# Offshore birds in the Dutch North Sea

Background document for a protection plan

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[3] Vogelbescherming Nederland

Wageningen University & Research report: C087/23

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# Contents

# Samenvatting

In het Akkoord voor de Noordzee is afgesproken om een aantal beschermingsplannen te ontwikkelen voor soorten en habitats die het meest kwetsbaar zijn voor de ontwikkeling van offshore windenergie, die bescherming nodig hebben in het algemeen, zoals overeengekomen in internationale kaders of die van cruciaal belang voor natuurherstel en -verbetering.

Elk plan bestaat uit twee delen: een achtergronddocument en een actieplan. Het achtergronddocument bundelt en evalueert de actuele en wetenschappelijke informatie. Het actieplan bevat de maatregelen die de Nederlandse overheid zal nemen en zal worden opgesteld door het ministerie van LNV na consultatie van stakeholders van het Noordzeeoverleg. Het huidige rapport is het achtergronddocument voor het natuurbeschermingsplan: Offshore foeragerende zeevogels waarvoor twee vogelsoorten zijn geselecteerd: Jan-van-gent (*Morus bassanus*), Drieteenmeeuw (*Rissa tridactyla*).

In dit rapport wordt informatie verstrekt en geëvalueerd voor Jan-van-gent en Drieteenmeeuw met betrekking tot de volgende aspecten: soortbeschrijvingen, huidige status van de soort, monitoring en onderzoek, evaluatie van bedreigingen, effecten en kansen, bestaande nationale en internationale instandhoudingsmaatregelen, in het algemeen status, kennislacunes en mogelijke acties. Hieronder zijn alleen de meest relevante informatie en bevindingen met betrekking tot de ontwikkeling van een beschermingsplan samengevat.

De Jan-van-gent is het hele jaar door aanwezig op het gehele Nederlands Continentaal Plat (NCP) en in de kustzone. De soort is het meest schaars in de lente en de winter en het meest talrijk in de herfst en de zomer. De trend van de populatie van Jan-van-gent sinds 1991 was positief tot de massale sterfte in 2022 als gevolg van de hoog-pathogene vogelgriep (HPAI). Drieteenmeeuwen zijn het hele jaar door aanwezig op het gehele NCP, met een kleine broedpopulatie op platforms nabij het Friese Front. Voor Drieteenmeeuwen is de trend sinds 1991 positief, maar de laatste 12 jaar negatief.

Zowel wereldwijd als in Europa wordt de staat van instandhouding van Jan-van-gent beoordeeld als ‘Least Concern’, en de recente reproductiecijfers van de Jan-van-gent voldoen aan het criterium voor ‘Good Environmental Status’ onder de MSFD (KRM) in alle OSPAR-regio’s in het noordoostelijke deel van de Atlantische Oceaan. De door HPAI geïnduceerde sterfte in 2022 veroorzaakt echter onzekerheid over de toekomstige staat van instandhouding.

Sinds de jaren tachtig is de Europese populatie Drieteenmeeuwen sterk aan het afnemen, wat heeft geresulteerd in een Rode Lijst notering in de categorie ‘Vulnerable’ in Europa en als ‘Endangered’ in de EU. De soort is ook op de OSPAR-lijst van bedreigde en/of afnemende soorten en habitats geplaatst. De afgelopen jaren voldoet de reproductie productiviteit in de Grote Noordzeeregio ook niet aan het KRM GES-criterium, waardoor een verdere daling te verwachten is.

Bedreigingen/druk voor Jan-van-gent omvatten vogelgriep; vermindering van de beschikbaarheid van discards uit de visserij; sterfte door aanvaringen en verstoring/habitatverlies in windparken; bijvangst door kieuwnetvisserij. Bedreigingen/druk voor de Drieteenmeeuw zijn onder meer de vermindering van de voedselbeschikbaarheid door de visserij en de klimaatverandering; sterfte door botsingen in windparken; vogelgriep; predatie.

De kennislacunes omvatten populatieparameters, voedselbeschikbaarheid en de invloed van visserij en klimaateffecten, bijvangstrisico, actuele aanvaringscijfers met windturbines op zee en gevolgen van habitatverlies op populatieniveau, langetermijneffecten van HPAI-endemisme, gevolgen van klimaatverandering, doeltreffendheid van het aanbieden van kunstmatige broedplaatsen voor Drieteenmeeuwen.

Er worden maatregelen voorgesteld gericht op de problemen waarmee beide zeevogels te kampen hebben. Er wordt onderscheid gemaakt tussen prioritaire maatregelen en andere maatregelen. Dit is samengevat in onderstaande tabel.

| Probleem | Doel | Actie |
|---|---|---|
| Prioritaire maatregelen | | |
| Voedselgebrek | Compenseer negatieve effecten van de discard ban | Geen directe actie tegen de discard ban, maar initieer indirecte maatregelen m.b.t. andere beperkingen voor de populatie |
| | Bescherm de beschikbaarheid van pelagische vis | Houd bij het vaststellen van de vangstlimieten rekening met de beschikbaarheid van voedsel voor vogels<br><br>Verbod op de bodemtrawlvisserij in N2000-gebieden die geschikt zijn voor zandspiering |
| Vogelgriep | Reduceer de kans op overdracht van vogelgriep van pluimveebedrijven naar wilde vogels | Vaccineer pluimvee |
| | Reduceer de overdracht van vogelgriep binnen kolonies (en andere locaties waar veel vogels samenkomen) | Verwijder dode vogels in broedkolonies |
| Offshore windparken | Reduceer aanvaringen met windturbines | Plan windparken in gebieden met de minste vliegende vogels<br><br>Ontwikkeling en toepassing van mitigerende maatregelen gericht op reductie van aanvaringen |
| | Compenseer negatieve effecten van offshore windparken | Bijdrage en initiatief tot 'indirecte' maatregelen in broedgebieden buiten Nederland |
| Andere maatregelen | | |
| Gebrek aan (veilig) broedhabitat | Verbeter het reproductie succes | Creëer nieuwe / alternatieve broedplaatsen |
| Bijvangst | Reduceer bijvangst risico in verschillende vormen van visserij | Vul de kennislacunes voor bijvangst<br><br>Stimuleer het gebruik van bijvangst reducerende maatregelen |
| Verontreiniging en afval | Reduceer plastic, afval en verontreinigende stoffen in het mariene milieu | Reduceer verlies van vistuig en plastics<br><br>Reduceer het gebruik en lozen van giftige stoffen |

Deze beschermende maatregelen kunnen worden beschouwd als 'directe preventie' gericht op het voorkomen van een specifieke negatieve impact, zoals extra sterfte (bijvoorbeeld een aanvaring met een windturbine) of 'indirecte preventie' gericht op het vergroten van de veerkracht van de populatie. Voor beide vogelsoorten kan effectief behoud van populaties alleen worden bereikt door internationale samenwerking en coördinatie voor een aantal van de maatregelen, vooral die betrekking hebben op de visserij en de ontwikkeling van windenergie.

# Summary


In the North Sea Agreement it was agreed to develop a number of protection plans for species and habitats that are most vulnerable to offshore wind development, in need of protection in general, as agreed upon in international frameworks or key to nature restoration and enhancement.

Each plan consists of two parts: a background document and an action plan. The background document compiles and evaluates the current and scientific information. The action plan contains the measures to be taken by the Dutch government and will be drawn up by the ministry of LNV after consultation of "Noordzeeoverleg" stakeholders. The current report is the background document for the conservation plan: Offshore foraging seabirds: northern gannet (*Morus bassanus)*, black-legged kittiwake (*Rissa tridactyla*).

In this report information is provided and evaluated for northern gannet and black-legged kittiwake concerning the following aspects: species descriptions, current status of the species, monitoring and research, evaluation of threats, impacts and opportunities, existing national and international conservation measures, overall status, knowledge gaps and possible actions. Only the most relevant information and findings with regard to development of a protection plan are summarized below.

The northern gannet is a year-round present on the entire Dutch Continental Shelf (DCS) and in the coastal zone. The species is scarcest in spring and winter and most abundant in autumn and summer. The trend of the northern gannet population since 1991 is positive until the mass mortality in 2022 due to highly pathogenic avian influenza (HPAI). Black legged kittiwakes are present year-round on the entire DCS, with small breeding population on platforms near the Frisian Front. For black-legged kittiwake the trend since 1991 is increasing, but last 12 years decreasing.

Both worldwide and in Europe, the conservation status of northern gannet is assessed as 'Least Concern', and recent gannet breeding numbers meet the criterion for 'Good Environmental Status' under the MSFD in all OSPAR regions in the NE Atlantic. However, the HPAI induced mortality in 2022 causes uncertainty of the future conservation status.

Since the 1980s, the European population of black-legged kittiwake is in sharp decline resulting in Red-listing in the 'Vulnerable' category in Europe and as 'Endangered' in the EU. The species has also been placed on the OSPAR list of threatened and/or declining species and habitats. In recent years the breeding productivity in the Greater North Sea Region does also not meet the MSFD GES criterion, meaning that a further decline can be expected.

Threats/pressures to northern gannet comprise avian influenza; reduction in availability of fisheries discards; collision mortality and disturbance/habitat loss in wind farms; bycatch by gillnet fishery. Threats/pressures to black legged kittiwake include reduction of food availability by fisheries and climate change; collision mortality in wind farms; avian influenza; predation.

Many knowledge gaps are identified: population parameters, food availability and the influence of fisheries and climate effects, bycatch risk, actual OWF collision rates at sea and habitat loss consequences at the population level, long-term impacts of HPAI endemism, climate change impacts, effectiveness of providing artificial breeding sites for kittiwakes.

Proposed measures target the problems encountered by both seabirds. A distinction is made between priority measures and other measures. These are summarised in the table below.

| Problem | Objective | Action |
|---|---|---|
| Priority measures | | |
| Food shortage | Compensate negative effects of the discard ban | No direct action on discard ban but initiate indirect measures addressing other limitations on the population |
| | Safeguard availability of pelagic fish | Consider food availability for birds in setting upper limits on catch<br><br>Ban bottom-trawl fisheries from N2000 areas suitable for sandeel |
| Avian influenza | Reduce probability of transmission from poultry industry to wild birds | Vaccinate poultry |
| | Reduce transmission within colonies (and other sites where many birds gather) | Remove dead birds in breeding colonies |
| Offshore wind farms | Reduce effect of collisions with wind turbines | Plan windfarms in areas with fewest flying birds<br><br>Develop and employ collision-reducing mitigating measures |
| | Compensate negative effects of offshore wind farms | Contribute to and initiate 'indirect' measures in breeding areas abroad |
| Other measures | | |
| Lack of (safe) breeding habitat | Increase breeding productivity | Create new / alternative breeding sites |
| Bycatch | Reduce bycatch risk in various types of fishery | Fill knowledge gaps on bycatch<br><br>Stimulate use of bycatch-reducing measures |
| Pollution and litter | Less plastic litter and pollutants in the marine environment | Reduce wasting of fishing gear and other plastics<br><br>Reduce use and disposal of toxic compounds |

These protective measures can be regarded as either 'direct prevention' aiming to prevent a specific negative impact such as added mortality (e.g. collision with a wind turbine) or 'indirect prevention' aiming at increasing the resilience of the population. For both bird species effective conservation of populations can only be achieved by international cooperation and coordination for several of the measures, primarily those pertaining to fisheries and wind energy development.

# 1 Species (group)/habitat description

## 1.1 Name of species (group)/habitat

This plan covers the group of offshore foraging/residing seabirds in the northern Atlantic, with focus on two priority species in the Dutch North Sea:

| **Name** | **Name (UK)** | **Name (NL)** |
|---|---|---|
| *Offshore foraging/residing seabirds* | | |
| *Morus bassanus* | Northern gannet | Jan-van-gent |
| *Rissa tridactyla* | Black-legged kittiwake | Drieteenmeeuw |

## 1.2 Rationale for selection of species (group)/habitat for a protection plan under MONS

In the North Sea Agreement (OFL, 2020) it was agreed to develop a number of protection plans for species and habitats that are (1) most vulnerable to offshore wind development, (2) in need of protection in general, as agreed upon in international frameworks (EU Habitat Directive (HD), EU Bird Directive (BD), OSPAR, Red Lists, etc.), or (3) key to nature restoration and enhancement.

During the preparation of MONS (Monitoring-Onderzoek-Natuurversterking-Soortenbescherming[1]; Asjes et al., 2021) it was proposed for birds to write conservation plans per functional group, or alternatively for individual species within the groups.

The request of the ministry of LNV was to first focus on the bird species considered most vulnerable to offshore wind development, as identified under KEC 4.0 (Potiek et al., 2022): great black-backed gull *Larus marinus*, herring gull *Larus argentatus*, black-legged kittiwake *Rissa tridactyla* and northern gannet *Morus bassanus.* These species were identified by modelling the effect of various wind energy development scenarios on the long term survival of the population for different scenarios for 10 seabird species and 8 migratory bird species.

Combined with the concept of functional groups, this choice resulted in two conservation plans.

Plan 1: Surface-feeding birds of the coastal waters
Plan 2: Offshore foraging seabirds (this background document for a conservation plan)

## 1.3 Legislative and policy context

The Netherlands has obligations to protect seabirds under the EU Birds Directive, the EU Marine Strategy Framework Directive (MSFD) and the North Sea Agreement. This species protection plan has been developed as an obligation from the North Sea Agreement. For an overview, see *Table 2* in Annex 1.

[1] Monitoring-Research-Nature-enhancement-Species protection

## 1.4 National and international conservation targets

The MSFD targets are currently being updated by the Dutch government as part of the 6-year cycle of the MSFD. The update is expected in 2024.

- MSFD Good Environmental Status (Ministerie van Infrastructuur en Waterstaat & Ministerie van Landbouw Natuur en Voedselkwaliteit, 2018):
  - Overarching: "population densities and demography of populations of birds indicate healthy populations."
  - D1C2: "for each functional group, the population size (breeding pairs, or individuals outside of the breeding season, averaged over a recent 6-year period) of at least 75 percent of the species is ≥80% (species laying 1 egg per clutch) or ≥75% (species laying >1 egg, including gulls) of a baseline value derived from observed abundance in the period 1991-2000 (OSPAR 2023)".
  - D1C2: "populations of marine birds must comply with the national targets from the EU Bird Directive".
  - D1C3: "breeding success must on average (over a recent 6-year period) be sufficient to prevent a population decline of 30% or more over three generations" (OSPAR 2023).

