OSPAR COMMISSION

Marine Birds Thematic Assessment

OSPAR QUALITY STATUS REPORT 2023

2023

OSPAR's Quality Status Report 2023

Marine Bird 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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Executive Summary

Marine birds in the OSPAR Maritime Area are not in good status. Widespread declines in breeding productivity and population abundance have been observed in all OSPAR Regions assessed. Most marine birds were already not in good status in 2010 but additional deterioration has been observed for many species in the current assessment.

Climate change is considered a major cause of marine bird declines, mainly via changes to their food supply. Anthropogenic activities exert additional pressures such as direct mortality, habitat loss / degradation and disturbance. The decline of marine bird populations will adversely affect the ecosystem services they provide, primarily by leading to imbalances in the food web, and will cause negative impacts on various ecosystem and cultural services as well. Good progress has been made since QSR 2010 to develop the ecological coherence of the OSPAR network of MPAs, including, for example, the designation of the North Atlantic Current and Evlanov Sea basin (NACES) MPA. However, given the continuing poor status of the marine bird species assessed, it is unlikely that these measures on their own are sufficient to reduce the key pressures from human activities. Addressing the decline in marine birds has been identified as a priority for OSPAR in NEAES 2030. OSPAR has committed to taking appropriate actions to prevent or reduce pressures to enable the recovery of marine species and benthic and pelagic habitats in order to reach and maintain good environmental status, including action to halt the decline of marine birds. The latter will be addressed by OSPAR's forthcoming Regional Action Plan on Marine Birds, which will build upon the evidence provided by QSR 2023 to recommend action to reduce and eliminate, where possible, the main pressures and activities impacting marine birds.

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

Most marine birds are predators. They feed on invertebrates living within or on top of the seabed or on fish and plankton within the water column above. The size and condition of bird populations is therefore dependent on the size and condition of prey populations. The declines in both breeding productivity and population abundance in many marine bird species appear to be due to a shortage of prey. In general, those species that feed on small fish at the sea surface are struggling more than others to find enough food, though this varies with region. Links between seabird breeding productivity and increasing sea temperatures strongly suggest that climate change is driving at least some of the observed declines in their prey. Over-fishing has also played a part in some regions in the past and fisheries are currently competing with seabirds for sandeels in the Greater North Sea.

Climate change is also having a direct effect on marine birds that is evident through changes in the range and distribution of some species. There has been a north-eastward shift in the wintering range of many wader and wildfowl species (so-called "short-stopping"), leading to apparent declines in the Celtic Seas, which are partly offset by increases outside the OSPAR Maritime Area in the Baltic Sea. The breeding ranges of some seabird species are predicted to shrink northwards and this appears to be happening already with the disappearance of breeding colonies of black-legged kittiwake (one of the OSPAR threatened and declining species) from the Bay of Biscay region.

The 2010 Quality Status Report highlighted that the key pressures on marine birds were: the removal of prey species (e.g., by fishing), loss of and damage to habitats, and the introduction of non-indigenous species. It stated that some pressures were increasing in the OSPAR Maritime Area and were exacerbated by climate change. The synopsis of this 2023 report is that the pressure on marine birds from climate change is being exacerbated by additional pressures from direct mortality, habitat loss / degradation and disturbance.

Our need to address climate change - a major cause of marine bird declines - has led to unintended additional pressures on marine birds. Since the 2010 Quality Status Report there has been considerable expansion of renewable energy infrastructure, especially offshore wind farms, particularly in the Greater North Sea. Disturbance by windfarms at sea has permanently displaced birds from foraging areas or other important areas, leading to habitat loss; there is also a risk of mortality resulting from collisions with wind turbines. These impacts are likely to increase as renewable energy production is expanded offshore in most Regions. However, the cumulative impacts on bird populations of renewable energy production have yet to be adequately assessed.

Disturbance from other activities such as aggregates extraction, oil and gas production, shipping, and tourism can lead to temporary loss of habitat, which could have more significant impacts during the breeding season. These activities are predicted to change little in the future, except tourism, which is predicted to increase in most Regions.

Pressure from invasive predatory mammals has caused the loss of safe breeding habitat in the past. The largest seabird breeding colonies in all Regions occur on islands that are currently free of mammalian predators, but these are potentially at risk from future incursions, possibly facilitated by human activities such as tourism.

Seabirds and some waterbirds are accidentally caught and killed in fishing gear (commercial, recreational or artisanal) in the OSPAR Maritime Area. The population impacts of incidental by-catch mortality on birds are largely unquantified, but there is some evidence to suggest these could be significant in some areas and fisheries. Marine litter is another cause of increased mortality in seabirds, through ingestion or entanglement, but the level of population impacts is currently unknown.

Finally, an emerging threat comes from Highly Pathogenic Avian Influenza - although this was assessed as relatively low impact in QSR 2023. Major impacts (outside the reporting period) have already been seen in 2021 and 2022, also impacting seabird species which in previous outbreaks remained uninfected and thus unaffected.

The decline of marine bird populations will adversely affect the ecosystem services they provide, primarily by leading to imbalances in the food web. Healthy bird populations also contribute to the natural seascape and play a key role in ecotourism and the maintenance and enhancement of related economic activity. Their decline is therefore likely to impact other services including recreation, education, science and research, spiritual, artistic and symbolism, visual amenities and ecosystem species appreciation.

Fisheries are currently competing with seabirds for sandeels in the Greater North Sea. © cleancoasts.org

Q2. What has been done?

OSPAR has identified nine bird species of particular concern within the North-East Atlantic and agreed on recommendations for actions to be taken by Contracting Parties nationally and collectively in order to protect and conserve these species. Progress has been made in efforts to strengthen data collection and management to support policy action and knowledge exchange. Good progress has been made towards the ecological coherence of the OSPAR network of Marine Protected Areas (MPAs), for example by extending the area coverage contributing to the protection and support of marine bird species.

The designation of the North Atlantic Current and Evlanov Sea basin MPA in 2021 represents an important step forward for protecting the foraging grounds of many marine birds. This site is an important feeding and foraging area on the high seas, used both by seabirds breeding on the coasts of the North-East Atlantic and by birds migrating across the globe or nesting in other parts of the world. The NACES MPA is one of eight sites in areas beyond national jurisdiction (ABNJs) that have been designated to protect marine birds.

Measures taken by OSPAR to manage particular human activities or pressures relating to pollution, marine litter and physical damage are relevant for improving the status of marine birds.
The adoption of the 2017-2025 Roadmap for the implementation of collective actions within the Recommendations for the protection and conservation of OSPAR listed Species and Habitats (The Roadmap) has supported the implementation of collaborative efforts across the thematic boundaries within OSPAR and also helps to inform or support actions implemented at the national level.

Q3. Did it work?

Of the nine species identified for protection by OSPAR, five have been assessed for QSR 2023 and are still threatened and declining. In addition, the Iberian race of common guillemot became extinct shortly after it was listed. Furthermore, given the continuing poor status of other marine bird species assessed in this QSR, it is unlikely that the measures currently being implemented are succeeding in reducing the key pressures and human activities.

Notwithstanding this, good progress has been made to develop the ecological coherence of the OSPAR network of MPAs to protect OSPAR listed bird species. There is a need to better understand what role the MPA sites play at particular life history stages of marine birds, and therefore the purpose of an MPA in relation to marine bird conservation. OSPAR MPAs provide an opportunity for addressing impacts from disturbance and habitat loss, and possibly impacts from fishing (i.e. over-exploitation of marine bird prey and incidental by-catch).

Marine litter causes harm to marine birds through entanglement or ingestion (although these impacts, particularly at the scale of populations, remain unclear). OSPAR has been at the forefront of international efforts to tackle the marine litter problem since the adoption of its first Regional Action Plan on Marine Litter (RAP ML) (2014 to 2021). The Marine Litter Thematic Assessment reports positive signs of a decrease in the quantities of litter found on OSPAR beaches and of floating litter in the North Sea over the last 10 years. When considered against the upward trend in plastic production and consumption in Europe over a similar period, this suggests that progress has been made in preventing plastics from entering the marine environment.

An assessment of oil discharges and spills shows that measures under OSPAR's Offshore Oil and Gas Industry Strategy 2010-2020 have led to decreases in the discharges of both hydrocarbons and the most harmful offshore chemicals. This will have positive impacts on marine birds.

Other competent bodies with complementary competencies to those of OSPAR have implemented measures at regional level that are important in addressing the state of marine birds in the North-East Atlantic. A number of region- and species - specific action plans have been implemented under the European Union, the Arctic Council Conservation of Arctic Flora and Fauna (CAFF) and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), by the Nordic Council and under national action plans. Regional and species-specific action plans can help to provide an overview of the regulatory landscape and highlight the value of developing an OSPAR-scale action plan that can build on and strengthen existing responses.

Dead gannet. © Shutterstock

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

Seabirds are important top predators in the marine ecosystem. The status of marine birds impacts other features, and as top predators, seabirds can be a visible signal of the overall health of the ocean that – unlike some other components – is relatively easily monitored. The decline of marine bird populations will adversely affect the ecosystem services they provide, primarily by leading to imbalances in the food web, and will cause negative impacts on various cultural services as well.

Two common indicators were used to assess the status of species breeding and / or overwintering in all OSPAR Regions except the Wider Atlantic. Overall, more than a quarter (and often considerably more) of species were found to be in poor status in each of the four Regions assessed. A retrospective analysis showed that the QSR in 2010 would have reached the same conclusion if the same indicators had been used then. However, in all four Regions the proportion of species in good status has decreased by approximately 10% since 2010.

When the assessment was broken down into five groups according to foraging behaviour, grazing species was the only group where more than 75% of species assessed were in good status. This group was made up of a small number of duck and goose species, which winter along the coast of the North Sea and Celtic Seas and feed on saltmarsh vegetation and eelgrass beds.

A large number of wader species were assessed in the Greater North Sea and Celtic Seas, where the majority overwinter in often huge concentrations on a range of intertidal and adjacent habitats, from rocky coasts to estuaries, feeding mainly on invertebrates. Most of these species breed in the north of the OSPAR Maritime Area and elsewhere in the Arctic and sub-Arctic. These birds breed at low densities across large areas of tundra habitat and therefore cannot easily be counted or assessed there - this explains why no such assessment was possible for Arctic Waters. Approximately one third of wader species in both the Greater North Sea and Celtic Seas were in poor status in 2010, but now that applies to more than half in Celtic Seas and 40% in the North Sea. This regional difference is consistent with a north-eastward contraction of the wintering range of Arctic-breeding species in response to milder winters further north resulting from climate change. In the birds' Arctic breeding grounds, climate change impacts on food supply have reduced productivity and increased mortality from predation.

Only a few benthic-feeding seaduck species, which feed on invertebrates - mainly molluscs in or on the seabed - were assessed and around half were in poor status, both now and in 2010.

Waterbird and seabird species that forage in aquatic habitats were assessed in all Regions, except Wider Atlantic owing to lack of data reporting. They were divided into species that dive below the surface to chase and catch fish and those that feed on fish, plankton or detritus at the surface. In the Celtic Seas and Greater North Sea, a higher proportion of surface feeders were in poor status, and this was also the case in 2010. This would suggest that surface-feeding species suffered more limited food supply than species that could dive into the water column and catch prey at various depths. However, in Artic Waters the opposite is true, where currently 75% of water-column feeders are in poor status compared with 40% of surface feeders. The reasons for this discrepancy are unknown.

Table: Percentage of species assessed that had a relative abundance above the threshold values in each functional group. Calculations are based on the whole set of species assessed within each Region, thus including species observed in different sub-divisions. Number in parenthesis is the number of species in each grouping. No assessments are available for the Wider Atlantic. From: [OSPAR QSR2023 Indicator Assessment - Marine Bird Abundance]

	Norwegian part of Arctic Waters		Greater North Sea		Celtic Seas		Bay of Biscay and Iberian Coast	
Functional Group	Breeding	Non-Breeding	Breeding	Non-Breeding	Breeding	Non-Breeding	Breeding	Non-Breeding
Surface feeders	67% (6)	67% (3)	36% (14)	60% (5)	58% (12)		75% (8)	
Water-column feeders	50% (8)	25% (4)	86% (7)	75% (4)	100% (6)	33% (3)		
Benthic feeders		50% (4)	0% (1)	33% (3)		0% (2)		
Wading feeders			40% (5)	63% (24)		47% (17)		
Grazing feeders		100% (1)	100% (1)	100% (5)		80% (5)		
Breeding / Non-breeding total	57% (14)	50% (12)	50% (28)	66% (41)	72% (18)	48% (27)	75% (8)	
All	54% (26)		59% (69)		58% (45)		75% (8)	

Above threshold value (≥75%)	
Below threshold value (<75%)	

Q5. What do we do next?

Addressing the decline in marine birds has been identified as a priority for OSPAR in NEAES 2030. By 2025 at the latest, OSPAR will take appropriate actions to prevent or reduce pressures to enable the recovery of marine species and benthic and pelagic habitats in order to reach and maintain good environmental status, as reflected in relevant OSPAR status assessments, with action by 2023 to halt the decline of marine birds (S5.O4). A Regional Action Plan on Marine Birds will act upon the evidence in this current assessment to recommend action to reduce and eliminate, where possible, the main pressures and activities impacting marine birds. These recommended actions will consolidate those already in operation under the OSPAR Recommendations for the nine threatened and/or declining bird species and through existing species action plans such as those under the EU, CAFF and AEWA and national strategies. This is an important area of work that will be drafted in consultation with the OSPAR / HELCOM / ICES Joint Working Group on Marine Birds and will help to build a coherent response.

Climate change has been identified in this assessment as the main cause of the continuing declines in the status of marine birds in the North-East Atlantic. Climate change mitigation underlies all other responses, and without such action adaptation is likely to be ineffective. The pressure on marine birds from climate change is being exacerbated by additional pressures from direct mortality, habitat loss / degradation and disturbance. As part of its efforts to ensure sustainable use of the marine environment, OSPAR has committed to continue its work with the relevant competent authorities and other stakeholders to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles and fish so that it does not represent a threat to the protection and conservation of these species, and will also work towards strengthening the evidence base concerning incidental by-catch by 2025 (S7.O6). This will increase the focus on the effects of incidental by-catch, including for marine birds. OSPAR should also take into consideration relevant incidental by-catch studies conducted in the framework of OSPAR, the European Commission, ICES, ACCOBAMS and ASCOBANS and their future conclusions.

By 2023, OSPAR will develop common principles, and by 2024 develop guidance, to promote and facilitate sustainable development and the scaling-up of offshore renewable energy in a way that minimises cumulative environmental impacts (S12.O4). This will help to address emerging threats of habitat loss and disturbance from the growing development in offshore renewables. There are also other areas where marine birds could benefit from OSPAR's work, including that on the restoration of benthic habitats, particularly for benthic feeding and grazing birds.

The effective implementation of many of these objectives will depend heavily on national action, which should continue to be reported through, for example, the implementation reporting requirements under the Recommendations on threatened and/or declining species and habitats. For migratory species, such as many marine birds, national action is not enough. To protect and conserve such species, regional or international collective actions will be crucial, as detailed in the OSPAR Roadmap. OSPAR recognises the need to increase its focus on identifying and implementing collective actions that add value to existing national actions and to the efforts of other international organisations. Overall, the 2019 implementation reporting indicates that there is a good level of engagement in implementing national actions within the Recommendations, in particular within the areas where the species and habitats are considered to be under threat and / or in decline. The level of engagement in collective actions is clearly at a lower level, with some of the more complex actions not having been progressed.

Many of the actions focus on monitoring and assessment, relatively few on response, but in either case there has been only modest progress. OSPAR will therefore develop a series of biodiversity action plans, starting with marine birds and coastal shelf benthic habitats, in order to identify priority response measures which are well-defined, add value and can be delivered within the resources available to the OSPAR Contracting Parties.

The 2023 QSR provides a powerful evidence base for action. OSPAR will strengthen its capacity to use this evidence base, and all future assessments, to support engagement with other international partners. Engagement cannot be an end in itself; the development of a practical approach to ecosystem-based management (EBM) will provide the opportunity and the mechanism to share evidence and common objectives for a more sustainable use of the marine environment (see cross-cutting SX.O2 of the NEAES 2030). Working with partners and drawing on international best practice, OSPAR will consider the design and implementation of a pilot project on EBM in one of the OSPAR Regions.

Progress against all of these challenging objectives for biodiversity will be tracked through OSPAR's NEAES Implementation Plan. A planned review in 2025 will provide an opportunity to adjust the NEAES and, if necessary, take further action to protect and conserve marine birds.

D - Drivers

Social and economic drivers for activities affecting marine birds

All social and economic drivers have the potential to influence the quality status of marine birds. Marine birds provide a tangible and iconic focus for society's need to appreciate nature and biodiversity and to support them by conserving and sustainably using the oceans, seas, and marine resources. Threats to iconic species drive public pressure on political debate and action.

The list below presents the drivers of the main activities impacting on marine birds.

Society's need for stable economies, energy, and materials has been one of the main drivers for the extraction of materials and oil and gas production. These activities have been linked to increases of impulsive noise and visual disturbance and releases of chemicals directly into marine bird habitats. The oil and gas industry is also one of the main contributors to climate change, and society's responses to mitigate and adapt to the effects of climate change have resulted in:

- the expansion of renewable energy technologies to meet society's need for energy, resulting in the introduction of associated infrastructure to the marine environment which can either directly or indirectly affect marine birds;
- increased need for coastal and flood protection infrastructures to mitigate threats to society; sea defences; levees and dikes, all with the potential to either directly or indirectly affect marine birds and their habitats.

Society's needs for industrial processes and for the trade and movement of goods can introduce marine pollutants, including oil and litter, and lead to increases in underwater noise levels, which can affect marine birds. Shipments of goods by sea and navigational dredging in support of shipping can each contribute to the input or remobilisation of contaminants in the marine environment. Vessel movements disturb marine birds.

Growing global populations increase society's need for food and fisheries, which aquaculture and agriculture will help to meet. These activities can influence contaminant and nutrient levels in the marine environment. Some fishing activities and farming practices can be detrimental to marine birds (and in a few cases help support them).

Services related to society’s need for health and wellbeing, such as the demands of an increasing human population for leisure, recreation and tourism in and around marine areas, bring many benefits (including greater contact with and understanding of marine birds and their habitats), but can also cause conflicts with marine birds.

Policy responses for managing human activities need to consider all these driving forces in order to meet society’s needs while reducing the risks to marine birds and facilitating societal change.

Offshore platform. © Shutterstock

A – Activities

Activities exerting pressures on marine birds

Human activities are distributed widely across the North-East Atlantic, but the intensity of the 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 many activities; in others, only a few may be significant. **Table A.1** below is taken from the Human Activity Thematic Assessment and gives a high-level summary of the intensity and trends of selected activities across the OSPAR Regions, based on analysis in the feeder reports.

Aquaculture, fisheries, renewable energy and tourism have increased in the last 10 years in most of the OSPAR Regions, while aggregate extraction, agriculture, oil and gas extraction and shipping remained generally stable. Aquaculture, renewable energy and tourism are expected to increase in the coming years. The future trends of some activities such as fisheries and shipping are uncertain, but their intensity is likely to increase in the OSPAR Maritime Area (particularly shipping in some Arctic waters). See the Human Activity Thematic Assessment for further details on main activities occurring in each OSPAR Region.

Table A.1: Intensity and trends of selected human activities in OSPAR Regions adapted from the Human Activity Thematic Assessment. All the activities listed are relevant to marine birds. 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 (Region I)**	**Greater North Sea (Region II)**	**Celtic Sea (Region III)**	**Bay of Biscay and Iberian Coast (Region IV)**	**Wider Atlantic (Region V)**
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	↑	↑	↔	↑	↑

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Coastal defence and flood protection, Offshore structures (other than oil/gas/renewables) and Land claim [Physical restructuring of rivers, coastline or seabed (water management)]:
Land claim can include the draining of coastal areas (such as the polders in the Netherlands or Norfolk Broads in the United Kingdom) and the seaward extension of ports (such as Zeebrugge and Rotterdam). The related reclamation activities can lead to habitat losses and disturbance of marine birds (e.g. noise, light, presence of machinery, people, equipment) as well as disturbance to water currents.

The coastal defences and flood protections needed to protect people and property involve the construction, operation and decommissioning of, for example, seawalls, flood doors and embankments, which can lead to disturbance of birds during construction and the loss of habitats.

Certain types of construction, operation and decommissioning of intentionally built structures (e.g. artificial islands) cause changes to habitats which could affect bird roosting, breeding and feeding areas, and behaviours.

Most navigational dredging is within established waterways, so there is potential for habituation. Capital dredging operations (i.e. to a depth not previously dredged, or to a depth not dredged within the last 10 years) have the potential to lead to the loss of marine bird habitats, but also to disturb and displace them.

Extraction of oil and gas, including infrastructure and Extraction of minerals [Extraction of non-living resources]:
Society's needs for energy and stable economies are drivers for the extraction of oil and gas. Society's need for material drives the extraction of minerals.

The exploration, operation and decommissioning of oil and gas platforms and the associated infrastructure (pipeline and cables) interact directly with marine bird habitat. Oil and gas production activities can cause disturbance, but oil spills, litter and habitat loss can also affect birds at sea.

The extraction of oil and gas can potentially interact with marine bird habitat through physical loss of habitat (wellheads, platforms, pipelines) and the degradation of surrounding habitat, for example through increased turbidity, chemical contaminants and visual disturbance. The extraction of minerals has the potential to interfere with marine bird feeding areas because disturbance of the seabed can reduce the food supply to marine birds feeding on benthic prey or demersal fish. Further detail is provided in the relevant feeder report, OSPAR Feeder Report 2021 – Extraction of non-living Resources.

Military operations [Security/defence]:
The removal or detonation of lost / sunken munition can affect marine birds because of the underwater noise disturbance, and there is potential for (lethal) injuries (not yet sufficiently well documented). Shooting practice, as well as training with jets, helicopters and naval ships, cause disturbance (Danil and Leger, 2011; Fuller *et al*., 2018; van der Kolk *et al*., 2020a, b, van der Kolk, 2021).

Renewable energy generation (wind, wave and tidal power), including infrastructure, Nuclear energy and Transmission of electricity and communications (cables) [Production of energy]:
Seabirds are impacted by the construction and operation of renewable energy developments, including far-ranging displacement and lethal collisions caused by offshore wind farms and mortality from tidal-stream energy generation. The laying of power cables related to offshore renewable energy generation causes disturbance during construction and habitat change at the seafloor.

