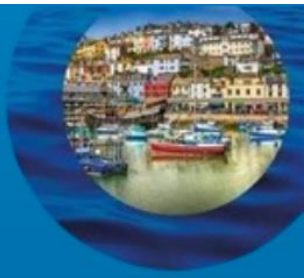
Marine Management Organisation



Marine Non-Licensable Activity Impacts Evidence: Birds (DRAFT)

September 2026

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Marine Non-Licensable Activity Impacts Evidence: Birds (DRAFT)

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Executive Summary

This document collates and analyses the best available evidence on the impacts of marine Non-Licensable Activities (mNLA) on marine protected area (MPA) features and will inform site level assessments of the impact of mNLA on MPAs as part of the Marine Management Organisation's (MMO) work to manage MPAs. MNLA have the potential to impact birds, therefore management of these activities may be required within an MPA. For each MPA, a site level assessment considering the site conservation objectives, spatial and temporal activity levels and exposure to natural disturbance will be completed to determine whether management will be required.

Available evidence indicates that above water noise, underwater noise, and visual disturbance are the primary mechanisms through which mNLA may affect protected bird species considered in this document. The literature indicates that non-motorised watercraft and sailing activities primarily disturb birds through visual presence and above water noise, while hovercraft, motorised watercraft, motorised personal watercraft (MPW) and commercial wildlife watching from the sea can additionally generate underwater noise. The extent of this disturbance is influenced by a range of factors, including species-specific traits, flock size, breeding status, habituation to human presence, environmental conditions, and the type, speed and proximity of the activity. Consequently, the potential for adverse effects on MPA site integrity will vary between species and locations and should be considered on a site level basis, taking account of the level and distribution of activity, the species present, and the need for appropriate management measures where required.

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1 Introduction

Marine Management Organisation (MMO) is the principal regulator for England's seas, including leading the assessment and management of marine Non-Licensable Activities (mNLA) for marine protected areas (MPA) inshore of 12 nautical miles (nm).

This document forms part of MMO's work to achieve the government's aim of identifying and implementing appropriate management measures in place for all inshore MPAs in English waters by the end of 2030. It is one of a suite of documents which focus on the interaction of designated features with mNLA, and it will support the delivery of site level assessments.

The potential for pressures resulting from mNLA and their impacts on designated features within MPAs have been assessed by gathering and analysing the available evidence for activity-feature interactions.

This document describes the pressures resulting from mNLA which may impact birds.

The Marine Non-Licensable Activity Impacts Evidence: Summary[1] provides further background information and details of other documents produced and the features and activities included within the scope of this programme of work.

1.1 Key definitions

A separate glossary in the Marine Non-Licensable Activity Impacts Evidence: Methodology[1] includes the important terms used in this document. Wherever possible these are taken from Natural England's Glossary of terms used within conservation advice packages (CAP)[2].

The following terms are particularly important when reading this document:

Designated Feature ("feature") - a species, habitat, geological or geomorphological entity for which an MPA is identified and managed. This includes both designated and qualifying features.

[1] Marine Non-Licensable Activity Impacts Evidence documents are available: www.gov.uk/government/calls-for-evidence/marine-non-licensable-activities (last accessed 30 September 2026)

[2] Natural England's MPA Conservation Advice: Glossary of Terms: www.designatedsites.naturalengland.org.uk/pdfs/MPA_CAGlossary_March2019.pdf (last accessed 10 September 2026)

Sensitivity – the sensitivity of a feature (species or habitat) is a measure that is dependent on the ability of the feature (species or habitat) to resist change and its ability (time taken) to recover from change (**Figure 1**).

Pressure - the mechanisms through which an activity has an effect on a feature.

Impact - the consequence of a pressure/pressures (such as habitat degradation) where a change occurs that is different to that expected under natural conditions.

Figure 1: The approach to determine sensitivity from pressures for each feature and activity interaction.

1.2 Structure of this document

Section 2 lists the MPA features considered and references the evidence sources used in this document.

Section 3 describes the types of mNLA considered in this document.

Section 4 describes the mechanisms underpinning all bird responses to disturbance, the factors influencing these responses, and the resulting behavioural and ecological impacts.

Sections 5 to 8 describe the available evidence of the pressures resulting from the mNLA and their impact on the designated features. Where a feature is potentially sensitive to mNLA (based on its resistance to the pressure and ability to recover) the interaction is considered. Each section lists the pressures to which the features may be sensitive, using Natural England's CAPs and MMO judgement. Each section also lists those pressures which have not been assessed or where insufficient evidence has been found to assess sensitivity. Each section also details available evidence about the designated feature, its ability to resist and recover from change, and its resultant sensitivity.

Section 9 summarises the conclusions of the assessed pressure feature interactions within this review.

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Annex 1: describes how feature-pressure interactions have been identified; and provides a table of all the potential pressure-feature interactions and the sensitivity assessment for each.