- MSFD Environmental targets:
  - D1T1: "contributing to the further development of the assessment of bird populations and identifying the most important pressures at regional level" (OSPAR).
  - D1T2: "recovery of undisturbed situation for sea mammals and birds due to reduced fishery in the Natura 2000 areas "De Vlakte van de Raan" and "the North Sea Coastal Zone" (in the framework of the VIBEG agreement)".
  - D1T3: "achieving the conservation objective for habitat types and species in the Natura 2000 areas at sea (EU Bird and Habitat Directives)".
  - D1T7: "monitoring of bird collisions with wind turbines in the framework of Wozep".

- Natura 2000 and the Birds Directive:
  - Protection of birds in the North Sea consists of species protection and area protection. The Birds Directive requires to maintain bird populations at a level which corresponds to their ecological, scientific and cultural requirements (Bijlsma et al., 2019). In addition to the general protection of species, two offshore areas in the North Sea have been designated as Natura2000 areas on the basis of the Birds Directive: Brown Ridge and Frisian Front. The Brown Ridge is designated for the northern gannet. Currently, no offshore sites have been specifically designated for the black-legged kittiwake.
  - "Maintain size and maintain habitat quality for population conservation of the species". A Favorable Reference Value for the non-breeding population of northern gannet in the Netherlands has been set at a seasonal average of 17.000 birds (SOVON, 2022). For black-legged Kittiwake no FRV has been set (yet).

- Nature conservation act
  - The protection, maintenance or restoration of biotopes and habitats in sufficient variety is required under the Nature conservation act for all bird species naturally living in the wild in the Netherlands. The current conservation status of these bird species is described in section 2.4.

## 1.5 Description/definition of species

### 1.5.1 Northern Gannet

*Figure 1: Adult (left) and juvenile (right) northern gannet (Morus bassanus) in the North Sea. Photos: Oscar Bos (Wageningen Marine Research), Hans Schekkerman.*

The northern gannet (*Morus bassanus*) is the largest seabird in the northern Atlantic (length: ~90 cm, wingspan 170-192 cm). It is widespread across the seas of the continental shelf on both sides of the North Atlantic, but primarily established in the eastern North Atlantic (Nelson, 2002).

The northern gannet spends most of its life at sea. Food consists mainly of shoaling fish such as herring and mackerel but also of other fish species, squid and fisheries discards (Camphuysen et al., 1995; Brierley & Fernandes, 2001; Cox et al., 2016; Garthe et al., 2000) classified as "offshore subsurface feeder" (Burdon et al., 2017) or "water column feeder" (OSPAR, 2022). Prey are caught after a steep plunge into the water from heights up to 60 m (Garthe et al., 2014). They reach depths of 5-35 m and actively search for prey under water (Brierley & Fernandes, 2001; Garthe et al., 2000 , Cox et al., 2016). During the breeding season they may search for food several hundreds of kilometers away from the breeding colony (Lewis et al., 2002).
At sea, gannets also benefit from fishing discards, frequently following fishing vessels, especially in the winter when exploiting schools of live fish is harder (Camphuysen et al., 1995).

The breeding season runs from April-September (Nelson, 1978). Breeding colonies are usually located on steep cliffs and rocky islands. Gannets have a propensity to return to the colony where they hatched (Massetti et al., 2021; Mowbray, 2020; Nelson, 1978). The mean adult lifespan is about 17 years, with some ringed individuals known to have lived for more than 27 years. Adult annual survival is about 92% and juvenile survival roughly 30% over the first three years (BTO Birdfacts). In general, reproductive success is high (>75% of breeding pairs fledging a chick; Mowbray, 2020).

*Figure 2: Adult (left) and first-winter (right) black-legged kittiwakes (Rissa tridactyla) above the North Sea. Photos: Oscar Bos (Wageningen Marine Research), Hans Schekkerman.*

### 1.5.2 Black-legged kittiwake

The black-legged kittiwake (*Rissa tridactyla*) is a medium-sized pelagic gull occurring at sea and along temperate and arctic coastlines of the northern Hemisphere. The bird has a characteristic upperpart coloration with a mid-grey mantle that contrasts slightly with paler grey primaries and a black wing tip. The body is predominantly white with a grey ear-mark and nape collar in winter (*Figure 2*). Adults have a greenish-yellow bill and blackish legs. Kittiwakes attain full adult plumage when two or three years old. First-year birds show blackish markings on the wings, neck and tail. They also have a darker bill than adult birds.

Black-legged kittiwakes are "offshore surface feeders" (Burdon et al., 2017). During the breeding season kittiwakes feed mainly on small (up to 15-20 cm) pelagic shoaling fish, such as sandeels, capelin, herring, and sprat, and invertebrates such as euphausiids (Barrett and Tertitski, 2000; Cramp, 1983; Barrett and Krasnov, 1996). In winter, when most of the birds are at sea, planktonic invertebrates (including sea butterflies *Thecosomata*) are often consumed and fishing vessels discarding 'waste' fish and invertebrates are often visited, as well as occasionally sewage outfalls (del Hoyo et al., 1996; Reiertsen et al., 2014).

The black-legged kittiwake is a migratory bird and disperses to open sea after the breeding season, around July/August (del Hoyo et al., 1996; Frederiksen et al., 2012). From January birds start returning to their breeding grounds, and eggs are laid from mid-May till mid-June. Breeding occurs in colonies that may consist of more than 100,000 pairs, but generally between a few hundred to 1000 pairs (del Hoyo et al., 1996; Snow & Perrins, 1998). Colonies are situated on steep coastal or island cliffs (often mixed with other seabirds such as common guillemot and razorbill), but also on man-made structures: ledges of buildings in harbours, harbour walls, offshore platforms, etc. Non-breeding birds, often the juveniles, remain at sea throughout the first 2-3 years (Hatch et al., 2020; Snow & Perrins, 1998). First breeding occurs at an average age of about four years but this may vary per region and sex (Coulson & Porter, 2008; Coulson, 2011; Mcknight et al., 2019; Wooller & Coulson, 1977). The species usually has one brood per year, consisting of 1-3 eggs. The incubation period lasts 25-32 days and the nestling period 41-43 days (del Hoyo et al., 1996). The species has an average adult lifespan of c.12 years and an adult annual survival rate of c. 88% per year (range 67-93%, O'Hanlon et al., 2021); first-year survival is lower at about 79% (BTO BirdFacts).

## 1.6 Ecological importance

These bird species, particularly the northern gannet, are top predators. Top predators may play crucial roles in the marine food-web through top-down pressure on their prey species, although this role is likely to be limited in the smaller kittiwake. Besides their potential important role in shaping marine food webs (mostly locally), marine top predators often exhibit clear responses to environmental variability and indicate anthropogenic impacts on ecosystems (Hazen et al., 2019). Seabirds have been suggested as good ecological indicators of the marine environment (Durant et al., 2009). For example a link between seabirds and climate through their prey has been identified for the black-legged kittiwake: the bottom-up effect of changing ocean climate conditions is a controlling factor in the abundance and quality of sandeels, which are a major source of food for kittiwakes in the North East Atlantic and North Sea and therefore influences the condition of the kittiwakes (Wanless et al., 2007).

## 1.7 Ecosystem services

Seabirds can contribute to shaping coastal ecological processes and services in a multitude of ways, among which directly influencing trophic status, biodiversity and food webs (Signa et al., 2021). Seabirds are natural scavengers and thereby contribute towards waste breakdown by recycling organic matter (e.g. discarded fish) back into the marine and coastal ecosystems. They also contribute to a net flow of nutrients from sea to land at and around breeding colonies (Burdon et al., 2017). This is part of the ecosystem service category of regulation and maintenance (Haines-young & Potschin, 2011). Seabirds also contribute to coastal and marine views ('seascapes'). Northern gannets and black-legged kittiwakes nest in large numbers as colonial seabirds and are an integral part of the seascape that is widely appreciated by society (Burdon et al., 2017). They therefore supply a relatively high contribution to the ecosystem service "formation of seascapes" (Burdon et al., 2017).

## 1.8 Commercial importance

There is a licensed hunt of young northern gannets on the island of Sula Sgeir off western Scotland. These young birds, called *gugas*, are hunted for local human consumption (Burdon et al., 2017). At several sites in Europe, companies run sight-seeing boat-trips to islands and sea-cliffs with breeding gannets and kittiwakes, boosting local tourism industries.

Black-legged kittiwake is hunted in Greenland, and eggs are collected for consumption in Iceland (BirdLife International, 2015c).

# 2 Current status of the species

## 2.1 Distribution in the international North Sea and Dutch North Sea

### 2.1.1 Northern Gannet

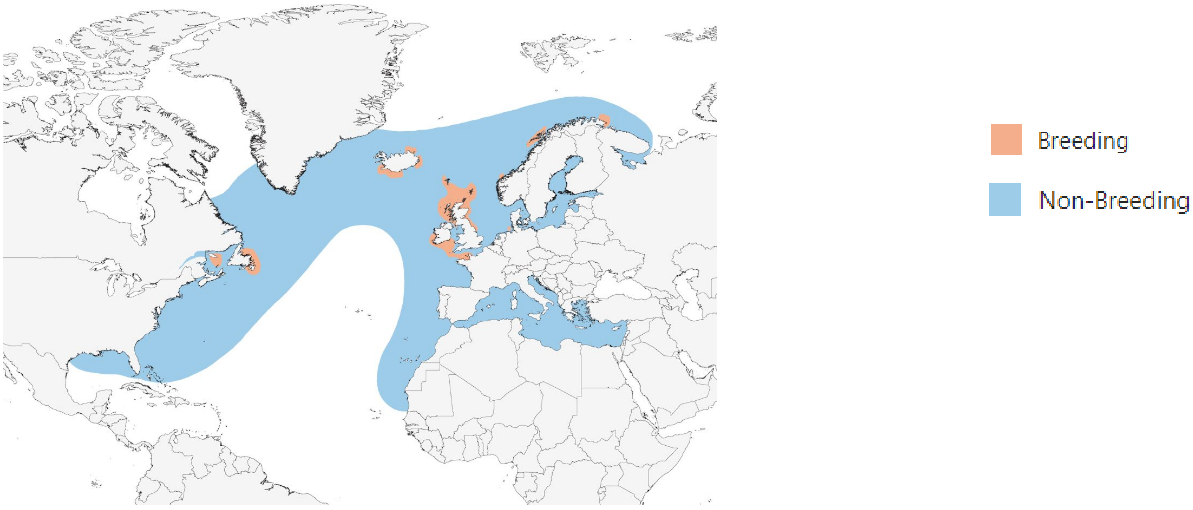


*Figure 3. Northern gannet (Morus bassanus) distribution map (Mowbray, 2020).*

The global distribution of the northern gannet is the northern Atlantic (*Figure 3*) (BirdLife International, 2022a). Most (>75%) gannets breed in European waters, where they are dispersed over 32 dense colonies from the coast of Brittany in France up to Iceland and Norway (Nelson, 2002). Most colonies are located on islands off the British and Irish coast and harbour up to around 75,000 pairs (Murray et al., 2015). The northern limit of the breeding range is set by the presence of waters that are free of sea ice during the breeding season and the southern limit mainly depends on the presence of sufficient prey. Adult gannets may forage up to 500 km from their colony. Outside the breeding season birds cover far greater distances; while some (mainly adults) winter in NW-European waters, others make long-distance migrations towards the Mediterranean Sea and particularly to upwelling zones off NW Africa (Kubetzki et al., 2009; Garthe et al., 2016; Camphuysen 2022(Kubetzki et al., 2009; Garthe et al., 2016; Camphuysen 2022).

The northern gannet is a fairly common non-breeding visitor and may forage in the Dutch North Sea from colonies at the British east coast (Hamer, 2007; Hamer, 2001; Wakefield et al., 2013). The occurrence along the Dutch coast depends on the prevailing wind direction, food supply (the availability of schooling fish) and time of the year. They are most numerous in late summer and autumn, and scarcest between December and March (Camphuysen & Leopold, 1994; Fijn et al., 2022). In the winter about 0.1% of the European population occurs in Dutch waters, and in late summer and autumn about 3% (Sovon, 2022). During summer mostly immature gannets are seen on the Dutch continental shelf (DCS). Following the breeding season also adult gannets disperse over the North Sea (Nelson, 2002, 1978). In September and October tens of thousands of gannets move through the North Sea, and especially during strong onshore winds or when condition for fishing are favorable large numbers can be observed from the Dutch coast (Leopold & Platteeuw, 1987; Platteeuw et al., 1994). In winter, still relatively high densities of gannets are observed on the southern part of the DCS, including in the Brown Ridge Natura 2000-site (Ministerie LNV, 2021) (*Figure 4*).