The nuclear energy plants located on the coast in some regions normally deploy some form of cooling water intake / outfall, often with pipes running into the sub-tidal area (bird habitat). Further detail is provided in the relevant feeder report, OSPAR Feeder Report 2021 – Offshore Renewable Energy Generation.

Fish and shellfish harvesting (professional, recreational) and Hunting and collecting for other purposes [Extraction of living resources]:
The extraction of living resources can easily affect marine birds. Fishing activities differ between regions and interact with seabirds in multiple ways, ranging from prey depletion, mortality of birds in fishing gear (incidental by-catch), and release of litter (with potential for lethal entanglement and ingestion) to additional food supply (discards). Hunting, egg harvesting and the use of unfledged offspring for food influence both the mortality and the productivity of marine bird populations. Further detail is provided in the relevant feeder report, OSPAR Feeder Report 2021 - Fisheries.

Transport shipping and Transport infrastructure [Transport]:
Transport interacts directly with marine bird habitats through physical and visual disturbance by moving vessels / aircraft, underwater noise, light, contaminants, litter and non-indigenous species. Further detail is provided in the relevant feeder report, OSPAR Feeder Report 2021 – Shipping and Ports.

Tourism and leisure infrastructure and Tourism and leisure activities [Tourism and leisure]:
Tourism and leisure infrastructures can be adjacent to or within marine bird habitat. The very wide range of tourism activities affects seabirds in several ways, including disturbance and displacement from habitats. Further detail is provided in the relevant feeder report, OSPAR Feeder Report 2021 – Recreation and Tourism.

Aquaculture - marine, including infrastructure and Agriculture [Cultivation of living resources]:
Aquaculture and agriculture directly interact with marine bird habitat and can influence contaminant and nutrient levels in the marine environment, affecting water quality and negatively impacting on marine biodiversity. In addition, microbial pathogens - such as Highly Pathogenic Avian Influenza – can circulate between kept birds within agricultural systems and wild bird populations (Horimoto and Kawaoka Y. 2005; de Bruin *et al*., 2022), including those migratory species covered by this assessment, sometimes with

significant mortality. Further details are provided in the relevant feeder report, OSPAR Feeder Report 2021 – Aquaculture, OSPAR Feeder Report 2021 – Agriculture.

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P – Pressures

Pressures on marine birds

Human activities exert numerous pressures on marine birds across the North-East Atlantic. Their relative importance varies greatly between species and OSPAR Regions, depending on the extent of the respective activities and the sensitivity of the species.

Climate change has pervasive and fundamental implications for marine birds throughout the OSPAR region, including indirect effects on food supply and direct effects on bird physiology; given its importance the effects are detailed in a dedicated Climate Change section.

The main other pressures affecting marine birds, according to the main reporting sources, are direct disturbance from various activities (including recreation, shipping and wind farm activities), fisheries impacts (including extraction of forage fish such as sandeels and mortality from incidental by-catch in fishing gear), physical disturbance of the seabed (e.g. bottom-trawling fisheries which affect the habitats of birds' prey) and mortality caused by collisions with offshore structures such as wind turbines. Breeding birds are under pressure from invasive non-indigenous mammalian predators and from habitat loss due to land reclamation. The ranking in the Pressures section is based only on the information available from main reporting sources (OSPAR, EU Marine Strategy Framework Directive 2008/56/EC (MSFD), EU Birds Directive (Directive 79/409/EEC)). The confidence in such assessment was considered low because of various information gaps identified in the reporting sources considered.

A more detailed ranking of the importance of pressures affecting marine birds is provided in the bow-tie section based on analysis of "Exposure" (comprising spatial and temporal overlap) and "Consequence" (comprising pressure persistence, likely impact and ecosystem recovery potential), see: Cumulative Effects. Some differences in the relative rankings of individual pressures were highlighted, and a caveat inserted, in the bow-tie section.

Trends in the pressures are difficult to elaborate, but trends in the human activities exerting them could provide a suitable proxy for trends in the pressures themselves.

Owing to the large number of marine bird species, which use various kinds of marine habitat and belong to five different feeding guilds, it is not straightforward to identify the most important anthropogenic pressures acting on this ecosystem component. In order to investigate these pressures in the OSPAR Maritime Area, various sources of reporting were reviewed. As reporting methods are not consistent among Contracting Parties and EU Member States, respectively, and because different terminology was used for the pressure categories, it is challenging to aggregate information about pressures across countries and conventions at the same level. Here, all information has been translated into the pressure categories used in the MSFD.

In order to identify the main pressures impacting marine birds in the North-East Atlantic, the following reporting sources were investigated:

- OSPAR MPA database;
- MSFD Art 8 reporting;
- MSFD Art 16 reporting;
- Birds Directive Reporting, Art 12.

For each reporting source, the relative importance of individual pressures impacting marine birds was assessed and assigned to a qualitative category (high-medium-low-no importance). An overall assessment for each pressure was then obtained by averaging the relative importance ranks obtained from all reporting sources.

Details of this analysis and confidence gaps are described in this Supplementary Material.

Although the picture can vary slightly depending on the source, it is generally apparent that disturbance and additive mortality are the most important pressures. While disturbance is caused by various activities, additive mortality mostly refers to incidental by-catch in fishing gear and hunting (**Table P.1**). A number of pressures were found to be of medium importance, with physical loss of habitat, physical disturbance of the seabed, input of anthropogenic sound and the occurrence of non-indigenous species (here mostly invasive mammalian predators in breeding colonies) also of high importance in one or other source. A full overview of the levels of importance shown by this analysis is given in **Table P.1**. It should be noted that this table does not consider new and emerging pressures (or recent step-changes to the prevalence of existing ones) such as the Highly Pathogenic Avian Influenza (HPAI). Major impacts on seabird species from HPAI were observed in 2021 and 2022, including also species that were unaffected in previous outbreaks.

The overall confidence in the assessment of relative importance of individual pressures is considered **low.** Various gaps were highlighted in the four reporting sources analysed, ranging from (often severe) uncertainties regarding the pressure categories used, and incomplete coverage of OSPAR Regions, to limited details / coverage of the bird species reported. For details see Supplementary Material.

Major impacts from avian flu were observed in 2021 and 2022. © Shutterstock

Table P.1: Pressures by MSFD pressure category showing relative importance as derived from sources related to OSPAR MPAs, MSFD and Birds Directive. * Owing to the different terminologies used, incidental by-catch can be placed in different pressure categories, and therefore the MSFD category "Selective extraction of species" is not included in the overall assessment

	Pressure category (MSFD terminology)	Overall assessment	Birds Directive Art. 12 Reporting	MSFD Art. 8 Reporting	MSFD Art. 16 Assessments	OSPAR MPA Database
Physical	Physical loss	medium	medium		low	high
	Physical disturbance to seabed	medium	high	low	medium	high
	Changes to hydrological conditions	medium	medium	low	low	medium
Substances, litter, energy	Input of anthropogenic sound	medium	high	low		high
	Input of other forms of energy	low	low	low	low	medium
	Input of litter	medium	medium	medium	low	medium
	Input of nutrients	medium	medium	low	low	medium
	Input of organic matter	low	low	low		medium
	Input of substances	medium	medium	medium	low	medium
	Input of water	no importance				
Biological	Input of genetically modified species and translocation of native species	low				medium
	Input of microbial pathogens	low			low	medium
	Input or spread of non-indigenous species	medium	medium	low	low	high
	Selective extraction of species, including non-target catches	*				high
	Loss of, or change to, natural biological communities due to cultivation of animal or plant species	low	low	low		
	Disturbance of species	high	high	high	low	high
	Extraction of, or mortality/injury to, wild species	high	high		high	high

Summary of pressures on marine birds

Various effects arising from human-induced climate change exert pressure on marine birds world-wide; these are observed also in the North-East Atlantic. A section dedicated to this topic describes the connections in more detail: Climate Change. The pressures from climate change in the OSPAR region are exacerbated by the following additional pressures:

Disturbance of species (e.g. where they breed, rest and feed) due to human presence [Biological]**:** Disturbance to marine birds can be caused by visual stimuli and above-water noise and the disorientation caused by the introduction of artificial light. Important examples of sources of visual disturbance are recreation, shipping, fisheries and windfarm activities. Disturbance at sea can displace birds from foraging areas or other important areas, leading to (temporary) habitat loss, higher energy expenditure (flights for food, migration distances), with consequences for survival and reproduction (including carry-over effects from non-breeding to breeding season) (Burger *et al*., 2019; van der Kolk, 2021; Krüger, 2016; Fliessbach *et al*., 2019; Linssen *et al*., 2019; Mendel *et al*., 2019; Peschko *et al*., 2020).

Lighting can disorient or displace sensitive species. Birds can be drawn to lighted vessels and structures offshore and may become disoriented and collide with them. The young of species that fledge at night, such as Atlantic puffin, Manx shearwater and storm-petrels, are particularly susceptible to disorientation caused by artificial light on land and offshore (Rodríguez *et al*., 2017, 2022; Ryan *et al*., 2021).

Disturbance of adult birds at breeding sites can leave chicks and eggs vulnerable to chilling or predation. Continued disturbance at nesting sites can lead to reduced breeding success or desertion (see e.g. Buxton *et al*., 2017, for airborne anthropogenic sound effects).

Extraction of, or mortality / injury to, wild species (by commercial and recreational fishing and other activities) [Biological]:

Selective extraction of species, including non-target**:**

Seabird by-catch: Seabirds and some waterbirds are accidentally caught and killed in fishing gear (commercial, recreational or artisanal) in the OSPAR Maritime Area. (Oliveira *et al*., 2015; Christensen-Dalsgaard *et al*., 2019; Northridge *et al*., 2020), Pilot Assessment of Marine Bird Abundance - Non-Breeding Offshore Birds. This can happen when birds are foraging for fish caught in trawls or purse seines or used for bait on longline hooks, or if they enter fixed nets when diving below the sea surface. Gillnets and / or hook gears (hand- and longlines) are reported to be the deadliest fishing gears for marine birds (Pott and Wiedenfeld, 2017; ICES, 2013). Most recorded gillnet by-catch relates to species that undertake plunge or pursuit diving, such as seaducks, auks and shearwaters ((Žydelis *et al*., 2013; Pott and Wiedenfeld, 2017), but fulmar was the most common by-catch in gillnet fisheries on the Norwegian coast, probably through entanglement while the gillnets were being set (Bærum *et al*., 2019). Mortality due to incidental by-catch in longlines mainly occurs in birds that are feeding at the surface - species such as shearwaters, fulmar, gannet and gulls (Anderson *et al*., 2011; Dunn and Steel, 2001).

Impacts on the food supply for marine birds: The extraction of fish and invertebrates can reduce the prey available to marine birds through competition for the same species (e.g. intertidal bivalves, sandeels, sprat, and small herring) (Cury *et al*., 2011). (Food webs Thematic Assessment - Response Section - Case Study). A reduction in available prey can lead to immediate reductions in fitness, which can affect survival and reduce the numbers attempting to breed. If food is scarce during the chick-rearing period, breeding success can also be reduced or whole colonies may fail to produce any young (Camphuysen *et al*., 2002; Frederiksen *et al*., 2008, 2013; Cury *et al*., 2011; Cook *et al*., 2014; Mitchell *et al*., 2020; Carroll *et al*., 2017; Cook *et al*., 2014; Fayet *et al*., 2021).

Hunting, egg harvesting and control: All of these directly remove individuals and offspring from marine bird populations (Merkel and Barry, 2008). The hunting and harvesting of eggs and chicks for human consumption is permitted for certain species and regulated in the OSPAR Maritime Area under national and international legislation (Nørrevang, 1986; Trinder, 2016; Murray, 2018). The killing of certain species or the destruction of their nests / eggs is also permitted and regulated to protect other wild birds, to preserve public health and safety or air safety, or to prevent damage to crops or inland fisheries.

Physical disturbance to seabed (temporary or reversible) [Physical]:

Physical disturbance impacts the feeding habitats of marine birds by reducing prey availability. For example, the construction of infrastructure, aggregate extraction, bottom trawling fisheries, kelp trawling and the laying of cables and pipelines all disturb, reduce and / or remove the benthic fauna (including demersal fish) that serve as bird prey, with consequences for feeding and reproduction (Cook and Burton, 2010; Christensen-Dalsgaard *et al*., 2020).

Extraction of, or mortality/injury to, wild species (other activities) [Biological]:

Death or injury by collision above water: Collisions with offshore windfarm turbines / tidal devices, vessels / aircraft and offshore structures such as oil and gas platforms remove individuals from populations and thus cause additive mortality (Busch and Garthe, 2018; García-Barón *et al*., 2019; Kelsey *et al*., 2018; Merkel and Johansen 2011; King, 2019; Potiek *et al*., 2019; Searle *et al*., 2019). The risk of collision with an obstacle is a function of birds' flight height in relation to an obstacle and of their ability to avoid it. Offshore wind turbines are becoming the most significant obstacles in some areas. The flight height of some seabirds, particularly large gulls, kittiwake, gannet, cormorant and shag, is such that they could potentially collide with turbines (Furness *et al*., 2013; Johnston *et al*., 2014; Mendel *et al*., 2014; Johnston and Cook, 2016).

Death or injury by collision below water: Diving seabirds such as auks and shag could potentially be injured or killed by collision with tidal stream turbines below the surface (Furness *et al*., 2012). A lack of information exists regarding the collision risk of seabirds with underwater structures, including wave energy generators (Grecian *et al*., 2012).

Input or spread of non-indigenous species [Biological]:

The deliberate or accidental introduction of mammal predators to places where they would not naturally occur has had catastrophic impacts on bird populations around the world (see for example Courchamp *et al*., 2003; Jones *et al*., 2008; Towns *et al*., 2006; Dias *et al*., 2019). Most marine bird species nest on the ground or in burrows, where they are potentially accessible to mammalian predators. Predation of eggs and young birds can cause reductions in breeding success and could lead to the desertion of whole colonies (Mitchell *et al*., 2004). In the OSPAR Maritime Area, seabird colonies are at risk from introduced non-native predatory mammals such as brown rats, cats and American mink and also from native mammals such as hedgehog, stoat and fox, which have been introduced by humans to offshore islands that they otherwise could not reach unassisted (Stanbury *et al*., 2017; Mitchell *et al*., 2018). The presence of invasive native and non-native mammals can limit the amount of safe nesting habitat available and therefore impact the distribution and size of breeding population of marine bird species (e.g. Mitchell *et al*., 2004; Ewins and Tasker, 1985).

The Non-indigenous Species Thematic Assessment only considers the introduction and spread of marine NIS, which excludes the impacts of mammals on marine birds.

Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate) [Physical]:

Loss of nesting sites or intertidal feeding areas is particularly associated with land reclamation and coastal development, coastal nuclear energy power stations, coastal and flood defences, bottom trawling, aggregate extraction and offshore renewables, with consequences for feeding and reproduction among marine birds.

Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, atmospheric deposition, acute events [Substances, litter and energy]:

In bird species, the input of other substances into their environment can cause contamination of the food chain. These substances can be spilt into the marine environment during activities such as oil and gas extraction, non-renewable energy generation, shipping, agriculture and extraction of minerals. Such contamination can take the following forms:

- Polybrominated diphenyl ethers (PBDE) in biota can impact behaviour, learning and hormonal function.

- Polychlorinated biphenyl (PCB) in biota can cause genotoxic effects, immune suppression, inflammatory response and endocrinal effects.
- Radionuclides in biota can cause genetic, reproductive, cancerous and acute effects.

PBDE and PCB both cause reduced reproduction and bioaccumulation in benthic, fish, bird and mammal species (Sagerup *et al*., 2009; Millow *et al*., 2015).

Oil can contaminate and adhere to plumage, causing its insulating effect to be lost. This and the ingestion of oil during grooming can lead to the death of affected birds (Jenssen, 1994). The impacts of oil depend upon the timing and location of spills, and are likely to be more severe when they occur around breeding colonies, when birds are highly concentrated.

Inputs of other substances and these pressures on marine mammals are closely linked with environmental impacts in the Hazardous Substances Thematic Assessment.

Input of litter (solid waste matter, including micro-sized litter) [Substances, litter and energy]:
Litter introduced from land and via rivers (e.g. industrial sources, tourism) and directly into the marine environment (e.g. from shipping, fishing, aquaculture) can impact marine birds' health and also kill them. Surface-feeding seabirds such as fulmars ingest plastics that they mistake for food, and these accumulate in their stomachs (Kühn and Van Franeker, 2020), Plastic Particles in Fulmar Stomachs in the North Sea. Plastic ingestion can lead to the accumulation of endocrine-disrupting compounds in body tissues (Wang *et al*., 2021) and reduce the space for food in the digestive tract of seabirds, but little is known about the population-level effects for the species inhabiting the OSPAR Maritime Area. Marine birds can become entangled in litter (e.g., discarded fishing gear), often leading to injury or death. This can occur in breeding colonies where some species use litter as nest material, which can then ensnare adults and young and lead to reduced reproductive rates (O'Hanlon *et al*., 2019). Input of litter into the environment can also cause loss or degradation of breeding and nesting habitats, alterations to suitable foraging habitats, and diseases, all of which affects the abundance of marine birds.

The input of litter and the pressure on marine birds is linked with environmental impacts in the Marine Litter Thematic Assessment.

Input of anthropogenic sound (impulsive, continuous) [Substances, litter and energy]:
Military operations that produce impulsive noise into the marine environment can have behavioural and physiological impacts on marine birds.

Underwater noise can also trigger behavioural responses which have potential detrimental effects for marine birds (Anderson Hansen *et al*., 2020).

In the worst case, underwater noise can lead to injury or even death (insufficient knowledge as yet).

Input of noise and the pressure on marine birds is linked with environmental impacts in the Underwater Noise Thematic Assessment.

New, emerging and increasing activities and pressures

Large increases in offshore wind infrastructure, especially in Greater North Sea, are projected, owing to the dual imperatives of increased energy security and carbon-reduction. Offshore wind infrastructures can lead to mortality and disturbance (including permanent displacement) in marine birds.

Highly Pathogenic Avian Influenza: Although assessed as relatively low impact in QSR 2023, it has already been seen to have a major impact in 2021 and 2022 (outside the reporting period), and to impact seabird species which in previous outbreaks were unaffected (Rijks *et al*., 2022).

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S – State

Marine birds are not in good status

The integrated status of marine bird species was assessed with the help of indicators for: (a) breeding and non-breeding abundance, and (b) breeding productivity for five species groups in four OSPAR Regions. Good environmental status was not achieved for surface-feeding birds (Regions I, II, III, IV), water column-feeding birds (Regions I, II, III, IV), benthic-feeding birds (Regions I, II, III) and wading feeding birds (Regions II, III). Good status was achieved by grazing feeding birds in Regions I, II, and III. The overall status is not good for marine birds in Regions I, II, III, and IV. No assessment could be made of Region V.

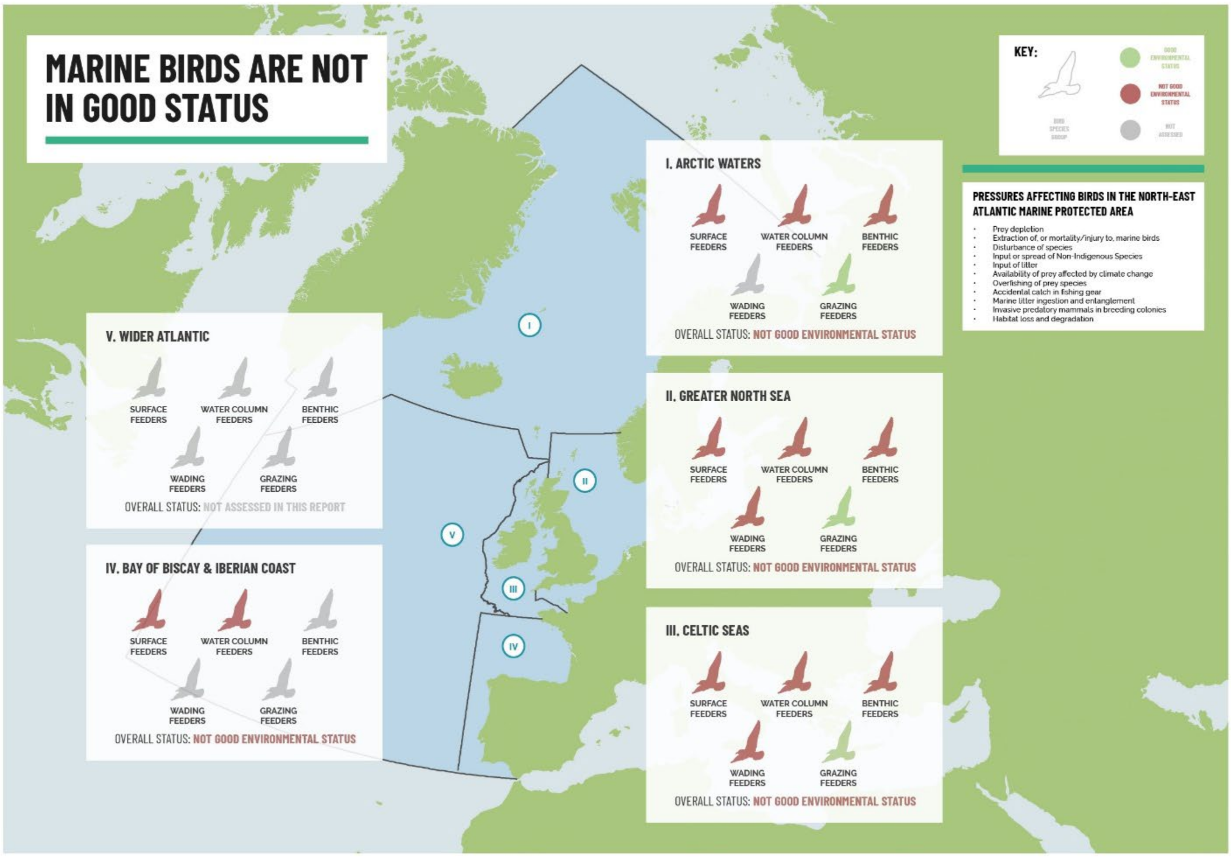

Figure S.1: Integrated status of marine birds in the different Regions of the OSPAR Maritime Area

The confidence of the assessment is high for all regions except Region IV, where it is considered to be medium because of the limited number of species assessed and the reduced temporal data available in this Region.

