levels of noise (in 2021 IMO agreed to review and update these guidelines). Shipping is covered by measures under OSPAR's 2014 Regional Action Plan for Marine Litter (RAP ML) and the OSPAR Guidelines for the Management of Dredged Material at Sea (OSPAR Agreement 2014-06).

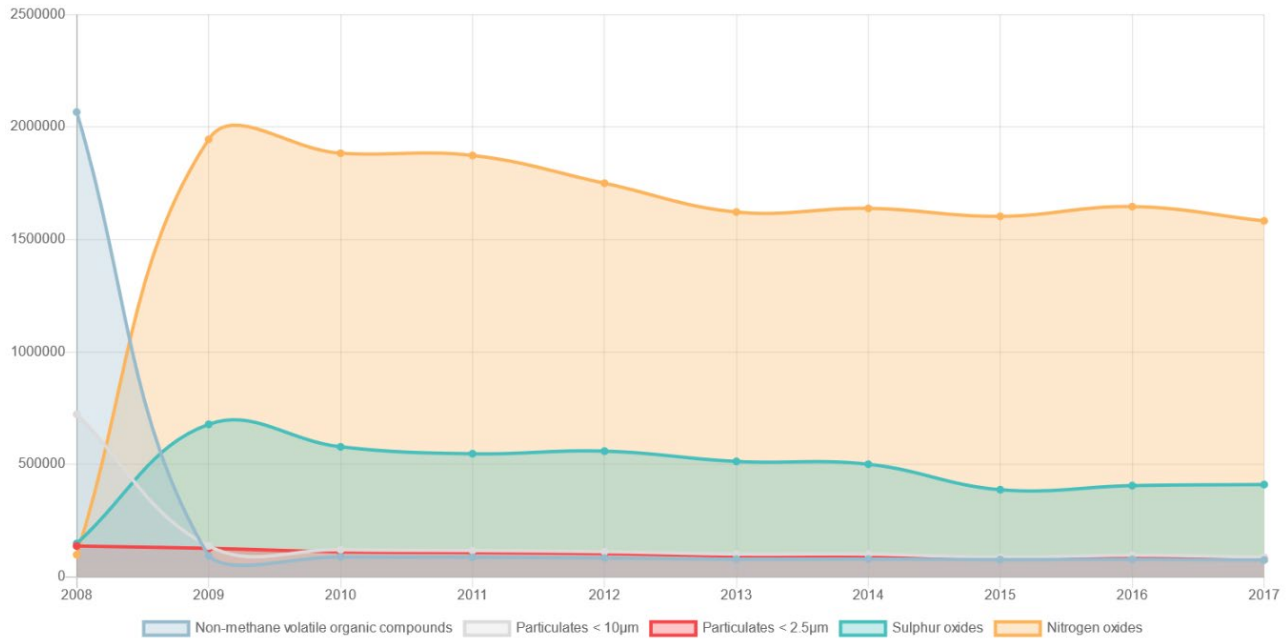


Figure A.6: Emissions of air pollutants from shipping in OSPAR countries (OSPAR, 2021c)

Future priorities for OSPAR

OSPAR will keep a close watch on the implementation and effect of measures already introduced for the management of some pressures, such as ballast water, air pollution, and litter. Effective development and implementation of the Polar Code is important for management of shipping pressures in Arctic Waters. OSPAR should consider how to better understand and monitor trends in shipping, including changes in the volume and distribution of shipping in the North-East Atlantic, changes in ship size, environmental improvements in the fleet, and use of alternative fuels. (Relates to NEAES 2030 Operational Objectives S2.O1-S2.O3, S4.O1, S7.O2)

Increasing knowledge of the scale and impact of shipping noise, and of the effect of measures to incentivise less noisy ships, will be an important area for continued OSPAR work under the Regional Action Plan on Underwater Noise. (Relates to NEAES 2030 Operational Objective S8.O2)

The impact of ship strikes on cetaceans remains an issue of concern. OSPAR should consider what further action should be taken to reduce the impact of ship strikes on the species in the OSPAR List of Threatened and / or Declining Species and Habitats. (Relates to NEAES 2030 Operational Objective S5.05)

OSPAR will consider the impacts of discharges from exhaust gas cleaning systems, microplastics in ship paints, and grey water discharges. It should also consider the significance of newly emerging or poorly understood issues such as risks from accidents involving wind farms or larger ships; biocides and other contaminants used for antifouling (hull maintenance activities); and the impact of ship wakes, and promote the adoption of regional or global measures as appropriate.

By 2023, OSPAR will assess, review, and potentially revise the OSPAR criteria, guidelines and procedures relating to the dumping of wastes or other matter and to the placement of matter. (Relates to NEAES 2030 Operational Objective S7.O4)

Tourism

(see: OSPAR Feeder Report 2021 – Recreation and Tourism in the North-East Atlantic)

What has happened since QSR 2010

Marine and coastal tourism and recreation occurs widely across all OSPAR Regions. Activities such as beach-based recreation, coastal walking, recreational fishing, and recreational boating are widespread, although the scale and nature of specific activities differ between countries and localities. In some areas tourism is a major part of coastal economies. The Greater North Sea, Celtic Seas, and the Bay of Biscay and Iberian Coast account for the majority of tourist arrivals, but tourism is increasing in Arctic Waters and in the Wider Atlantic (the Azores).

Since 2010 tourism has grown across all OSPAR Regions. Many OSPAR countries observe a trend towards shorter, but more frequent vacations among visitors, as well as day-tourism. Cruise tourism and expedition tourism are increasing in Arctic Waters.

Beach-based tourism in Brighton, United Kingdom. © Anne Roberts

Future developments

Marine and coastal tourism is expected to grow in the coming decade. Potential trends which may influence pressures exerted by tourism include changes in demand patterns (more frequent but shorter trips); an aging society (which may reduce seasonality); growing interest in local cultural and environmental characteristics; geopolitical tensions favouring so-called 'safer' destinations in Europe; and climate change.

It is hard to predict the long-term impact of COVID-19, but it may be that domestic holidays could grow in importance or that existing niche trends of 'sustainable' or 'eco' tourism are reinforced.

Pressures from tourism

While a healthy ecosystem has economic benefits for many forms of marine tourism and recreation, these activities also bring multiple pressures including:

- *physical loss (due to permanent changes of seabed substrate or morphology and to extraction of seabed substrate)- associated with the construction of recreation and tourism facilities and beach nourishment affecting coastal habitats;*
- *physical disturbance to the seabed (temporary or reversible) - associated with the construction of recreation and tourism facilities and beach nourishment affecting coastal habitats;*
- *inputs of organic matter and other substances- tourism can add to pressures on waste water infrastructure;*
- *input of litter (solid waste matter, including micro-sized litter)- from tourism and recreational activities (including fishing and boating);*
- *physical disturbance to the seabed (temporary or reversible) - associated with recreational boating;*
- *input of anthropogenic sound (impulsive, continuous) - continuous noise from recreational boating affecting sensitive habitats and species;*
- *input of other substances - recreational boating and recreational fisheries can introduce hazardous substances through fuel and combustion products and antifouling paints;*
- *input or spread of non-indigenous species – associated with recreational boating, e.g,. the sea squirt Didemnum vexillum;*
- *disturbance of species (e.g., where they breed, rest and feed) due to human presence - cruise tourism can also be a pressure on sensitive destinations, including in Arctic Waters. Marine wildlife tourism, such as whale watching, can have negative effects if not well managed;*
- *extraction of, or mortality/injury to, wild species and selective extraction (incidental by-catch)- associated with recreational fisheries and other forms of disturbance may directly affect animal populations, including vulnerable species.*

Management of tourism to reduce pressures

OSPAR does not directly address tourism and recreation in its work, although the pressures are addressed to some extent by the work on matters such as litter, eutrophication, hazardous substances, biological diversity and the protection of species and habitats. Pressures will also be addressed through national or EU legislation, for example on water quality or on single-use plastics, and taken into account in maritime spatial planning.