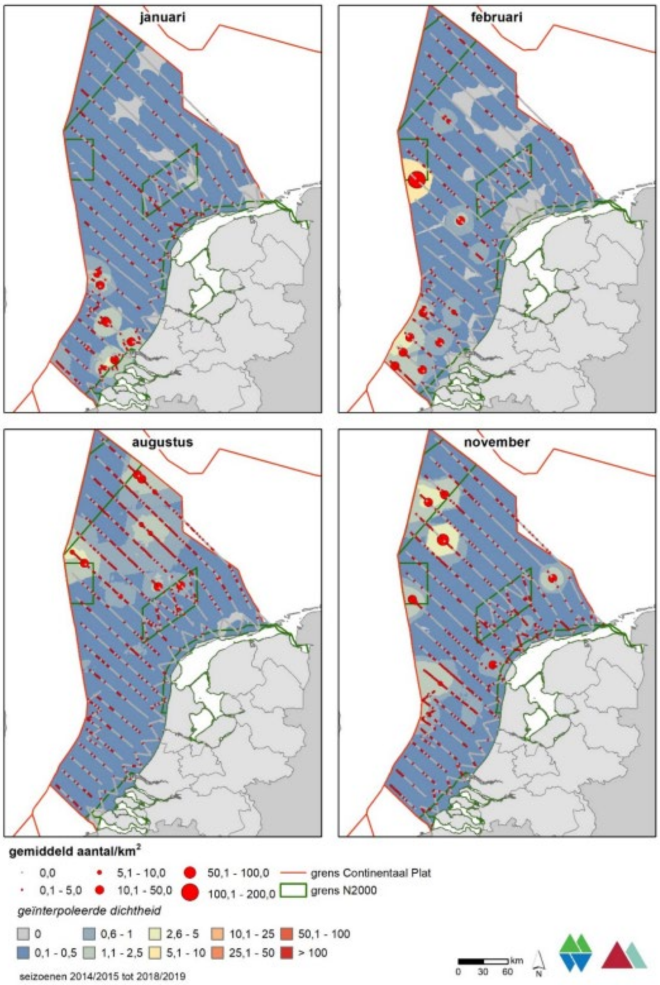


*Figure 4. Distribution (average densities, n/km²) of northern gannet, in four periods of the year, based on data collected between August 2014 and February 2019 (Source: Bureau Waardenburg//Delta Project Management) (Ministerie LNV, 2021).*

### 2.1.2 Black-legged kittiwake

The black-legged kittiwake has a Holarctic breeding distribution in arctic to subarctic regions (*Figure 5*, *Figure 6*). There are two recognized subspecies. Most of the global population is of the nominate subspecies *R. t. tridactyla* which can be found in the North Atlantic from Canada and North-east USA, east through Greenland to western and northern Europe and on to Russia. The other subspecies, *R. t. pollicaris,* is found in the North Pacific (BirdLife International, 2022c). Outside the breeding season kitiwakes are found almost exclusively at sea. The winter range extends south to waters off NW Africa, but the majority of birds winter in the western Atlantic between Newfoundland and the Mid-Atlantic Ridge, including offshore deep-water areas. Smaller, but still substantial numbers winter in the North Sea and west of the British Isles (Frederiksen et al., 2012).

Focusing on the European population, the greatest numbers breed in Iceland, Norway, the Faroe Islands and Great Britain. Around the North Sea there are large colonies in North-east England, eastern Scotland and on the Orkney and Shetland Islands (BirdLife International, 2022c; Hatch et al., 2020). Smaller colonies are located on Helgoland, in Denmark and on offshore platforms in the southern North Sea. On the offshore Dutch Continental Shelf (DCS) the black-legged kittiwake is the most numerous gull species, especially in winter (Mitchell et al., 2004; Fijn et al., 2022; *Figure 6*). During the breeding season the species still has a fairly northern distribution near their breeding grounds and is much scarcer in the southern part of the North Sea. In June large groups are present around the Frisian Front, in November and February kittiwakes can be found spread out over the entire DCS. Recently the species started breeding in small numbers on gas platforms in the North Sea on the southwestern side of the Frisian Front (Camphuysen & Leopold, 2008; Fijn et al. 2023).

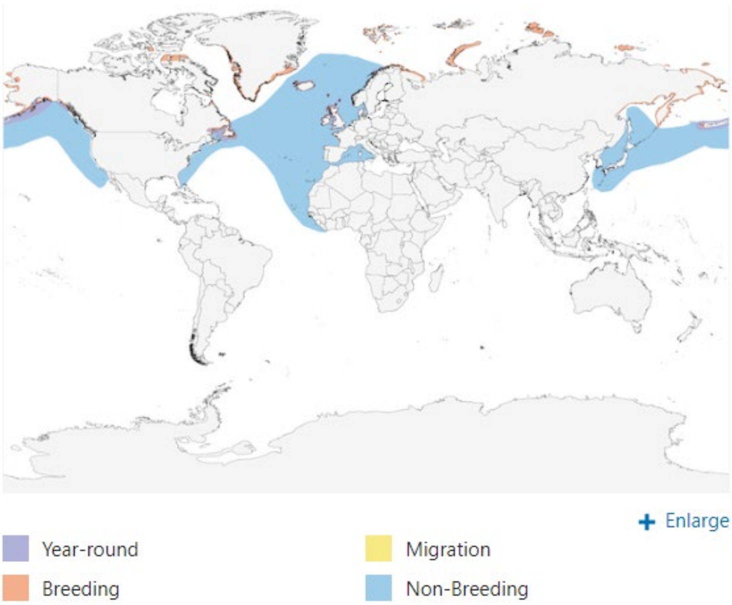

*Figure 5. Distribution map of black-legged kittiwake (From:* Hatch et al., 2020).

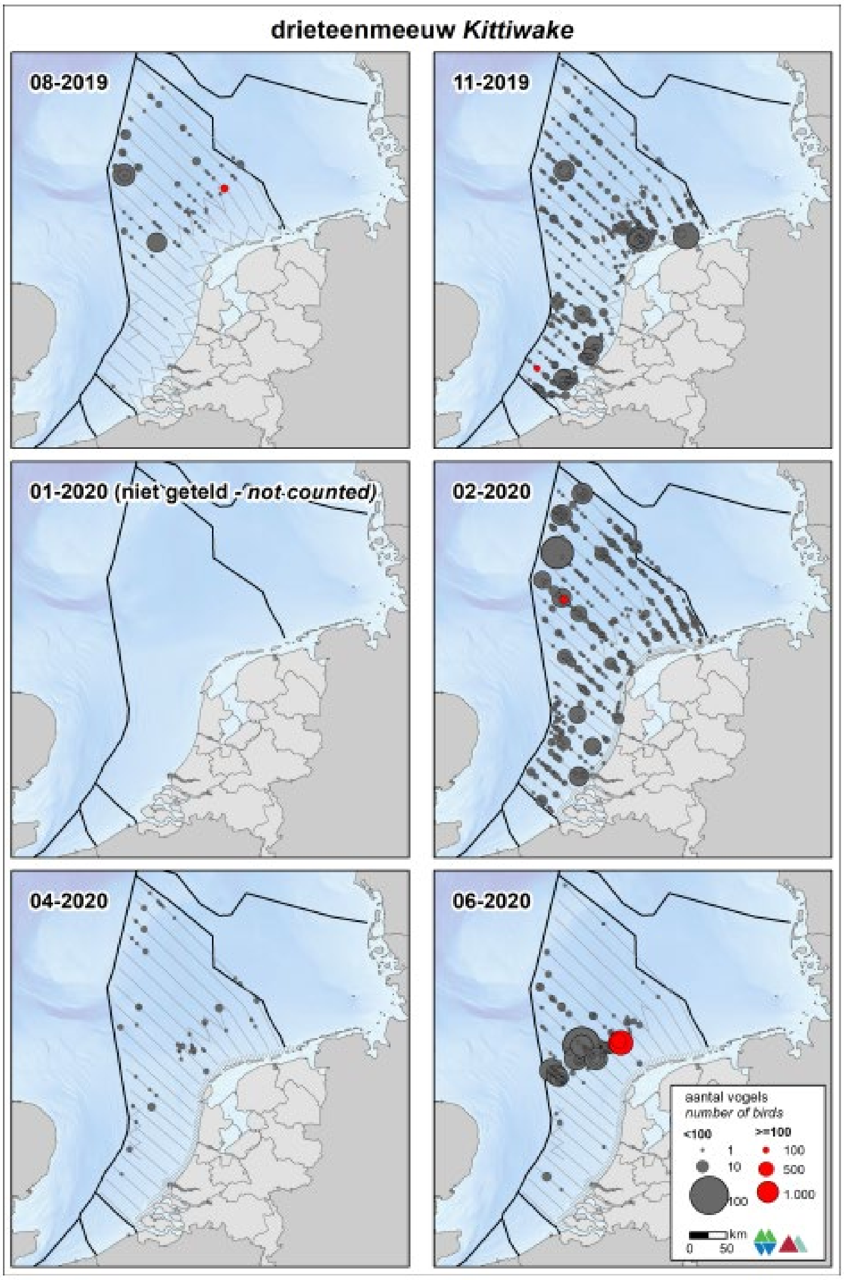


*Figure 6. Distribution of Kittiwake on the DCS in the counting season 2019/2020* (Fijn et al., 2020). *Grey lines show the transects flown during the aerial surveys. Note that the distribution may vary noticeably between years.*

## 2.2 Population in the international North Sea and Dutch North Sea

### 2.2.1 Northern gannet

The global population has increased significantly over recent decades at a rate of 3.0-3.5% per year, allowing colonization of new areas such as the German island of Helgoland (Mitchell et al., 2004; Veron & Lawlor, 2009). According to an estimate in 2015, there are 683,000 breeding pairs in Europe, which is ≥75 % of the global population. The 2021 Red List estimation assesses that the European population consisted of 821,000-823,000 mature individuals (BirdLife International, 2022c). Scotland, with 12 gannet colonies, is home to about half of the world population (Nelson, 2002). The largest colony in the world is located at Bass

Rock south-east of Edinburgh, and had more than 75,000 occupied nests in 2014 (Murray et al., 2015). In 2022, massive mortality of adults and chicks due to avian influenza occurred here as well as in many other colonies (see sections 2.3, 2.4 and 4.2.1).

At sea on the Dutch Continental Shelf a significant increase in the number of gannets has been observed since 1990 (*Figure 7*; Fijn et al., 2022). The gannets occur very widespread mostly in low densities. Larger concentrations are often found near fishing vessels. Highest numbers of gannets on the DCS are usually found in August, for example around 35,000 individuals in 2020 (Table 3 in Annex 1). Fewer gannets occur in the coastal zone (Fijn et al., 2022), where numbers observed depend on the prevailing wind direction and availability of fish (Leopold & Platteeuw, 1987).

### 2.2.2 Black-legged kittiwake

The black-legged kittiwake is a widespread and abundant species with an estimated global population of between 14.6 and 15.7 million individuals (Wetlands International, 2016). The European population is estimated at around 3.25 to 3.45 million mature individuals (BirdLife International, 2015, 2022c). Since the 1980s, this population has declined by more than 40% (BirdLife International, 2015b, 2022d). The decrease has been attributed to changes in the marine environment which affect the prey (fish) populations (see paragraph 4.2.1).

The kittiwake is mainly a winter visitor in Dutch waters. In late spring and early summer, kittiwakes mainly concentrate in the central and northern North Sea and are much scarcer on the DCS. The highest numbers are found in November both on the offshore DCS and in the coastal zone, for example around 211,000 individuals in 2020 (Table 3 in Annex 1). Since 1991, the numbers of kittiwakes on the DCShave increased significantly at a moderate rate (<5% per year; *Figure 8*), in contrast to the decreasing European trend. However, zooming in on the last 12 years a decrease is observed at the DCS as well (Fijn et al., 2022).

Dutch offshore waters also harbour a (comparatively small) breeding population of kittiwakes. Since 2001 breeding has been observed on a number of oil and gas platforms in the vicinity of the Frisian Front, including platforms L-8P and L7-B (Camphuysen & Leopold 2007, Geelhoed *et al.* 2011). Numbers here are not monitored comprehensively but previous estimates ranged up to c. 200 pairs. In June 2023 however 350-400 breeding pairs were present on L7-B alone, indicating a substantial increase (Fijn et al. 2023).

## 2.3 Condition/quality in the international North Sea and Dutch North Sea

Condition/quality of these species' North Sea habitats are determined by a mixture of natural and climate processes and pressures from human activities. These pressures are described in chapter 4 of this document. Here we focus on two demographic indicators of environmental quality: reproduction and survival.

*Breeding productivity*

Because successful reproduction in birds depends on a multitude of environmental conditions, and reproduction is one of the key drivers of population development, breeding productivity of seabirds is a useful indicator of the quality of their environment, as acknowledged by its inclusion among the formal GES indicators used in OSPAR and EU MSFD assessments (OSPAR 2023).

The most recent assessment for the OSPAR region Greater North Sea region indicates that recent (2015-2020) breeding productivity of northern gannets has been sufficient to compensate for mortality levels reported for this species in the literature, in the breeding regions relevant to gannets occurring in Dutch waters (Greater North Sea and Arctic Waters) as well as in the Celtic Seas (Frederiksen et al. 2022). However, the outbreak of highly pathogenic avian influenza in 2022 has caused large-scale breeding failure and mortality in many North Atlantic colonies (see below and paragraph 4.2.1).

In the black-legged kittiwake, the situation is quite different. Recent breeding productivity in the Greater North Sea region has been so low that if maintained at the same level, a decline of ≥50% could occur over three generations, resulting in an IUCN Red List status 'Endangered'. Breeding success in Arctic (Mainly Norwegian) Waters has been even lower, leading to Red-listing as 'Critically Endangered' if maintained (Frederiksen et al. 2022). Breeding productivity of this species has been insufficient for a long period already, explaining the observed long-term population decline. Black-legged kittiwake has recently (2023) also been severely hit by avian influenza in countries around the North Sea (see below).

*HPAI-induced mortality*

In 2022 an outbreak of highly pathogenic avian influenza (HPAI) spread through northern gannet breeding colonies throughout the North Atlantic, with large impact. The majority of chicks and unprecedented numbers of adult birds died in 75% of all colonies. At the largest one, Bass Rock off eastern Scotland, the number of occupied sites decreased by at least 71%, breeding success declined by 66% compared to the long-term UK mean, and adult survival from 2021 to late 2022 was 42% lower than the preceding 10-year average (Lane et al., 2023). The latter figure suggests that c. 56,000 adult gannets died from HPAI in this colony alone.

Although the 2022 outbreak of HPAI caused mortality also in black-legged Kittiwakes, this species was less affected than the northern gannet. However, in the 2023 breeding season, the kittiwake was among the species hit hardest in the North Sea region and in Norway, by a new variant of the virus. A sound assessment of the impact on the population can however only be made in the next breeding seasons, when the number of birds returning to colonies can be quantified.[2].