Table S.1: Confidence of assessing state of marine birds

OSPAR Region	Arctic Waters (Region I)	Greater North Sea (Region II)	Celtic Seas (Region III)	Bay of Biscay and Iberian Coast (Region IV)	Wider Atlantic (Region V)
Confidence	High	High	High	Medium	Not assessed

OSPAR acts as a coordination platform in the North-East Atlantic for the regional implementation of the EU Marine Strategy Framework Directive (MSFD) that aims to achieve a Good Environmental Status (GES) in European marine environments, as well as for the coordination of other national frameworks. The characteristics of GES are determined by the individual EU member states, based on criteria elements, threshold values and methodological standards set regionally or at EU level.

Norwegian, Icelandic, United Kingdom, Greenlandic and Faroese marine areas are not covered by the MSFD.

The marine birds in the North-East Atlantic include some that spend the majority of their lives at sea (petrels and shearwaters, gannets and cormorants, skuas, gulls, terns and auks) and waterbirds that mostly inhabit intertidal areas or inshore areas close by (waders, ducks, geese, swans, grebes and divers).

The integrated assessment of marine birds in each Region was largely based on two common indicator assessments: Marine Bird Abundance (B1) and Marine Bird Breeding Productivity (B3). These Common Indicator Assessments were integrated to provide a status assessment of each species. If at least one indicator assessment fails the threshold, the status is not good; if all indicator assessments achieve the threshold, the status is good. Breeding and non-breeding populations of a species were assessed separately, and thus count as two elements. The assessments of populations were combined to assess the status of five species groups (surface feeders, water column feeders, benthic feeders, wading feeders, grazing feeders). A species group achieved good status if 75% or more of the populations were in good status. The overall status of marine birds in each OSPAR Region is based on a one-out-all-out assessment of the species group assessments: if one species group is in not in good status in one Region, the overall status of the Region is considered not good. Integration was done separately for the OSPAR Regions Arctic Waters (Norwegian section only), Greater North Sea, Celtic Seas and Bay of Biscay and Iberian Coast, whereas insufficient information was supplied to assess the marine bird species in the Wider Atlantic. The integration method is described in detail in the CEMP Guideline.

Additional information about the status of marine bird species is available from the pilot assessments for the candidate indicators offshore extension of common indicator (B1), by-catch (B5) and habitat quality (B7) (**Table S.2**). This information is given in the text but did not contribute to the integrated status of species.

Table S.2: Indicators used in QSR 2023 for assessing the state of marine birds per OSPAR Region. Entries indicate whether breeding populations (B) and/or non-breeding populations (NB) were assessed. * denotes candidate indicator pilot assessments, which did not contribute to the integrated assessment

Indicator	Status	OSPAR Region I	OSPAR Region II	OSPAR Region III	OSPAR Region IV	OSPAR Region V
Marine bird abundance (B1)	common	B/NB	B/NB	B/NB	B	
Marine bird abundance (offshore) (B1)*	candidate		NB			
Marine bird productivity (B3)	common	B	B	B	B	
Marine bird by-catch (B5)*	candidate	NB	B	B	B	B
Marine bird habitat quality (B7)*	candidate		NB			

The indicator assessments also contributed to the status assessments of three species on the OSPAR list of threatened and / or declining species: the black-legged kittiwake, the roseate tern and Brünnich's guillemot (also known as the thick-billed murre). Where data were insufficient for indicator assessments, they were supplemented by status assessments for the *fuscus* sub-species of lesser black-backed gull, the Iberian guillemot (a sub-species of the common guillemot) and the Balearic shearwater (see details below). Assessments have not yet been made for two Arctic species (Steller's eider and the ivory gull) and one species from the wider Atlantic (the Barolo shearwater (separate from the little shearwater and also known as the Macaronesian shearwater)).

Iberian Guillemots. © Shutterstock

Surface-feeding birds

Surface-feeding birds typically peck food items from the surface or take it during shallow dives within the upper 1 to 2 m of the water column. Their main prey consists of small fish, zooplankton and other invertebrates and also includes discarded incidental by-catch from fisheries.

Based on the indicator assessments for abundance and productivity and the status assessments for the lesser black-backed gull (sub-species *fuscus*) and the Balearic shearwater, the species group of surface-feeding birds is in not in good status in the Arctic Waters, the Greater North Sea, the Celtic Seas and the Bay of Biscay and Iberian Coast, because the percentage of species in good status is below the threshold of 75% (**Table S.3**).

The pilot assessment for the candidate indicator on Marine Bird habitat quality (B7) shows that habitat quality in the southern North Sea (part of Region II) is good for the surface feeders: the black-legged kittiwake, the great black-backed gull and the herring gull, since they appear to be undisturbed by offshore wind farms, shipping and bottom-trawling fisheries. In the same area, the threshold for offshore winter abundance was achieved by the black-legged kittiwake, whereas the offshore abundance of great black-backed gull and herring gull was far below the threshold (pilot assessment for B1 offshore).

In the pilot assessment of the candidate indicator Marine bird bycatch (B5), it was found through population modelling that the incidental by-catch of Cory's shearwater in the breeding population in the Bay of Biscay and Iberian Coast would exceed a provisional threshold, indicating that the long-term viability of this species is threatened. In the same pilot assessment, the roseate tern (Greater North Sea, Celtic Seas, Wider Atlantic) and the Barolo shearwater (Wider Atlantic) achieved the threshold because there is no indication of incidental by-catch happening. The latter two species are included in the OSPAR List of Threatened and/or Declining Species and Habitats. From this list, the assessments do not show good status for the lesser black-backed gull (subspecies *fuscus*) in the Arctic Waters, for the Balearic shearwater in the Greater North Sea, the Celtic Seas and the Bay of Biscay and Iberian Coast, and for the black-legged kittiwake in the Arctic Waters, the Greater North Sea, the Celtic Seas and the Bay of Biscay and Iberian Coast. No such assessments are so far available for the ivory gull, the roseate tern and the Barolo shearwater. In the case of the lesser black-backed gull, the assessment based on the indicators Marine bird abundance (B1) and Marine bird productivity (B3) for Arctic Waters was used for the integrated assessment, as well as the status assessment for the northern sub-species *fuscus* only (two sub-species are breeding in Norway, also in mixed colonies).

Table S.3: Surface-feeding marine birds species group common indicator outcomes (B1, B3) and integrated status. Breeding populations (B) and non-breeding populations (NB) are assessed separately. Green: indicator threshold achieved or status good; Red: indicator threshold not achieved or status not good; OSPAR Listed species are shown in italics; * status solely derived from status assessment

Surface feeders		Arctic Waters Region I			Greater North Sea Region II			Celtic Seas Region III			Bay of Biscay and Iberian Coast Region IV		
		B1	B3	Status	B1	B3	Status	B1	B3	Status	B1	B3	Status
Black-legged kittiwake	B			not good			not good			not good			not good
Black-headed gull	B						not good			not good			good
Black-headed gull	NB						good						
Mediterranean gull	B												good
Common gull	B						not good			good			
Common gull	NB			good			good						
Great black-backed gull	B			good			not good			good			good
Great black-backed gull	NB			not good			not good						
European herring gull	B			good			not good			not good			not good
European herring gull	NB			good			not good						
Lesser black-backed gull	B			good			not good			not good			good
Lesser black-backed gull	NB						good						
Lesser black-backed gull (subspecies *fuscus*)	B			not good*									
Sandwich tern	B						good			good			good
Little tern	B						good			good			
Roseate tern	B						good						
Common tern	B						not good			not good			good
Arctic tern	B						not good			not good			
Great skua	B			good			not good			good			
Arctic skua	B						not good						
Northern fulmar	B			not good			not good			not good			
Balearic Shearwater	NB						not good*			not good*			not good*
Number of species in good status				6			6			5			6
Number of species not in good status				4			14			8			3
Proportion of species in good status				0,6			0,3			0,38			0,67
State of species group surface feeders				**not good**			**not good**			**not good**			**not good**

Fulmar. © Shutterstock

Water column-feeding birds

Water column-feeders typically dive in a broad depth range in the water column and take pelagic and demersal fish and invertebrates (e.g. squid, zooplankton). This access to a greater potential range of prey - compared with surface-feeders - has often been used to explain the differing fortunes of these two groups. On the other hand, water-column feeders are perhaps exposed to a greater risk of additive mortality due to incidental by-catch in fishery gears than are surface feeders.

As for surface feeders, the indicator assessments for abundance and productivity do not reveal good status for marine birds feeding in the water column in the Arctic Waters, in the Greater North Sea and in the Celtic Seas, because fewer than 75% of the species assessed were in good status (**Table S.4**). In addition, the status assessment for the Iberian guillemot (a probably extinct population of common guillemot) does not show good status (see below), which carries over to the species group status in the Bay of Biscay and Iberian Coast, where no other water-column feeders were assessed. The confidence in the regional assessment of water-column feeders in Bay of Biscay and Iberian Coast is low as it is based only the Iberian guillemot assessment.

For the three species (red-throated diver, common guillemot, northern gannet) examined in the southern North Sea under the Marine bird habitat quality (B7) pilot assessment, habitat disturbance by offshore wind farms, shipping and bottom-trawling fisheries was found. Nevertheless, these three species still achieved the threshold in the pilot assessment for offshore winter abundance in the southern North Sea.

Table S.4: Water-column feeding marine bird species groups indicator outcomes (B1, B3) and integrated status. Breeding populations (B) and non-breeding populations (NB) are assessed separately. Green: indicator threshold achieved or status good; red: indicator threshold not achieved or status not good; OSPAR listed species are shown in italics; * status solely derived from status assessment

		Arctic Waters Region I			Greater North Sea Region II			Celtic Seas Region III			Bay of Biscay and Iberian Coast Region IV		
Water column feeders		**B1**	**B3**	**Status**	**B1**	**B3**	**Status**	**B1**	**B3**	**Status**	**B1**	**B3**	**Status**
Red-breasted merganser	NB			not good			good			not good			
Great crested grebe	NB									not good			
Red-necked grebe	NB						not good						
Brünnich's guillemot [*Thick-billed murre*]	B			not good									
Common guillemot (includes *Iberian guillemot* in Region IV)	B			good			good			good			not good*
Razorbill	B			not good			good			not good			
Black guillemot	B			not good			good			good			
Black guillemot	NB			not good									
Atlantic puffin	B			not good			not good						
Northern gannet	B			good			good			good			
Great cormorant	B			not good			good			not good			
Great cormorant	NB			good			good			good			
European shag	B			not good			not good			good			
European shag	NB			not good			good						
Number of species in good status				**3**			**8**			**5**			**0**
Number of species not in good status				**9**			**3**			**4**			**1**
Proportion of species in good status				**25%**			**73%**			**56%**			**0%**
State of species group water column feeders				**not good**			**not good**			**not good**			**not good**

Benthic-feeding birds

Benthic feeders dive to the seafloor and prey on invertebrates (e.g. molluscs, echinoderms).

In Arctic Waters, the Greater North Sea and Celtic Seas, benthic feeders did not achieve the threshold and therefore are not in good status in all three Regions (**Table S.5**). In addition, a pilot assessment for the common scoter in the southern North Sea showed that its winter abundance is far below the threshold value.

The pilot assessment of the by-catch indicator (B5) dealt with only one benthic feeder. It showed that the distribution of Steller's eider in northern Norway (Arctic Waters) overlaps spatio-temporally with the practice of gillnet fishing, where incidental by-catch of this species is known to occur. According to the assessment method for species on the OSPAR List of Threatened and/or Declining Species and Habitats (which applies to Steller's eider), the presence of an overlap implies that the indicator threshold is not achieved for the Steller's eider. However, as there is no status assessment for this species it cannot yet be included in the integrated assessment.

Table S.5: Benthic-feeding marine bird species group indicator outcomes (B1, B3) and integrated status. Breeding populations (B) and non-breeding populations (NB) are assessed separately. Green: indicator threshold achieved or status good; red: indicator threshold not achieved or status not good

Benthic feeders		Arctic Waters Region I			Greater North Sea Region II			Celtic Seas Region III		
		B1	B3	Status	B1	B3	Status	B1	B3	Status
Greater scaup	NB						not good			not good
King eider	NB			good						
Common eider	B						not good			
Common eider	NB			not good			not good			
Long-tailed duck	NB			not good						
Common goldeneye	NB			good			good			not good
Number of species in good status				**2**			**1**			**0**
Number of species not in good status				**2**			**3**			**2**
Proportion of species in good status				**50%**			**25%**			**0%**
State of species group water column feeders				**not good**			**not good**			**not good**

Wading birds

Wading feeders walk and wade in shallow water or on mudflats and in the rocky intertidal, but also along the shoreline. They typically prey on invertebrates (molluscs, polychaetes, crustaceans, etc.) although some species (e.g. little egret, spoonbill) also feed on fish.

Wading feeders were assessed in the Greater North Sea and the Celtic Seas only, mostly birds in the non-breeding season (**Table S.6**). In both Regions the threshold for good status (75% of species in good status) was not achieved. There is no additional information from pilot assessments or status assessments.

Table S.6: Wading feeder marine birds species group indicator outcomes (B1, B3) and integrated status. Breeding populations (B) and non-breeding populations (NB) are assessed separately. Green: indicator threshold achieved or status good; red: indicator threshold not achieved or status not good

		Greater North Sea Region II			Celtic Seas Region III		
Wading feeders		**B1**	**B3**	**Status**	**B1**	**B3**	**Status**
Common shelduck	NB			good			not good
Eurasian teal	NB			good			good
Northern pintail	NB			good			not good
Eurasian spoonbill	B			good			
Eurasian spoonbill	NB			good			
Eurasian oystercatcher	B			not good			
Eurasian oystercatcher	NB			not good			good
Pied Avocet	B			not good			
Pied Avocet	NB			good			
Grey Plover	NB			not good			not good
Common ringed Plover	B			good			
Common ringed Plover	NB			good			not good
Kentish Plover	B			not good			
Kentish Plover	NB			not good			
Black-tailed godwit	NB			good			good
Bar-tailed godwit	NB			good			not good
Eurasian whimbrel	NB			good			
Eurasian curlew	NB			good			not good
Spotted redshank	NB			not good			
Common redshank	NB			good			good
Common greenshank	NB			good			good
Ruddy turnstone	NB			good			not good
Red knot	NB			not good			good
Sanderling	NB			good			good
Purple sandpiper	NB			not good			not good
Dunlin	NB			not good			not good
Curlew Sandpiper	NB			not good			
Ruff	NB			not good			
Little egret	NB			good			good
Number of species in good status				17			8
Number of species not in good status				12			9
Proportion of species in good status				59%			47%
State of species group				**not good**			**not good**

Grazing birds

Grazing feeders typically forage on salt marshes adjacent to the shoreline, but also in intertidal areas and shallow waters. They are herbivores, taking various plants (e.g., eelgrass, saltmarsh plants) and algae.

The threshold for good status of a species group was achieved in grazing feeders in the three assessments conducted for the Arctic Waters, the Greater North Sea and the Celtic Seas (but only one species was assessed in the Arctic Waters) (**Table S.7**). This assessment is based almost entirely on non-breeding populations, without information from pilot assessments or status assessments being available.

Table S.7: Grazing feeders marine birds species group common indicator outcomes (B1, B3) and integrated status. Breeding populations (B) and non-breeding populations (NB) are assessed separately. Green: indicator threshold achieved or status good; red: indicator threshold not achieved or status not good

		Arctic Waters Region I			Greater North Sea Region II			Celtic Seas Region III		
Grazing feeders		**B1**	**B3**	**Status**	**B1**	**B3**	**Status**	**B1**	**B3**	**Status**
Barnacle goose	B						good			
Barnacle goose	NB						good			good
Brent goose	NB						good			good
Eurasian wigeon	NB						good			good
Mallard	NB			good			good			not good
Northern shoveler	NB						good			good
Number of species in good status				**1**			**6**			**4**
Number of species not in good status				**0**			**0**			**1**
Proportion of species in good status				**100%**			**100%**			**80%**
State of species group water column feeders				good			good			good

Overall assessment

The results of the species group assessments are summarised in **Table S.8.** It is clear that marine birds are not in good status across the OSPAR Regions and species groups, with the striking exception of grazing feeders in all three Regions examined.

In order to investigate possible changes in the status of marine bird species groups, the status of marine bird species and species groups was assessed retrospectively for the year 2010, using the outputs from the Common Indicators Marine bird abundance (B1) and Marine bird productivity (B3). This method of comparison was chosen because in QSR 2010 the status of marine birds was not assessed. Compared with 2010, the assessment for 2020 shows no major differences (**Table S.8**). Status remained unchanged in all combinations of Region and species group. Further, the percentages of species in good status only slightly differed between 2010 and 2020. This indicates that most marine birds were already not in good status in 2010. However, for the “all species” grouping the proportion of species in good status decreased from 2010 to 2020 in all Regions (**Table S.8**).

The species groups in this assessment were compiled on the basis of their diet and feeding habits. In this context, if one species group fails to achieve good status it cannot perform its role in the marine environment, i.e. in the food web. Because of the link to food and feeding, the role of one species group cannot be taken on by another species group. As a consequence, if one species group is not in good status, marine birds as an ecosystem component have to be treated as not being in overall good status. Integration from species groups to ecosystem component is not required in EU MSFD Article 8 assessments*, but if needed for other purposes it is recommended to use the one-out-all-out approach, as outlined above. Applying this to the bird assessments shown in **Table S.8**, marine birds were not in good status both in 2010 and 2020 in the four OSPAR Regions assessed: Arctic Waters, Greater North Sea, Celtic Seas and Bay of Biscay and Iberian Coast.

**OSPAR acts as a coordination platform in the North-East Atlantic for the regional implementation of the EU Marine Strategy Framework Directive (MSFD) that aims to achieve a Good Environmental Status (GES) in European marine environments, as well as for the coordination of other national frameworks. The characteristics of GES are determined by the individual EU member states, based on criteria elements, threshold values and methodological standards set regionally or at EU level.*

Norwegian, Icelandic, United Kingdom, Greenlandic and Faroese marine areas are not covered by the MSFD.

Table S.8: Status overview for species groups of marine birds in the five OSPAR Regions (N/A = not assessed) for 2020 compared with 2010 (retrospective assessment using the same methods). Changes in the proportions of species in good status and in the status of species groups are shown as increase/improvement (↑), decrease/degradation (↓) or no change (=). Note that some species assessments are done with data up to 2016, 2017 or 2019 only. Summary information for "all species groups" is given only for illustration, but is not part of the assessment

		2010			2020			2010/2020	
		no. species	% species in good status	status of species group	no. species	% species in good status	status of species group	trend in proportion of species in good status	trend in species group status
Surface feeders	Arctic Waters	9	56%	not good	10	60%	not good	↑	=
	Greater North Sea	20	32%	not good	20	30%	not good	↓	=
	Celtic Seas	12	33%	not good	13	38%	not good	↑	=
	Bay of Biscay and Iberian Coast	7	71%	not good	9	67%	not good	↓	=
Water column feeders	Arctic Waters	12	50%	not good	12	25%	not good	↓	=
	Greater North Sea	11	64%	not good	11	73%	not good	↑	=
	Celtic Seas	9	44%	not good	9	56%	not good	↑	=
	Bay of Biscay and Iberian Coast			N/A	1	0%	not good		
Benthic feeders	Arctic Waters	4	50%	not good	4	50%	not good	=	=
	Greater North Sea	4	50%	not good	4	25%	not good	↓	=
	Celtic Seas	2	50%	not good	2	0%	not good	↓	=
Wading feeders	Greater North Sea	29	72%	not good	29	59%	not good	↓	=
	Celtic Seas	17	71%	not good	17	47%	not good	↓	=
Grazing feeders	Arctic Waters	1	100%	good	1	100%	good	=	=
	Greater North Sea	6	100%	good	6	100%	good	=	=
	Celtic Seas	5	80%	good	5	80%	good	=	=
All species groups	Arctic Waters	26	54%		26	46%		↓	
	Greater North Sea	69	61%		70	54%		↓	
	Celtic Seas	45	58%		46	48%		↓	
	Bay of Biscay and Iberian Coast	7	71%		10	60%		↓	

Threatened and / or declining seabirds

Nine species or sub-species of birds are on the OSPAR List of Threatened and/or Declining Species and Habitats (Agreement 2008-06). The status of all nine species / sub-species was assessed in 2003 to 2010 as requiring priority protective action. Since then, five species have been reassessed. All five species are still declining in status and it is highly likely that the Iberian race of common guillemot has become extinct (**Table S.9** and **Table S.10**). Threatened and declining bird species are not distributed evenly across the OSPAR

Regions (see **Table S.10**). Three species are confined to Arctic Waters and the Barolo shearwater (split from the little shearwater, also known as Macaronesian shearwater) breeds in the Azores and is confined to the Wider Atlantic Region. The other species are distributed across multiple regions, with the black-legged kittiwake the most wide-ranging.

Balearic shearwater breed on islands in the Mediterranean but venture into the North-East Atlantic when not breeding. The numbers in breeding colonies are undergoing a severe decline of -14% per year, mainly owing to the poor survival rates of adults when they are away from the colonies at sea. Incidental by-catch in fisheries is believed to be contributing to mortality at sea and is the most significant threat to this species in the OSPAR Maritime Area.

The Iberian race of common guillemot was almost extinct when it was added to the OSPAR List in 2003. The last known breeding attempts in Portugal were in 2002 and in Galicia in north-west Spain in 2007. The last recorded individuals were seen in Galicia in 2013. Numbers of breeding Iberian guillemots declined by 33% per year between 1960 and 1974. Incidental by-catch mortality resulting from the rapid development of gillnet fisheries appears to be the main factor underpinning the population crash. Pollution derived from large oil spills could also have contributed to their extinction.

The breeding success of the OSPAR listed sub-species of lesser black-backed gull has been exceptionally low in recent years at the breeding sites in northern Norway. Climate change and pollution remain serious threats and the pressure from predators at breeding colonies appears to be increasing.

The status of black-legged kittiwake breeding populations is still declining in Arctic Waters and the Greater North Sea and is also declining in the Celtic Seas and the Bay of Biscay. Climate change appears to continue to affect food supply in the Arctic, Greater North Sea and the Iberian coast, as well as in wintering areas partly outside the OSPAR Region. Food supply in the North Sea is also threatened by sandeel fishing in some areas (see: Food webs Thematic Assessment – Response Section – Case study). A northward contraction in breeding range in the Bay of Biscay and Celtic Seas appears consistent with climate change predictions.