Evidence on the scale of pressures from recreational fisheries is often difficult to obtain, due to the large numbers and wide variety of small fishing vessels or shore-based fishing. While some management measures are in place nationally, governance and management of recreational fishing remains patchy.

While research has suggested that marine protected areas (MPAs) can have a positive effect on tourism and recreation, the relationship between MPAs and tourism requires better understanding.

Future priorities for OSPAR

Since tourism and recreation are expected to continue to grow in the long term, it will be important for OSPAR to monitor how they develop, and their relevance to objectives in the NEAES 2030. For example, in the case of marine litter, there is potential for OSPAR to address the sector more specifically in the updated OSPAR Regional Action Plan for Marine Litter (RAP ML 2). Recreational boating should be considered in other future OSPAR work, including that on non-indigenous species and underwater noise. Obtaining good data, both on the scale of tourism activities and their impact, remains a challenge.

Waste water

see: OSPAR Feeder Report 2021 – Waste water

What has happened since QSR 2010

The distribution and intensity of waste water from domestic, commercial and industrial sources broadly reflect that of the human population. Over 23 600 settlements with treatment plants are covered by the EU's Urban Waste Water Treatment Directive (UWWTD) (Directive 91/271/EEC).

Industrial point sources of pollution, covered by the Industrial Emissions Directive (IED) (Directive 2010/75/EU), are identified as a relatively small source of pressure, but smaller industrial point sources not regulated by the IED may exert greater pressure on water quality. Eco-toxic loading of pollutant groups, such as heavy metals and organic substances, has decreased or remained relatively constant from most sources. However, the toxic loading due to direct releases to water from treatment plants has increased for heavy metals, which suggests that other sources not regulated under the IED (e.g., smaller agro-industrial facilities) are impacting on heavy metals in these releases.

Future developments

Further investment is still required for European countries, including OSPAR Contracting Parties, to reach and maintain full compliance with the UWWTD. Treatment systems will also face challenges such as population growth straining the capacity of existing infrastructure, more extreme and frequent weather events associated with climate change, and concerns about novel pollutants. For example, heavy rainfall can overload sewer networks, leading to flooding, overflow and release of untreated sewage.

Pressures from waste water

Waste water discharges can potentially be associated with

- *input of organic matter - diffuse sources and point sources;*
- *input of nutrients - diffuse sources, point sources, atmospheric deposition;*
- *input of microbial pathogens;*
- *input of other substances (e.g,. synthetic substances, non-synthetic substances, radionuclides)- diffuse sources, point sources, atmospheric deposition, acute events;*
- *input of litter (solid waste matter, including micro-sized litter) - waste water and storm water overflows are vectors for litter and for microplastics.*

Treatment processes designed to meet UWWTD requirements do not remove all these emissions from waste water. However, some European treatment plants have installed more advanced treatment to reduce emissions of emerging concern.

There is increasing awareness of chemicals in the water environment at low concentrations and in mixtures – the so-called 'cocktail effect'. Many arise from domestic use via leaching from products, cleaning products

or pharmaceuticals, and reach surface waters via urban waste water treatment plants and storm water overflows. Areas of concern include endocrine-disrupting chemicals and antimicrobials. The biological processes required for waste water treatment, including those required for the production of sewage sludge, emit greenhouse gases such as carbon dioxide, methane, and nitrous oxide

Management of waste water to reduce pressures

Regulation through the UWWTD and IED has done much to control the emissions of nutrients and industrial pollution. The UWWTD requires collection and treatment of urban waste water to reduce biological and chemical oxygen demand, and nutrients. Most OSPAR Contracting Parties have predominantly secondary and tertiary treatment plants. Collection and treatment have improved over the last decade in the EU, with compliance rates for plants covered by the UWWTD of 95% for collection, 88% for secondary (biological) treatment, and 86% for more stringent treatment (removal of phosphorus and nitrogen). However, some EU member states are still some way from full compliance with the UWWTD. Smaller, less regulated settlements and industries remain of concern.

In addition, for hazardous substances, OSPAR has agreed measures including emission and discharge limit values for industries, substitution of hazardous substances, usage bans or restrictions.

Management issues still remain. Some substances, in particular micropollutants (such as microfibres and microparticles, where knowledge is emerging), are not routinely removed by waste water treatment. Furthermore, the complexity of chemical effects presents a mismatch with the single-substance approach of current chemicals assessment under most environmental legislation. Bypassing of treatment plants due to storm surges is another challenge; sustainable urban drainage systems can provide a solution. The European Commission has launched an impact assessment to consider revising the UWWTD.

Future priorities for OSPAR

The new OSPAR Regional Action Plan on Marine Litter (RAP ML 2) will continue to target marine litter from waste water treatment plants and foster the development of harmonised monitoring and best practices for prevention and reduction of riverine litter. (Relates to NEAES 2030 Operational Objectives S4.O6, S4.O7)

OSPAR should consider further efforts to better monitor, research and control issues of current or growing concern, including the presence of microplastics in waste water; the impact of low concentrations and mixtures of chemicals; pharmaceuticals; and inputs from industrial sources not regulated under the IED. (Relates to NEAES 2030 Operational Objectives S1.O3, S1.O4, S2.O3, S4.O1)

Other activities

The pressures from some other current or emerging human activities are also of interest to OSPAR, or may be in the future. These include underwater cabling (e.g., for energy transmission or communications); carbon capture and storage; geoengineering to counter anthropogenic climate change; land reclamation and coastal defence, including for the purposes of protection against sea-level rise due to climate change; and the disposal of mine tailings in coastal waters. More information on these activities is available in the series of mini-assessments referred to in **Table A.4** below.

Though not an ongoing human activity, the legacy of unexploded conventional and chemical munitions in the OSPAR Maritime Area remains a significant risk to human safety and the natural environment. OSPAR

Recommendation 2010/20 provides a mechanism to facilitate the reporting of encounters with such munitions. Research projects under way in the OSPAR Maritime Area, most notably the Interreg North Sea Wrecks and the DISARM projects, are expected to significantly improve the capacity of Contracting Parties to take a more systematic approach to risk assessment of wrecks and munition dump sites.

New, emerging and increasing activities and pressures

OSPAR's NEAES 2030 includes an operational objective that "*by 2024 OSPAR will review the risks from new, emerging and increasing pressures on the marine environment, taking account of OSPAR's Quality Status Report 2023, and prioritise them for action and the adoption of measures where necessary*". (NEAES 2030 Operational Objective S7.O5)

Table A.4 below summarises activities which may require review under this objective, including those where OSPAR guidance or other measures may need to be considered. As well as new activities, it covers some activities whose intensity, distribution or risks may change as a result of climate change. Several of these activities are covered in the series of feeder reports produced as part of QSR 2023 and / or in separate mini-assessments produced for the QSR.