## 2.4 Conservation status

4.4.1 International

*Northern gannet*

Both worldwide and in Europe, the conservation status of northern gannet is assessed as 'Least Concern', based on large population size and increasing trends (Birdlife International, 2022a, 20022b).
Analyses for the OSPAR Quality Status Report 2023 showed that recent gannet breeding numbers meet the criterion for 'Good Environmental Status' under the MSFD in all OSPAR regions in the NE Atlantic where the species was assessed. Between the early 1990s and 2015-20, breeding populations have increased 2.8 times in the Greater North Sea, 2.1 times in Arctic Waters, and 1.2 times in the Celtic Seas. In addition, breeding productivity also meets the GES criterion in all three regions (OSPAR 2023).
However, in the breeding season of 2022 highly pathogenic avian influenza (HPAI) outbreaks caused mass mortality of both adult breeding birds and their chicks in northern gannet colonies throughout the North Atlantic (Lane et al. 2023, see § 4.3). The unprecedented level of mortality in this one year alone may induce such a large reduction in the population that a reassessment of the conservation status is warranted. For instance, a reduction by ≥30% over three generations is a criterion for Red-listing as 'Vulnerable'.

*Black-legged kittiwake*

Since the 1980s, the European population is in sharp decline resulting in Red-listing in the 'Vulnerable' category in Europe and as 'Endangered' in the EU (BirdLife International, 2015, 2022b) . The species has also been placed on the OSPAR list of threatened and/or declining species and habitats (OSPAR Commission, 2008).

Analyses for the OSPAR Quality Status Report 2023 showed that recent Kittiwake breeding numbers still fail to meet the criterion for Good Environmental Status in all four OSPAR regions in the NE Atlantic in which the species is assessed, meaning that populations have declined by >30% since the early 1990s (OSPAR 2023). Within the Greater North Sea region, the GES criterium is met only in the subregions Skagerrak, Southern North Sea and English Channel. Breeding productivity in recent years does also not meet the GES criterion in any region, meaning that a further decline can be expected (OSPAR 2023).

2

4.4.2 National

Information about the 'Conservation Status' (in Dutch: *Staat van Instandhouding* SvI) is used as an aid for conservation measures for birds in the Netherlands[3]. The Dutch populations of both species are considered to be in favourable status.

*Northern Gannet*

The national conservation status (SvI) of northern gannet was recently re-assessed as favourable for all four components (population, distribution, habitat and future prospects; Table 4). A Favourable Reference Value (FRV) for the aspect 'population' has been set at a seasonal average number of 17,000 birds on the DCS (based on abundance data from 1990-2005, a period with fairly favourable conditions), and this FRV was exceeded in recent years (2014/15-2019/20 mean seasonal average 20,000 birds; Sovon 2022). Both the long-term (since 1990) and short-term trends (last 12 years) are moderately increasing (Figure 9). Note however that impact of the massive outbreak of HPAI in 2022 is not yet included in this trend and in this assessment of the conservation status.

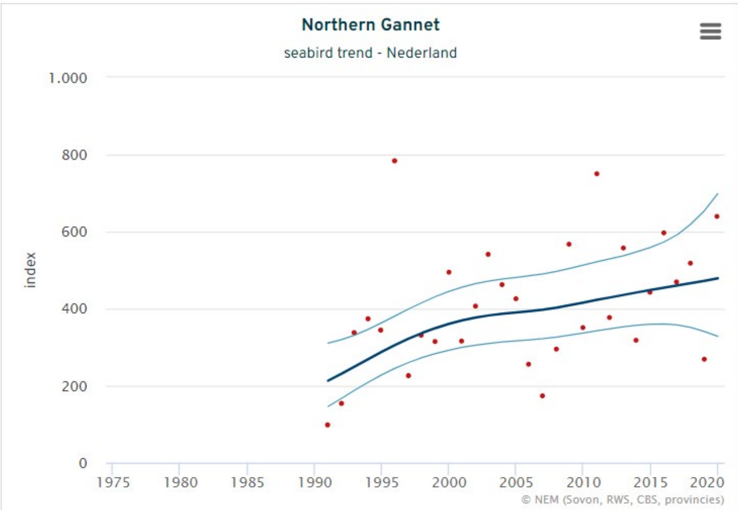


*Figure 7. Trends in northern gannets in the Netherlands (1991-2020). 1991 = 100% (source: NEM (Sovon, RWS, CBS, provincies)( https://stats.sovon.nl/stats/soort/710/?language=english)*

*Black-legged kittiwake*

The national conservation status (SvI) of black-legged kittiwake as a non-breeding bird is currently assessed as favourable, but the 'population' aspect was evaluated as 'unknown' (*Table 1*). Although the MWTL monitoring indicates that numbers on the DCS have increased on the long term (since 1990), over the last 12 years they have declined significantly (Figure 10). Because the kittiwake is not included in the conservation targets of one or more designated Natura 2000 areas in The Netherlands, no Favourable Reference Value for the national population size has been defined for this species (Sovon 2022).

The conservation status of kittiwake as a breeding bird was assessed as 'unknown', due to lack of data on the development of the small breeding population. Recent data indicate that this population is increasing, although still small (Fijn et al., 2023).

[3] https://www.sovon.nl/bepaling-staat-van-instandhouding

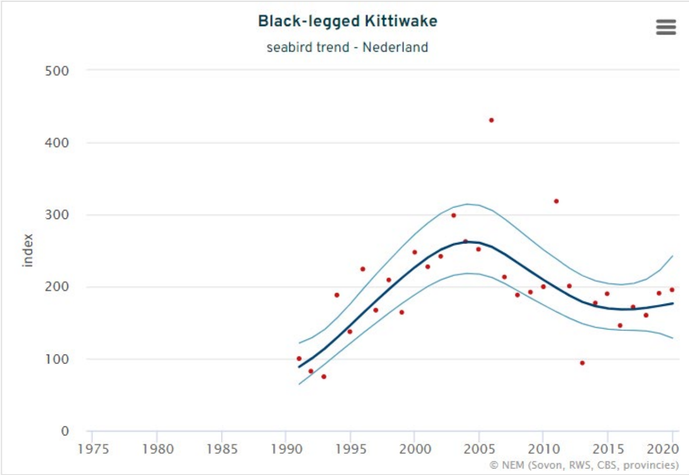


*Figure 8. Trends in Kittiwake in the Netherlands (1991-2020). 1991 = 100% (source: NEM (Sovon, RWS, CBS, provincies)( https://stats.sovon.nl/stats/soort/6020).*

*Table 1 Current conservation status (2013-2018) (Birds Directive) of northern gannet and black-legged kittiwake* (Sovon, 2023b, 2023a).

| **Conservation Status (2013-2018)** | **Northern gannet** | | **Black-legged Kittiwake** | |
|---|---|---|---|---|
| | **Breeding** | **Non-breeding** | **Breeding** | **Non-breeding** |
| Distribution | - | Favourable | Unknown | Favourable |
| Population | - | Favourable | Unknown | Unknown |
| Habitat | - | Favourable | Favourable | Favourable |
| Future | - | Favourable | Favourable | Favourable |
| Total status | - | Favourable | Unknown | Favourable |

# 3 Monitoring and research

## 3.1 National research and data collection

### 3.1.1 Long-term monitoring

*MWTL and NEM*

These two bird species (and other seabirds) are monitored within the program *Monitoring van de Waterstaatkundige Toestand des Lands* (MWTL), run by Rijkswaterstaat, and the Netwerk Ecologische Monitoring (NEM), a collaboration between national and provincial governments for the purpose of collecting nature data for policy underpinning. Counting seasons run from July to June in both programs.

Birds present at sea on the Dutch Continental Shelf (DCS) are counted from airplanes in the context of the MWTL program (e.g. Fijn et al. 2022). In the coastal zone, counts are made six times a year, in August, November, January, February, April and June. Four counts per year are made at the open sea (August, November, January and February). A fixed flight path is followed over the entire DCS (*Figure 9*), and bird numbers are extrapolated from these transect counts. In addition, designated marine Natura 2000 areas (Voordelta, North Sea Coastal Zone, Frisian Front and Brown Ridge) are examined in more detail. The census design allows for population estimates per census for each species, in addition to the assessment of trends in abundance.

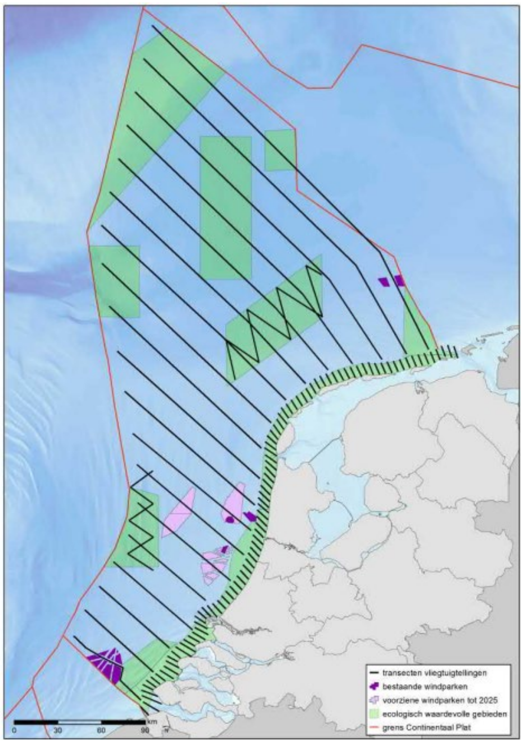


*Figure 9. Monitoring transects on the Dutch Continental Shelf (DCS; border indicated by the red line), with special emphasis on Brown Ridge, Frisian Front and coastal zone* (Fijn et al., 2022).

The MWTL data feed into the nation-wide monitoring program NEM. Another part of the NEM framework consists of counts of birds passing by in the coastal zone made from observation posts along the coast. Data from ca. 20 sites contribute to trend calculation for a number of seabird species. Trends for northern gannet and kittiwake are currently based on the MWTL data alone, but the seawatches do provide an additional source of information on abundance in the coastal strip.

Within the NEM data are also collected on the development of breeding bird populations. No northern gannets breed in The Netherlands, but a small breeding population of kittiwake is present on offshore platforms on the DCS. Their numbers are monitored assessed only opportunistically when observers are in the area at the right time. These data are stored in the breeding bird database of Sovon.

The trend data is collected by Sovon and trends are assessed by Statistics Netherlands. Results are published as population index numbers with derived trends per species and accessible via the Sovon website. Here also other information on these bird species is made available including distribution data and Conservation Status assessments (https://stats.sovon.nl/stats/soort/710 (gannet) and https://stats.sovon.nl/stats/soort/6020 (kittiwake). Results of the MWTL monitoring for seabirds are also available in annual reports, accessible via: https://puc.overheid.nl/rijkswaterstaat/ (e.g. Fijn et al., 2022).

*ESAS*

Other at-sea count data such as counts from ships by Wageningen Marine Research and other parties are collected in the ESAS (European Seabirds At Sea) database (https://esas.ices.dk). Any party (government institutions, windfarm operators, ngo's) can submit seabird data, both from aerial and ship-based counts.

*Beached Bird Survey*

Systematic counts by volunteers of dead birds washed up along the North Sea shores (Nederlands Stookolieslachtoffer Onderzoek NSO) has run since the 1960s (Camphuysen 2022). The survey was initiated to expose and monitor the effects of chronic oil pollution at sea, but monitors any kind of mortality in seabirds. Apart from the main metric (numbers of dead birds per km of shoreline), additional data are collected on age distribution, proportion of birds that are oiled, and other indications for cause of death (e.g, Camphuysen et al., 2023).

### 3.1.2 Other research programs

*Wozep and MONS*

Seabirds are and will also be monitored as part of Wozep (Wind Op Zee Ecologisch Programma, a research program on the ecological effects of wind energy development at sea, starting in 2016 and ongoing, https://www.noordzeeloket.nl/functies-gebruik/windenergie/ecologie/wind-zee-ecologisch-programma-wozep/) and MONS (the 'Nature Strengthening and Species Protection Monitoring Survey' 2022 - ongoing ) (Asjes et al., 2021). These two programs are and will be conducted in close collaboration. Relevant studies, planned or ongoing, are:

- Monitoring Seabirds Digital Aerial Surveys (ID-68); Monitoring of seabirds via Digital Aerial Surveys will in the future replace the current method with visual observations, which require low altitude flights not allowed within offshore wind farms. Digital Aerial Surveys are made from greater heights.
- Tagging Local Breeding Birds (ID-69). The tracking of breeding birds' movements is useful in studying the effects of wind farms and the success of breeding colonies (Asjes et al., 2022). In 2023, a start with such a tracking study was made outside the MONS framework in kittiwakes breeding on platform L7-B near the Frisian Front (Fijn et al. 2023).
- Model development (probably IBM) with the goal to model all possible effects of OWF (collisions, habitat loss and ecosystem effects) and possibly also other pressures on these species (as part of MONS), for several seabird species. Possibly, including both species mentioned in this plan. This will involve different steps like trying to quantify the effect of habitat loss.
- One year of digital aerial surveys of Borssele windfarm area and a reference area were analysed for species distribution and possible habitat loss. A repeat survey is scheduled for 2027 to see whether habituation occurred.
- Development of automatic image recognition for analysing digital aerial surveys.
- Preparation of density maps of seabirds, including the two species in this plan, based on a statistical analysis of environmental variables which may explain their distribution.
- Measuring simultaneously actual collisions and avoidance behaviour inside offshore windfarm Luchterduinen, and flight behaviour inside Borssele windfarm.

## 3.2 International research and data collection

There is no international monitoring programme for these two species, but breeding populations are monitored in some way in all countries in the NE Atlantic region except most of arctic Russia. Collation and analysis of trend data is carried out within the framework of the OSPAR Quality Status Reporting, currently within a cycle 6 years (OSPAR 2017, 2023), and of the EU Marine Strategy Framework Directive (part I).

Monitoring at-sea abundance is carried out also in some neighbouring North Sea countries, though a complete coverage of national sea areas is only achieved in The Netherlands, Belgium and Germany. Elsewhere the coverage is incomplete and often project-directed. For example, in the UK data are collected by the Crown estate and by offshore wind companies. Data are collected in the ESAS database, currently managed by ICES.

The two species covered in this plan are among the most well-researched seabirds worldwide, with many hundreds of publications published on each of them. However, there are still important gaps in knowledge, most of which concern the ecology of these species at sea, at all times but particularly at sea outside the breeding season and in sub-adult birds. Recent technological advances including satellite and GPS-tags, dive-depth recorders *et cetera* are helping to lift the curtain on these aspects which have long remained out of view.