The breeding populations of the thick-billed murre (Brünnich's guillemot) in Svalbard, East Greenland and northern Norway are currently declining. Climate change and its indirect effects, such as oceanographic shifts in the wintering grounds resulting in reduced food supplies, are believed to be driving this negative trend. Further threats in some areas include hunting, disturbance by predators, as well as chemical and oil pollution. Populations in Iceland and Franz Josef Land appear to be either stable or increasing.

Table 1: Status assessments for lesser black-backed gull (sub-species fuscus - 2021), thick-billed murre (Brünnich's guillemot - 2020) 2020), Balearic shearwater, Iberian guillemot and black-legged kittiwake (2022). Most have been recognised by OSPAR as threatened and/or declining (●) Based on Chapter 10 Table 10.1 and Table 10.2 in QSR 2010 (except for cases marked with ○). Status of criterion assessed: Good (green), not Good (red), unknown (blue). Trends in status (since the assessment in the background document) in the criterion assessed: ↓ decreasing trend or deterioration, ↑ increasing trend or improvement, ←→ no change observed, ? trend unknown, NA – not applicable (i.e. species not present during breeding or non-breeding season). Method of assessment: 1 – direct data driven, 2 – indirect data driven, 3 – third party assessment close-geographic match, 4 - third party assessment partial-geographic match, 5 – expert judgement

	Lesser black-backed gull	Thick-billed murre (Brünnich's guillemot)	Balearic shearwater			Iberian guillemot	Black-legged kittiwake				
Region	I	I	II	IIII	IV	IV	I	II	III	IV	V
Distribution: non-breeding	N/A	?	? [3]	? [3]	↔ [1,3,4,5]	?	?	?	?	?	?
Distribution: breeding	↔ [2]	↔ [1,3,5]	N/A	N/A	N/A	↓ [1]	↔ [5]	↔ [5]	↓ [1]	↓ [1]	N/A
Population size: non-breeding	N/A	?	↔ ? [4]	↔ ? [4]	↓ [2,4]	?	?	*↑ [1]	?	?	?
Population size: breeding	↔ [1]	↓ [1,3,5]	N/A	N/A	N/A	↓ [1]	↓ [1]	↓ [1]	↓ [1]	↓ [1]	N/A
Condition: breeding productivity	↓ [2,3,5]	↔	N/A	N/A	N/A	?	↓ [1]	↓ [1]	↓ [1]	?	N/A
Condition: habitat quality	?	?	?	?	?	↓ [1,2,3]	?	?	?	?	?
Previous OSPAR status assessment	•	•	•	•	•	•	•	•	○	○	○
Status: overall assessment	not good	not good	not good	not good	not good	not good	not good	not good	not good	not good	?

* Assessment of non-breeding population size is based on wintering numbers offshore in the southern North Sea only, using data from NL, BE and DE. This only a very small part of the non-breeding distribution of black-legged kittiwake, which covers large parts of the North Atlantic. Source: Pilot assessment of B1 Marine bird abundance – non-breeding birds offshore (OSPAR, 2023).

Table S.10: Overview of status assessments available for OSPAR threatened and declining marine birds. ? = Not assessed since listing in 2008-10, * probably extinct; blank cells indicate species not present in region (or occurs in low numbers and/or infrequently)

OSPAR threatened and/or declining bird species	**Arctic Waters Region I**	**Greater North Sea Region II**	**Celtic Seas Region III**	**Bay of Biscay and Iberian Coast Region IV**	**Wider Atlantic Region V**
Lesser black-backed gull *Larus fuscus fuscus*	Poor				
Ivory gull *Pagophila eburnea*	?				
Steller's eider *Polysticta stelleri*	?				
Barolo shearwater (synonym: Macaronesian shearwater) *Puffinus baroli*					?
Balearic shearwater *Puffinus mauretanicus*		Poor	Poor	Poor	?
Black-legged kittiwake *Rissa tridactyla*	Poor	Poor	Poor	Poor	?
Roseate tern *Sterna dougallii*		?	?	?	?
Iberian guillemot *Uria aalge* (synonyms: *Uria aalge albionis, Uria aalge ibericus*)				Poor*	
Thick-billed murre (synonym: Brünnich's guillemot) *Uria lomvia*	Poor				

I – Impact (on ecosystem services)

Impacts on the provision of ecosystem services by marine birds

Marine birds are generally not in good status in all the Regions of the OSPAR Maritime Area. This is likely to cause strong negative impacts on ecosystem services, in particular on services for biotic provisioning, biotic regulation and maintenance and on several cultural services.

Impacts on ecosystem services: method for development of the schematic

This section evaluates the impact of changes in the state of marine birds observed in the QSR assessments on the ecosystem services that the North-East Atlantic provides. It was developed through literature review combined with expert judgement, using the same methodology across all thematic assessments. Several workshops involving ecosystem services experts and marine bird experts were held to discuss and agree the results presented below.

Detailed rationale for the role that marine birds (and their state) play in relation to the provision of ecosystem services

The physical damage or death of organisms (lethal effects directly affecting survival rates), can negatively affect ecosystem services in a relatively straightforward way. Likewise, it should be noted that the alteration of feeding behaviour, reproductive behaviour, fertility, reproductive success, mobility and other factors (i.e. sublethal effects indirectly impacting survival, often with a lagged effect) resulting from different environmental impacts can also affect ecosystem services. It is known that reduced prey availability, the introduction of non-indigenous species, exposure to marine litter or other substances (e.g. PBDEs, PBCs) and many other factors can lead to alterations in birds' reproductive rates, fecundity and metabolic mechanisms, while visual disturbance and other human activities can cause impacts such as displacement from habitats (see the pressure-related thematic assessments from Non-indigenous Species Thematic Assessment for more details about human-induced pressures and associated environmental impacts), with possible carry-over effects on productivity and survival.

Several traits identified in the literature relating to categories such as morphology, behaviour, demography, physiology are comparable across different groups of marine megafauna (large fishes, marine mammals, and marine birds); they underpin the ecosystem functions performed by these organisms that in turn support the provision of ecosystem services. These traits include, for example, body size, body mass, migration, mortality rate, fecundity, reproductive success, survival rate, reproductive location and feeding strategy. For example, dispersal performance and mortality rate (traits) are associated with nutrient transport (ecosystem function) that, in turn, enables the provision of ecosystem services such as 'nursery population and habitat maintenance' (through biodiversity promotion) and 'regulation and maintenance of marine food webs' (through the function of nutrient cycling) (Tavares *et al.*, 2019). Consequently, if these traits are adversely affected, for example due to habitat loss or exposure to pollutants, negative consequences for the provision of ecosystem services can be expected. The identification of links between state (changes) and ecosystem services was also based on this reasoning.

As mentioned in the "Pressures" section, various pressures associated with human activities and consequent environmental impacts can affect the breeding performance and abundance of marine birds. Especially in the Norwegian Arctic, Greater North Sea and Celtic Seas, "not good" state has been assigned to more than a quarter of assessed species, the result of insufficient productivity to maintain population sizes and of low abundance compared with baseline values (see: State section). The fact that marine birds are not in good state, as shown schematically in **Figure I.1**, can in turn negatively impact the provision of several ecosystem services. Indeed, the scientific literature demonstrates a positive relationship between bird abundance and the provision of ecosystem services (Gaston *et al*., 2018).

Impacts on ecosystem services: key messages

The schematic in **Figure I.1** shows that **when marine birds are not in good status, widespread and intense negative effects are likely to occur in several ecosystem services**. There are instances in which limited positive impacts may also arise from a reduction in marine birds, but these always have low importance and are negligible in comparison with the negative effects.

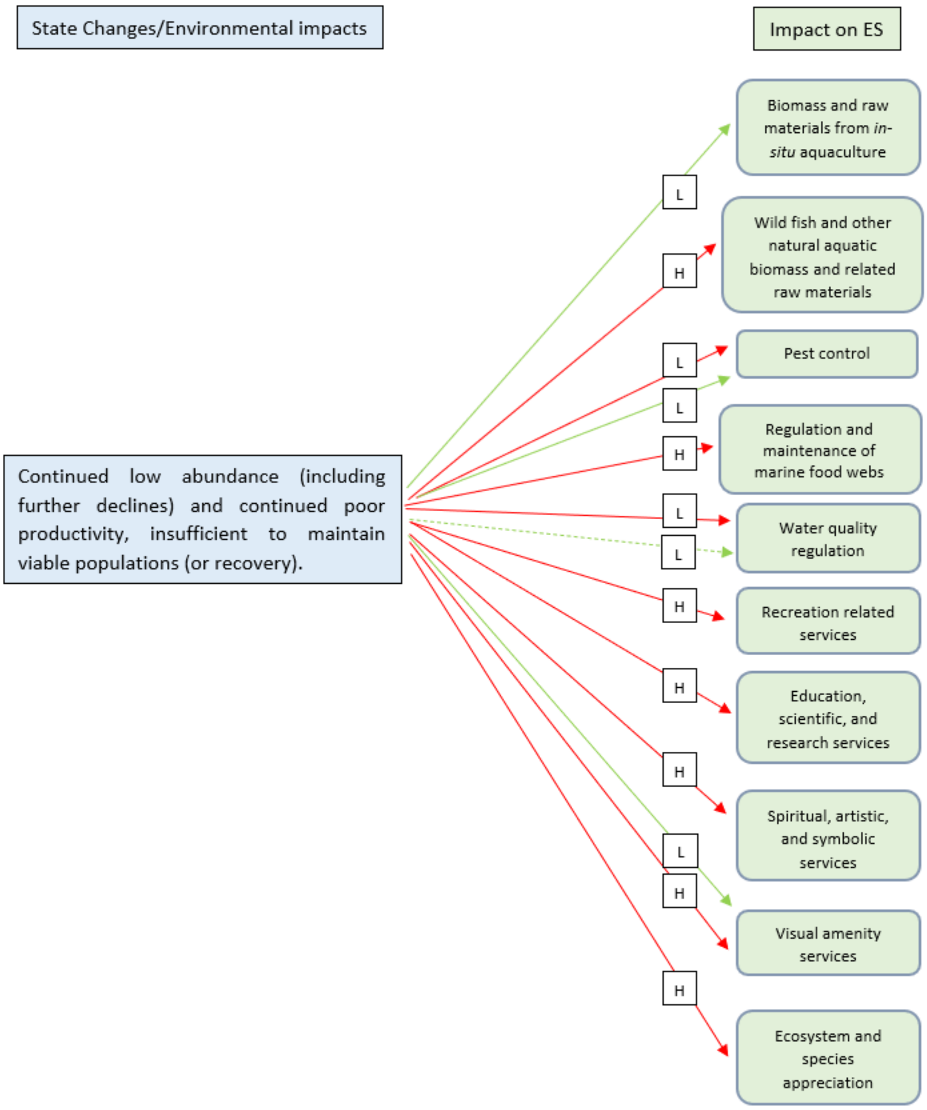

Figure I.1: Schematic depicting the 'State (changes)' - 'Impacts on ES' linkages for the Marine Birds Thematic Assessment. The ecosystem services shown are those considered most relevant to the Marine Birds Thematic Assessment. Each arrow also denotes an expert estimate of the nature and magnitude of the impact (red arrow = negative impact, green arrow = positive impact, green dashed arrow = potential positive impact; H = high impact, L = low impact)

The following section provides, where deemed necessary, a further elaboration of the identified links between state changes and ecosystem services illustrated in the previous section.

Negative impacts

Figure I.1 shows that a reduction in marine birds might lead to widespread negative impacts on the following ecosystem services:

Wild fish and other natural aquatic biomass and related raw materials:
Declining abundance of marine bird species can adversely affect this ecosystem service and the associated traditional / local activities. Wild marine birds, being considered game, are sometimes hunted for human consumption, though the contribution by wild bird species to human nutritional needs is very small. As reported by Culhane *et al*., (2019a), an example can be found in the United Kingdom where, for legal quarry species, as long as quantities are limited to a maximum of 10 000 animals per year any hunter registered as a food business can supply game (including marine birds) in unprocessed form to primary consumers or suppliers such as butchers. This practice is known as 'wildfowling'. At local scale, the collection of marine bird eggs may also be mentioned including, for example the licensed collection of black-headed gull eggs in an EU Special Protection Area in Hampshire (UK) for resale to restaurants (Wood *et al*., 2009). Unlike the marine bird hunting practices included under recreational services, the consumption of birds and their eggs under this ecosystem service is deemed as being for nutritional purposes (Culhane *et al*., 2019a). One example of the raw materials provided by seabirds is the use of feathers from hunted birds as fly-fishing tying material (Culhane *et al*., 2019a). Another is the collection of down from the common eider by both the indigenous people of the Arctic and Europeans (Vestbo *et al*., 2019).

Regulation and maintenance of marine food webs:
Declining abundance of marine bird species can adversely affect this ecosystem service by leading to imbalances in the food web. For example, the absence of avian predators from a rocky intertidal community has been observed to increase the abundance of limpet species, which in turn has led to a decrease in algae (Whelan *et al*., 2008). Other examples could be changes in the status (e.g. abundance) of fish-eating birds that may lead to changes in the trophic structure of fish communities, or seaducks and waders exploiting harvestable size classes of bivalves (Zwarts and Wanink, 1993; Kube and Skov, 1996). Moreover, grazing feeders such as geese play an important role in increasing the diversity of submerged macrophytes and stimulating primary production, which in turn is crucial for maintaining the balance of food webs (Green and Elmberg, 2014).

Water quality regulation:
Marine birds and migratory birds using OSPAR marine areas in their flight routes are known to move nutrients from the shore to the coast and vice versa, as in the case of breeding seabirds and guano. Surface feeders and grazing feeders in particular use both aquatic and terrestrial systems to feed, which results in nutrient cycling along these habitats (Gaston *et al*., 2018; Noordegraaf, 2020). The nutrient cycling provided by birds contributes to water quality, in turn positively contributing to food web (primary) productivity (the ecosystem service of regulation and maintenance of marine food webs) (Gaston *et al*., 2018). Declining abundance of marine bird species can therefore adversely affect water quality.

Pest control:

Some surface feeders such as terns and waders contribute to the reduction and control of mosquitos by consuming their larvae (known to be major pests and vectors of disease; Green and Elmberg 2014). In this sense, a decline in abundance can have a negative effect on this ecosystem service. Moreover, pest control is underpinned by a balanced food web, and therefore all components of the marine ecosystem are relevant to the provision of this ecosystem service, including marine birds (Culhane *et al*., 2019a).

Recreation-related services:
It is well known that marine birds are the focus of popular recreational activities such as on-site birdwatching (Noordegraaf, 2020). Healthy bird populations, as contributors to the natural seascape, play a key role in ecotourism and the maintenance and enhancement of related economic activity. For example, some species of gulls, the northern gannet and the Atlantic puffin contribute to this benefit by being charismatic species (Burdon *et al*., 2017). Bird-watching tourism in Europe represents a growing market, especially in countries such as the United Kingdom and the Netherlands. Ornithological organisations such as The Royal Society for the Protection of Birds (UK) and the Dutch Ornithological Organisation have over 1 million members and 141 000 members, respectively (Noordegraaf, 2020).

Education, scientific, and research services:
Marine birds are a central topic in many scientific research activities. Proof of this is the large number of studies involving marine birds that can be found in various online literature databases (Noordegraaf, 2020). However, precisely because this ecosystem service can be enjoyed offsite, for example by reading a book, it may not be impacted by a decline in seabird abundance as it is not directly influenced by the current state of seabird populations (Culhane *et al*., 2019a). Seabirds play a key role in education, as they can provide striking examples of certain biological features that are taken as models for demonstrating processes of biological evolution (e.g. explanation of the species formation process; Liebers-Helbig *et al*., 2010). With regard to education services, reference can also be made to the role of citizen science in bringing volunteers into the activity of monitoring bird species and the consequent role of environmental education (Earp and Liconti, 2020; Kloetzer *et al*., 2021). Furthermore, the fact that few organisms can provide such long time series of data as birds underscores the value of seabirds to environmental science. Marine birds are also used in many monitoring programmes as indicators, for example in monitoring eggs for contaminants. Finally, research and monitoring activities increase overall knowledge about marine birds and enable them to be protected more efficiently, with possible benefits to their provision of ecosystem services (examples provided by the experts involved in the Marine Birds Thematic Assessment).

Spiritual, artistic, and symbolic services:
The value of birds such as swans in relation to this ecosystem service is reflected in their artistic and historical importance. Birds, including marine birds, are used for taxidermy (which can be considered art) and the feathers from marine birds such as gulls and terns have also been used in the clothing industry, as happened in the past with kittiwakes in Heligoland (Gätke, 1895). In addition, marine birds are often used as symbols by entities such as NGOs, the Lutheran church, and others, and they can have spiritual and ritual identity (Noordegraaf, 2020). However, precisely because this ecosystem service can also be enjoyed offsite, for example through artistic representations, it may not be impacted by the decline in seabird abundance as it is not directly influenced by the current state of seabird populations (Culhane *et al*., 2019a).

Visual amenity services:
Marine birds provide this service because they can convey a 'sense of place' through their appearance and their vocalisation. For example, the calls of great northern divers are often used as background sound in movies and the vocalisations of seagulls are commonly heard in any film that takes place on the coast (Rüter and Palmer 2012), and they are also used in artistic representations (e.g. works of art that use marine wildlife

as inspiration; UK NEA, 2011c). Consequently, a decline in these marine birds may have negative impacts on this ecosystem service. However, precisely because this ecosystem service can be also be enjoyed offsite, for example through artistic representations, it may not be impacted by the decline in seabird abundance as it is not directly influenced by the current state of seabird populations (Culhane *et al*., 2019a).

Ecosystem and species appreciation:
This ecosystem service represents the value placed on species (charismatic or not) of marine birds simply by knowing that they exist and that they are in good condition, even if perhaps the very people who place this value on them will never see them. This ecosystem service includes knowing that future generations will have the opportunity to enjoy marine birds (Noordegraaf, 2020). Therefore, a significant decline in marine bird populations negatively affects the provision of this service.

Positive impacts

Figure I.1 shows that a reduction in marine birds might lead to limited positive impacts on the following ecosystem services:

Biomass and raw materials from in-situ aquaculture:
Important aquatic species that provide biomass through aquaculture processes, such as bivalves, are the prey of several species of marine birds, including eider, velvet scoter, common scoter, herring gull, oystercatcher and great black-backed gull. Aquaculture stock losses due to seabird predation can be significant, sometimes up to 30% of the total stock (Varennes *et al*., 2013; Aquaculture Advisory Council, 2022). The implication of this is that in selected sites a decline in the abundance of some marine bird species can be assumed to have an indirect positive effect on the provision of biomass from in situ aquaculture.

Pest control:
Marine birds can be vectors (as well as victims) of avian influenza, transporting viruses over long distances (Ramey *et al*., 2010) and eventually infecting domestic poultry (Blagodatski *et al*., 2021). This can lead to significant economic loss, as well as harm to animal welfare. Marine birds can also play a role in spreading alien species (Signa *et al*., 2021). Thus, a decline in the abundance of certain marine bird species could – theoretically – have partly positive effects on the control of pathogens and alien species considered to be pests. Such positive effects are counteracted by the fact that marine birds also play an important ecological role in pest control, and therefore their reduction would lead to negative effects on this ecosystem service as well (see "Negative impacts" section).

Visual amenity:
Some seabirds, especially gulls, can evoke negative visual associations in specific contexts, as in urban areas where gulls can be perceived by some to be a nuisance. Thus, their decline could have a (limited) positive effect on this ecosystem service (Rock, 2005). However, it should be noted that negative impacts on this ecosystem service are likely to be much more important, as marine birds generally convey a "sense of place" and are linked to pleasant visual associations (see "Negative impacts" section)

Water quality regulation (potentially):
Facultative scavengers, such as gulls, can contact pathogens and toxins by feeding extensively at landfills, posing hazards to water quality (Whelan *et al*., 2008). Consequently, a reduction in their abundance could have partly positive effects on beach water quality, for example (Converse *et al*., 2012). Biomagnification of contaminants has been found in many seabirds, due to their position at the apex of the food web and their wide foraging range. Therefore, seabirds can potentially release various contaminants into the environment

through feathers, eggs, guano and carrion, with a consequent negative impact on water quality and the marine food web (Signa *et al*., 2021). It should be noted that, as marine birds are also a vector of nutrients, their reduction is also associated with negative effects on water quality (see "Negative impacts" section).

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R – Response

Measures taken by OSPAR to protect marine birds

OSPAR has identified nine bird species as of particular concern within the North-East Atlantic and has agreed on recommendations for actions to be taken by Contracting Parties both nationally and collectively to protect and conserve these species. Progress has been made in the efforts to strengthen data collection and management to support policy action and knowledge exchange. Good progress has also been made in developing the ecological coherence of the OSPAR network of MPAs for protecting OSPAR listed bird species. The designation of the NACES MPA in 2021 represents an important step forward for protecting foraging marine birds.

Several measures have been taken by OSPAR to manage particular human activities or pressures relating to pollution, marine litter, physical damage which are relevant to the status of marine birds. The Collective Arrangement provides a useful framework for working with other competent organizations on responses of relevance to marine birds in selected areas outside of national jurisdiction, for example fisheries.

The responses to date have not been able to change the downward trajectory in the status of marine birds. Addressing this decline has been identified as a priority in OSPAR's North-East Atlantic Environment Strategy (NEAES) 2030, and an action plan to achieve the recovery of marine birds is in preparation. Progress in achieving the NEAES objective to minimize and where possible eliminate incidental by-catch will be an important future response for marine birds, with reliance on OSPAR's commitment to continue working with relevant competent organizations and stakeholders. Marine birds stand to benefit from responses targeted at other ecosystem components, for example benthic habitat restoration for benthic feeding and grazing marine birds.

Future responses will need to take into account the impacts of climate change on marine birds.

Marine bird R-section ANNEX: The section development has been supported by the collation of relevant measures: measures of relevance to marine birds included in this section.

Section Overview

This section describes the responses to minimize the effect of human activities, their resulting pressures or impacts on ecosystem services, and aims to improve the state of marine birds in the North-East Atlantic. These responses can include the development of policy, legislation or measures to manage or regulate specific human activities, or to mitigate impacts on ecosystem services.

The primary focus is on the responses adopted by the OSPAR Commission in order to implement the Contracting Parties' commitments under the OSPAR Convention and the strategic objectives of the North-East Atlantic Environment Strategy. Article 22 of the OSPAR Convention requires that the Contracting Parties report to the OSPAR Commission at regular intervals on the steps they have taken to implement the OSPAR Decisions and Recommendations, the effectiveness of those measures and the problems encountered in their implementation. This section aims to describe the progress made in implementing these measures and whether they are working in terms of achieving the ambitions set out in the North-East Atlantic Environment Strategy 2030 (NEAES 2030). It attempts to set OSPAR's responses in the wider policy context and to examine the responses by other competent organisations, where these address marine birds in the context of the North-East Atlantic, and provides a more detailed look at the range of measures undertaken to address the decline of marine birds under the EU MSFD.