Annex 2: Species-specific sensitivity to disturbance provides an adapted table (Goodship and Furness, 2022) summarising species-specific sensitivity to disturbance and recommended buffer zones. These buffer zones are precautionary measures to reduce disturbance during the breeding and non-breeding seasons for each species.

Annex 3: Birds considered in this literature review provides a table of all bird species discussed in this review and all bird species in scope of MMO assessment.

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2 Overview of bird features

This section describes the different species considered in this document under the broad terminology of “bird features”.

2.1 Bird functional groupings

There are 62 species of birds in scope of this review which are all features of the special protection areas (SPAs) which MMO has prioritised for assessment. Numerous species can be found in significant numbers across English waters throughout the year, while others are primarily seasonal visitors appearing during either breeding or non-breeding periods (**section 2.3**). Detailed species profiles are available on the British Trust for Ornithology (BTO) website (BTO, 2023).

To understand and mitigate the ecological impacts of mNLA on bird populations, species have been classified into functional groups (**section 2.1**) reflecting their differing feeding and habitat traits and taxonomical relatedness. This approach was taken to provide a framework to enable use of proxy species (**section 2.2**) in the assessment of data-deficient species.

2.1.1 Breeding and non-breeding birds

Birds across all functional groups have been categorised as breeding or non-breeding based on differences in their ecological roles, spatial patterns, and seasonal behaviours within SPAs (NatureScot, 2023). These distinctions are important for understanding bird species population dynamics and habitat use throughout the annual cycle. Breeding birds typically exhibit strong site fidelity, often returning to specific nesting locations year after year. In the breeding season, activities are concentrated around reproductive tasks such as nest building, incubation, and chick-rearing (Gibson et al., 2018).

In contrast, non-breeding birds tend to display greater mobility and occupy a wider range of habitats (Jarrett et al., 2021). The term “wintering birds” is often used specifically for species present during winter months but is not a synonym for all non-breeding birds. Non-breeding birds can also include summer visitors outside of their breeding season as well as passage migrants. Their movements are often driven by foraging needs, seasonal migrations, and environmental conditions (Marra et al., 2015). During the non-breeding period, birds may form large aggregations or disperse across broader geographic areas, utilising diverse habitats for feeding and roosting.

The behavioural and spatial differences between breeding and non-breeding birds are key to understanding bird ecology and informing management strategies across different life stages.

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2.1.2 Functional group 1: Breeding seabirds

Seabird species typically nest colonially in exposed coastal habitats and display strong site fidelity. Nesting occurs on cliff faces, islands or beaches, with synchronised breeding efforts. Adults engage in extensive foraging excursions, often travelling considerable distances to provide for their chicks (Drewitt and Langston, 2006; Méndez-Roldan, 2013).

2.1.3 Functional group 2: Non-breeding seabirds

Outside the breeding season, seabirds become more dispersed and highly mobile. Species can be pelagic or coastal, some foraging and roosting offshore, others preferring sheltered bays. Foraging involves plunge-diving, underwater pursuit diving or surface seizing prey (Drewitt and Langston, 2006; Desprez et al., 2018).

2.1.4 Functional group 3: Breeding waders

Breeding waders nest in open coastal or estuarine zones, with ground-level nests and eggs camouflaged among vegetation or substrates. These birds are territorial during breeding and exhibit behaviours such as display flights and alarm calls to protect their nests. Feeding typically involves probing soft substrates and searching vegetation for invertebrates (Smart and Gill, 2003; Pearce-Higgins et al., 2007).

2.1.5 Functional group 4: Non-breeding waders

Non-breeding waders form large aggregations on intertidal flats where uninterrupted access to feeding and roosting sites is essential for survival. Foraging involves synchronised movements across mudflats to exploit tidal cycles, while roosting sites are chosen based on proximity to feeding areas and safety from predators (Goss-Custard et al., 2006; Stillman et al., 2007).

2.1.6 Functional group 5: Breeding waterfowl

Breeding waterfowl nest in wetlands, ponds and slow-moving rivers, using dense vegetation for cover. Nesting females often remain close to nest sites and engage in vigilant incubation. Feeding occurs in shallow waters and includes dabbling or diving for aquatic vegetation and invertebrates (Beale and Monaghan, 2004).

2.1.7 Functional group 6: Non-breeding waterfowl

Non-breeding waterfowl form large flocks in estuaries and freshwater habitats. Their behaviour centres around energy conservation, with efficient feeding and communal roosting. They forage in groups and select sites where food is easy to find and where they can stay warm (Gill, 2007).

2.1.8 Functional group 7: Breeding birds of prey

Raptors (another term for birds of prey) establish nesting territories in coastal cliffs or upland woodlands. Nesting pairs show high fidelity to sites and invest in provisioning

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and defending their nests. Feeding involves hunting live prey, often over wide territories (Goodship and Furness, 2022).