# 4 Evaluation of threats, impacts and opportunities

## 4.1 Sensitivity of the species (group)/habitat in relation to pressures

As top predators with a specialised diet of fish and planktonic invertebrates, both northern gannet and black-legged kittiwake are sensitive to environmental pressures affecting all lower trophic levels of the marine ecosystem. Being birds with a 'slow' life history (i.e. a long lifespan but a relatively high age at first breeding and small number of young produced per breeding year), their populations recover only slowly from declines in size caused by low breeding success or high mortality. This applies most strongly to the larger northern gannet. On the other hand, the smaller black-legged kittiwake has a more restricted foraging range from the breeding colony, so is more likely to be affected by local changes in abundance or availability of prey. Also, it does not dive deep into the water and therefore partly depends on other predators (large fish, sea mammals, alcids) to chase fish to the surface (e.g. Camphuysen & Webb, 1999).

Burthe et al. (2014) assessed the vulnerability of seabird species in the Firth of Tay region, Scotland, to various anthropogenic threats. For northern gannet they listed reduction of fisheries discards and collision with offshore wind turbines as the most important pressures in this area, and fisheries effects through bycatch of birds and competition for prey fish and pollution as the second most. Kittiwakes were considered to be most vulnerable to competition for prey by fisheries and to wind farm collisions, with additional roles for discard reduction of discards, introduced predators and oil pollution. Note however that this prioritization may be region-specific and did not include effects of climate change and threats arising after 2014, like avian influenza.

## 4.2 Threats and impacts

### 4.2.1 Priority threats and impacts

*Reduction of prey stocks: fishery*

Because of their relatively restricted foraging range from the breeding colony (mainly within 50 km), kittiwakes are more likely to be affected by local changes in abundance or availability of prey than wider-ranging seabirds (Furness & Tasker, 2000). Also, as surface-feeders they partly depend on other predators (large fish, sea mammals, alcids) for making fish available at the surface (e.g. Camphuysen et al., 1999). Kittiwakes are affected by reductions in the availability of small pelagic shoaling fish, affecting both breeding success and survival, and caused by a combination of climate change and industrial fisheries (e.g. OSPAR 2009).

There is substantial published evidence for a link between the observed decline of kittiwakes in the UK and lack of sandeels. Frederiksen et al. (2004) showed that both breeding success and adult survival was negatively affected by high sea surface temperatures and by the presence of an industrial sandeel fishery. Kittiwake colonies in the UK could be grouped into regional clusters with similar patterns of temporal variability in breeding success, and these clusters were consistent with sandeel population structure (Frederiksen et al. 2005). Survival rates of adult kittiwakes in Shetland were also affected by sandeel abundance (Oro & Furness 2002).

In response to the above and other information the Scottish Government has installed a partial closure of sandeel fisheries in NE UK waters in 2000 and designated three Marine Protected Areas for sandeels and feeding seabirds (Daunt et al. 2008; https://marine.gov.scot/sma/assessment/case-study-sandeels-scottish-waters). In spring 2023 it announced a public consultation to completely close Scottish waters to industrial sandeel fishing, which is mainly conducted by EU trawlers from Denmark. In addition to sandeel, sprat and young herring are other important prey fish for kittiwakes in the North Sea, which are also targeted by commercial fisheries.

*Reduction of prey stocks: climate change*

For kittiwakes, a climate effect acting via the availability of sandeel in UK waters during the breeding season has received particular attention. Warming of the North-East Atlantic and the North Sea has caused major changes in plankton communities, in particular a decline in the copepod *Calanus finmarchicus*, which is often eaten by sandeels. The abundance of sandeel larvae has been shown to be strongly related to plankton abundance, and kittiwake breeding productivity to be positively related to the abundance of sandeel larvae in the previous year Frederiksen et al. (2006). Frederiksen et al. (2004) also reported a negative effect of between-year variations in SST on the survival of adult kittiwakes, and indicated that if mean SST in the North Sea were to increase further, this would lead to kittiwake population declines irrespective of whether the sandeel fishery was opened or not. However, Ruffino et al. (2020) note that subsequent studies have not all yielded consistent results, and the exact mechanisms behind the observed changes in kittiwake abundance, productivity and survival are likely to be varied and complex.

In northern Norway, capelin *Mallotus villosus* are the preferred food of kittiwakes and large stock fluctuations (including several collapses) in the Barents Sea had negative effects on the population. In 2003, when the capelin stock was low and spawning took place exceptionally far west, kittiwakes left their colonies and large numbers died from starvation. When small amounts of capelin appeared along the Finnmark coast in mid-May the birds returned to their colonies and breeding proceeded as normal (Barrett et al., 2004, Barrett, 2007). Over a period of 22 years, the survival of adult kittiwakes from N-Norway correlated positively with both the biomass of capelin in the Barents Sea where the gulls stay between March and October, and with the density of sea butterflies (*Thecosomata*) in their main wintering region in the Grand Banks-Labrador Sea area (NW Atlantic). These planktonic swimming sea snails form an important food source for fish, seabirds and whales. They have an internal aragonitic shell which makes them sensitive to ocean acidification due to climate warming, a process that is expected to be most serious in Arctic oceans. A decline in winter *Thecosomata* densities was observed in the NW Atlantic between 1990 and 2011 (Reiertsen et al., 2014).

Burthe et al., (2014), in a correlative study of changes associated with increasing sea surface temperatures (SST) in the Firth of Tay, eastern Scotland, noted a negative response of kittiwake population counts, survival and productivity. For northern gannet on the other hand, positive associations with climate change were found in in this study.

*Reduction of fisheries discards*

Probably, fisheries have been a driver of the historical increase of northern gannet in the North Sea area, and possibly also locally augmented kittiwake populations, through the added food availability created by discarding of unwanted fish, invertebrates and offal. Sherley et al. (2019) estimated that in 1990 about 510,000 tonnes of discards were produced in the North Sea, that could theoretically sustain 5.7 million seabirds, but that this had declined by 39% (equivalent to 2 million birds) in 2010 due to modifications in fishing methods and reduction of the fleets. In 2013, the EU introduced a 'discard ban', an obligation to land undersized fish of commercially exploited species, in sea fisheries which was expected to further reduce this food source (Bicknell e.a. 2013). Note however that this ban does not include offal (the waste parts of gutted fish) and bycaught invertebrates. Kittiwakes forage behind fishing vessels particularly on offal, and much more frequently in winter than during the breeding season, apparently reflecting the greater difficulty to feed naturally in winter (Camphuysen et al. 1995). Gannets do not feed on offal, but prefer discarded roundfish the discard type likely to be most reduced by the landing obligation. There is evidence of great dietary flexibility in gannets, and they might switch to alternative prey such as pelagic fish in the face of a discard ban. A key question is whether there are sufficient pelagic fish to meet the needs of the current numbers of gannets in the absence of discarding, particularly during the nonbreeding period when discards appear to be more important (Bicknell et al. 2013).

It is not yet clear what the actual impact of the EU landing obligation, in place since 2013, has been on gannets and kittiwakes. Looking at recent figures on the development of breeding numbers and breeding success in the Greater North Sea region, abundance of kittiwakes has shown a slower (rather than faster) decline in the years since 2013 than in the preceding period, and breeding productivity has been higher rather than lower as might have been expected (Dierschke et al. 2022, Frederiksen et al. 2022). In gannets, neither the trend in breeding abundance nor that of breeding productivity have shown a sudden change around 2013, although the latter does seem to show some decline since 2018. This seems to indicate that the impact of the landing obligation itself has been limited so far, but that does not mean that the long-term reduction of discard availability (due to fleet reductions and changes in fishing methods) haven't had significant effects.

*Avian influenza*

Highly Pathogenic Avian Influenza (HPAI) has recently emerged as a serious pressure on populations of the northern gannet and several other seabird species. A HPAI outbreak spreading through many seabirds colonies around the European coastlines in 2022 affected 75% of all existing gannet colonies and induced massive mortality in chicks as well as adults (Lane et al. 2023, see also § 4.3). The full impact of this event can only be assessed after colony occupancy and return rates of ringed birds have been assessed in the 2023 breeding season, but it has the potential of wiping out the gains of 10-20 years of population growth. Moreover, it seems unlikely that HPAI will stay away in the coming years. Whether or not the gannet population can recover from the loss incurred will then depend on the frequency of outbreaks and the extent to which immunity is built up in the population.

Although the 2022 outbreak of HPAI have caused mortality also in black-legged kittiwakes, this species was less severely affected than the northern gannet. However, the species appears to be hit hard- in the 2023 breeding season. A sound assessment of this mortality on population sizes can only be made after the next breeding season, and there is no guarantee that impact will remain low in future years. The recent history has shown that different bird species can be affected in different years, possibly as a result of small modifications in the virus.

*Offshore wind energy development*

Northern gannet and black-legged kittiwake populations are vulnerable to the development of offshore wind farms (OWF). Negative effects of wind farms may arise through fatal collisions of flying birds with turbine blades, and through disturbance leading to avoidance of windfarm areas and hence a loss of foraging area. Relative OWF sensitivity scores for seabirds were proposed by Bradbury et al. (2014). northern gannet and black-legged kittiwake were regarded as highly sensitive to collision but far less sensitive to displacement by OWF. However, while kittiwake was among species in which no net avoidance (nor attraction) was apparent in a recent review of 20 post-placement studies, the majority of these studies found a strong avoidance of OWF by northern gannets (Dierschke et al., 2016).

Lane et al. (2020) tracked the flight behaviour of gannets breeding on Bass Rock, eastern Scotland, and used the results to model collision risk in existing and planned windfarms. They found that risk was higher in the chick-rearing period than during pre-laying and incubation, and three times higher in females than in males due to differences in behaviour. Modelling indicated that the resulting mortality would slow down the (then) current population growth rate but not induce a decline.

Potiek et al. (2022) modelled the expected population level effects of collisions for 10 seabird species in four future OWF scenarios. All scenarios resulted in a violation of the pre-defined Acceptable Level of Impact (ALI) for the northern gannet population. For the black-legged kittiwake, only the largest national scenario (16.7 GW) violated the ALI. Note however that the latest policy plans envisage installment of 70 GW in Dutch Continental Shelf waters. Soudijn et al. (2022) modelled the potential impact of disturbance on gannets for the same OWF scenarios. Even though they assumed substantial avoidance of windfarms by gannets (at least 80%), they found that estimated mortality as a result of habitat loss did not lead to violation of the ALI in any scenario. However, the combination of habitat loss and collision by OWF did lead to exceedance of the ALI. Black-legged kittiwake was not considered in this study in view of the low disturbance by OWF observed in this species.

Development of offshore windfarms at the scale envisioned in the North Sea may also affect the ecosystem in general, e.g. by changing local current and wind patterns. The effects of such changes on gannets and kittiwakes are as yet hard to predict.

### 4.2.2 Other threats and impacts

*Bycatch mortality in fisheries*

Both the northern gannet and the black-legged kittiwake are consistently recorded as bycatch in fisheries (BirdLife International, 2022a&c). In the North Sea, gill netting seems to be the fishing method most likely to induce bycatch of these two species, but compared to the more documented impact of longline fisheries, the impact of gillnet fisheries on seabirds remains poorly known. Northern gannets were classified as susceptible to bycatch in gillnets by (Žydelis et al., 2013), whereas black-legged kittiwake were not. However, a study in Norwegian waters reported that kittiwakes made up 6% of the 52,000 seabirds by-caught over 10 years, and gannets 9% (Bærum et al. 2019). In a study on bycatch in coastal fisheries in Portugal, northern gannets were the species most often by-caught in all fisheries types including gillnets, while 'gulls' were recorded much less often (Oliveira et al., 2015). For kittiwakes, the frequency of bycatch in various fishing gear is generally low compared to northern fulmars and other procellariids, and alcids, although "gull species" recorded as bycatch may include kittiwakes (Johansen et al., 2020).

The WGBYC working group of ICES collates information on bycatch of protected species, including mammals, birds, turtles, and rare fish (https://www.ices.dk/community/groups/Pages/WGBYC.aspx). Since 2007 several reports of the WGBYC provided an overview of reported monitoring and fishing effort data and bycatch records that were submitted to the WGBYC database. As reporting non-cetacean protected species bycatch is not a mandatory requirement of EC Regulation No 812/2004[4] reporting format, the numbers reported are not a full record of the bycatch. Lack of dedicated monitoring, of both bycatch rates and the total effort in the corresponding fisheries (necessary for extrapolations and assessment of population impacts), is identified as the reason why a formal indicator for bycatch mortality could not be assessed in the OSPAR QSR 2023, except for a few specific bird-fisheries combinations (Dierschke et al. 2022). Because of this inability to evaluate the effects of bycatch on the bird populations, it is unclear whether this pressure should be listed as a 'main' or an 'other' threat.

*Predation*

Predation is a pressure confronting black-legged kittiwakes more than northern gannets. Both adult and young kittiwakes experience predation at the nests from a variety of predators, e.g. large gulls, skuas, corvids and raptors. Predation rates increase when these predators' main prey abundance is reduced, as found in Newfoundland as a consequence of changes in sea temperatures and delayed capelin availability to large gulls (Massaro et al., 2000) and in Shetland where the concomitant increase in great skua numbers and decrease in sandeel availability correlated with an increase in adult kittiwake and chick mortality rates (Heubeck 2002; Oro & Furness 2002). White-tailed eagles are predators of chicks and there is evidence that increasing harassment from eagles in colonies along the Norwegian coast causes local breeding failures and declines in both gannet and kittiwake numbers (Pettex et al., 2014; Anker-Nilssen et al., 2023). Mammalian predators, particularly introduced mink and rats, are also a threat to kittiwake eggs and chicks, but in many colonies on steep cliffs and sea stacks access for these land-based predators to breeding kittiwakes is limited.

The much larger northern gannet has less to fear from most predators except for the white-tailed eagle. Harassment by eagles has been mooted as a cause of a local decline in breeding gannet numbers in Lofoten and Vesterålen, Norway (Barret 2008), but it does not seem to pose a significant threat to the population as a whole.