Table A.4: New, emerging and increasing activities and pressures on the marine environment of the North-East Atlantic

Activity	**Prospects for 2030**	**What is the issue**	**Potential OSPAR action**
Large-scale aquaculture	Expanded finfish aquaculture; may include larger facilities and offshore developments. Potential increases in shellfish and seaweed production. Recirculating aquaculture systems (RAS) may increase.	Potential for increase in pressures due to large-scale expansion. RAS can mitigate impacts but issues such as nutrients in effluents and energy use will require management.	Engagement with ICES to address knowledge gaps on environmental impacts associated with expansion, including offshore and RAS facilities. Consideration of potential need for OSPAR guidance if gaps in existing guidance identified.
Carbon capture and storage	Storage of CO_2 in geological formations including depleted oil and gas reservoirs and saline aquifers is an emerging offshore activity. There are two large scale CO_2 storage	The pressures from CO_2 storage, inter-alia development and decommissioning activities, could be similar to pressures from offshore oil and gas activities. There is the risk of CO_2	While scientific knowledge of the environmental risks of storage of CO_2 in geological formations is developing, the need for improving and refining the reporting to OSPAR

	projects currently operating in the OSPAR Maritime Area (*Sleipner* and *Snøhvit* in Norway). A number of new project proposals are being developed and are at various stages of progression including the *Greensand* project in Denmark, the *Porthos* and *Aramis* project in the Netherlands, the *Longship* project in Norway, and the *Acorn*, *Northern Endurance* and *HyNet North West* projects in the United Kingdom.	leakage from the storage site, which may have a negative effect on the receptors in the marine environment if CO_2 leakage were to occur.	on environmental monitoring from CO_2 storage projects has been identified. Work has been initiated by EIHA and the OIC to analyse the existing reporting obligations stemming from OSPAR and other national and international measures with a view to ensuring that adequate monitoring and reporting is undertaken.
Deep seabed mining	Deep seabed mining for resources such as key metals is likely to occur in coming decades. Some OSPAR countries are in the process of opening areas for exploration on the continental shelf.	Understanding of the environmental impacts is as yet uncertain. Further research and knowledge on the deep-sea environment and its resilience are required in order to move from exploration to exploitation.	Further research and knowledge. OSPAR to develop a common understanding on extent to which OSPAR measures can apply to deep seabed mining activities in the Area Beyond National Jurisdiction.
Fisheries	Changing patterns of fish stocks due to climate change. Potential new or increased fisheries, such as for the copepod *Calanus finmarchicus* or for mesopelagic fish.	Potential complications for fisheries management, which could increase pressures on certain fish stocks. Increased fisheries activities in some parts of the OSPAR Maritime	OSPAR to better understand future trends, including impacts of climate change on fish stocks and the ecosystem, any instabilities caused by tensions over fisheries

		Area. Impacts on the food chain, including incidental by-catch of fish larvae.	management or new fisheries.
Geoengineering	Geoengineering techniques such as carbon dioxide removal (CDR), ocean fertilisation (OF) and solar radiation management (SRM) commit to deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change. Ocean fertilisation is currently restricted in the OSPAR Maritime Area (application of London Convention/London Protocol legal framework); SRM is at a laboratory testing stage only.	The implications of most of these techniques are largely unknown as far as feasibility is concerned and their potential impacts will require further research into details and quantifications. Potential impacts include acidification, effects on productivity and fisheries, deoxygenation, altered regional nutrient supply, coverage of sea floor, local anoxia, competition to indigenous biodiversity, disease outbreaks.	Contracting Parties to be engaged as appropriate in exploring governance issues for both SRM and CDR in marine environment, distinguishing between research and deployment.
Land reclamation, coastal defence and other structures	Additional coastal defence (e.g., through beach replenishment) is to be expected due to climate change.	Loss or damage of coastal habitats and changes to physical nature of the seabed. Noise, siltation, and air pollution during construction.	Minimise and put right any adverse environmental effects. Continue to promote a shift to a sediment approach and modern methods and soft coastal engineering. Consider update of OSPAR's guidelines.
Sea disposal of mine tailings	Two mining activities with disposal of mine	Physical loss due to coverage of the deposit area by	OSPAR to be aware of work to develop BAT for sea tailings disposal, and to

	tailings in fjords are planned in Norway.	tailings; potential impacts include loss of benthic fauna in and around the deposit area.	improve understanding of the effect of this activity.
Offshore renewables - wind	Major expansion of offshore wind, particularly in the Greater North Sea and Celtic Seas. In the coming decade most will be bottom-fixed installations but floating offshore wind may increase in the longer term.	Potential impacts on habitats, species, and physical processes. The scale and nature of impacts remain uncertain but are expected to be substantial.	OSPAR to engage with major evidence programmes. OSPAR to develop common principles and guidance to promote and facilitate sustainable development and scaling-up of offshore renewable energy so that cumulative environmental impacts are minimised.
Wave and tidal, and other offshore renewable technologies	Relatively small expansion of tidal and wave energy to 2030; longer term growth, including in other technologies such as floating solar photovoltaic installations, if technology becomes commercially viable.	Nature and scale of impacts on physical processes, habitats, and species currently uncertain.	OSPAR to keep in touch with work (in ICES or elsewhere) to better understand impacts, and to consider need for any OSPAR guidance.
Shipping	Potential increase in shipping in some Arctic waters, or in routes leading to them (e.g., in the Greater North Sea) as Arctic routes become more ice-free. Increased use of exhaust-gas cleaning systems (EGCS) across	Pressures from shipping (e.g., noise, air pollution, water-borne contaminants; litter) in areas formerly less affected by these.	Cooperate with IMO to tackle shipping noise and discharge from EGCS into waters.

	the OSPAR Maritime Area.		
Subsea cables	Increase in installation of telecommunication cables to meet capacity demands; decommissioning of cables reaching end of service. Increase in number and length of power cables within and from wind farms and in interconnectors for renewable energy import/export.	Temporary impacts associated with installation of cables; power cables also produce electromagnetic fields and heat, with potential to affect marine life.	OSPAR to complete in 2022 work to review / update its document on environmental impacts of cables; OSPAR should then consider update of its best practice guidelines on assessment of environmental impacts of cables.
Waste water	Increased risks of waste water treatment facilities being overwhelmed by storm events.	Increased input of pollutants (e.g., contaminants, marine litter) in coastal areas.	OSPAR to take this risk into account in work on Regional Action Plan on Marine Litter and on reducing inputs of hazardous substances.

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P – Pressures

Summary of the main pressures from human activities

Details of the main pressures from each human activity are summarised in the subsections on each activity in the previous section of this assessment. A summary table of the main pressures related to human activities in the North-East Atlantic is presented below.