The section considers the diversity of marine birds across five feeding guilds that occur within the OSPAR Maritime Area. A subset of these species is represented in the indicator assessments, and nine species have been nominated by OSPAR Contracting Parties as being of particular concern and so listed as threatened and / or declining.

There are several "entry points" within NEAES 2030 for future action relating to marine birds, in particular Operational Objective 4 under Strategic Objective 5, which commits OSPAR to the urgent development of an action plan to halt the decline of marine birds.

Strategic Objective 5: Protect and conserve marine biodiversity, ecosystems and their services to achieve good status of species and habitats, and thereby maintain and strengthen ecosystem resilience.

> **S5.O1:** By 2030 OSPAR will further develop its network of marine protected areas (MPAs) and other effective area-based conservation measures (OECMs) to cover at least 30% of the OSPAR Maritime Area to ensure it is representative, ecologically coherent and effectively managed to achieve its conservation objectives.

S5.O2: By 2022 OSPAR will identify barriers to the effective management of MPAs, and by 2024 take steps to address them appropriately to enable all OSPAR MPAs to achieve their conservation objectives.

S5.O3: By 2024, OSPAR will establish a mechanism to provide that where Contracting Parties are authorising human activities under their jurisdiction or control that may conflict with the conservation objectives of OSPAR MPAs in areas beyond national jurisdiction (ABNJ), these activities are subjected to an Environmental Impact Assessment (EIA) or Strategic Environmental Assessment (SEA).

S5.O4: By 2025 at the latest OSPAR will take appropriate actions to prevent or reduce pressures to enable the recovery of marine species and benthic and pelagic habitats in order to reach and maintain good environmental status as reflected in relevant OSPAR status assessments, **with action by 2023 to halt the decline of marine birds.**

S5.O5: By 2025 OSPAR will have implemented all agreed measures to enable the recovery of OSPAR Listed threatened and/or declining species and habitats and will take additional measures as needed.

Strategic Objective 7: Ensure that uses of the marine environment are sustainable, through the integrated management of current and emerging human activities, including addressing their cumulative impacts.

S7.O6: OSPAR will work with relevant competent authorities and other stakeholders to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles and fish so that it does not represent a threat to the protection and conservation of these species and will work towards strengthening the evidence base concerning incidental bycatch by 2025.

There are a number of linkages to other thematic assessments, including: Fish, Benthic Habitats, Food webs, Marine Litter, Climate Change.
The reader is referred to the following feeder reports for additional information on some of the key human activities affecting marine birds: Fisheries, Offshore Renewable Energy Generation, Aquaculture, Recreation and Tourism, Shipping and Ports

Measures adopted by OSPAR

This section focuses on measures that have been adopted by OSPAR and draws on efforts to protect and conserve marine birds of particular concern and to establish an ecologically coherent and well managed network of MPAs, as well as specific measures that OSPAR has adopted to address human activities and pressures and improve the conservation status of these species.

The implementation status of all OSPAR measures was reported in 2021: Implementation of OSPAR measures - A progress report.

Addressing bird species in decline and under threat within the OSPAR Maritime Area:
OSPAR Contracting Parties have identified nine marine bird species that are of particular concern in the North-East Atlantic and included in the OSPAR List of Threatened and/or Declining Species and Habitats (the OSPAR List). The OSPAR List, which was first adopted in 2003 and updated in 2008 and 2021, guides the OSPAR Commission in setting priorities for its further work to conserve and protect marine biodiversity in implementing Annex V to the OSPAR Convention. Recommendations for actions to protect and conserve these marine bird species were adopted by OSPAR between 2011 and 2014 and are considered to be in the process of implementation.

The purpose of these Recommendations is to agree actions to be taken nationally and collectively to strengthen the protection of the listed marine bird species, recover their status and ensure that they are effectively conserved in the OSPAR Maritime Area. A common understanding of the Recommendations was adopted in 2013 (Agreement 2013-13). The Recommendations are broad in nature, addressing a range of human activities and pressures. The actions to be taken nationally include steps to ensure appropriate national legislation for the protection of marine birds, consideration of how to strengthen the knowledge base, monitoring and assessment, steps to manage key human activities, a call for the designation of MPAs, and raising awareness. The collective actions include coordination of monitoring and assessment, enhancing knowledge exchange, collaborating and maintaining cooperation with relevant competent organisations in addressing key pressures such as fishing and shipping, as well as the development of research. In considering the measures taken to address the impacts of drivers, pressures and threats on birds it is useful to distinguish between breeding areas and non-breeding or wintering areas, as their significance may vary at different stages of their annual cycle. Four of the listed bird species occur in the OSPAR Maritime Area throughout the year but are present in some Contracting Parties' waters only at certain times of year.

There have been two rounds of implementation for the listed marine bird species, all of which were reported on in 2013 and 2019 except for the Iberian guillemot, for which reporting took place in 2016 and 2019. Further reporting on the implementation of the measures will take place every six years, with the next reports due in 2025. The following text sets out the progress made in the implementation of these measures and the challenges encountered. See: Implementation of OSPAR measures - A progress report.

Progress in implementation of the Recommendations

Of the nine listed species, implementation reports relating to national actions were submitted by at least four Contracting Parties for only three species (roseate tern, black-legged kittiwake and Balearic shearwater), making it difficult to identify commonalities and differences in approach. For the most part, evidence of implementation was provided by Contracting Parties where these species occur, but still with some gaps. The actions in the Recommendation were reported as being implemented mostly through legislative and administrative actions, with a lower number through actions resulting from negotiated agreement.

It should be noted that some of the listed species are present in the waters of Contracting Parties, but only outside the OSPAR Maritime Area. An example is the *fuscus* sub-species of the lesser black-backed gull, which occurs in Sweden and Finland, but only along their Baltic coasts; accordingly, neither Sweden nor Finland reported on this species. The Barolo shearwater (formally referred to as the little or Macaronesian shearwater) only breeds in the Azores (PT) within the OSPAR Maritime Area, but has a breeding range that extends to the Canary Islands (ES) and the Madeira archipelago (PT), which are outside the OSPAR Maritime Area. Portugal did not report, but Spain did, on actions taken at colonies in the Canaries. Spain also reported on measures taken at its only colonies of Balearic shearwater, which are in Spanish Mediterranean waters.

For most species, the relevant Contracting Parties have legislation in place that bans the deliberate killing or taking of chicks and eggs. However, regulated hunting of thick-billed murres (also known as Brünnich's guillemot) and the black-legged kittiwake is permitted by some Contracting Parties, for example by Iceland and Denmark with respect to Greenland. It is unclear whether statutory regulation of hunting should represent full or partial implementation of this action. Clarification may depend on whether Contracting Parties can provide evidence that legislation is having an effect on the hunting of a species.

Marine protected areas (MPAs) that protect populations and critical habitats have been designated as part of the OSPAR network of MPAs for all listed bird species. The implementation of national action to promote monitoring and assessment programmes and the contribution to a data collation strategy for these species was difficult to assess without specific attributes against which the existing programmes could be evaluated. It was concluded that there would be merit in developing standards for monitoring and assessment under the appropriate collective action (action (36; see below)) against which future reporting could be made and assessed.

Actions to address incidental by-catch were taken by several Contracting Parties across the listed bird species, ranging from improvements to by-catch observer schemes to mapping by-catch incidence so as to inform management at the national level, including by developing a national action plan to reduce marine bird by-catch as a contribution to the EU Plan of Action (PoA) for reducing incidental by-catch of seabirds in fishing gears (COM (2012) 665 final) and to the ICES working group on by-catch.

The adoption of the Roadmap for the implementation of collective actions within the Recommendations for the protection and conservation of OSPAR listed Species and Habitats (2017-2025) (The Roadmap), has supported the implementation of collaborative efforts across the thematic boundaries within OSPAR and helped to inform or support actions implemented at the national level.

Given the distribution of species, collective action is likely to add value to only three or four of the listed species, which are all migratory: the black-legged kittiwake, the roseate tern and the Balearic shearwater, and possibly the thick-billed murre (but other marine bird species not listed could also benefit). The latter species is more debatable, because Greenland, Iceland and Norway already work together with other Arctic nations on issues relating to thick-billed murres via the Conservation of Arctic Flora and Fauna (CAFF) working group under the auspices of the Arctic Council.

There are two examples of where progress has been made collectively through OSPAR to develop the knowledge base for listed marine birds:

- Strengthening regional collaboration on data collection and management for seven of the listed species by establishing a joint working group that brings together expertise and information from the North Atlantic (including Baltic Sea), thus creating a stronger evidence base for informing responses (See: Action 36);
- The establishment of an expert group for the roseate tern to enhance knowledge exchange and improve the evidence base to support further action (See: Action 41).

For species that occur in a geographically discrete region, implementation of these collective actions has been more challenging. The Barolo shearwater breeds only in the Azores (PT) within the OSPAR Maritime Area and then disperses across large tracts of the Wider Atlantic, making it difficult to see what other Contracting Parties can do to protect it. The ivory gull is only found in Greenland and Norway, with the lesser black-backed gull and Steller's eider confined to the Norwegian part of the Arctic region, suggesting that national or perhaps bilateral measures may be most appropriate, apart from any action to raise awareness.

The Iberian guillemot is an example of measures possibly having been adopted too late. This local race of the common guillemot once bred in its thousands along the northern coasts of Portugal and Spain and may now be extinct. Among the likely causes of its decline are the two large oil spills in the Bay of Biscay – the *Erika* off the coast of France in 1999 and, soon after, the *Prestige* in 2002 – very close to its breeding areas in Galicia. Ironically, the focus of the collective actions that include Iberian guillemot is the reduction of oil pollution.

Are these measures working?:

Although the implementation of the Recommendations has generated conservation action at the national and collective level for these species, the status of all the listed marine birds continues to be assessed as not good, with further declines in distribution, population size and condition (see: State section). Contracting Parties are making efforts to protect features that are threatened on a regional scale through various awareness-raising activities, by introducing national measures and legislation to regulate human activities causing pressures on the features, and by establishing monitoring programmes to assess the status of the features. It has, however, been difficult to objectively assess the level of implementation of many actions under the Recommendations, and not possible to evaluate whether or not these have been effective.

To understand the effectiveness of a measure, there needs to be an understanding of whether the response reduces human activity or pressure, and whether this results in a positive change in the status of the feature in question. One of the challenges to understanding these Recommendations is that each addresses many aspects – some specific, others more general – making it difficult to determine linkages and causality.

Given that all the bird Recommendations contain very similar, if not identical, actions, it has been proposed that future reporting could benefit from distinguishing which measures are being directed at breeding populations on land or in colonies, and which are being targeted at non-breeding populations offshore; and also whether there should be reporting on actions taken outside the OSPAR Maritime Area in order to provide any information on the impact or effectiveness of the measure.

The NEAES includes an objective to implement all agreed measures relating to the OSPAR listed species and habitats and take new measures by 2025 (S5.O5) with a specific mention to agree action by 2023 to halt the decline of marine birds (S5.O4).

Inclusion of listed marine bird species in Environmental Impact Assessment

Consideration for the approval of marine licences for certain activities and projects requires an environmental impact assessment (EIA) in order to assess potential impacts and enforce conditions that reduce impacts on species, including marine birds. An EIA usually includes: screening (deciding if an EIA is required); scoping (what needs to be included in the assessment); making an application to the competent authority; consultation with interested parties; and a decision by the competent authority. In 2010 OSPAR adopted Recommendation 2010/05, with the aim of ensuring that the features of the OSPAR List are specifically taken into consideration when EIAs of human activities are prepared.

The most recent reporting on the implementation of Recommendation 2010/05 took place in 2020. Contracting Parties that are also EU Member States reported that they effect this Recommendation through national legislation adopted to implement the EU EIA and SEA Directives. Some Contracting Parties also pointed to other relevant legislation that complements their EIA and SEA obligations. Examples are the EC Habitats Directive (Council Directive 92/43/EEC), including the Natura 2000 network, and the Habitats Directive assessments being imposed as a requirement for any plan or project likely to have an effect on a protected site, and also the EU Marine Strategy Framework Directive (Directive 2008/56/EC). As an example, in Sweden, there is a requirement to describe any impacts on the Swedish Red List, HELCOM, and OSPAR List through the EIA process. Subsequently, issuance of the permit can be made subject to conditions, for example by limiting the impact on certain species by regulating the dates on which certain activities can be performed, or avoiding certain areas.

Is the measure working?:
Overall, the approach of using EIA and SEA legislation is an important mechanism to promote the protection of OSPAR listed threatened and / or declining species and habitats. The fact that the OSPAR List (Agreement

2008-06 and Recommendation 2010/05) is non-binding can mean that effective implementation is dependent on overlaps with national practice.

Current reporting on the application of Recommendation 2010/05 focuses on the extent to which species and habitats in the OSPAR List are expressly included within the scope of EIAs / SEAs; it is not possible to determine whether those assessments have resulted in effective mitigation measures or otherwise resulted in the reduction of impacts, but this could be a useful area for further good-practice sharing.

Under NEAES 2030, OSPAR will establish a mechanism by 2024 to provide that, where Contracting Parties are authorising human activities under their jurisdiction or control that may conflict with the conservation objectives of OSPAR MPAs in the ABNJ, these activities are subjected to an Environmental Impact Assessment (EIA) or Strategic Environmental Assessment (SEA) (S5.O3).

The OSPAR network of Marine Protected Areas

Within OSPAR, MPAs are understood to be areas in which protective, conservation, restorative or precautionary measures have been instituted for the purpose of protecting and conserving species, habitats, ecosystems or ecological processes of the marine environment (as defined in Recommendation 2003/3 implementing Annex V of the OSPAR Convention). In 2003, OSPAR adopted a Recommendation to establish an ecologically coherent and well managed network of MPAs; this was then amended in 2010. By 1 October 2021, the OSPAR network comprised 583 MPAs, of which eight have been collectively designated in ABNJs. The network of MPAs has a total surface area of 1 468 053 km^2, covering 10,8% of the OSPAR Maritime Area and achieving the spatial coverage component of Aichi Biodiversity target 11 of the United Nations Convention on Biological Diversity (CBD) and of Sustainable Development Goal 14, target 14.5, to conserve at least 10% of coastal and marine areas by 2020. See: Report and assessment of the status of the OSPAR network of Marine Protected Areas in 2021.

MPAs as a response for the conservation of marine birds

MPAs play an important role as part of a wider suite of management measures in protecting and conserving marine bird species which have geographically distinct life history characteristics, such as areas important for breeding, loafing and feeding. MPAs offer the potential to reduce or remove pressures from human activities in these critical locations that could impair the conservation status of marine birds, for example activities that may cause disturbance, reduce prey abundance or result in incidental by-catch. As marine birds have life histories that depend both on land and sea areas, there is a need to ensure management consistency between coastal and fully marine protected areas to ensure success in protecting the life history characteristics of concern.

For the nine bird species that are listed as threatened and/or declining by OSPAR, there is a national action to consider whether any sites within its jurisdiction justify selection as Marine Protected Areas for the protection of populations of and critical habitats for the species. The 2019 implementation reporting against these Recommendations mentioned three types of protected area as having been designated by Contracting Parties to protect marine birds: 1. Coastal (to protect breeding colonies); 2. Coastal with a marine component (to protect waters adjacent to a protected colony); 3. Marine – (to protect inshore or offshore feeding areas.

From the reporting it was not possible to obtain a clear picture of the purpose of the MPA's role in the life history and its consequences for seabird conservation, in part as a result of inconsistent reporting. Some

Contracting Parties reported on only wholly marine sites while others reported all sites including coastal and marine.

The MPAs designated in areas beyond national jurisdiction (ABNJs) play an important role in protecting the marine birds of the North-East Atlantic by protecting their feeding and foraging grounds. The evidence supporting those designations identifies marine birds as a feature of ecological significance in the nomination proformas:

- Charlie Gibbs South – Seabirds identified as a feature both sitting and flying – considered to be important for the great shearwater (*Puffinus gravis*);
- Charlie Gibbs North;
- Milne seamount (Cory's shearwater identified as of potential concern);
- Antialtair seamount (Cory's shearwater identified as of potential concern);
- Altair seamount (Cory's shearwater identified as of potential concern);
- MAR north of the Azores (Cory's shearwater identified as of potential concern);
- Josephine seamount (oceanic seabirds);
- North Atlantic Current and Evlanov Sea basin MPA.

Case study: North Atlantic Current and Evlanov Sea basin MPA: *The North Atlantic Current and Evlanov Sea basin MPA was designated at the 2021 Cascais Ministerial meeting under OSPAR Decision 2021/01 which came into force in April 2022. This MPA covers an area of nearly 600 000 km^2 and has been designated to protect a vitally important area for seabirds. Based on tracking data, the site was found to be an important feeding and foraging area and is used both by seabirds breeding on the coasts of the North-East Atlantic and by those migrating across the globe or nesting in other parts of the world (OSPAR, 2021).*

Ecological coherence of the OSPAR MPA network for marine birds

One of the criteria for understanding whether the network is achieving the ambition of ecological coherence is how well represented the OSPAR listed habitats are within the network, and how many MPAs these habitats occur in. This can help identify where the network may need to be further strengthened.

The one out, all out principle applies, so if there is either insufficient representativity or replication within the network for one region where the species is under threat and / or in decline, then the criteria for ecological coherence are not met.

Eight of the nine marine bird species listed by OSPAR as threatened and/or declining are considered to be adequately represented and replicated within MPAs in the OSPAR Regions where they are considered to be under threat / subject to decline. One species (*Puffinus mauretanicus)* lacks representation and replication in the Wider Atlantic Region, where it is considered to be under threat / subject to decline (**Table R.1**). It was outside of the scope of the OSPAR MPA status assessment to consider the ecological coherence of marine bird species not on the OSPAR List.

Table R.1: Overview of the ecological coherence (representation and replication) of threatened and declining marine bird species within the OSPAR MPA network (Source: Table 2.3 of the 2021 MPA status assessment)

Key: Green = There is MPA protection in OSPAR Region(s) where the species is considered to be under threat/ subject to decline; Red = the species is not protected in a region where it is considered to be under threat and subject to decline; Grey = the species is not known to occur in that region; White = the species is present in the region and protected but not considered to be under threat or in decline. The number represents the number of MPAs designated for that feature in the given Region. The number is only bolded in Regions where the feature is of particular concern. *since publication, the NACES MPA in Region V has been approved – kittiwake, thick-billed murre and Barolo shearwater have been listed as features in the MPA

OSPAR threatened and/or declining bird species	Arctic Waters Region I	Greater North Sea Region II	Celtic Seas Region III	Bay of Biscay and Iberian Coast Region IV	Wider Atlantic Region V
Lesser black-backed gull *Larus fuscus fuscus*	**4**				
Ivory gull *Pagophila eburnea*	**2**				
Steller's eider *Polysticta stelleri*	**2**				
Barolo shearwater (synonym: Macaronesian shearwater) *Puffinus baroli*					**5***
Balearic shearwater *Puffinus mauretanicus*		**2**	**3**	**21**	**0**
Black-legged kittiwake *Rissa tridactyla*	**4**	**34**	19	18	0*
Roseate tern *Sterna dougallii*		**7**	**5**	**5**	**5**
Iberian guillemot *Uria aalge* (synonyms: *Uria aalge albionis, Uria aalge ibericus*)				**17**	
Thick-billed murre (synonym: Brünnich's guillemot) *Uria lomvia*	**4**	1		1	*

Management status of the OSPAR MPA network

At the 2010 OSPAR Ministerial Meeting in Bergen, Norway, OSPAR ministers committed to ensuring that the OSPAR MPA network is well managed, namely that coherent management measures have been set up and are being implemented to achieve the conservation objectives of the protected features of OSPAR MPAs. While there is no formal agreement on what constitutes 'well managed' in terms of an MPA, four questions have been posed in order to help understand the progress made in implementation: whether the MPA management has been documented, whether measures to achieve the conservation objectives of the MPA are being implemented, whether monitoring is in place to assess if the measures are working, and finally whether the MPA is moving towards its intended conservation objectives.

OSPAR has made progress in managing the MPA network. The 2021 status assessment showed that 88% of the OSPAR MPAs have either full or partial management information in place which is publicly documented. The report showed a further 17% rise – to a level of 83% – since assessments began in 2016 in the implementation of measures considered to be required in order to achieve conservation objectives. Another area of improvement is the increase in the monitoring to detect progress towards achieving conservation objectives. The assessment showed that 75% of OSPAR MPAs have either full or partial monitoring programmes in place, albeit these are largely based on the ability to monitor sea users' compliance with the rules and regulations associated with OSPAR MPAs, as opposed to direct site condition monitoring, which is costly. Nearly half of OSPAR MPAs are thought to be moving towards achieving their conservation objectives. It is important to note that the percentage of OSPAR MPAs achieving or moving towards their conservation objectives has increased over time, from 36%, to 44% and to 49% between 2016, 2018 and 2021, respectively.

Despite improvements in understanding the management status of the MPA network, it is still difficult to determine whether the protected features of the OSPAR MPAs are moving towards their conservation objectives, owing to lack of site-specific information or long-term monitoring programmes, as noted above.

Future OSPAR work should focus on implementing the management measures considered necessary to achieve the conservation objectives of the protected features of MPAs. In parallel, there is a need for long term monitoring programmes to be established in order to evaluate the effectiveness of management measures and be able to conclude with greater confidence whether the conservation objectives of the protected features of OSPAR MPAs are being achieved. In addition, work should progress on improving methods of evaluating the degree to which the OSPAR MPA network is sufficiently well managed to support a more sophisticated assessment of whether the network is delivering a genuine conservation benefit to targeted habitats, species and ecological processes, as well as the wider marine environment.

For OSPAR MPAs in ABNJs, efforts should continue to further the Collective Arrangement (OSPAR Agreement 2014-09) and to cooperate through other mechanisms, such as Memoranda of Understanding, with the relevant competent authorities so that they can consider appropriate management actions to help deliver the conservation objectives for OSPAR MPAs in ABNJs.