[4] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:150:0012:0031:EN:PDF

*Pollution*

The threats to the northern gannet and the black-legged kittiwake of environmental pollution including litter are similar to a certain extent. Both birds spend large amounts of time on the open sea, and are therefore vulnerable to marine pollution. Since the 1990s, chronic oil pollution in the North Sea has been reduced to levels at which it does no longer seem a threat to seabird populations (Camphuysen, 2018), although larger spills may still occur due to accidents.

Gannets are particularly vulnerable to building up high concentrations of certain toxic compounds due to their high trophic level and preference for larger fish, which contain more organochlorine residues than smaller fish both in absolute and relative proportions (Parslow & Jefferies, 1977). Additionally, various studies on northern gannets and their eggs show elevated levels of mercury (Hg) and cadmium (Cd), relative to for seawater background values and diet, as well as PCBs (Barrett et al., 1996; Fimreite et al., 1980; Parslow & Jefferies, 1977; Pereira et al., 2009; Thompson et al., 1998).

Persistent organic pollutants (hereafter POPs) and heavy metals, such as mercury, can have negative effects on physiological, developmental and immune functions and have been shown to reduce both survival and breeding probability in kittiwakes (Tartu et al. 2013; Goutte et al. 2015). High concentrations of mercury have been found in kittiwakes breeding in Svalbard, and have been associated with a higher probability to skip breeding (Tartu et al. 2013). Whereas there is no clear sign of a reduction of mercury levels in arctic seabirds, levels of POPs in kittiwake eggs have decreased in the period 1983–2003 in northern Norway (Johansen et al., 2020).

*Marine litter*

In general, marine litter and microplastic debris pose a threat to many seabirds both through entanglement and ingestion. Small floating plastic particles may be ingested by birds, and although not directly linked to death this may lead to obstruction in the digestion system and starvation (Pierce et al., 2004). Ingestion of plastics seems more likely for kittiwakes than gannets given that they commonly feed on planktonic organisms. However, lower incidences of plastic debris have been documented in kittiwakes than in some other surface feeders such as northern fulmars (e.g. Poon et al. 2017).

Entanglement and drowning in nets, plastics, ropes, or (hooked) lines is a common cause of death for the northern gannet (Camphuysen, 1994; 2001, 2008). Rodríguez et al. (2013) reported that roughly 1% of the observed gannets in their study were entangled in plastic debris. This mostly affected immature gannets and varied with region; off Mauritania 20% of all birds showed entanglement in late spring. Plastics causing entanglement originate both from fishery (nets, lines) and other sources (e.g. beverage can wrappers). Camphuysen (2001) reported that in the 1980s, most gannets found entangled on Dutch beaches were entangled in fishnets or in various types of ropes and nylon fibres from trawlers, whereas in the 1990s most were killed in nylon fish lines of the type normally used by sports anglers. The effect of mortality by entanglement on the population level is still largely unknown however.

Several studies also show that many nests of both species contain plastic material in which chicks can become entangled (Hartwig et al., 2007; Nelson, 1978; O'Hanlon et al., 2017, 2019). In kittiwakes, the incorporation of larger plastic litter in nests has been documented in the UK and Denmark, but seems to be much less prevalent in arctic colonies (Johansen et al., 2020).

*Exploitation*

Human harvesting of eggs was formerly a problem for the black-legged kittiwake in Norway but is no longer a threat (Barrett & Tertitski, 2000). Kittiwakes are still hunted in Greenland, but the annual take has declined from 50,000-60,000 birds per year in the 1990s to 5,000-8,000 in 2004–2016 (Johansen et al., 2020). In Iceland, a harvest of fully-grown kittiwake chicks has dwindled since 2000, but there is still a poorly documented harvest of eggs. However this is unlikely to affect populations in the North Sea as kittiwakes from Iceland and Greenland winter predominantly in the NW Atlantic (Frederiksen et al. 2012). Currently, the overall pressure of harvesting on kittiwakes is probably not impacting the global kittiwake populations (Johansen et al., 2020).

Northern gannets are not directly taken in most of their range, except on Sula Sgeir off NW Scotland, where about 2000 large chicks (about 17% of the average chick production) are taken annually as a traditional source of human food. Modelling suggests that this harvest has reduced the rate of population growth in this colony, but it has continued to grow nevertheless (Trinder 2016). At the level of the total N Atlantic population the harvest has negligible impact. In 2022 no chicks were taken because of the avian influenza outbreak and it will also not take place in 2023.

### 4.2.3 Future threats and impacts

Potential impacts, risks and opportunities resulting from the three major transitions that are currently taking place on the North Sea (nature-, food- and energy transition) as described in the North Sea Agreement (OFL, 2020) are listed in Table 7 in Annex 1.

## 4.3 Opportunities

- Breeding space: For the kittiwake, artificial offshore breeding sites (‘kittiwake hotels') could be created or enhanced through non-decommissioning of offshore installations, improved management of existing platforms (toleration of birds), or construction of floating or other artificial reefs that offer breeding locations.
- Marine protected areas and offshore windfarms may increase prey availability, although also larger predatory fish may increase resulting in competition.
- Ecosystem based management of fisheries should take bird food requirements into account.

# 5 Existing national and international conservation measures

For the kittiwake, the Arctic Council has developed a protection plan and conservation strategy (Johansen et al., 2020). For the northern gannet, no such plan exists (for an overview, see Table 8 in Annex 1). In the Brown Ridge BD area, fishery measures will be taken in 2025, consisting of a ban on the use of gillnets and entangling nets from 1 October to 31 March. Furthermore, the ‘OSPAR Regional Action Plan - Recovery of Marine Birds’ is being developed and due in 2024.

# 6 Conclusion on overall status

| | **Northern Gannet** | **Black-legged kittiwake** |
|---|---|---|
| Rationale for protection plan | These birds are predicted to be vulnerable for further development of offshore wind | |
| Distribution | Present year-round on the entire Dutch Continental Shelf (DCS) and in the coastal zone; scarcest in spring and winter, most abundant in autumn and summer. | Present year-round on the entire DCS, with small breeding population on platforms near the Frisian Front; lowest numbers on DCS and almost absent from coastal zone in spring-summer. |
| Population | Yearly average number in 2014/15-2019/20 is 20,000 birds; recent seasonal maximum ca. 35,000.<br>Trend since 1991 is increasing (before mass mortality in 2022 due to HPAI). | Yearly average number in 2014/15-2019/20 is 20,000 birds; recent seasonal maximum ca. 200,000 birds.<br>Trend since 1991 is increasing, but last 12 years decreasing. |
| Condition (of habitat) | SvI for Habitat is Favourable; breeding productivity allows for population growth | SvI for Habitat is Favourable, but breeding productivity has been far too low to offset mortality for a long time |
| Threats/pressures | Avian influenza; reduction in availability of fisheries discards; collision mortality and disturbance/habitat loss in wind farms; bycatch by gillnet fishery | Reduction of food availability by fisheries and climate change; collision mortality in wind farms; avian influenza; predation |

# 7 Knowledge gaps

Knowledge gaps, including the ones identified in the MONS programme, are:

Population status

- Population parameters (nesting numbers, reproductive output, mortality) of both species are studied in several important breeding regions, but nevertheless several gaps remain. Many breeding areas are difficult to access and abundance monitoring is therefore not done annually but with longer intervals. This severely hampers evaluation of the impact of sudden events like the recent outbreak of avian influenza. Modelling studies of the impact of human activities like offshore wind development suffer from insufficient knowledge of survival rates of immature kittiwakes and gannets, spatial variation (between colonies/regions) in annual survival, and density dependence of mortality and dispersal in both species.
- In the Dutch breeding population of black-legged kittiwake, there is little information on even basic parameters such as total numbers, annual changes in numbers, and breeding output, although the first steps have been taken to collect some of this information (Fijn et al., 2023).

Food availability

- There is a lack of insight into the impact of the reduction in discards on both bird species, and the role of the discard ban herein.
- Mechanisms and relative importance of fisheries and climate effects on prey availability are insufficiently known;
- Importance and future outlook of winter prey availability in relation to climate change are not yet clear;

Bycatch

- Bycatch numbers are not known and not monitored well in most fisheries in the North Sea. Note that to assess the impact of bycatch on bird populations, not only the number of birds killed per unit of fishing effort should be known, but also the total fishing effort and preferably its spatial and temporal distribution. The CIBBRiNA EU LIFE project is envisaged to only partly fill this gap.

Offshore wind development

- Impact assessments for offshore wind development are still based on modelling approaches due to the difficulty of obtaining field data on actual collision rates at sea. In modelling of habitat loss there are still major uncertainties concerning its consequenses at the population level.
- Indirect effects of OWF via changes in hydrodynamics on food availability in the ecosystem is a knowledge gap.

Avian influenza

Long-term impacts of HPAI endemism are as yet unknown, but reason for concern.

Climate change

A big unknown is how climate change will play out for the North Sea ecosystem. Potentially, these effects may dwarf any other effect, including those of offshore wind farms. Should the Gulf Stream be severely affected by climate change, as predicted by Ditlevsen & Ditlevsen (2023), all the above becomes rather meaningless and we need to deal with a totally new situation.

Breeding sites

There is insufficient knowledge on the effectiveness of providing artificial breeding sites for kittiwakes, not only in terms of numbers settling but particularly in terms of breeding success. There is a danger of establishing an ecological trap, e.g. when attractive sites are provided too far from profitable foraging areas. It is yet unknow if breeding conditions might be better in the northern half of the DCS, where waters are generally clear and stratified in summer, as compared to the southern half, where waters are more turbid and less clear.

# 8 Possible actions

## 8.1 Introduction

Protective measures can be divided into 'direct prevention' aiming to prevent a specific negative impact such as added mortality (e.g. collision with a wind turbine) and 'indirect prevention' aiming at increasing the resilience of the population, so that the specific impact has less impact on the population.

Direct measures have a direct impact on species, because the individual bird won't die and can keep contributing to the population, or because no habitat or resource is taken away, preventing a (further) decline of the conservation status. An example of an indirect measure is enhancing breeding success by preventing predation at nest sites (eggs or juveniles).

Northern gannet does not breed in the Netherlands, while black-legged kittiwake has a breeding population that is very small in comparison to numbers present in Dutch waters outside the breeding season, and to numbers breeding in other North Sea countries. Potential measures for both species within The Netherlands will necessarily be targeted at improving foraging conditions and reducing mortality factors within these waters. The latter will however prove difficult in view of the pressure on realising the energy transition (which is in itself a necessity from a nature conservation perspective). Although mitigation measures to minimise the impact of wind farms, solar farms and other infrastructure related to this transition can and should be further developed and implemented, the most achievable options to avert the impact of these pressures may lie in 'indirect measures' strengthening the resilience of populations by other means. Apart from improving feeding conditions in Dutch waters, such indirect measures will probably be most effective in the areas where the majority of northern gannets and black-legged kittiwakes using Dutch waters reproduce, but of course the Netherlands have no direct management power there. This highlights a general characteristic of seabird conservation: in many species effective conservation of populations can only be achieved by international cooperation (see section 8.6).

In the next paragraphs the distinct pressures and impacts (Chapter 4) are revisited to describe the measures that could be taken to lessen or remove their effects.

## 8.2 Conservation and/or restoration goals of the proposed actions

- The main conservation goal for northern gannet is to maintain the population size above (as was the case before the mass mortality due to HPAI) or at the favourable reference value (FRV) for the national conservation status (Staat van Instandhouding; see section 2.4).
- The main goal for black-legged kittiwake is to stop the decline and bring back or stabilise the population size to some former level. In order to do this it is useful to define a favourable reference value (FRV) for population size.

## 8.3 Priority measures

| Problem | Objective | Action | Rationale |
|---|---|---|---|
| **Food shortage** | | | |
| Reduced availability of discards | Compensate negative effects of the discard ban | | The discard ban is a measure taken for the protection of a range of fish species. It should lead to fewer discards, and may thus be detrimental to scavenging seabirds, but it will not be lifted or adjusted to benefit gannets and kittiwakes. The effect of the discard ban thus cannot be resolved directly, calling for indirect measures addressing other limitations on the population. |
| Availability of schooling pelagic fish | Safeguard availability of pelagic fish | Consider food availability for birds in setting upper limits on catch | A reduction of fisheries targeting pelagic fish could enhance food availability, but it is not entirely clear whether current fisheries levels in the southern North Sea significantly reduce pelagic fish stocks to such extent that effects on bird populations can be expected (e.g. at about one-third of the maximum biomass observed in long-term studies; Cury et al., 2011). Sandeels are a special case as these species are demersal (bottom-dwelling) in sandy areas for much of the year and mainly become available to surface-feeding seabirds when they move up in the water column to feed and spawn, in spring and summer. |
| | | Ban bottom-trawl fisheries from N2000 areas suitable for sandeel | There are indications that a reduction of seafloor disturbance by bottom-trawl fisheries could positively affect sandeels (Tien et al., 2017), and such a measure could be implemented in marine N2000 areas where sandeel occur. |
| **Avian influenza** | | | |
| Avian influenza | Reduce probability of transmission from poultry industry to wild birds | Vaccinate poultry | Now that HPAI has become endemic and H5N1 sustains itself across years in wild birds, it will not be possible to fully prevent future outbreaks and or the emergence of new virus variants. Nevertheless, reducing the chance of transmission events from the poultry industry to wild birds remains a useful strategy, if only to reduce the likelihood of transmitting new variants that can overcome existing or newly achieved immunity in populations. Introducing vaccination in the poultry industry is long overdue.<br>A full reform of the international poultry industry will be needed to minimise this risk of newly emerged variants spilling back to wild birds, but is outside the scope of this protection plan. |

| Problem | Objective | Action | Rationale |
| --- | --- | --- | --- |
| | Reduce transmission within colonies (and other sites where many birds gather) | Remove dead birds in breeding colonies | There are indications that spread of HPAI through breeding colonies / roost sites can be slowed down by immediate removal of dead birds. At many inaccessible breeding sites of gannets and kittiwakes this will however often be a logistical challenge or even impossible. Collecting carcasses floating at sea near affected breeding colonies could be achievable, but it is as yes unclear whether this will contribute to containing an outbreak, so this should be tested. |
| Offshore wind farms | | | |
| Negative effects of wind farms | Reduce effect of collisions with wind turbines | Plan windfarms in areas with fewest flying birds | The impact of windfarms will grow with each new park built. Direct impact may be reduced to some extent by thoughtful spatial planning of new wind farms, avoiding areas where most birds occur. Bird distribution has played a limited role in the spatial planning of windfarms so far, partly because our knowledge of seabird distribution in time and space was less good than it is now. More informed choices about the spatial development of offshore wind can now be made, although the scale of the current ambitions for the next decades is such that avoiding high density bird areas will only partly be possible. |
| | | Develop and employ collision-reducing mitigating measures | Because of this limited scope for spatial mitigation, it will be of the utmost importance to employ 'operational' mitigating measures reducing collisions with turbines. This calls for more research into and field experiments with a wide suite of possible measures, including local curtailment, increasing lowest tip height and enhancing the visibility of turbine blades for birds. |
| | | Contribute to and initiate 'indirect' measures in breeding areas abroad | Given the scale of development of offshore wind energy plans for the near and mid-term future and the results of modelling studies of expected effects, it seems unrealistic to think that mitigation and spatial planning will be sufficient to avoid negative impacts on gannet (and possibly kittiwake) populations. This calls for a (internationally) concerted effort to increase the resilience of these populations through indirect measures, such as reducing other mortality factors and enhancing breeding productivity. |