Table P.1: Summary of main pressures from human activities in the OSPAR Maritime Area

	Physical loss of seabed	Physical disturbance of seabed	Loss of / change to natural biological communities	Input or spread of non-indigenous species
Aggregates extraction	Removal of rock, gravel, sand	Associated with dredging; can be temporary or long lasting		
Deep seabed mining	Removal of seabed mineral resources	Associated with removal of mineral resources	Loss or change to specialised communities	
Agriculture				
Aquaculture			Removal of mussel seed	For example, the sea squirt *Didemnum vexillum* or the Pacific oyster *Crassostrea gigas*
Fisheries	From bottom trawling	From bottom trawling	Shifts in trophic guilds	
Oil and gas	From oil and gas infrastructure	From oil and gas infrastructure		Oil and gas infrastructure provide a hard substrate for colonisation

Plastics production and consumption				
Renewable energy	From offshore energy infrastructure	From offshore energy infrastructure		Foundations provide a substrate for colonisation
Shipping	From dredging			From ballast water and transfer on ships' hulls
Tourism	Construction of recreation and tourism facilities and beach nourishment	Construction of recreation and tourism facilities and beach nourishment; disturbance from recreational boating		Associated with recreational boating, e.g., the sea squirt *Didemnum vexillum*
Waste water				

Table P.2: Summary of main pressures from human activities in the OSPAR Maritime Area

	Input of nutrients	Input of other substances (synthetic / non-synthetic)	Input of organic matter	Input of litter
Aggregates extraction				
Deep seabed mining		Chemical plumes, release of toxic metals		
Agriculture	Nitrogen and phosphorous losses	Pesticides in agricultural run-off		From plastics used in agriculture; micro-plastics in sewage sludge

Aquaculture	From fish feed	Chemicals (including contaminants from fish feed); pharmaceuticals	From diffuse and point sources	For example, nets, bags, other plastic equipment
Fisheries				From fishing equipment including nets
Oil and gas		Discharges from oil and gas installations		From oil and gas activities
Plastics production and consumption				Plastic waste; microplastics (e.g., from pellet loss, use in products, abrasion such as tyre wear)
Renewable energy				From activities associated with construction and operation
Shipping		Including NOx and SOx emissions, discharges from exhaust-gas cleaning systems, contaminated water, oil pollution, anti-fouling paints		Shipping litter and losses of transported goods
Tourism		Fuel, combustion products and antifouling paints from recreational boating and fishing	Pressures on waste water infrastructure	From general tourism and recreational activities (including fishing)
Waste water	From waste water discharges	Chemicals from commercial and domestic use,	From waste water discharges	Including as a vector for microplastics

		including pharmaceuticals, endocrine disruptors and antimicrobials		

Table P.3: Summary of main pressures from human activities in the OSPAR Maritime Area

	Input of anthropogenic sound	Input of other forms of energy	Input of genetically modified species / translocation of species	Input of microbial pathogens
Aggregates extraction	From aggregate dredging operations			
Deep seabed mining	Noise and vibration from mining activities	Lighting from mining vehicles		
Agriculture				
Aquaculture	Devices to deter predators		Escaped or introduced fish	Transfer of parasites or diseases, including sea lice
Fisheries				
Oil and gas	Input from seismic surveys and installations	Platform lighting		
Plastics production and consumption				
Renewable energy	Associated with construction, operation, and decommissioning	Lighting, electromagnetic fields		
Shipping	From sources including propeller cavitation and			From ballast water

	onboard machinery			
Tourism	From recreational boating			
Waste water				From waste water discharges

Table P.4: Summary of main pressures from human activities in the OSPAR Maritime Area

	Loss of target species	Loss of non-target species	Death or injury by collision	Disturbance of species (e.g. where they breed, rest and feed) due to human presence
Aggregates extraction				
Deep seabed mining				
Agriculture				
Aquaculture				
Fisheries	Removal of wild species	Removal of fish, mammals, birds as incidental by-catch		
Oil and gas production				
Plastics production and consumption				
Renewable energy			With infrastructure (e.g., for birds)	
Shipping			For example, with marine mammals	

Tourism	From recreational fisheries	Incidental by-catch associated with recreational fisheries		Cruise tourism in sensitive destinations; marine wildlife tourism
Waste water				

S – State

State of the marine environment

This thematic assessment encompasses the broad range of human activities in the North-East Atlantic. These activities have multiple effects on the marine environment. This section of the QSR is not the place to report on the overall quality status, since information on quality status can be found elsewhere in the QSR, including in other thematic assessments.

The status assessments of threatened and / or declining species and habitats conducted for QSR 2023 include information on the pressures to which they are subject. A summary table of the pressures affecting each of those species and habitats is available here. Some species and habitats are affected by a wide range of pressures; for others, the assessments highlight just one or a few pressures, such as incidental by-catch for some fish species. Commonly occurring pressures include loss of target and non-target species (primarily due to fisheries); physical loss or disturbance of the seabed; input of substances to the marine environment; marine litter; and disturbance by human activities.

I – Impact (on Ecosystem Services)

Ecosystem services

Activities and pressures can have positive and negative impacts on the marine environment and the goods and services it provides. Many of those goods and services ('ecosystem services') are used and valued by society, either directly or indirectly, and may in turn influence the drivers of basic human needs. The comprehensive integrated management of human activities, in line with the ecosystem approach, requires consideration of environmental, social and economic parameters. Embedding ecosystem services into the assessment of marine environment quality status allows us to better understand and manage the causes and consequences of change, in terms of both the impact on the environment and the impact on society (human welfare). This integrated approach allows us to identify and take action on influences which are critical to the health and integrity of marine ecosystems, while achieving sustainable use of ecosystem goods and services (including natural capital assets).

In order to understand the potential impacts on society due to changes in the marine environment (the 'I' within the DAPSIR framework), a methodology was developed that could be applied to the relevant thematic assessments to describe the linkages between information on the environmental state changes and impacts on ecosystem services.

The list of ecosystem services that are considered in the QSR 2023 is presented in **Figure I.1**. These ecosystem services are considered to be representative of the goods and benefits provided to serve society's basic human needs by a range of activities in the North-East Atlantic. Changes in the provision of ecosystem services may in turn have an impact on the societal drivers underlying the range of activities which exert pressures on biodiversity and ecological components, thus closing the DAPSIR loop. Analysis of ecosystem services therefore allows us to build in the linkages to consider the impacts on the environment, society and the economy in an integrated way.