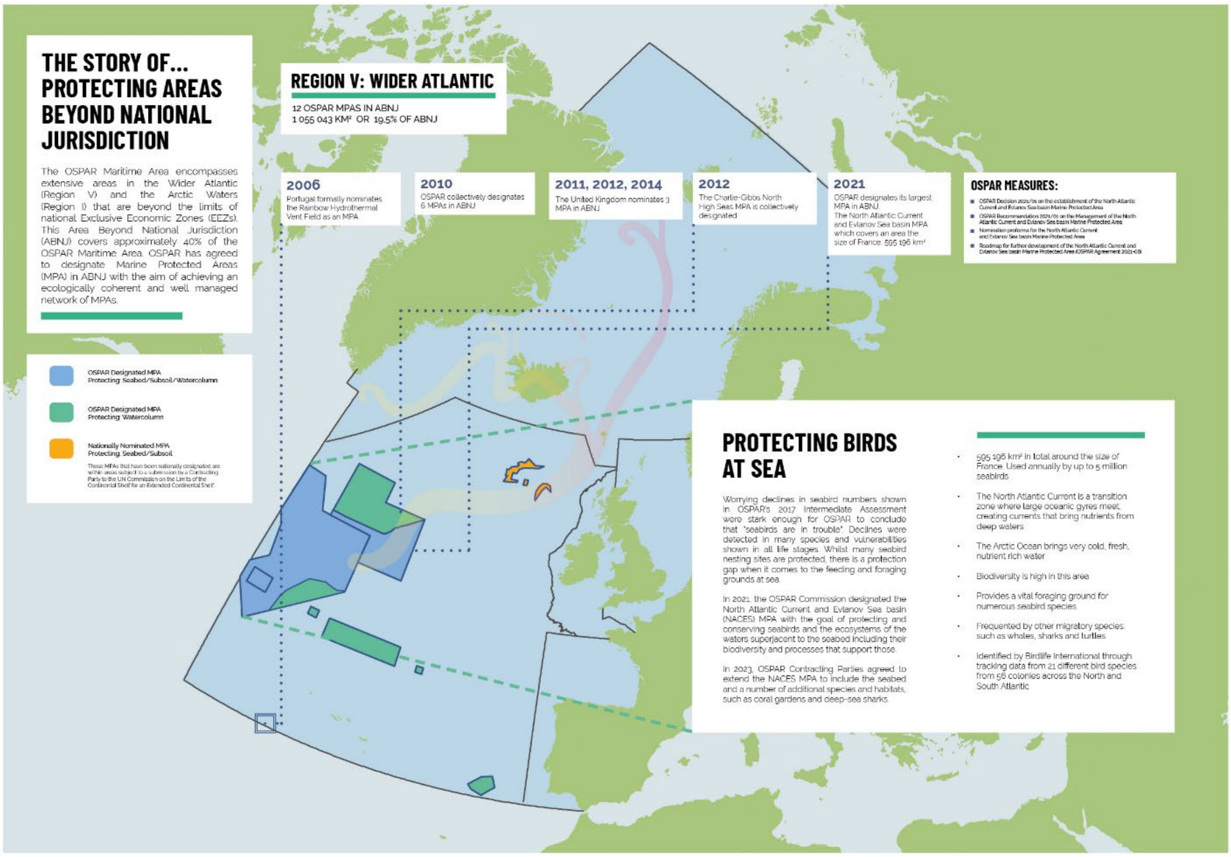
Is this measure working?:
OSPAR is progressing towards key metrics in terms of area-based protection; however, there are still gaps in geographic coverage (particularly in the Arctic Waters Region), ecological coherence and in understanding of whether or not management is effective. Of particular significance to marine birds is the need to better understand what role the MPA sites play at particular life history stages, and therefore the purpose of an MPA in relation to marine bird conservation. The reporting on protected areas could enable more consistent assessment if Contracting Parties were asked to report on the extent of the protection, such as the number of sites, the percentage of population covered by protected areas, and the nature of the protection provided to marine birds.

Within the The 2030 North-East Atlantic Environment Strategy (NEAES 2030) Contracting Parties have committed to further developing the OSPAR network of MPAs and other effective area-based conservation measures (OECMs) by 2030 to cover at least 30% of the OSPAR Maritime Area, and thus to ensure that it is representative, ecologically coherent and effectively managed to achieve its conservation objectives (Objective S5.O1). This an ambition is in line with the global target under negotiation within the Convention on Biological Diversity.

The mandate of OSPAR is restricted when it comes to the management of certain human activities, and effective implementation relies on action by Contracting Parties for areas within national jurisdiction, and by other competent organisations for areas beyond national jurisdiction. However, the common ambition of a regionally coherent network is important and brings useful attention to the protection of threatened and /or declining habitats. Under NEAES 2030, OSPAR has committed to establish a mechanism by 2024 whereby Contracting Parties authorising human activities under their jurisdiction or control that may conflict with the conservation objectives of the OSPAR MPAs in ABNJs will be required to subject those activities to an EIA or SEA.

The requirement for regular reporting provides a valuable mechanism for tracking progress and accountability. There is, however, a need to continue improving the availability of data relating to the OSPAR MPA network so as to inform those responsible for the management of different human activities in the marine environment. This includes information on the features that are protected and the management plans that are in place, and a necessary development in order to deliver on NEAES S11.O2: “By 2023, and every six years thereafter, OSPAR will assess at a regional scale the OSPAR network of marine protected areas in respect of the resilience of marine biodiversity to climate change, with the aim of ensuring that the network provides a good representation of species and habitats and that its spatial design and management regime remains relevant”.

Understanding the management effectiveness of the MPAs within the network, and of the network itself, remains an important gap to address. By 2022, OSPAR will identify barriers to the effective management of MPAs, and by 2024 take steps to address them appropriately to enable all OSPAR MPAs to achieve their conservation objectives (NEAES S5.O2).



Other OSPAR measures responding to relevant human activities and pressures

Fish and shellfish harvesting (professional, recreational) and Hunting and collecting for other purposes [Extraction of living resources]:

Article 4 of Annex V of the OSPAR Convention states that no programme or measure concerning a question relating to the management of fisheries shall be adopted under that Annex. Where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the competent authority or international body. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them. Where there are “questions relating to the management of fisheries” at the national level, they will be considered within the context of the Contracting Parties' different legislation and management regimes (OSPAR Agreement 2013-13).

The 'Collective Arrangement between competent international organisations on cooperation and coordination regarding selected areas in areas beyond national jurisdiction in the North-East Atlantic' (Collective Arrangement, OSPAR Agreement 2014-09) is a formal agreement between legally competent authorities with responsibility for managing human activities in the Areas Beyond National Jurisdiction (ABNJ) in the North-East Atlantic. It has successfully provided a framework for productive dialogue not only between OSPAR and the NEAFC, but also for other relevant competent organisations. In 2017, a joint commitment was submitted under target 4.c of SDG 14 in which both secretariats committed to further promoting the Collective Arrangement and to widening its collaborative scope with the secretariats of other intergovernmental organisations and bodies in other regions and sectors. Under the NEAES, OSPAR will work with relevant competent authorities and other stakeholders to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles and fish so that it does not represent a threat to the protection and conservation of these species, and will work towards strengthening the evidence base concerning incidental by-catch by 2025 (S7.O6).

Please refer to Important measures taken by other competent bodies for more information about measures implemented by other competent organisations relevant to OSPAR's work, and OSPAR Feeder Report 2021 - Fisheries.

Renewable energy generation (wind, wave and tidal power), including infrastructure, Nuclear energy generation, Transmission of electricity and communications (cables) [Production of energy]:
OSPAR Feeder Report 2021 – Offshore Renewable Energy Generation:
Commitments to increase renewable energy production are leading to the rapid and, in some areas, extensive development of marine renewable infrastructure. There are several measures of relevance to the conservation and protection of birds, including those relating to EIA (see section 2.2) and the EU Directive 2014/89/EU establishing a framework for maritime spatial planning, as well as guidance on taking nature conservation into account in renewable developments.

OSPAR produced guidance on the environmental considerations for offshore wind farm development in 2008 (OSPAR Agreement 2008-03), intended to help approval authorities identify issues that may be associated with the environmental impacts of development at all stages: construction, operation and decommissioning. In the case of birds, the guidance discusses mitigation measures such as the design of infrastructure to reduce collision risk, scheduling of activities to avoid disturbance during sensitive periods, temporary shutdown of turbines, such as during migration periods, and the use of acoustic or visible deterrents.

The guidance refers to other measures relevant for managing impacts from the development of renewable energy infrastructure, including the EU Habitats Directive (92/43/EEC) and Environmental Impact Assessment Directive (2014/52/EU). A 2020 survey of OSPAR Contracting Parties showed that the offshore wind guidance was generally fully implemented or that implementation was in progress, although not all Contracting Parties provided information for the survey. OSPAR also maintains a database of individual marine renewable developments, including tidal, wave and offshore wind.

For the OSPAR Contracting Parties that are also EU Member States, the European Commission's offshore renewable energy strategy (2020/741) refers to the Birds and Habitats Directives to ensure that developments do not have negative impacts on listed species or habitats and that any potential impacts are reduced or minimised. The EU has developed guidance under Commission notice (2020) 7730 and in the form of the Wildlife Sensitivity Mapping Manual, which provides practical guidance for renewable energy planning within the European Union. As an example of a national level response, the United Kingdom has developed wildlife sensitivity maps and the Seabird Mapping and Sensitivity Tool (SeaMaST), which provides evidence of the use of sea areas by seabirds and inshore waterbirds in English territorial waters, mapping their relative sensitivity to offshore wind farm developments.

By 2023, OSPAR will develop common principles, and by 2024 develop guidance, to promote and facilitate sustainable development and scaling up of offshore renewable energy in a way that cumulative environmental impacts are minimised (S12.O4).

Extraction of minerals [Extraction of non-living resources]:
OSPAR Feeder Report 2021 – Extraction of non-living Resources
Aggregate extraction has the potential to interfere with marine bird feeding areas. OSPAR Agreement 2003-15 on sand and gravel extraction requires Contracting Parties which are coastal states of the Maritime Area to take the ICES Guidelines for the Management of Marine Sediment Extraction into account within their procedures for licensing the extraction of marine sediments (including sand and gravel). The agreement encourages an ecosystem-based approach to the management of human activities, with general plans for the extraction of sediments being made subject to strategic environmental assessment and controls being placed on the extraction of sediments from any ecologically sensitive site. Mitigation measures could include seasonal closures for specific areas; rotation of dredging intensity to allow recolonization and recovery of benthic habitats; and exploratory restoration techniques. The ICES Guidelines are subject to a forthcoming review.

Extraction of oil and gas including infrastructure [Extraction of non-living resources]:
Oil production activities can affect marine bird habitats and cause physical loss or degradation of habitat, increased turbidity, chemical contamination or visual disturbance from light, as well as the impacts of any oil spill through ingestion or plumage contamination. While this activity is in decline, there are still more than 1 350 operational installations, with an increasing number reaching their end of life in the next two decades. OSPAR is the key international organisation addressing environmental aspects of offshore oil and gas activities in the North-East Atlantic. OSPAR has adopted a wide range of programmes and measures to reduce pollution from all phases of offshore activities. These include the reduction of oil in produced water, substantial restrictions on the use and discharge of organic-phase drilling fluids and the banning of dumping or leaving in place disused offshore installations, subject to derogation in certain specified cases. Nearly all offshore operators have followed OSPAR's promotion of environmental management systems for offshore installations to support the objectives of the Offshore Oil and Gas Industry Strategy 2010-2020 and have adopted comparable schemes. Measures under the 2010-2020 Strategy have shown a high level of implementation and an assessment of the discharges and spills shows that the OSPAR measures have led to decreases in discharges of both hydrocarbons and the most harmful offshore chemicals, see: Offshore Industry Thematic Assessment.

Physical restructuring of rivers, coastline, or seabed (water managment):
The dredging and the dumping of waste and other matter has been well regulated since the Oslo Convention came into force in 1974. OSPAR has adopted the Guidelines for the management of dredged material at sea (OSPAR Agreement 2014-06), designed to assist Contracting Parties in managing dredged material in ways

that will prevent and eliminate pollution in accordance with Annex II to the 1992 OSPAR Convention and protect marine species and habitats in the OSPAR Maritime Area in accordance with Annex V. These provisions set out a Best Environmental Practice approach for minimising both the amount of material dredged and the impacts of dredging and disposal. The guidelines include specific information on appropriate placement of dredged material in relation to the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR Agreement 2008-06). National authorities use these guidelines to manage dredging and dumping and to minimize effects on the marine environment. They serve as a tool that Contracting Parties which are also EU Member States can use for the management of dredged material that is subject to current European Directives (such as, Water Framework Directive 2000/60/EC, Marine Strategy Framework Directive 2008/56/EC, Natura 2000 areas under the Birds and Habitat Directives 2009/147/EC and 92/43/EEC). Directive 2008/98/EC of the Parliament and of the Council of 19 November 2008 on waste, (the Waste Framework Directive) has also been identified by Contracting Parties as having implications for the management of dredged material, in addition to relevant national legislation.

Since 2000, assessment and licensing procedures for dredged materials in most OSPAR countries have included action levels for contaminant loads based on the OSPAR guidelines. Since 1998, OSPAR has also had guidelines in place on the dumping of fish wastes. The management of dredged material should respect natural processes of sediment balance. Selecting the appropriate location for a dumpsite is essential in order to minimize environmental impact. Several dumpsites have been relocated by applying the OSPAR guidelines: a planned site in the Weser estuary was relocated after a site survey detected a mussel bank. Dumpsites have also been relocated or closed to avoid impacts on MPAs, fisheries and shipping. The ban on dumping vessels or aircraft has been implemented successfully.

A report on the use of OSPAR guidelines was presented to the EIHA in 2020. Returns from Contracting Parties have reported that the 2014 dredging guidelines are being fully implemented in the greater part of the OSPAR Maritime Area (§6.46 Shipping and Ports Feeder Report). Under NEAES 2030, 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 by 2023 (S7.O4).

Marine litter

Marine litter causes harm to marine birds through entanglement or ingestion. OSPAR has been at the forefront of international efforts to tackle the marine litter problem since the adoption of its first Regional Action Plan on Marine Litter (RAP ML) (2014-2021). A Second Regional Action Plan on Marine Litter (RAP ML 2) was adopted in 2022 and will continue the work to prevent and significantly reduce marine litter in the North-East Atlantic. The RAP ML 2 includes actions that address various sources of marine litter. The action areas include preventing fishing-related litter like abandoned, lost and discarded fishing gear from ending up in the marine environment, continuing the Fishing for Litter initiative (Recommendation 2016/01), a scheme encouraging fishers to remove marine litter from the sea and seabed, preventing and reducing microplastics including pre-production pellets (Recommendation 2021/06), and building an evidence base for understanding ecological harm. Besides the RAP ML, other measures have been taken, especially within the EU and the IMO.

The Marine Litter Thematic Assessment reports positive signs of a decrease in the quantities of litter found on OSPAR beaches and of floating litter in the North Sea over the last 10 years. Given the upward trend in plastic production and consumption in Europe over a similar period, this suggests that progress has been made on preventing plastics from entering the marine environment. The successful implementation of the new Regional Action Plan will be key to building on and maintaining the momentum for achieving OSPAR's objective to prevent inputs of and significantly reduce marine litter.

Other relevant activities

Tourism (including leisure infrastructure) has been identified as an activity affecting marine birds, but no measures have been taken to address these. However, infrastructure development activities for tourism, as well as for transport infrastructure, land claim, coastal defence or construction of offshore infrastructure, will be subject to EIA (see section 2.2). Military operations may also affect marine birds, but these are not usually covered by environmental legislation.

Important measures taken by other competent bodies

This section highlights measures taken by other competent bodies that complement OSPAR's response for improving the state of marine birds within the North-East Atlantic.

General conservation measures

A number of general measures at the regional level are important for addressing the state of marine birds of the North-East Atlantic in the coastal zone and beyond.

The EU Birds Directive (2009/147/EC) and Habitats Directive (92/43/EEC) are the cornerstones of the EU's biodiversity policy and establish the Natura 2000 network as a key response to protect bird habitats used for breeding and feeding. Marine birds are also considered within Descriptor 1 of the Marine Strategy Framework Directive 2008/56/EC, which notes coherence and connects to action under the Birds and Habitats Directives (including the Natura2000 network). Under Article 13 of the MSFD, EU Member States are required to take measures to achieve or maintain good environmental status by 2020. Status assessments under Article 8 and environmental targets under Article 10 help to identify where measures are needed. A more detailed analysis of the reported programmes of measures put in place by EU Member States was undertaken by the EU funded NEA PANACEA project as a contribution to this assessment (See: Programmes of measures relating to marine birds under the MSFD). The Maritime Spatial Planning Directive has also been identified by some EU Member States as relevant in helping to designate areas for fishing while reducing impacts on birds.

A number of regional and species-specific action plans have been implemented under the European Union, the Arctic Council Conservation of Arctic Flora and Fauna and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) as well as those under the Nordic Council and national level action plans. Examples include:

- International Species Action Plan for the Balearic shearwater, *Puffinus mauretanicus*. (Arcos, 2011);
- International (East Atlantic) Species Action Plan for the Conservation of the Roseate Tern *Sterna dougallii* (2021-2030);
- Arctic Council Conservation of Arctic Flora and Fauna (CAFF) 'International Ivory Gull Conservation Strategy and Action Plan';
- Arctic Council Conservation of Arctic Flora and Fauna (CAFF) 'International Black-legged Kittiwake Conservation Strategy and Action Plan';

- The Nordic Action Plan for Seabirds,
- AEWA: Resolution 7.6 Priorities for the conservation of seabirds in the African-Eurasian Flyways, International Single Species Action Plans e.g. for long-tailed duck, velvet scoter and common eider.

Programmes of measures relating to marine birds under the MSFD

The approach: The very long lists of measures are difficult to compare with efforts to protect marine birds. This is more easily done by using the assessments in the Programmes of Measures (PoM) of each Member State under Article 16 of the MSFD. Therefore, measures have been extracted from the Article 16 Technical Assessment of the MSFD 2015 reporting on Programme of Measures of 2017, in which the EU Commission reviewed the Programmes of Measures (PoM) of all individual Member States (including the UK). These PoM addressing birds are very diverse, and mostly formulated in very general terms, at least judging from their titles. From the Article 16 assessments it was possible to extract the Key Type Measures (KTM) for bird-related measures. Note that more than one KTM could be assigned to an individual measure. The KTMs partly overlap with those used in the Water Framework Directive (WFD01-WFD25) but are supplemented by MSFD-specific KTMs (MSFD26-MSFD39) (European Commission 2018).

Measures were considered if they related to waters in the OSPAR Region (i.e. excluding the Mediterranean and the Baltic for the Member States ES, FR, DE, DK, SE) or were listed as directed at birds (i.e. excluding horizontal measures; however, this was treated very differently among the Member States). In the next step, the KTM entries for the Member States were summarised according to OSPAR Region. Some Member States covered more than one maritime region. While measures identified from codes referring to the Baltic Sea (SE, DK, DE) and the Mediterranean Sea (FR, ES) could be excluded easily, it was not possible to see to which OSPAR Region the measures referring to the North-East Atlantic belonged. It was therefore assumed that any measure taken by a Member State would be valid for all marine areas touched by that Member State. For the OSPAR Regions this means:

- Region I (Arctic Waters): no reported measures as there are no EU Member States in this OSPAR Region.
- Region II (Greater North Sea): measures from UK, SE, DK, DE, NL, BE, FR, but no information from NO (not a Member State).
- Region III (Celtic Seas): measures from UK, IE, FR.
- Region IV (Bay of Biscay and Iberian Coast): measures from FR and ES, but not from Portugal (the four bird-related measures were not assigned to KTM).
- Region V (Wider Atlantic): not included here, because only Portugal is relevant and the four bird-related measures were not assigned to KTM.

Therefore, the KTMs of some Member States are included in the analysis for more than one OSPAR Region. **Table R.2** highlights the five most frequent KTM entries for each Region. There is much consistency in this across the Regions, because four KTMs are among the top five in every Region. These are MSFD37 (Restore and conserve marine ecosystems), MSFD38 (Spatial protection), MSFD35 (Extraction of species) and MSFD27 (Physical damage).

Table R.2: The top five KTMs per OSPAR Region (no. of entries)

Region II		Region III		Region IV	
MSFD37 Restore and conserve marine ecosystems	24	MSFD36 Other biological disturbance	29	MSFD37 Restore and conserve marine ecosystems	29
MSFD38 Spatial protection	18	MSFD37 Restore and conserve marine ecosystems	24	MSFD38 Spatial protection	25
MSFD27 Physical damage	15	MSFD38 Spatial protection	24	MSFD35 Extraction of species	13
MSFD35 Extraction of species	12	MSFD35 Extraction of species	20	WFD14 Research and knowledge	5
MSFD36 Other biological disturbance	9	MSFD27 Physical damage	18	MSFD27 Physical damage	4

In order to explore the main pressures and activities against which the four KTMs among the top five KTMs in all Regions are directed, the entries for pressure (OSPAR terminology) and activity for the KTMs MSFD37, MSFD38, MSFD35 and MSFD27 were aggregated (**Table R.3** and **Table R.4**). It is important to know that the respective compilations in **Table R.3** and **Table R.4** are strongly biased, because for many bird-related measures no pressures or activities were reported (or "various", which includes unknown pressures and activities).

Table R.3: Pressure entries summed up for each of the four most frequently entered KTMs (bird-related measures across the OSPAR Regions II, III and IV)

KTM	Removal of non-target species	Penetration/disturbance of substrate	Litter	Introduction/spread of NIS	Introduction of light	Visual disturbance	Physical loss
MSFD37 Restore and conserve marine ecosystems	7	7	1	4	2	2	1
MSFD38 Spatial protection	7	4	5	2	1	1	
MSFD35 Extraction of species	27	8	3	1			
MSFD27 Physical damage	7	10	3	1			

Table R.4: Activity entries summed up for each of the four most frequently entered KTMs (bird-related measures across the OSPAR Regions II, III and IV)

KTM	Fisheries	Shipping	Extraction of non-living resources	Hunting	Renewable energies	Recreation	Land reclamation	Maintenance of cable/pipelines	Research	Civil aviation	Aquaculture
MSFD37 Restore and conserve marine ecosystems	12	3	3	1	2	3	2	2	1	1	
MSFD38 Spatial protection	12	3			1						
MSFD35 Extraction of species	23			4							
MSFD27 Physical damage	7	1	3	1	1	1	2	1	1		1

The majority of measures for marine birds target impairment from fisheries and the related pressures Removal of non-target species (i.e. incidental by-catch) and Penetration of the substrate (which mostly refers to bottom-trawling). This holds for the KTMs addressing the restoration and conservation of ecosystems (MSFD37), spatial protection (MSFD38), extraction of species (MSFD35) and physical damage (MSFD27). Other pressures and activities are much less well represented.