## 8.4 Other measures

| Problem | Objective | Action | Rationale |
|---|---|---|---|
| Safe breeding habitats | | | |
| Lack of (safe) breeding habitat | Increase breeding productivity | Create new / alternative breeding sites. | In view of the decline in breeding kittiwake numbers that has been ongoing for decades and has left many formerly occupied island and cliff faces (partly) abandoned, one could surmise that availability of safe nest sites should not currently be a limiting factor for the population. However, it is possible that offering new or alternative safe nesting habitat could profit the species because such habitat is in short supply locally, safer than existing sites, or closer to rich foraging areas. Distance to good feeding grounds is important for the small kittiwake which does not range as far from the colony as larger seabirds like gannets. The occupation of (abandoned) oil and gas platforms on the DCS is a case in point; these sites allow the birds to make use of feeding opportunities in, e.g., the Frisian Front area which probably could not be exploited from the UK or Helgoland, the nearest breeding sites. Also along the Norwegian coast, substantial numbers of kittiwakes have occupied oil and gas installations, and achieve on average better breeding success than birds breeding along the mainland coast (T. Anker-Nilsen pers. comm.). In the UK, artificial structures have been purposely created to accommodate breeding kittiwakes, either to compensate negative impact of windfarms or to relocate birds from harbour city buildings where they are considered a nuisance.<br>It is also important to tolerate and protect kittiwakes breeding on existing anthropogenic structures, like oil and gas platforms. This may require a change of mind among platform managers and crew. |
| Bycatch | | | |

| Problem | Objective | Action | Rationale |
|---|---|---|---|
| Bycatch | Reduce bycatch risk in various types of fishery | Fill knowledge gaps on bycatch | The number of birds bycaught in the Dutch part of the North Sea is thought to be low at present, but insufficiently well known. With the possible expansion of gillnet fisheries, and of longline fisheries at windfarm sites, the number of casualties may rise in the future. |
| | | Stimulate use of bycatch-reducing measures | The knowledge gap must be filled to see if dedicated measures are called for, like banning certain fishing methods from important bird areas. A suite of practical measures that can reduce bycatch risk in various types of fishery has been identified internationally, and should be advocated within the fishing community. To date, the most feasible way to mitigate bycatch in gillnets has been through spatial and temporal regulation of fishing effort or gear substitution. In comparison to longline and trawl fisheries, research into technical bycatch mitigation measures for seabird bycatch in gillnet fisheries has been limited. Scaring lines and reduction in the release of wastewater during fishing operations have been advocated as effective mitigation measures in reducing bycatch rates of surface feeders (Baerum et al. 2019). In addition, increasing the visibility of nets and deployment of acoustic pingers can be considered (Zydelis et al. (2013). |
| Pollution and litter | | | |
| Pollution and litter | Less plastic litter and pollutants in the marine environment | Reduce wasting of fishing gear and other plastics | Threats posed by plastics and other marine litter should be reduced through lessening the use of plastics, recycling, better awareness of not dumping trash overboard, and better legislation on fishing gear. |
| | | Reduce use and disposal of toxic compounds | The suspected accumulation of toxic compounds can only be reduced by reducing the amount used and better regulation and control of disposal by industry. |

## 8.5 Research and monitoring to evaluate effectiveness of the measures

Studies into the effectiveness of measures can be divided into two main types: (1) research conducted before a measure is applied, aiming to investigate whether a given measure does likely work in practice (proof of principle, will the measure take away some limitation on the system?) or to optimise the 'design' of the measure, and (2) research/monitoring aiming at establishing the effectiveness of the measures that are taken. Note that the timing of the latter type is not confined to after the introduction of the measure, as in many cases the response of the system/ population must be compared to a baseline situation. In principle, any measure adopted should be flanked by type (2) research/monitoring into its effectiveness. Necessary type (1) studies have mostly been listed in chapter 7 ('knowledge gaps').

## 8.6 Collaboration

International collaboration and coordination, e.g. within the context of OSPAR, is essential for several of the measures proposed above, primarily those pertaining to fisheries and wind energy development. Particularly because the great majority of both the northern gannets and the black-legged kittiwakes using Dutch waters during part of their annual cycle breed outside the Netherlands, this is however equally important for most other measures, in particular those aiming to increase population resilience by improving conditions on breeding grounds. In addition to the obvious role for Dutch governance agencies in defining and implementing measures within our own borders therefore, there also lies a quite important task in initiating and contributing to conservation measures elsewhere, both at the level of international conservation and resource exploitation policy and in the form of tangible, hands-on (or ‘wallet-on’) contribution to projects.

## 8.7 Communication/awareness

*Communication and data sharing*

The species protection plan will be shared on the MONS-pages on Noordzeeloket.nl. A schematic overview will be given of the measures including their time frame. Also related research reports will be made available on Noordzeeloket.nl, as well as evaluations of the effectiveness of the plan. Where applicable, targets, monitoring and measures will be integrated into the MSFD-cycle.

Statistics on the population development per species are already shared through the website of Sovon. These pages link to more background information on the website of Vogelbescherming. On the latter site, more details will be added on the measures that are taken within the context of the species protection plan.

*Awareness*

Since both northern gannet and black-legged kittiwake are not often seen near the coast the general public may not be familiar with them. Quite a few Dutch will know the northern gannet since it is an iconic species, but most will not know or recognize the black-legged kittiwake. It is therefore of importance to give more information about these species and the need for their protection. One of the ways to do this, next to the information provided on above-mentioned websites, is through excursions at sea or to coastal sites like the Pier of IJmuiden during times of the year that there is a higher likelihood of seeing them.

# 9 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. The organisation has been certified since 27 February 2001. The certification was issued by DNV.

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# Justification

Report C087/23
Project Number: 4318100403

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved: M.F. Leopold, PhD
Senior researcher

Signature:

Date: 21 December 2023

Approved: A.M. Mouissie, PhD
Business Manager Projects

Signature:

Date: 21 December 2023

# Annex 1. Summary tables

Table 2(Inter)national legal and policy instruments and their applicability for the northern gannet and the black-legged kittiwake (“Yes” = relevant; “No” = not relevant)

| **Instrument** | **Description** | **Northern gannet (*Morus bassanus*)** | **Black-legged kittiwake (*Rissa tridactyla*)** |
|---|---|---|---|
| **International** | | | |
| EU Birds Directive (BD) | The BD seeks to conserve all wild birds in the EU by setting out rules for their protection and management. | Yes | Yes |
| Natura 2000 | Natura 2000 (a European network of protected nature areas where designated species and their natural habitats are protected in order to preserve biodiversity) areas in the Netherlands designated for bird species. Designation of Cleaver Bank, Central Oyster Grounds, Dutch Coast and Dogger Bank is currently being considered by the Dutch government. | Brown Ridge | No |
| EU Marine Strategy Framework Directive (MSFD) | The MSFD aims to protect the marine environment across Europe, including the conservation of seabirds.[1] | Yes | Yes |
| Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) | The Bern Convention aims to promote cooperation between the signatory countries in order to conserve wild flora and fauna and their natural habitats and to protect endangered migratory species. Appendix II: Strictly protected species; Appendix III: Protected species | Yes Appendix III | Yes Appendix III |
| OSPAR List of Threatened and/or Declining Species and Habitats | In order to protect biodiversity, OSPAR has defined a list of 'threatened and declining species and habitats' that are in need of protection. | No | Yes |
| EU Common Fisheries Policy (CFP) | The CFP is aimed at sustainable management of fish stocks. It also plays a crucial role in the reduction of negative impacts of fishing activities on seabirds, including seabird bycatch. [2] | Yes | Yes |
| **National** | | | |
| Nature Conservation Act | Dutch law containing rules for the protection of nature | Yes | Yes |
| Red List | List of species that have disappeared or have threatened, near-threatened or vulnerable status in the Netherlands | No | Yes Sensitive |
| Framework Ecology and Cumulation (KEC) | The KEC is an assessment framework initiated by the Dutch government to generate insights into how offshore wind farms affect birds, bats and marine mammals. | Yes | Yes |
| North Sea Agreement | The NSA is an agreement between central government and stakeholder parties about policy and choices about activities in the North Sea until 2030 and beyond. As part of the North Sea Agreement, species protection plans will be developed and implemented for vulnerable species including birds. | Yes | Yes |

1 The assessments of Good Environmental Status (GES) under the MSFD also includes the state of marine bird populations: MSFD Primary Criterion D1C2 “The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured” (Commission Decision EU 2017/848). The underlying species protection plan derives from the Dutch MSFD program of measures that describes that more generic species protection is important for long-lived and vulnerable species, such as seabirds.

2 An Action Plan has been developed to reduce incidental catches of seabirds in fishing gear and minimize seabird bycatch to levels which are as low as practically possible

Table 3. Estimated population size (per aerial survey) of gannets and kittiwakes on the Dutch Continental Shelf (DCS) and coastal zone (average + 95% confidence interval) (2017-2021). Highest numbers are shown in bold.

| Count | Estimate >12 nm (DCS) | Min | Max | Estimate <12 nm (coastal zone) | Min | Max | Total | Source |
|---|---|---|---|---|---|---|---|---|
| **Gannet** | | | | | | | | |
| Aug-17 | 18,894 | 13,452 | 26,537 | 756 | 327 | 1,538 | 19,650 | (Fijn et al., 2018) |
| Nov-17 | 9,343 | 6,190 | 14,104 | 556 | 276 | 1,121 | 9,899 | (Fijn et al., 2018) |
| Jan-18 | 3,126 | 2,104 | 4,645 | 2,360 | 1,013 | 5,496 | 5,486 | (Fijn et al., 2018) |
| Feb-18 | 11,179 | 6,736 | 18,555 | 723 | 331 | 1,581 | 11,902 | (Fijn et al., 2018) |
| Aug-18 | 41,814 | 30,640 | 57,062 | 278 | 123 | 630 | **42,092** | (Fijn et al., 2019) |
| Nov-18 | 17,567 | 9,018 | 34,220 | 1183 | 519 | 2696 | 18,750 | (Fijn et al., 2019) |
| Jan-19 | 6,568 | 3,229 | 13,361 | 61 | 11 | 332 | 6,629 | (Fijn et al., 2019) |
| Feb-19 | 5,825 | 3,209 | 10,573 | 706 | 234 | 2132 | 6,531 | (Fijn et al., 2019) |
| Apr-19 | 10,351 | 7,133 | 1,502 | 298 | 112 | 794 | 10,649 | (Fijn et al., 2019) |
| Jun-19 | 13,231 | 8,364 | 20,932 | 461 | 227 | 937 | 13,692 | (Fijn et al., 2019) |
| Aug-19 | 19,371 | 14,284 | 26,270 | 268 | 89 | 813 | 19,639 | (Fijn et al., 2020) |
| Nov-19 | 9,411 | 5,365 | 16,508 | 1,139 | 546 | 2,374 | 10,550 | (Fijn et al., 2020) |
| Feb-20 | 4,047 | 2,868 | 5,711 | 42 | 15 | 119 | 4,089 | (Fijn et al., 2020) |
| Apr-20 | 6,141 | 4,152 | 9,082 | 103 | 43 | 245 | 6,244 | (Fijn et al., 2020) |
| Jun-20 | 19,578 | 12,427 | 30,842 | 831 | 282 | 2,448 | 20,409 | (Fijn et al., 2020) |
| Aug-20 | 34,950 | 25,295 | 48,290 | 52 | 18 | 150 | **35,002** | (Fijn et al., 2022) |
| Nov-20 | 29,530 | 17,707 | 49,246 | 4,729 | 20,240 | 9,987 | 7,682 | (Fijn et al., 2022) |
| Jan-21 | 12,848 | 6,083 | 27,136 | 391 | 199 | 765 | 13,239 | (Fijn et al., 2022) |
| Feb-21 | 22,437 | 12,954 | 38,862 | 87 | 27 | 279 | 22,524 | (Fijn et al., 2022) |
| Apr-21 | 29,972 | 16,776 | 53,548 | 0 | 0 | 0 | 29,972 | (Fijn et al., 2022) |
| Jun-21 | 8,130 | 5,493 | 12,033 | 75 | 30 | 190 | 8,205 | (Fijn et al., 2022) |
| **Kittiwake** | | | | | | | | |
| Aug-17 | 31,766 | 17,495 | 57,678 | 390 | 162 | 938 | 32,156 | (Fijn et al., 2018) |
| Nov-17 | 33,903 | 23,527 | 48,857 | 19,850 | 14,575 | 27,034 | 53,753 | (Fijn et al., 2018) |
| Jan-18 | 62,136 | 50,571 | 76,345 | 12,871 | 9,689 | 17,098 | 75,007 | (Fijn et al., 2018) |
| Feb-18 | 37,121 | 27,357 | 50,370 | 4,465 | 3,045 | 6,546 | 41,586 | (Fijn et al., 2018) |
| Aug-18 | 41,001 | 27,416 | 61,318 | 375 | 124 | 1,129 | 41,376 | (Fijn et al., 2019) |
| Nov-18 | 86,068 | 68,703 | 10,782 | 6,382 | 4,871 | 8,361 | 92,450 | (Fijn et al., 2019) |
| Jan-19 | 82,452 | 62,297 | 10,913 | 7,303 | 5,433 | 9,818 | 89,755 | (Fijn et al., 2019) |
| Feb-19 | 60,299 | 36,387 | 99,926 | 1,142 | 482 | 2,706 | 61,441 | (Fijn et al., 2019) |
| Apr-19 | 12,112 | 7,806 | 18,793 | 161 | 29 | 877 | 12,273 | (Fijn et al., 2019) |
| Jun-19 | 17,546 | 10,079 | 30,545 | 0 | 0 | 0 | 17,546 | (Fijn et al., 2019) |
| Aug-19 | 27,711 | 13,261 | 57,907 | 48 | 9 | 264 | 27,759 | (Fijn et al., 2020) |
| Nov-19 | 59,104 | 41,582 | 84,009 | 19,645 | 11,158 | 34,586 | 78,749 | (Fijn et al., 2020) |
| Feb-20 | 139,166 | 96,460 | 200,782 | 881 | 399 | 1,944 | **140,047** | (Fijn et al., 2020) |
| Apr-20 | 7,831 | 5,184 | 11,829 | 0 | 0 | 0 | 7,831 | (Fijn et al., 2020) |
| Jun-20 | 136,950 | 43,755 | 428,646 | 0 | 0 | 0 | 13,695 | (Fijn et al., 2020) |
| Aug-20 | 40,990 | 14,189 | 118,414 | 324 | 149 | 705 | 4,423 | (Fijn et al., 2022) |
| Nov-20 | 191,882 | 134,600 | 237,542 | 19,298 | 9,899 | 37,621 | **211,180** | (Fijn et al., 2022) |
| Jan-21 | 77,795 | 59,344 | 101,983 | 10,209 | 5,436 | 19,174 | 88,004 | (Fijn et al., 2022) |
| Feb-21 | 72,232 | 38,865 | 134,245 | 46 | 9 | 241 | 72,278 | (Fijn et al., 2022) |
| Apr-21 | 91,274 | 48,535 | 171,649 | 0 | 0 | 0 | 91,274 | (Fijn et al., 2022) |
| Jun-21 | 12,817 | 5,771 | 28,468 | 0 | 0 | 0 | 12,817 | (Fijn et al., 2022) |