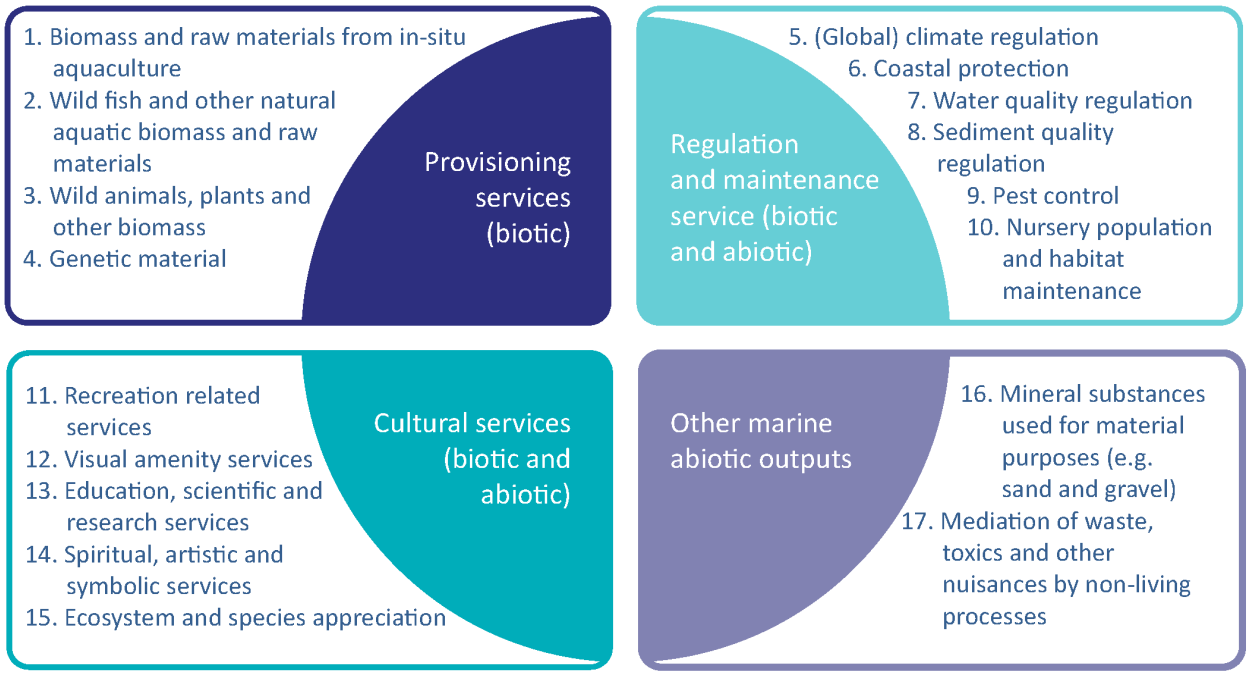

Figure I.1: Overview of ecosystem services described

Human activities leading to state changes covered by several thematic assessments can have impacts on the same ecosystem service. Similarly, if a topic covered by a thematic assessment has impacts on a number of ecosystem services, the chapter on impacts will describe more than one ecosystem service.

Natural capital

The work on ecosystem services can be seen as one of the contributions to the NEAES 2030 objective that by 2025 OSPAR will start accounting for ecosystem services and natural capital in order to recognise, assess and consistently account for human activities and their consequences in the implementation of ecosystem-based management. (Relates to NEAES 2030 Operational Objective S7.O3)

In 2021 a first version of these accounts was developed (Alarcon Blazquez, 2021), following the new UN guidelines on Ocean Accounting. The following accounts were prepared (see also **Figure I.2**):

1. Ecosystem extent account: Describes the extent or area of the various ecosystem types;
2. Condition account: Overview of status and pressure indicators;
3. Physical supply and use accounts: Describe the flows of final ecosystem services supplied by ecosystem assets, and used by economic units during an accounting period, in physical terms;
4. Monetary supply and use accounts: As above, but in monetary terms (valuation in this first version was largely based on benefits transfer);

5. Monetary asset account: Presents information on stocks and changes (additions and reductions) of ecosystem assets. This includes accounting for ecosystem enhancement and degradation and is thus a value beyond GDP.

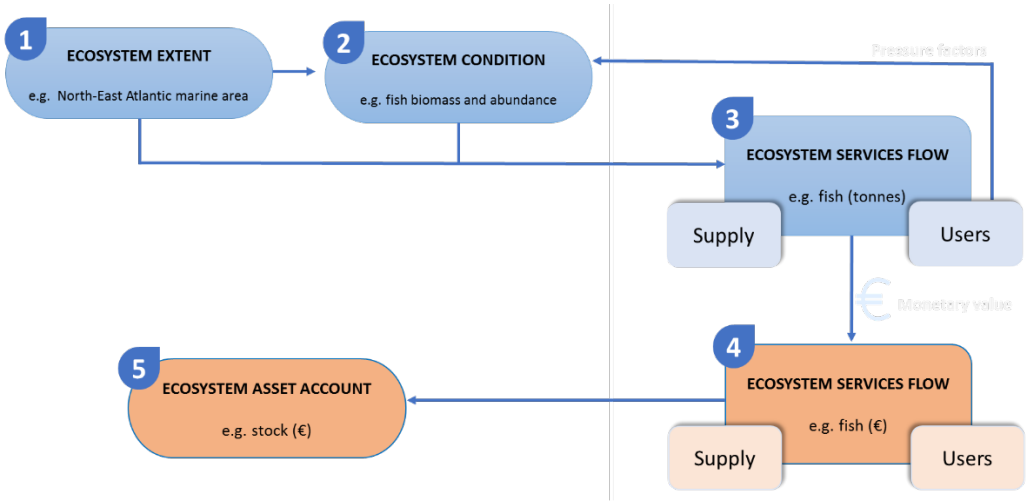

Figure I.2: UN Ecosystem Accounting framework applied to the OSPAR area (Alarcon Blazquez, 2021)

The first version of the natural capital accounts describes the supply and use of the following ecosystem services: fisheries; aquaculture; carbon sequestration; outdoor recreation; generation of electricity from wind power; oil and gas; and minerals extraction. In 2022 a second version of the natural capital accounts will be developed including more ecosystem services and possibly also more analyses. Information from the above-described study on the link between changes in the marine environment and ecosystem services will also be included.

The 2021 report considered the compatibility of the basic structure of physical accounts in the SEEA EA framework with the changes in the State and Impact on Ecosystem Services aspects of the DAPSIR (**Figure I.3**). Implementing and using systemic thinking frameworks such as DAPSIR can create synergies with a Natural Capital Approach (and *vice versa*). Thus, the DAPSIR framework can help to build OSPAR logic chains and facilitate the connections between the natural capital accounts and the sustainable use of ecosystem services.

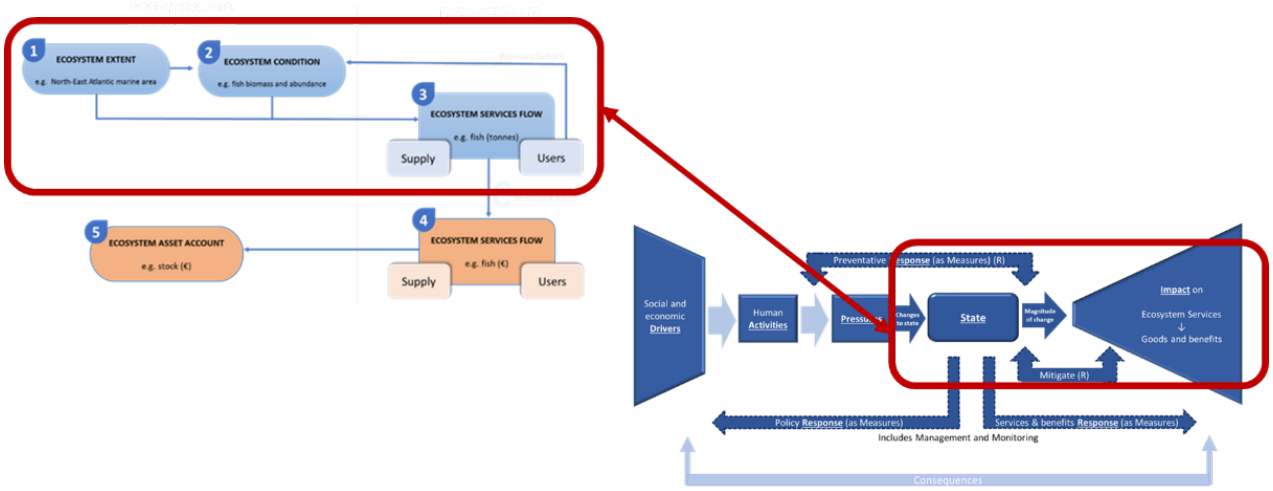

Figure I.3: The synergy between the SEEA EA physical accounts and the OSPAR DAPSIR framework for QSR 2023 thematic assessments

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R – Response

OSPAR measures relating to pressures

Since QSR 2010, OSPAR has put in place recommendations and guidance relating to pressures from several human activities. Key examples of these are summarised in Table 6 below. The table is focused on OSPAR measures; the section of this assessment relating to activities includes other information on management measures. It does not include OSPAR provisions relating to monitoring – for example of noise, litter, or discharges. Measures related to the oil and gas industry are listed in the Offshore Industry thematic assessment.