Fish and shellfish harvesting (professional, recreational) and Hunting and collecting for other purposes [Extraction of living resources]:

OSPAR Feeder Report 2021 - Fisheries:

OSPAR does not itself have the competence to address questions relating to the management of fisheries. However, given that fisheries are an important human activity affecting the state of marine birds, OSPAR maintains a watching brief on responses taken to address fisheries management by the relevant competent organizations.

There is a global framework for fisheries management which establishes common principles, including conservation measures, for vulnerable species. These include United Nations General Assembly Resolution 64/72 on Sustainable fisheries and the UN Food and Agriculture Organization (FAO) International Guidelines for the management of deep-sea fisheries in the high seas. Within the North-East Atlantic, the key responses are the national fisheries management legislation for those Contracting Parties that are not EU Member States and the Common Fisheries Policy (CFP) for those Contracting Parties that are also EU Member States. EU Regulation 2019/1241 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures was adopted to support the implementation of the EU CFP. It addresses the reduction of ecosystem impacts through approaches including closed areas and measures regulating certain fishing gear. There are also Regional Fisheries Management Organisations (RFMOs) such as the North East Atlantic Fisheries Commission (NEAFC), which regulates certain fisheries outside national jurisdiction, and the International Commission for the Conservation of Atlantic Tunas (ICCAT).

Fishing activities differ between regions, being particularly intense in the Greater North Sea and Celtic Seas, and can interact with seabirds through incidental by-catch by creating litter (including ghost gear) and by impacting the food web through prey depletion or creating feeding hotspots. Even at maximum sustainable yield (MSY) levels, fishing will have impacts on the ecosystem and its food webs, with substantial effects on marine bird productivity observed when prey stock falls below one third of its historic maximum (Cury *et al*., 2011). Changes in fisheries regulation can affect ecosystems. For example, the potential impacts of a discard ban on populations of seabirds include changes in the food supply of scavenger species as well as reduced incidental by-catch if birds are less attracted to fishing gear (e.g. Bicknell *et al.*, 2013; Clark *et al.*, 2020).

Incidental by-catch is an important threat to marine birds and, as noted in the section "*Programmes of measures relating to marine birds under the MSFD*", is an area where progress has been made in the policy response. Those Contracting Parties that are EU Member States have stated, in their MSFD article 13 reporting, that they are applying the rules of the Common Fisheries Policy as set out in the technical measures (EU Regulation 2019/1241) which address incidental by-catch. This involves for example, restricting the use of certain fishing gear so as to reduce the chance of birds being caught, or promoting sustainable fishing tools and techniques. In addition, the 2012 European Union Action Plan for reducing incidental catches of seabirds in fishing gears (COM (2012) 665) describes recommended measures for addressing the incidental by-catch associated with various types of fishing. An international plan of action for reducing the incidental catch of seabirds in longline fisheries has been developed under the FAO, in line with that organisation's Code of Conduct for Responsible Fisheries. The NEAFC has also taken measures to regulate non-selective gear types, such as gillnets, entangling nets and trammel nets, in their regulatory area.

Some improvements in addressing incidental by-catch have occurred, for example in the North Sea, where there has been some evidence of large by-catches of seabirds in coastal gillnets in the past. Fisheries with high incidental by-catch have either been closed or their by-catch risk reduced (ICES, 2019). Nevertheless, in view of the problems that remain, international bodies have highlighted the need for more to be done. For example, to improve data availability, the ICES has advised that better monitoring of incidental by-catch is needed, including for smaller vessels.

Entanglement of marine birds in abandoned, lost and discarded fishing gear (ALDFG) is a persistent issue in the North-East Atlantic. The measures implemented to address it include the NEAFC Scheme of Enforcement, Arts 7, 7a and 7b on Net marking, removal or disposal of unmarked or illegal gear, and Garbage at sea and Retrieval of lost gear; and the FAO Voluntary Guidelines on the Marking of Fishing Gear. This also links to the efforts underway in OSPAR with regard to the Regional Action Plan for Marine Litter.

Fisheries and related management measures such as discard bans directly impact food webs and ecosystem dynamics, resulting in trophic cascades that can impact the availability of prey for marine birds. Fisheries management measures tend to focus on sustainable management of fish stocks and not on ecosystem functions such as predator-prey capacities. This situation calls for more ecosystem-based management protocols.

Transport – shipping:
OSPAR Feeder Report 2021 - Fisheries:
Transport directly interacts with marine bird habitats through physical disturbance from moving vessels, underwater noise, light, contaminants and non-indigenous species.

Petroleum waxes and vegetable oils can be discharged legally (under certain conditions regulated by Annex II of the MARPOL Convention) as a result of cargo-tank washing, as well as through accidental releases. These can have detrimental impacts on birds and marine species; around 3% of all beach litter retrieved in 2016 in the EU was paraffin waxes (Addamo *et al.*, 2017). An amendment to MARPOL adopted in 2019 strengthens the discharge requirements for cargo residues and tank washings containing persistent floating products with high-viscosity and / or a high melting point that can solidify (such as certain vegetable oils and paraffin-like cargoes). This applies in specified areas including North West European waters, Western European Waters and the Norwegian Sea and Baltic Sea area, and entered into force on 1 January 2021.

In order to support the implementation of EU Directive 2005/35/EC (since amended by Directive 2009/123/EC) on ship-source pollution, the European Maritime Safety Agency (EMSA) has developed CleanSeaNet - a European satellite-based oil spill and vessel detection service. EMSA also has a network of stand-by oil response vessels as well as mechanisms to provide rapid advice to support coastal states responding to incidents involving chemicals or hazardous and noxious substances that could affect marine birds. EMSA's report on the first decade of CleanSeaNet concluded that there had been significant progress by coastal states in addressing illegal discharges of oil and other substances through measures such as monitoring, inspection, enforcement, and pollution response plans (EMSA, 2017). EMSA also suggests that the CleanSeaNet satellite-based oil monitoring service has had a clear deterrent effect. Although the number of CleanSeaNet detections in the Bonn Agreement area actually rose between 2017 and 2018, this is potentially due to better resolution of images as well as increased volume of services (Bonn Agreement, 2019a). According to the Bonn Agreement BE-AWARE Trend Analysis in 2019, the risk-reducing measures introduced over the previous decade and the recent levels of emergency intervention capacities had a positive effect either with respect to navigational safety or in mitigating the extent of oil spills, more or less stabilising the risk situation despite growing ship sizes and ship passage numbers (Bonn Agreement, 2019b).

The designation of Particularly Sensitive Sea Areas (PSSAs) under the IMO is a response addressing the potential environmental threat from shipping in ecologically sensitive areas. According to the guidance on the designation of PSSAs (Resolution A.982(24)), these hazards are identified as relating to operational discharges and accidental or intentional pollution, including noise. The Wadden Sea (2002) and Western European Waters (the Western coasts of the United Kingdom Ireland, Belgium, France, Spain and Portugal, 2004) have been designated as PSSAs by the IMO in light of the risks posed by the carriage of goods. Area-specific routeing and reporting schemes are in place to reduce the risks to these PSSAs. The re-siting shipping lanes further out from the coast to reduce the risk of harm from factors such as oil spillage has also been done in Icelandic waters (ICES, 2019b).

Marine aquaculture, Freshwater aquaculture, Agriculture and Forestry [Cultivation of living resources]:
OSPAR Feeder Report 2021 – Aquaculture:

There is potential for impacts by shellfish aquaculture on sensitive species of birds or mammals, for example through alterations in ecosystem functioning, disturbance, exclusion, or entanglement (ICES, 2020). Site-specific decisions on the location and management of aquaculture, via assessment of projects under individual countries' regulatory systems, are the primary measure for addressing the environmental impacts of aquaculture. Understanding of how to manage impacts has grown over the past decade, although some knowledge gaps remain. Some general measures can be applied to address certain impacts, including disturbance under the EU Birds Directive, EIA and licensing legislation and water quality under the EU Water Framework Directive.

Disturbance of marine birds

The disturbance of marine birds by artificial light is an issue of concern that was highlighted on the international agenda as the theme for World Migration Day in 2022. Light pollution, including at sea and along the coastline, can affect marine bird behaviour, causing disorientation and collision. In 2020 the Parties to the Convention on Migratory Species adopted guidelines on light pollution (UNEP/CMS/Resolution 13.5), including for marine birds. The guidelines call for projects that could result in light pollution to be made subject to EIA. There are also examples of national light pollution guidelines, such as the Australian National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, adopted in 2020.

Regional differences

There is a wide range of responses relevant to the protection and conservation of marine birds across the North-East Atlantic, particularly in the busy coastal regions of the Greater North Sea, Celtic Sea and Bay of Biscay and Iberian Peninsula.

In the deep seas and areas outside national jurisdiction, the main response from OSPAR has been the designation of MPAs to protect areas important to seabirds. However, the competence to manage the main human activities of concern that may take place in those areas lies with other competent organisations, and efforts such as the Collective Arrangement will need to be strengthened in order to ensure coordination and coherence in achieving conservation and management objectives.

Gaps and opportunities

Are we doing enough?

Given the continuing not good status for most marine bird species assessed, it is argued that the measures as they are currently being implemented are not succeeding in managing the key pressures and human activities. Good progress has been made in developing the ecological coherence of the OSPAR network of MPAs for protecting OSPAR listed bird species.

It is not particularly easy to see how the range of responses identified could or should fit together, where there may be gaps and how these could be filled. For those OSPAR Regions within the EU, actions to implement OSPAR measures at the national level are also often being reported to fulfil other obligations, and vice versa (e.g. as collective actions under the MSFD), adding another layer of complexity to trying to understand the added value of particular responses. The region- and species-specific action plans can help to provide an overview of the regulatory landscape and highlight the value in developing an OSPAR-scale action plan that can build on and strengthen existing responses.

Are there other types of responses that could be undertaken by OSPAR to improve the status of marine birds?

Addressing the decline in marine birds has been identified as a priority for OSPAR in the NEAES 2030.

In the context of protecting and conserving biodiversity, "by 2025 at the latest OSPAR will take appropriate actions to prevent or reduce pressures to enable the recovery of marine species and benthic and pelagic habitats in order to reach and maintain good environmental status as reflected in relevant OSPAR status assessments, with action by 2023 to halt the decline of marine birds" (S5.O4). The plan will build on this current assessment in order to recommend action for reducing and eliminating, where possible, the main pressures and activities impacting marine birds, including pressures from Highly Pathogenic Avian Influenza, which have increased in prevalence very recently. The recommended actions will consolidate those already in operation under the OSPAR Recommendations on the nine threatened and declining bird species, and through the existing species action plans under the EU, CAFF and AEWA and national strategies. This important area of work will be implemented via the joint OSPAR / HELCOM / ICES working group on marine birds and will help to build a coherent response.

As part of its efforts to ensure sustainable use of the marine environment, OSPAR has committed to continuing its work with relevant competent authorities and other stakeholders to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles and fish so that it does not represent a threat to the protection and conservation of these species, and will also work towards strengthening the evidence base concerning incidental by-catch by 2025 (S7.O6). This will increase the focus on the effects of incidental by-catch, including for marine birds; OSPAR should take into consideration relevant by-catch studies (in the framework of OSPAR, European Commission, ICES, ACCOBAMS, ASCOBANS) and their future conclusions.

There are other areas where marine birds could benefit from OSPAR's work, including that on the restoration of benthic habitats, particularly for benthic feeding and grazing birds, see: Benthic Habitats Thematic Assessment - Response - Gaps and Opportunities.

Climate change has pervasive and fundamental implications for marine bird communities, including changes in the suitability of breeding locations, breeding success and prey availability, with major implications for management. While the focus for responses to climate change lies outside of OSPAR's remit, mitigation underlies all other responses, and without such action adaptation is likely to be ineffective, see: Climate Change.

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Cumulative Effects

Cumulative effects assessment for marine birds

It should be noted that the Sankey plots and associated narratives in this Thematic Assessment are an illustrative representation of a complex set of interactions between DAPSIR components at the coarse North-East Atlantic scale and should be considered and interpreted alongside the supporting full Thematic Assessment narrative. The Sankey plots should therefore be applied with caution and not considered or used as the sole basis for management decisions.

A range of human activities contribute pressures with the cumulative potential to affect the state of marine birds and associated ecosystem services. The predominant pressures on marine birds are prey depletion caused by prevailing environmental conditions (e.g., climate change), fishing and shellfish harvesting; mortality from fishing (incidental by-catch) and climate change (e.g., storm 'wrecks') and other activities (e.g., collisions with wind turbines); and disturbance caused by multiple activities. Other important pressures are habitat loss, physical disturbance of the seabed, non-indigenous species (NIS), input of other substances and input of litter. Following a Driver-Activity-Pressure-State-Impact-Response (DAPSIR) framework and a weighting exercise, an indicative assessment of cumulative effects has been undertaken (see: CEMP Guideline for details) as a first step to describing the potential pathways of the cumulative causes and consequences of change in the ecosystem, linking these to impacts on ecosystem services.

The Marine Birds Thematic Assessment describes the connectivity between the relevant DAPSIR components. The bow-tie analysis provides a schematic of potential pathways describing cumulative causes and consequences of change in the ecosystem, demonstrating that multiple human activities are contributing to multiple pressures which can lead to multiple impacts on the state of marine birds and the associated ecosystem services. A better understanding of this complexity in the causes and consequences of cumulative effects from human activities on ecosystem state and ecosystem services is critical in order to explicitly apply the ecosystem approach so as to target management measures appropriately.

The evidence underpinning the analyses described in this section is drawn from the Driver, Activity, Pressure, State, Impact and Response sections of this thematic assessment, and thus should be read and interpreted alongside the extended narratives provided therein. The Human activities and Pressures sections of this thematic assessment provide details of the threats that the left-hand side of the Sankey plot (**Figure CE.1**) pose to marine birds. The State section of this Thematic Assessment provides details of ecosystem state, shown in the centre of the Sankey plot (**Figure CE.1**), illustrated for marine birds. The right-hand side of **Figure CE.1** incorporates the scores for impact on ecosystem services in order to present the Activity, Pressure, State and Impact components of the marine birds 'ecosystem' in a single plot. This is consistent with the aim of NEAES operational objective S7.O3 on ecosystem services and natural capital, "to recognise, assess and consistently account for human activities and their consequences in the implementation of ecosystem-based management".

Figure CE.1 shows the complex combinations of human and pressures on state changes (left-hand side) and of state changes on ecosystem services (right-hand side). However, there is currently insufficient understanding and evidence to be able to directly track from left to right, hence the single bar in the centre. This should be a focus of study to inform future assessments.

Overall, confidence in the evidence for the weighted bow-tie analysis outputs presented in this marine bird thematic assessment is described as **medium for evidence** and **medium for degree of agreement**. Additionally, separate confidence assessments have been applied to each module.

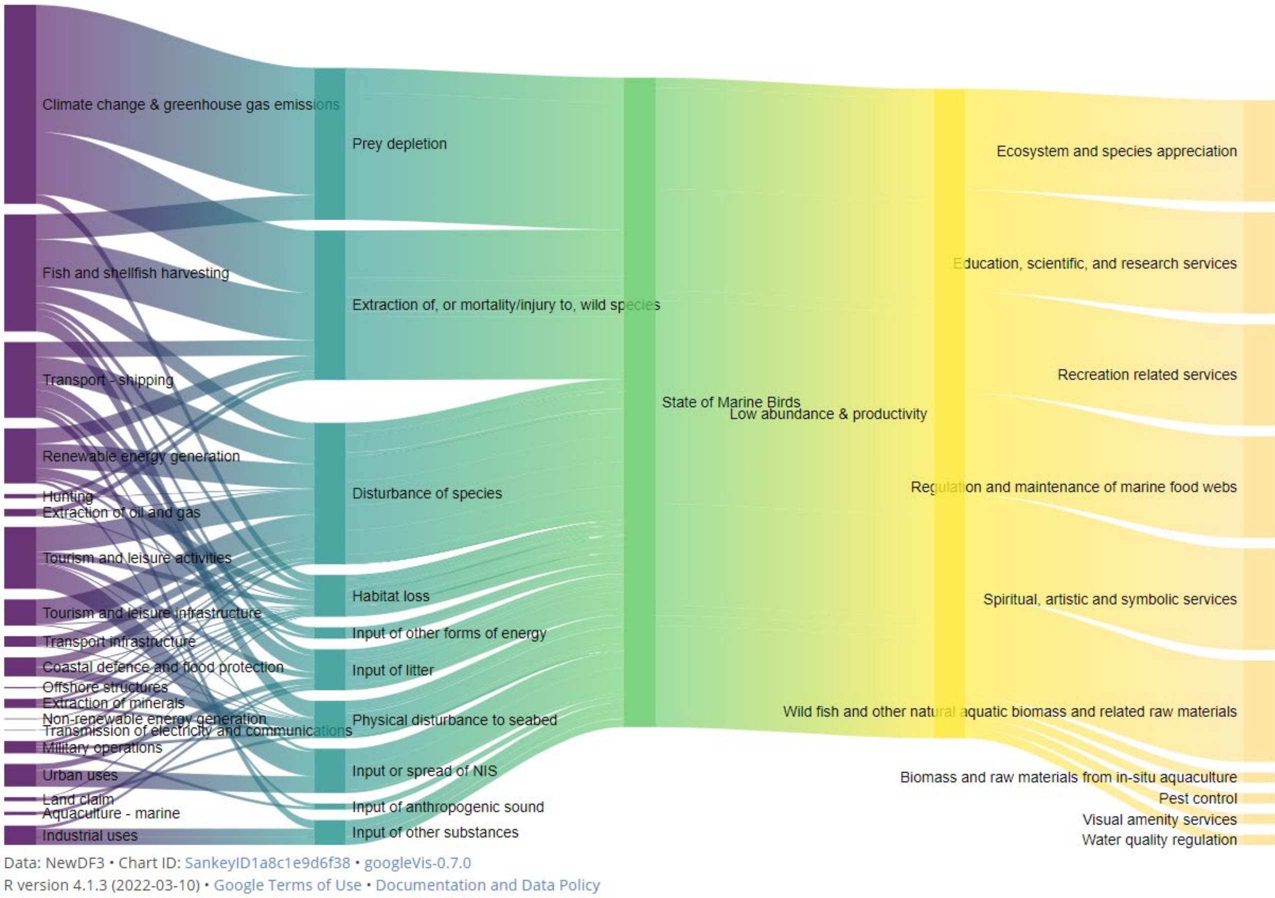

Figure CE.1: Impact potential of marine birds to exposure to pressures from human activities in the North-East Atlantic. Derived from Exposure score (Extent x Frequency of pressure) x Degree of Impact score (in terms of whether impact is Acute or Chronic). Pressures with a low Degree of Impact score have been removed for clarity. 'Impact' in this context does not consider the persistence of the pressure or the resilience of the ecosystem associated with that pressure. Were these parameters to be included, the relative contribution for some pressures would most likely increase and score higher in the relative ranking. Links are weighted to indicate relative contribution to impact. A wider link = greater potential for impact

It should be noted that the Sankey plots and associated narratives in this thematic assessment are an illustrative representation of a complex set of interactions between DAPSIR components at the coarse North-East Atlantic scale and should be considered and interpreted alongside the supporting full thematic assessment narrative. The Sankey plots should thus be applied with caution and not considered or used as the sole basis for management decisions

Figure CE.1 demonstrates the complex relationships between the collective pressures from human activities and the quality status of marine birds. This complexity suggests that while single-issue responses may be effective, in order to fully apply ecosystem-based management OSPAR needs to consider the causes and consequences of changes in ecosystem state more holistically, by

- recognising that any measures to reduce impacts whilst critical to ecosystem health could have potential consequences for our ability to maintain ecosystem services to meet society's needs, which in turn has consequences for the viability of human activities in the North-East Atlantic;
- recognising that pressures may have additive, multiplicative, synergistic or antagonistic interactions when combined, which has implications for the nature of the threats posed to marine birds and how best to manage those threats.

Methodology

A modified bow-tie analysis (Cormier *et al*., 2018, Cormier *et al*., 2019) was developed to identify and connect all the DAPSIR components, integrating these into either a pressure- (e.g., underwater sound, litter, hazardous substances, eutrophication) or a biodiversity receptor-focused analysis of the causes and consequences of change (e.g., pelagic habitats, benthic habitats, fish, marine birds, marine mammals). For the biodiversity assessments, the APS connections are weighted to determine which are the most important, using an adaptation of the ODEMM pressure assessment (Robinson et al., 2013; Knights et al., 2015) focusing on:

- **Exposure module:** spatial extent and frequency for all activity pressure combinations on state, to generate exposure weightings;
- **Impact potential module:** spatial extent, frequency of occurrence and impact potential for all activity pressure combinations on state, to generate impact potential weightings;
- **Risk module:** spatial extent, frequency of occurrence and impact potential for all activity pressure combinations on state, combined with pressure persistence and ecosystem resilience, to generate risk weightings.

The SI (ecosystem services) connections are weighted to determine which are the most important (Cornacchia, 2022).

The impact potential and ecosystem services outputs are combined and presented in Sankey diagrams (**Figure CE.1**).

The confidence in this weighted bow-tie analysis for marine birds has been assessed following the QSR 2023 Guidance Document. Confidence is based on two criteria to communicate the degree of uncertainty in the key findings: (i) level of evidence and (ii) degree of agreement.

Exposure module:

Confidence Assessment: Evidence – Medium; Consensus – Medium

Pressures from human activities have been demonstrated in the assessments for this QSR to be widely distributed in the OSPAR Maritime Area. The presence of pressures does not automatically lead to adverse impacts. However, in the first instance, consideration of the spatial and temporal extents of pressures provides a useful basis for consideration of cumulative effects within a risk-based approach (in line with North-East Atlantic Ecosystem principle and strategic approach).

The exposure module describes the amount of pressure from human activities in the North-East Atlantic. It considers the spatial extent and frequency of human activity / pressure combinations which have been identified as important for marine birds (derived from spatial extent score multiplied by the frequency score). Exposure only relates to the Pressure cell in the DAPSIR schema (Figure CE.1). Consideration of exposure in isolation provides a coarse cross-cutting assessment to provide an early identification which allows OSPAR to develop management strategies for pressures to prevent / minimise impacts.