Table 4. Summary table for status of northern gannet and black-legged kittiwake.

| **Description of species** | **Northern gannet** | **Black-legged kittiwake** | **Comment** |
|---|---|---|---|
| Is the species (group) native to the Netherlands? | Yes | Yes | |
| Does the species depend on different habitats throughout its lifecycle? | Yes (breeding vs non-breeding) | Yes (breeding vs non-breeding) | |
| Is the quality of its habitat currently in decline/threatened? | Yes | Yes | see Pressures |
| Is it a migratory species? | Yes | Yes | |
| Does the species fulfil the role of apex predator in the food web? | Yes | (Yes) | |
| Is the species (group) a keystone species[5] or is the habitat a critical habitat[6]? | No | No | |
| Is the species (group)/habitat rare[7]? | No | No | Kittiwake is scarce as a breeding bird |
| Is the species of commercial importance? | No | No | |
| Is the condition of the species currently in decline/threatened? | Yes (HPAI) | Yes | Internationally Yes, but SvI in Dutch waters favourable |
| Is the population in decline/threatened? | International: No/Yes (HPAI); NL: No | International: Yes NL: No/Yes | |
| Is the distribution of the species in decline? | No | No | |

[5] A species whose impact on the community is disproportionately large relative to its abundance. Effects can be produced by consumption (trophic interactions), competition, mutualism, dispersal, pollination, disease, or habitat modification (non-trophic interactions) (MEA, 2005).

[6] A critical habitat is of significant importance to certain species, threatened or unique ecosystems, or key evolutionary processes (Martin et al., 2015). For example an identified breeding site, nursery area or feeding ground.

[7] Bird species are considered rare because of small populations or restricted local distribution (EC, 2010); Habitat species are considered rare with small populations that are not at present endangered or vulnerable , but are at risk. The species are located within restricted geographical areas or are thinly scattered over a more extensive range (EC, 1992).

Table 5. Overview of national and monitoring programs and (inter)national status assessments.

| National monitoring programs and status assessments | Northern gannet | Black-legged kittiwake |
|---|---|---|
| Network Ecological Monitoring (NEM) | Yes | Yes |
| National Water Systems Monitoring Programme (MWTL monitoring) | Yes | Yes |
| Statutory Research tasks (WOT) and Policy Support tasks (BO) monitoring | Yes | Yes |
| Offshore wind ecological programme (WOZEP) monitoring | Yes[8] | Yes[9] |
| Coast-based seawatching (NEM) | Yes | Yes |
| Beached bird survey (NSO) | Yes | Yes |
| N2000 management plan reviews | Yes | No |
| **(Inter)national monitoring programs and status assessments** | | |
| Birds Directive/Vogelrichtlijn Art. 11 | Yes | Yes |
| MSFD/KRM Mariene Strategie Deel 1 | Yes | Yes |
| OSPAR Quality Status assessments | Yes | Yes |
| OSPAR species/habitat status assessment | No | Yes |
| Red List assessment (Birdlife International, 2022b) | Yes | Yes |

[8] https://www.noordzeeloket.nl/en/functions-and-use/offshore-wind-energy/ecology/offshore-wind-ecological-programme-wozep/birds/

[9] https://www.noordzeeloket.nl/en/functions-and-use/offshore-wind-energy/ecology/offshore-wind-ecological-programme-wozep/birds/

Table 6. Summary table of key threats and impacts to the species (NG: northern gannet, BK: black-legged kittiwake.

| | Type of pressure/ impact | Cause of threat and effect | Scale of threat | Prospects |
|---|---|---|---|---|
| Climate change | reduced prey availability | decline/shift of sandeel (NE North Sea), capelin (Barentsz Sea), and/or sea butterflies (NW Atlantic) | NG: limited?<br>BK: substantial? | Increase |
| Fisheries | reduced availability of forage fish | competition for food in breeding season | NG: limited<br>BK: substantial | Decline due to closure? |
| | reduced availability of fishery discards | change of fishing methods, EU landing obligation | NG: limited/ moderate<br>BK: limited/ moderate | Increase? |
| | bycatch mortality | accidental bycatch in fishing gear | NG: moderate?<br>BK: limited?<br>(both poorly known) | Increase due to shift from bottom trawl to set nets? |
| Wind energy development | direct mortality | collisions with turbine blades | NG: substantial<br>BK: moderate | Large increase |
| | loss of foraging habitat | disturbance by turbines and traffic | NG: moderate?<br>BK: limited | NG: Large increase |
| Pollution | mortality due to oiling | chronic oil spillage, accidental spills | NG: limited<br>BK: limited | Stable/Decline |
| | entanglement and ingestion of litter | plastics and other litter | NG: unknown<br>BK: Unknown | Unknown |
| | toxic effects of contaminants | mainly river- and airborne | NG: unknown<br>BK: Unknown | Unknown / Decline |
| Predation | mortality of eggs, chicks and sometimes adults | direct predation | NG: limited<br>BK: moderate (substantial?) | NG: Limited?<br>BK: Decline (of great skua) |
| | disturbance and desertion of colonies | disturbance / harassment by predators | NG: limited<br>BK: moderate? | NG: Increase?<br>BK: Decline? |
| Disease (HPAI) | Adult mortality, low breeding success | HPAI (from poultry) endemic in wild birds | NG: substantial<br>BK: limited | Increase / Pertain |
| Exploitation | Adult mortality, reduced breeding success | Shooting of adults, harvesting eggs / young | NG: Limited<br>BK: Limited | Stable / Decrease |

Table 7 Impacts, risks and opportunities regarding the transitions on the North Sea.

| **Regarding the transitions on the North Sea:** | **Species** | **Comment** |
|---|---|---|
| **Nature transition** | | |
| Does creation of MPAs without bottom trawling activities improve the species (group) /habitat? | NG: unlikely<br>BK: likely in sandeel regions | MPAs without fisheries (and discards!) could support fewer northern gannets and BK; however sandeel stocks may benefit (Tien et al. 2017) |
| Further tightening of fish landing obligation | NG: negative?<br>BK: positive? | Directs system back towards 'natural state' with fewer discards |
| Ecosystem-based fisheries management | NG: Unknown<br>BK: Positive | Management explicitly targets bird food requirements |
| **Energy transition** | | |
| Is improvement of the species a means of mitigating effects of the energy transition? (In other words: do large-scale wind farms have negative effects on the species/habitat?) | NG: Yes<br>BK: Possibly | |
| Or do large-scale wind farms offer an opportunity to improve the species/habitat? | NG: No<br>BK: No? | BK: unless non-fished windfarms increase sandeel availability<br>Comment: very unlikely. There is under water competition with large fish, living in these wind farms: they eat forage fish too! |
| Can the improvement or protection of the species contribute to the climate goals? | No | |
| **Food transition** | | |
| Is improvement of the species (group)/habitat related to the food transition? (Think of: mariculture in offshore wind farms; growing areas for commercial fish; farming of oysters; etc). | Probably not | |

Table 8 Overview of current protection measures and regulations in place.

| **National conservation measures** | **Species** |
|---|---|
| Does a national species protection plan already exist for this species? | NG: No<br>BK: No |
| Does a national management or protection plan already exist in another framework? | No |
| Do national protective measures already exist? | Both: general protection under Wet Natuurbescherming |
| Is the species protected in one or more N2000 management plans? | NG: Yes, in Brown Ridge<br>BK: No |
| Are there measures in the Programme of measures under the Dutch Marine Strategy (Part 3)(Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015)? | Both: Yes, but no new ones (the implementation of a new BD N2000 area (Brown Ridge), the implementation of fishery measures within N2000 areas). |
| … | |
| **International conservation measures.** | |
| Do international species protection plan already exist for this species/habitat? | OSPAR Regional Action Plan - Recovery of Marine Birds, in preparation |
| Do international protective measures already exist? (e.g. EU regulations) | Both: General (Bird Directive);<br>NG: None specific<br>BK: NE UK Sandeel Closure |
| Are OSPAR Recommendations applicable (recommendations for species and habitats on the OSPAR List of Threatened and/or Declining Species and Habitats[10]) | NG: No<br>BK: Yes |
| Are measures applicable under the Trilateral Wadden Sea Collaboration? | Both: No |
| Or under the EU Common Fisheries Policy? | ? |
| … | |

[10] https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats

Table 9 Overview of recommendations for new protective measures.

| **Nr** | **measures** | **Framework policy/legal** | **Responsible parties** | **Executing parties** | **Time** |
|---|---|---|---|---|---|
| 1 | Reduce fishing on certain pelagic stocks | CFP | LNV, EC | | |
| 2 | Ban pelagic fisheries from N2000 areas | BD, N2000 | LNV | | |
| 3 | Ban bottom trawl fisheries from N2000 areas if useful for sandeel | BD, N2000 | LNV | | |
| 4 | Advocate bycatch-reducing methods in fisheries | CFP | LNV, fisheries organisations | LNV, VBN, fisheries organisations | |
| 5 | Establish need to regulate bycatch ( e.g. impose bycatch-reducing methods) | CFP | LNV, science | LNV, science | |
| 6 | Strategic planning offshore windfarms | BD, MSDF | LNV, EZK, RWS | LNV, EZK, RWS, private companies | 2023 > |
| 7 | Reduce collision risk at turbines and habitat loss | | LNV, industry | | |
| 8 | Create new/alternative breeding sites for kittiwake | | | | |
| 9 | Measures to reduce transmission of HPAI from poultry to wild birds | | LNV, industry | | |
| 10 | Reduce consumer plastics | | | | |
| 11 | Reduce loss of fishing gear | | | | |
| 12 | active contribution to international collaboration and implementation of measures | | | | |

# Annex 2. Lists of pressures, threats and impacts

Marine Strategy Framework Directive (MSFD) pressures list (EU, 2017)[11]

| Theme | Pressure |
|---|---|
| Biological | Input or spread of non-indigenous species |
| | Input of microbial pathogens |
| | Input of genetically modified species and translocation of native species |
| | Loss of, or change to, natural biological communities due to cultivation of animal or plant species |
| | Disturbance of species (e.g. where they breed, rest and feed) due to human presence |
| | Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities) |
| Physical | Physical disturbance to seabed (temporary or reversible) |
| | Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate) |
| | Changes to hydrological conditions |
| Substances, litter and energy | Input of nutrients — diffuse sources, point sources, atmospheric deposition |
| | Input of organic matter — diffuse sources and point sources |
| | Input of other substances (e.g. synthetic sub stances, non-synthetic substances, radionuclides) — diffuse sources, point sources, atmospheric deposition, acute events |
| | Input of litter (solid waste matter, including micro-sized litter) |
| | Input of anthropogenic sound (impulsive, continuous) |
| | Input of other forms of energy (including electromagnetic fields, light and heat) |
| | Input of water — point sources (e.g. brine) |

OSPAR Pressure list: key pressures reported by OSPAR (2010)[12]

**Key Pressures**
Barriers to species movement
Climate changes
Death or injury by ship strikes
Habitat damage
Habitat loss
Hazardous substances
Hydrographical changes
Introduction of non-indigenous species and translocations
Litter
Loss of prey species
Microbial pathogens
Nutrient and organic enrichment
Oil pollution
pH changes
Predation

[11] Commission Directive (EU) 2017/845 of 17 May 2017 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies. Official Journal of the European Union L 125/27.
[12] OSPAR Quality Status Report 2010 (https://qsr2010.ospar.org/en/ch10_02.html)

Removal of target and non-target species
Siltation rate changes
Threats outside the OSPAR area
Underwater noise

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