Measures to address incidental by-catch and habitat damage from human activities, notably fisheries, are referred to in several OSPAR Recommendations on threatened and / or declining species and habitats, including species of elasmobranchs, seabirds, and cetaceans as well as shallow and deep-water habitats such as cold-water corals and deep- sea sponge aggregations (see: Overview Assessment of Implementation of OSPAR Recommendations for Protection and Conservation of Threatened and/or Declining Species and Habitats).

A progress report on the implementation of all OSPAR measures is available here. While take-up of guidelines is not universal, there is nonetheless good evidence of most Contracting Parties using them in their regulatory processes.

Table R.1: Major OSPAR recommendations or other agreements concerning human activities, introduced since QSR 2010

Title of measure	Activities affected	Content of measure
OSPAR Recommendation 2010/20 on an OSPAR Framework for Reporting Encounters with Conventional and Chemical Munitions in the OSPAR Maritime Area (Recommendation 2010/20)	Not an ongoing activity	Reporting framework designed to improve data on munitions, enabling better management of historical dumping sites and evaluation of risks
Guidelines for Best Environmental Practice in Cable Laying and Operation	Power transmission (including offshore	Sets out measures to avoid and mitigate the ecological impacts of construction, operation, and removal of underwater cables

(Agreement 2012-02) (Revised 2017)	renewables); telecommunications	
OSPAR Guidelines on Artificial Reefs in relation to Living Marine Resources (Agreement 2012-03)	Fisheries, nature conservation	Assists Contracting Parties in considering the consequences for the marine environment of the placement of artificial reefs on the seabed
Regional Action Plan for Prevention and Management of Marine Litter in the North-East Atlantic (Agreement 2014-01) (Amended 2018)	Shipping, fisheries, aquaculture, plastics, waste water	Sets out a range of actions for limiting input of litter to the marine environment, and for removal of existing litter. An updated action plan (RAP ML 2) is in preparation for adoption in 2022
OSPAR Guidelines for the Management of Dredged Material at Sea (Agreement 2014-06)	Shipping and ports; coastal protection; dredging for ecosystem enhancement	Provides a technical framework for assessing dredged material for deposit at sea in line with best environmental practice
Fishing for Litter Guidelines (Agreement 2017-08)	Fisheries	Sets out the parameters for Fishing for Litter schemes
Recommendation on the reduction of marine litter through the implementation of sustainability education programmes for fishers (Recommendation 2019/01); Guidelines on the reduction of marine litter through the implementation of sustainability education programmes for fishers (Agreement 2019-08)	Fisheries	Promoting the implementation of sustainability education programmes for fishers including addressing the social, economic and ecological impacts of marine litter; guidance on content of programmes
Joint Harmonised Procedure on the granting of exemptions under the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Agreement 2020-01)[5]	Shipping	Sets out a procedure to ensure that exemptions under the International Convention for the Control and Management of Ships' Ballast Water and Sediments are applied by OSPAR and HELCOM Contracting Parties in a manner that prevents damage to the environment, human health, property or resources

[5] Other OSPAR agreements relating to ballast water also applied before the Convention came into force

Recommendation on the reduction of plastic pellet loss into the marine environment (Recommendation 2021/06); Guidelines in support of OSPAR Recommendation 2021/06 on the reduction of plastic pellet loss into the marine environment (Agreement 2021-06)	Plastic supply chain, including production and transport	Recommends that OSPAR Contracting Parties should promote pellet loss prevention standards and certification schemes, and sets out guidance on the content of these standards and schemes

In considering responses, it is important to assess the effectiveness of measures taken and which of those measures are delivering the greatest effect in relation to costs. This may require more consideration of alternatives to existing or planned measures. OSPAR may wish to consider further analysis on the success and costs of key management measures, as a way to improve decision making on what measures should be prioritised. It may also wish to consider work to better analyse how maritime spatial planning contributes to efforts to improve the state of the marine environment.

Cumulative Effects

Analysis of cumulative effects

Pressures can lead to changes in ecosystem state either singly or collectively (cumulative effects). The application of the ecosystem approach integrates conservation and management approaches in all of OSPAR's work and helps to adapt the management of human activities to the complex and dynamic nature of marine ecosystems. To apply the ecosystem approach and to consider cumulative effects in thematic assessments requires an understanding of:

- the **drivers** of change [D]
- how human **activities** and **pressures** affect ecosystems [AP]
- the health, integrity and dynamics of marine ecosystems – baseline vs impacted **state** [S]
- **the impact** of changes on ecosystem goods and services [I]
- integrated management measures (**responses**) [R]

In recognition of the connectivity and inter-relationships between these components OSPAR has developed a DAPSIR framework (**Figure CE.1**) to structure the thematic assessments.

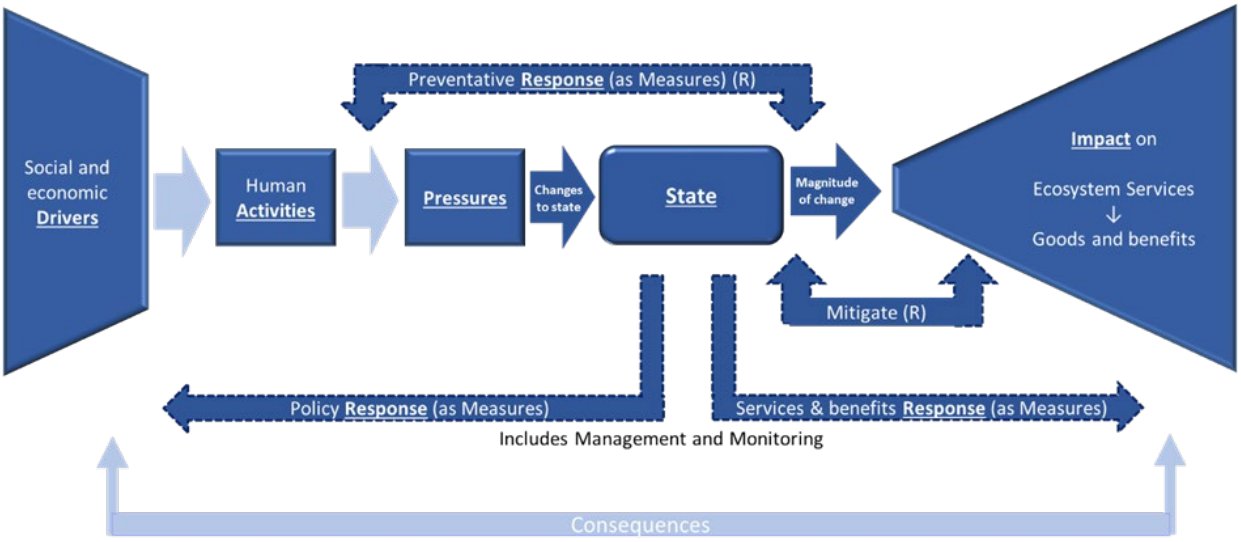

Figure CE.1: Framework to underpin thematic assessments. This schema is compatible with the European Commission Staff Working Document DAPSES-MMM framework