The Thematic Assessments on Hazardous Substances, Marine Litter, Underwater Noise, Offshore Industry, Human Activities, and Climate Change describe pressures on marine birds. The Radioactive Substances Thematic Assessment identifies inputs of radionuclides from a range of human activities but has concluded that there are no significant radiological impacts from the current levels of radionuclides on biodiversity.

The highest exposure scores relate to climate change, disturbance of species; habitat loss; extraction, mortality or injury of wild species; prey depletion; input of litter; input of radionuclides; physical disturbance of the seabed; input of substances and input or spread of NIS, thus demonstrating the ubiquitous nature of these pressures in the North-East Atlantic.

Climate Change pressures have been identified as important for marine birds. Multiple activities disturb bird species by their physical presence both at sea and on land. It should be noted that the intensity of the activities, and therefore of the exposure, will vary depending on location in the OSPAR area and on species group. Habitat loss and extraction or mortality / injury of birds will show considerable variation in levels of activities and in the subsequent intensity of this pressure across the OSPAR area. Habitat loss relates to the loss of nesting sites and loss of or displacement from feeding areas. Extraction of or mortality / injury to wild species is linked to either intentional extraction in the form of hunting and culling (in specific areas) or unintentional injury and mortality through incidental by-catch and collisions (e.g. with energy infrastructure such as wind turbines). Inputs of radionuclides, litter and other substances are also notable and unsurprising, given that these pressures and the associated human activities are widespread in the North-East Atlantic.

The exposure scores support the importance that OSPAR places on these pressures under the North-East Atlantic Environment Strategy:

- Strategic Objectives 10 to raise awareness of climate change and ocean acidification; 11 to facilitate adaptation to the impacts of climate change and ocean acidification; and 12 to mitigate climate change and ocean acidification;
- Strategic Objective 2 to prevent pollution by hazardous substances (and the work of the Hazardous Substances and Eutrophication Committee) (Hazardous Substances Thematic Assessment);
- Strategic Objective 3 to prevent pollution by radioactive substances (and the work of the Radioactive Substances Committee (Radioactive Substances Thematic Assessment);
- Strategic Objective 4 to prevent inputs and significantly reduce marine litter (Marine Litter Thematic Assessment) (and the work of the Environmental Impacts of Human Activities Committee (Human Activities Thematic Assessment);
- Strategic Objective 5 to protect and conserve marine biodiversity and ecosystems (this Marine Birds Thematic Assessment and the work of the Biodiversity Committee, including the other biodiversity thematic assessments (Pelagic Habitats Thematic Assessment, Benthic Habitats Thematic Assessment, Fish Thematic Assessment, Marine Mammals Thematic Assessment, Food Webs Thematic Assessment).
- Strategic Objective S7.02 to develop a coordinated management approach to ensure that the number of non-indigenous species introduced via human activity is minimised and where possible reduced to zero;
- Strategic Objective 9 to safeguard the structure and functions of the seabed/marine ecosystems by preventing significant habitat loss and physical disturbance (this Marine Birds Thematic Assessment and the work of the Biodiversity Committee, including the Benthic Habitats Thematic Assessment).

Multiple human activities have been identified as exerting these pressures in the North-East Atlantic. Any actions to manage these pressures in order to prevent or reduce impacts either individually or cumulatively (collectively) will need to consider if and how these human activities might best be targeted (and the consequences for the associated drivers and ecosystem services) within an Ecosystem Approach.

Impact potential module:

Confidence Assessment: Evidence – Medium; Consensus – High

The impact potential is incorporated with the exposure module (spatial extent and frequency) of pressures from specified human activities (derived from the aggregated exposure score multiplied by the degree of impact score). Degree of impact here relates to the generic interaction in terms of a pressure's likely effects on the ecological component, in the categories of low potential for significant impact, chronic impact or acute impact (Robinson *et al.*, 2013). **Figure CE.1** shows the combined weighted scores for exposure and impact potential.

Any activity-pressure combinations with a Degree of Impact score of Low was filtered out, following discussion with the expert groups. For example, the input of radionuclides has been filtered out based on the conclusions in the Radioactive Substances Thematic Assessment as these have been demonstrated to have a low potential for significant impact, based on the available evidence. Other pressures filtered out as having low potential for significant impact are the inputs of other forms of energy from the extraction of oil and gas and from physical disturbance of the seabed by transport – shipping.

The relative ranking of pressures changes when impact is considered. Climate change, leading to prey depletion and habitat loss pressures, ranks highly (see the Climate Change Thematic Assessment for detail on contributing human activities). The importance of climate change pressures on marine birds is described in the Climate Change section of this thematic assessment. Extraction, mortality and injury of species (predominantly from fisheries incidental by-catch) and disturbance of species (from multiple activities) pressures also rank highly in terms of impact. Habitat loss and physical disturbance of the seabed associated with a range of human activities rank highly; the latter contributes to prey depletion. Input and spread of NIS, inputs of other substances (chemical contaminants) and litter from multiple human activities were also shown to be important for marine birds.

Risk module:

Confidence Assessment: Evidence – Low; Consensus – Low

Given the low confidence scoring, the outputs from the risk analyses have not been included in this thematic assessment for QSR 2023. Nevertheless, it is beneficial to consider the agreed outputs of the persistence weightings. Details of the criteria applied in the risk module are described in the CEMP Guideline.

Regional summary of likely cumulative effects:

Confidence Assessment: Evidence – High; Consensus – Medium

While the weighted bow-tie analyses displayed in the Sankey diagrams have been produced at the North-East Atlantic scale, consideration can be given to where regional differences may arise by cross-referencing other assessments in QSR 2023.

The marine bird Thematic Assessment identifies the cumulative pressures on marine birds in terms of both exposure and impact (but no regional breakdown of pressures is attempted here).

The list below summarises the main pressures impacting marine birds, with information on associated activities. The activity-pressure combinations scored as low impact based on the current available evidence have been filtered out from the relevant Sankey diagram. However, the activity-pressure links listed below relate to the unfiltered outputs used in the Exposure assessment.

- Prey depletion from: fishing activities and the effects of climate change;

- Extraction of or mortality / injury to wild species from: fishing activities (by-catch); hunting; climate change (e.g., storm 'wrecks'); renewable energy generation (collisions); transport – shipping (collisions); extraction of minerals (aggregates) and extraction of oil and gas;
- Disturbance of species from: renewable energy generation; extraction of oil and gas; tourism and leisure infrastructure and activities; land claim; coastal defence and flood protection; transport infrastructure; offshore structures; extraction of minerals (aggregates); fishing activities; military operations; transport – shipping;
- Habitat loss from: climate change (e.g., 'coastal squeeze'); renewable energy generation; extraction of oil and gas; tourism and leisure infrastructure; land claim; subsea cables; coastal defence and flood protection; transport infrastructure; offshore structures; extraction of minerals (aggregates); fishing activities; military operations; tourism and leisure activities; non-renewable energy generation (nuclear);
- Input or spread of NIS (mainly invasive predatory mammals e.g., rats, American mink, feral cats) from: urban uses; tourism and leisure activities; transport – shipping;
- Input of litter from: tourism and leisure activities; transport – shipping; industrial uses; urban uses; fishing; aquaculture;
- Physical disturbance of the seabed from: extraction of oil and gas; tourism and leisure infrastructure; land claim; subsea cables; coastal defence and flood protection; transport infrastructure; offshore structures; extraction of minerals (aggregates); fishing activities; military operations; tourism and leisure activities; transport – shipping; with direct effects on supply of benthic prey or indirect effects on prey further up the food chain;
- Input of other substances from: extraction of oil and gas; military operations; non-renewable energy generation (nuclear); research, survey and educational activities; industrial uses; urban uses;
- Input of other forms of energy from: transport – shipping; renewable energy generation;
- Input of anthropogenic sound from shipping and industrial uses.

OSPAR does not have evidence on all human activities, but a regional breakdown of the relative intensities of Aquaculture; Extraction of minerals (aggregates); Oil and Gas; Nuclear; Renewable Energy; Fisheries; Shipping and Tourism has been extracted from the supporting evidence for QSR 2023 and is summarised below. The direct influence of the cumulative pressures from these activities on marine birds is likely to follow similar trends in intensity within these Regions. The pressures spread beyond the spatial extent of e human activities, but insufficient evidence is currently available, and so trends in indirect cumulative pressures have not been considered.

The Offshore Industry Thematic Assessment describes:

- low relative intensity of Oil and Gas sector activity in the Bay of Biscay and Iberian Coast (Region IV) and Wider Atlantic (Region V);
- moderate relative intensity of Oil and Gas sector activity in the Arctic Waters (Region I) and Celtic Seas (Region III);
- high relative intensity of Oil and Gas sector activity in the Greater North Sea (Region II).

The Human Activities Thematic Assessment describes:

- low relative intensity of Aggregate Extraction sector activity in the Arctic Waters (Region I) and Wider Atlantic (Region V);
- moderate relative intensity of Aggregate Extraction sector activity in the Celtic Seas (Region III) and Bay of Biscay and Iberian Coast (Region IV);

- high relative intensity of Aggregate Extraction sector activity in the Greater North Sea (Region II);
- moderate relative intensity of Aquaculture sector activity in the Celtic Seas (Region III) and Bay of Biscay and Iberian Coast (Region IV);
- high relative intensity of Aquaculture sector activity in the Arctic Waters (Region I) and Greater North Sea (Region II);
- low relative intensity of Fisheries sector activity in the Wider Atlantic (Region V);
- moderate relative intensity of Fisheries sector activity in the Bay of Biscay and Iberian Coast (Region IV);
- high relative intensity of Fisheries sector activity in the Arctic Waters (Region I), Greater North Sea (Region II) and Celtic Seas (Region III).
- low relative intensity of Offshore Renewable Energy sector activity in the Bay of Biscay and Iberian Coast (Region IV);
- moderate relative intensity of Offshore Renewable Energy sector activity in the Celtic Seas (Region III);
- high relative intensity of Offshore Renewable Energy sector activity in the Greater North Sea (Region II).
- low relative intensity of Tourism sector activity in the Arctic Waters (Region I) and Wider Atlantic (Region V);
- moderate relative intensity of Tourism sector activity in the Celtic Seas (Region III);
- high relative intensity of Tourism sector activity in the Greater North Sea (Region II) and Bay of Biscay and Iberian Coast (Region IV).
- low relative intensity of Transport and Shipping sector activity in the Wider Atlantic (Region V);
- moderate relative intensity of Transport and Shipping sector activity in the Arctic Waters (Region I);
- high relative intensity of Transport and Shipping sector activity in the Greater North Sea (Region II), Celtic Seas (Region III) and Bay of Biscay and Iberian Coast (Region IV).

The Radioactive Substances Thematic Assessment describes:

- no Nuclear sector activity in the Wider Atlantic (Region V);
- low relative intensity of Nuclear sector activity in the Arctic Waters (Region I);
- moderate relative intensity of Nuclear sector activity in the Bay of Biscay and Iberian Coast (Region IV);
- high relative intensity of Nuclear sector activity in the Greater North Sea (Region II) and Celtic Seas (Region III).

Regional evidence for trends in the intensity of other human activities or for climate change and ocean acidification were not available in sufficient detail to be utilised in this assessment.

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Climate Change

Climate change effects on marine birds

A changing climate acts as a pressure on the marine ecosystem (including the OSPAR Maritime Area) and the human activities within it. It leads to rising sea level and temperatures, changes in the amount of rainfall and reduced sea-ice coverage, among other effects. These pressures have resulted in documented changes in marine ecosystems, see: Climate Change Thematic Assessment.

The section below summarises the main impacts of climate change on marine birds. Information is provided separately for seabirds and waterbirds, as these two groups are likely to be differentially affected by climate change due to their different ecological characteristics.

Seabirds

- Dias *et al*., (2019) in a major global review of threats to seabirds, identified climate change in the top three most important threats. In the OSPAR region specifically, climate change is identified as important driver of change, for example in the United Kingdom (e.g. Pearce-Higgins *et al*., 2021; McDonald *et al*., 2015; Mitchell *et al*., 2020) and also in the Baltic (e.g. Meier *et al*., 2022).
- Hakkinen *et al*., (2022) summarised the main mechanisms for climate-change impacts on seabirds in western Europe and ranked their importance according to questionnaire responses gathered from seabird conservation practitioners (**Table CC.1**).

Table CC.1: Climate change impacts on seabirds according to conservation practitioners. Taken from Hakkinen et al., 2022)

Climate-change threat	Vote % among respondents
Reduced prey availability	79
Increased threats from human activities	64
Reduced habitat availability	64
Nest destruction caused by extreme climate events	45
Increased exposure to disease	45
Increased foraging difficulty due to extreme weather	39
Increased predation and/or competition	36
Increased heat stress on adults/chicks/eggs	33
Increased migration costs due to changes in climate along migration route	27

- The main mechanism for climate-change impacts on seabirds is change to their food supply and / or availability, though there is growing evidence that severe weather events also play an important role, for example in nest survival, but also in the survival of adults trying to forage during storms during the non-breeding season (Clairbaux *et al.*, 2021, Reiertsen *et al.*, 2021).
- Some of the best evidence of climate-induced changes to demographic rates (adult survival, breeding success) of seabirds comes from the black-legged kittiwake, a surface-feeder. Studies show that its over-winter survival is lower following winters with increased sea-surface temperatures (SST), with reduced breeding success one year later (Frederiksen *et al.*, 2004, 2005, 2007; Frederiksen, 2014). These patterns are likely to be mediated by the abundance of one of the kittiwake's preferred prey, namely energy-rich sandeels *Ammodytes* spp. (Daunt *et al.*, 2008; Eerkes-Medrano *et al.*, 2017). The recruitment of sandeels is in turn influenced by climate-induced changes in plankton abundance, distribution and timing (Wanless *et al.*, 2018). There have been northward shifts in the distribution of sandeels' key copepod prey, caused by climate change (Reygondeau and Beaugrand, 2011). As discussed in the (Pelagic Habitats Thematic Assessment, the indicator results for QSR 2023 reveal that increasing sea surface temperatures are linked to declining abundances of planktonic lifeforms, particularly small and large copepods, across the North-East Atlantic.
- More recent evidence suggests that other seabird species' food supply is also affected by climate-change impacts; the proportion of sandeels in the diet of seabirds in a colony in South East Scotland has declined over the last three decades, linked to changes in Sea Surface Temperature (SST) (Howells *et al.*, 2018; Wanless *et al.*, 2018; Harris *et al.*, 2022).
- In the context of climate change, there is also a need to account for natural variability over multi-decadal time scales in the marine environment of the North Atlantic, as demonstrated by the importance of SST for puffin productivity in SW Iceland over a 130-year period (Hansen *et al.*, 2021).
- While most research has focused on SST-mediated changes, recent evidence has emerged of other mechanisms, including the effects of climate-mediated water-column stratification on kittiwake breeding success (Carroll *et al.*, 2015).
- As well as climate-mediated changes in the abundance of seabird prey, there have also been mismatches between the timing of the occurrence of seabird prey and periods of peak energy demand (e.g. chick-rearing) (Burthe *et al.*, 2012).

Waterbirds

- Climate change may affect waterbird populations while they are in their northern / Arctic breeding grounds, on their migration stopovers and in their wintering grounds. Waterbirds that breed in temperate parts of the OSPAR Maritime Area may also be subject to climate-change impacts, particularly so for upland and more northern species.
- Climate change may impact abundance, distribution and the timing of occurrence, particularly in migration and in wintering areas (Pavón-Jordán *et al.*, 2019).
- Shifts in distribution, mediated by temperature changes, have been seen within the OSPAR Maritime Area and more generally within Europe, with waders and wildfowl species during the winter increasingly concentrated in north-eastern areas with, for example, fewer reaching south-western parts of their former range (so-called "short-stopping").

- Warmer winter temperatures have been linked to the earlier departure of waterbirds for their northern breeding grounds.
- Projected rises in mean sea-level as a result of climate change are expected to impact the extent and quality of waterbird habitats.

What has changed since the last Quality Status Report

The Quality Status Report 2010 identified climate-change impacts as an increasing pressure on marine ecosystems. In relation to seabirds, the QSR 2010 made the following projection for climate-change impacts:

"*Impacts on seabirds are likely to be more important through changes in their food supply than through losses of nests due to changed weather*".

The section below provides some considerations relating to the QSR 2010 projections based on the current status of marine birds in the OSPAR Maritime Area.

Did the foreseen change happen?

It is more likely than not that the change foreseen above did happen, though there is increasing evidence that loss of nests due to extreme weather might be playing an increasingly important part.

It is not possible to distinguish with any certainty between these two scenarios by reference to changes in the integrated assessment results or the individual indicators between QSR 2010 and QSR 2023, because both scenarios would to some degree impact both indicators, i.e., breeding abundance (B1) and breeding productivity (B3), albeit probably over different time-scales. For example, changes in food supply and accessibility might impact adult survival and therefore B1, but also impact food supply to chicks (B3). Similarly, reductions in nest survival impact directly on B3 but also, with increasing effect in later years, on B1 (fewer chicks are recruited into the breeding population). It should also be noted that marine birds have proved unable to adjust their timing of breeding optimally in response to changing climate conditions (Keogan *et al*., 2017). Also, effects are often species-specific and region-specific, which contributes to the difficulties in attributing coarse-scale changes in the indicators (whether integrated or not) to climate-change effects demonstrated in the literature.

Nevertheless, the State section indicates that there was no significant change in the status of species groups between 2010 and 2020 (applying the same method retrospectively to both periods); in other words, the status of all species groups (apart from grazing feeders) was not good in 2010 and was still not good in 2020, although the state of individual species may have deteriorated since the last assessment. However, even if there had been a change between these two assessments, the degree to which it might have been attributable to climate change impacts would, of course, not be known.

It should be noted that there are likely to be biases in terms of the location of evidence for climate-change effects in seabirds, particularly towards studies in the central North Sea (and in particular around the Isle of May in SE Scotland, where sandeels are the dominant prey). As the OSPAR Maritime Area is large and diverse, we recommend further examination of regional effects, a comprehensive assessment of which is beyond the scope of this section (but for example, some effects for kittiwakes are less strong in Celtic Seas (Lauria *et al*., 2013; Cook *et al*., 2014)).

A recent survey of seabird conservation practitioners in the OSPAR Maritime Area (Hakkinen *et al.*, 2022) showed that 79% saw changes in food supply as a serious or very serious threat to the seabird populations they managed, while 45% thought that nest destruction posed the same threat.

Johnston *et al.*, (2021), in a review of climate-change impacts on seabirds in the Celtic Sea, concluded that the strongest evidence of long term impacts of climate change in seabirds comes from studies in which impacts are mediated through changes in prey associated with changes in sea surface temperature. This has been demonstrated in systems where the predominant prey is sandeels. (Frederiksen *et al.*, 2005), herring (Durant *et al.*, 2003) or sprat (Österblom *et al.*, 2006), in studies of surface-feeding and pelagic-feeding seabirds. Johnston *et al.*, (2021) further conclude that there is also evidence for impacts of short-term extreme weather events (e.g., on nest survival) but that to date this has been less impactful on seabird population size than climate-mediated prey availability. However, they also identify that if such events become more frequent – as has been proposed in many climatic forecasts – then such impacts may become more important.

Mitchell *et al.*, (2020) concluded that, while the principal mechanism for climate-induced declines in seabird abundance in the United Kingdom is reductions in food supply, there is growing evidence that short term, extreme, weather events have an important effect.

How has the change happened?

There is some evidence that the observed rate of change in the abundance of "true seabirds" since 2010 has not been as negative or severe as was predicted by models that forecast changes up to 2050. However, this tendency is probably not very apparent in the Norwegian part of OSPAR Region I, which holds >50% of European ocean areas. For instance, the number of seabird species on Norway's Red List has increased constantly from 26% in 1998, 48% in 2010 to 63% in 2021 (34 of 54 species), almost exclusively assessed from population trends over three generations. For kittiwakes, one of the listed species, some iconic colonies have gone extinct during the last five years, much sooner than the predictions made by Sandvik *et al.*, (2014). N.B. this does not directly address the specific question regarding relative importance of food supply and extreme events.

Pearce-Higgins *et al.*, (2021) provided the first assessment of the projected (from 2010 to 2050) impact of expected climate change on seabird populations (i.e. "true seabirds") in the North-East Atlantic. 15 of the 19 species modelled were predicted to decline in Britain and Ireland; the most impacted species was the Arctic skua, which the authors predict will cease to breed there by 2050 (though the mechanism for this is likely to be direct physiological intolerance to heat rather than prey effects or nest loss due to extreme weather events). Steep declines of greater than 50% of abundance were predicted for fulmar, puffin, Arctic tern, little tern, Sandwich tern and storm-petrel, although the latter three species have results which are less reliable. Indeed, for all these species (except the Arctic skua) a scenario of no change in abundance falls within the spread of credible scenarios. Furthermore, for common gull, lesser black-backed gull, razorbill and puffin, the observed short term changes in abundance were more positive than the model had predicted. It should be noted that Pearce-Higgins *et al.*, (2021) were not able to include in their study specific parameters for sea-level rise or increased storminess, which were identified by Johnston *et al.*, (2021) as potentially important mechanisms for climate-mediated impacts on seabirds. Therefore, it is not possible to use the study of Johnston *et al.*, to directly compare the modelled food-supply effects and those of nest loss due to extreme weather events.

What has been the impact? [strong negative / mild positive etc]

The state section indicates that there was no significant change in the status of species groups between 2010 and 2020 (applying the same method retrospectively to both periods); in other words, the status of all species groups (apart from grazing feeders) was not good already by 2010 and was still not good in 2020. It is of note that climate-change effects on seabirds had been detected before 2010 (e.g., Frederiksen *et al.*, 2005), and it may be assumed that they contributed to the suppression of seabird demographics. There are some more subtle changes, however: the trend in the proportion of species in good status between 2010 and 2020 shows a slight improvement in surface feeders in Arctic waters, a decline in water-column feeders in Arctic waters, a decline in benthic feeders in the Greater North Sea and a decline in wading feeders in Celtic Seas. Furthermore, examination of the status of wading feeders by species reveals evidence of a greater number of species (six) showing good status for abundance (B1) in Greater North Sea and not good status in Celtic Seas, compared with only two species with good status for abundance in Celtic Seas and not good status in Greater North Sea. While this is consistent with the studies demonstrating north-easterly shift in distribution of this group of birds (Austin and Rehfisch, 2005; Maclean *et al.*, 2008) the degree to which the patterns shown by the QSR indicators are attributable to climate change impacts is not known.

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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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