Adapted from Elliott et al., (2017), application of the DAPSIR framework allows us to consider how multiple drivers (D) lead to multiple human activities (A) which exert multiple pressures (P) causing multiple changes in ecosystem state (S). These state changes have impacts (I) on multiple ecosystem services and the goods and benefits these provide to society which in turn influence the drivers of change. Management measures to prevent change or to mitigate the effects of change from these cumulative pressures are also incorporated into the assessment as responses (R). The section of this assessment on drivers describes some of the predominant drivers and the sections on activities, pressures and responses describe the predominant human activities, the associated pressures and management responses (DAPR). The section on impacts describes the work being progressed to incorporate the impact on ecosystem services (I) into the framework as well as OSPAR's consideration of how to adopt natural capital accounting and the synergies with the DAPSIR framework.

The earlier subsection on renewable energy activities concludes that the scale of offshore wind installation in the OSPAR Maritime Area is expected to increase greatly in the next decade and beyond, primarily in the Greater North Sea and Celtic Seas. As such, renewable energy development (and in particular offshore wind) provides a useful case study for cumulative effects assessment (**Figure CE.2**).

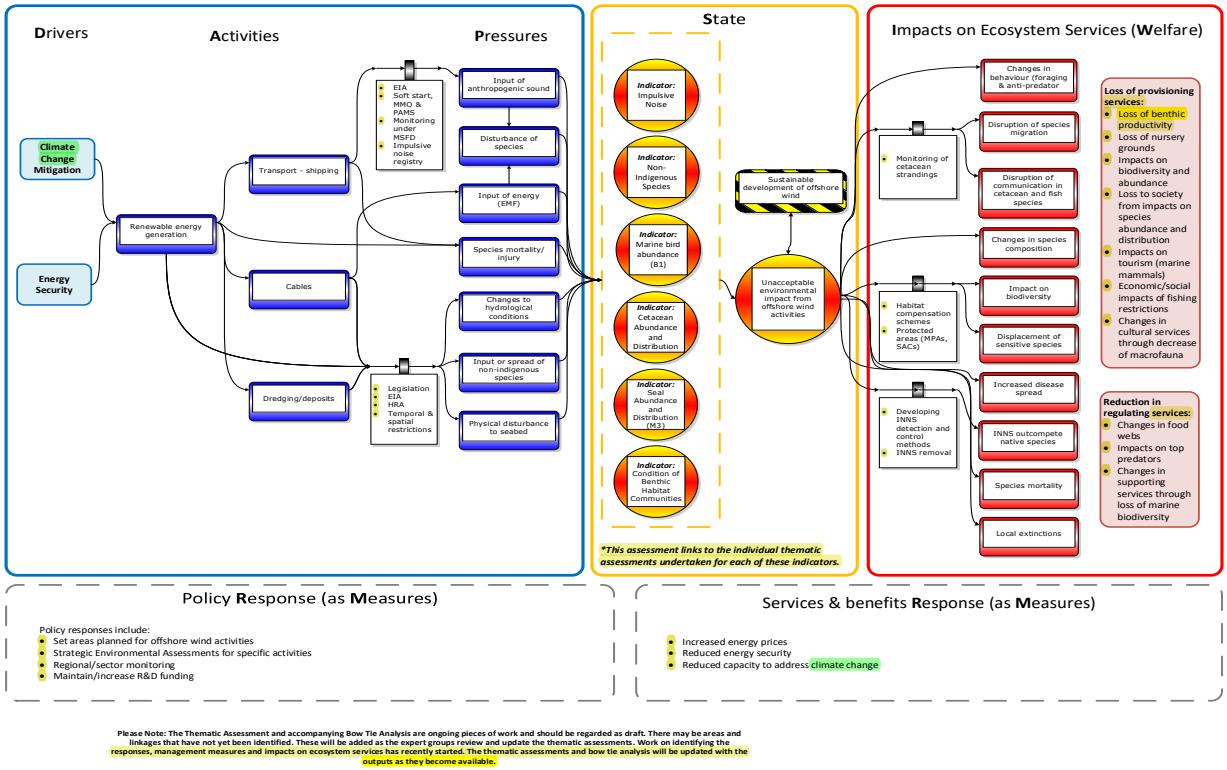

Figure CE.2: DAPSIR framework for offshore wind farm development, showing connectivity of the cumulative pressure pathways, relevant indicators of state change, an indicative list of ecosystem services impacts and management responses

The expansion of renewable energy will be associated with increases in construction activity (including piling) and turbine operation, as well as corresponding increases in shipping (construction, supply and maintenance vessel movements and operations); power cable laying and maintenance activities; and dredging and deposit operations associated with ground preparation and installation of offshore wind infrastructure. The range of pressures associated with these activities will also increase. OSPAR has a suite of indicators describing state change and these state changes can be influenced by pressures from offshore wind farm development (e.g,. impulsive noise; non-indigenous species; marine bird abundance; cetacean abundance and distribution; seal abundance and distribution; condition of benthic habitats). The outputs from these indicator assessments quantify such changes and these can be considered alongside the trends in human activities and pressures as part of a simplified cause and effect analysis. The overall objective is for OSPAR Contracting Parties to progress development to manage risks so as to avoid or minimise 'unacceptable environmental impact from offshore wind activities'. A range of ecosystem services are impacted (positively and negatively) by offshore wind farm development and the type and extent of impact has consequences for the drivers. Consideration of the effectiveness of management measures is a critical part of the assessment of cumulative effects in terms of how impacts are prevented or mitigated. A single pathway of the DAPSIR connections for underwater noise from offshore wind farm development is shown in **Figure CE.3**. Quantifications will be added once available from each of the individual indicator and thematic assessments.

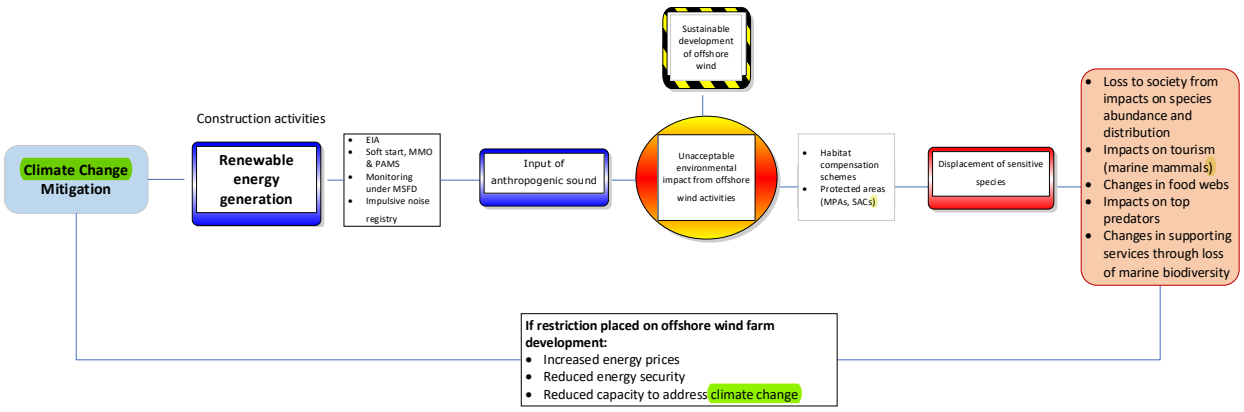

Figure CE.3: Underwater noise effects from offshore wind farm development

Figure CE.3 highlights the need for decision-makers to consider the negative environmental effects (e.g., underwater noise) and how these may be managed to reduce impacts (e.g., noise dampening) alongside the positive effects (e.g., mitigating the effects of climate change, renewable energy as alternatives to burning fossil fuels). This means there is a need to consider both the direct adverse effects on ecosystem status from offshore wind farm construction and operation **and** the adverse effects on the ecosystem if climate change effects are not abated. To ensure that society's needs for energy are maintained, it may not be possible (or appropriate) to restrain the scale of offshore wind farm development in the North-East Atlantic. Instead, responses may need to focus on directing development to areas of lesser environmental sensitivity, developing and applying effective measures to mitigate adverse effects or applying compensation measures, such as habitat creation / restoration. This can only be achieved by applying a systemic approach to the assessment and management of the ecosystem, such as the DAPSIR being applied in the QSR 2023 to consider the collective pressures form human activities on ecosystem state.

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Climate change

The North-East Atlantic has already experienced physical, chemical and biological effects linked to climate change, including changes in sea temperature, sea ice coverage and sea and oxygen levels, a decline in primary productivity in the North Sea in the past 25 years, and shifts in fish distribution. Further impacts due to a changing climate can be expected in the future, which will differ in different areas of the North-East Atlantic. In addition, actions to reduce greenhouse gas emissions, notably a major expansion of offshore renewable energy, will have consequences for the marine environment. (More details in the Climate Change Thematic Assessment)

Human activities affecting the marine environment of the North-East Atlantic are now being influenced by climate change and will continue to be affected in the next decade and beyond. Adaptation and resilience building will be needed in relation to negative impacts; in some cases, there could be positive impacts for activities. Measures to reduce greenhouse gas emissions will also affect activities. Potential influences on activities include:

- fisheries. Stock distributions and/or sizes may change, for example through increased catch potential in high latitude areas (although impacts on commercially important stocks are uncertain) and decreases further south. There may be increasing complexity and contention in assessment, allocation, and transboundary management of catches. Fishers may need to adapt fishing practices (e.g., to address changes in the frequency of extreme events, or to ensure resilience of fish stocks);
- aquaculture. Possible negative impacts include loss of production or infrastructure due to increased intensity or frequency of extreme events (such as storms or heatwaves); an increase in diseases, toxic and / or harmful algal blooms and parasites; decreased productivity due to temperature rise; effects on production of oyster spat or mussel seed; or the effect of ocean acidification on shellfish. However, there is some possibility of positive impacts such as higher growth rates in some warm-water finfish or shellfish aquaculture;
- aggregates extraction. Sea-level rise due to climate change could increase demand for sand for coastal reinforcement and maintenance. In the Netherlands, the most recent expectation is for 10-37 million m^3 of sand per year in the period after 2035, depending on a sea level rise of 2-8 mm per year;
- agriculture. Changes to rainfall patterns and impacts due to extreme rainfall events will impact hydrological connectivity and mobilisation of nutrients and other contaminants (including microplastics) from agricultural land to surface waters and in turn marine waters;
- waste water. More intense rainfall can overload sewer networks, leading to surface water flooding and overflow at urban waste water treatment plants, with untreated sewage flowing into rivers, lakes, or coastal areas;
- shipping. Reduced ice coverage in Arctic Waters could lead to further increases in shipping activity in some parts of that Region. How significant this will be remains uncertain, depending on factors such as the length of the Arctic shipping season and the economic viability of trans-Arctic routes;
- tourism. Factors such as changes in rainfall, extreme weather events, sea level rise, and beach erosion could affect this activity.

Future priorities for OSPAR

The NEAES 2030 includes an objective to carry out climate change impact assessments on the OSPAR Maritime Area and its uses in 2023 and every six years thereafter (NEAES 2030 S10.O3). These assessments should review how climate change is affecting the human activities covered by this thematic assessment, and how they are adapting.

Ocean acidification

Ocean acidification is a perturbation of the physicochemical environment of the world's oceans that changes the acidity of the water (pH) (see OSPAR's ocean acidification assessment for details). It is a multi-stressor of organisms, meaning it impacts organisms in multiple ways and at multiple stages of their development, and

the impacts coincide with other environmental changes (for example temperature change). It can also lead to the dissolution of exposed calcareous structures that are often essential in shaping benthic habitats harbouring protected species. Although protected and endangered species are more vulnerable to environmental change, ocean acidification impacts all organisms and also those of commercial interest: it is expected that standing stocks of commercial species may be significantly reduced under the influence of ocean acidification. Case studies in OSPAR's ocean acidification assessment suggest that ocean acidification may hamper the ability of Atlantic cod populations (*Gadus morhua*) to deal with changing water temperatures due to climate change and that bivalve larvae are especially vulnerable to shell dissolution due to ocean acidification, with potential ramifications for commercial bivalve cultivation.

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Thematic Metadata

Field	Explanation
Linkage	https://puc.overheid.nl/rijkswaterstaat/doc/PUC_657623_31/ https://www.noordzeeloket.nl/publish/pages/189058/exploring-the-future-together-a-scenario-analysis-for-the-ospar-region.pdf. https://doi.org/10.1016/j.marpolbul.2017.03.049
Relevant OSPAR Documentation	OSPAR Agreement 2021-01 North-East Atlantic Environment Strategy (replacing Agreement 2010-03) OSPAR Recommendation 2010-20 on an OSPAR Framework for Reporting Encounters with Conventional and Chemical Munitions in the OSPAR Maritime Area OSPAR Agreement 2012-02 Guidelines for Best Environmental Practice in Cable Laying and Operation (Revised 2017) OSPAR Agreement 2012-03 Guidelines on Artificial Reefs in relation to Living Marine Resources OSPAR Agreement 2014-01 Regional Action Plan for Prevention and Management of Marine Litter in the North-East Atlantic (Amended 2018) OSPAR Agreement 2014-06 Guidelines for the Management of Dredged Material at Sea OSPAR Agreement 2017-08 Fishing for Litter Guidelines OSPAR Recommendation 2019-01 On the reduction of marine litter through the implementation of sustainability education programmes for fishers OSPAR Agreement 2019-08 Guidelines on the reduction of marine litter through the implementation of sustainability education programmes for fishers OSPAR Agreement 2020-01 Joint Harmonised Procedure on the granting of exemptions under the International Convention for the Control and Management of Ships' Ballast Water and Sediments OSPAR Recommendation 2021/06 On the reduction of plastic pellet loss into the marine environment OSPAR Agreement 2021-06 Guidelines in support of OSPAR Recommendation 2021/06 on the reduction of plastic pellet loss into the marine environment

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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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