2.1.9 Functional group 8: Non-breeding birds of prey

Outside the breeding season, raptors shift to a more nomadic lifestyle, covering extensive areas in search of prey. Roosting is solitary or in loose aggregations, often in sheltered or elevated perches that allow for effective scanning of landscapes (Bühler et al., 2023).

2.1.10 Functional group 9: Breeding crepuscular insectivores

Species like the European nightjar *(Caprimulgus europaeus)* nest on the ground in heathlands and open woodland clearings (Global Kitesurfing Association, 2017). Active primarily during twilight hours, they rely on aerial insect hunting and exhibit low-profile nesting behaviour, camouflaging with ground substrates (Liley and Clarke, 2003).

2.1.11 Functional group 10: Non-breeding divers and seaducks

These birds overwinter in protected coastal waters and estuaries, feeding on benthic invertebrates and fish. Foraging is diving-based, requiring high energy expenditure and specialised physiological adaptations for cold conditions. Roosting often occurs in open water (Pearce-Higgins et al., 2007; Panter and Liley, 2017).

2.1.12 Functional group 11: Non-breeding songbirds

These birds occur primarily as passage migrants or wintering visitors, using coastal wetlands, reedbeds, saltmarshes and adjacent terrestrial habitats for foraging and roosting. These species are highly mobile, with site use driven largely by food availability and environmental conditions (Marra et al., 2015).

2.1.13 Non-breeding waterbird assemblage

The non-breeding waterbird assemblage is an SPA qualifying feature that represents the collective importance of all waterbird species using a site during the non-breeding season, rather than a biological or functional grouping. It includes species drawn from multiple functional groups, most commonly non-breeding waders, waterfowl, divers and seabirds, which together meet numerical thresholds of international importance within estuarine and coastal habitats. Unlike functional groups, which are used in this assessment to describe shared ecological traits and behaviours, the assemblage feature is designated to protect the overall abundance, diversity and integrity of the waterbird community as a whole, recognising that impacts may affect multiple species simultaneously even where no single species is significantly affected in isolation (Goss-Custard et al., 2006; Natural England, 2023).

2.1.14 Breeding seabird assemblage

The breeding seabird assemblage is an SPA qualifying feature that reflects the conservation value of a site for supporting a mixed community of breeding seabird

species, assessed collectively rather than individually. This assemblage may include species that are also listed separately as named SPA features, but its purpose is distinct. It protects the structure, diversity and total size of the breeding seabird community, recognising shared nesting habitats, synchronised breeding, and overlapping foraging areas (Drewitt and Langston, 2006; Méndez-Roldan, 2013). While the breeding seabirds functional group is used here to characterise common ecological traits and behaviours for assessment purposes, the assemblage designation captures community-level sensitivity and cumulative pressures that may affect multiple species at once, thereby providing broader ecosystem-level protection alongside species-specific conservation objectives (Natural England, 2023).

2.2 Proxy species

This review prioritises UK-relevant species that are in scope of MMO assessment (**Table A3. 1**). However, there is limited research for some functional groups, habitats, or disturbance types directly applicable to the UK context. Therefore, ecologically comparable proxy species, both UK and non-UK, were selected to represent similar functional groups to strengthen the overall assessment of bird responses to disturbance (**Table A3. 1**). For example, non-UK plovers such as the Malaysian plover *(Anarhynchus peronii)* and western snowy plover (*Anarhynchus nivosus*), and non-UK waterfowl such as canvasback (*Aythya valisineria*) and snow goose (*Anser caerulescens*) provide relevant analogues for disturbance responses where direct UK data are sparse. UK out-of-scope species such as the mallard (*Anas platyrhynchos*) and black-winged stilt (*Himantopus himantopus*) also supplement evidence for underrepresented groups. The inclusion of these proxies (**Table A3. 1**) allows for a more robust and precautionary review by inferring likely responses based on shared ecological traits and behavioural strategies.

2.3 Conservation status

The “Birds of Conservation Concern” (BOCC 5) assessments (Stanbury et al., 2021) outline the conservation status of established bird species in the UK (Stanbury et al., 2021). Species on the red list are either globally at risk or have experienced a 50% or more reduction in population size or habitat extent over the past 25 years (or longer depending on data availability). Amber listed birds are present in the UK in internationally notable numbers and/or have declined by 25% to 49% within a similar timeframe or across extended historical periods. Species classified under the green list are generally considered to have a favourable conservation status and more secure populations. Within this review, there are eight species with a green listing, 36 species with an amber listing and 18 species with a red listing (**Table 1**).

The International Union for Conservation of Nature (IUCN) Red List assessment of extinction-risk indicates the European and global extinction risk of bird species, based on geographic range, population size, population trajectory and extinction probability. From the global perspective none of the 62 species in this review are

Critically Endangered or Endangered and only one is Vulnerable, which is the Atlantic puffin *(Fratercula arctica)* (**Table 1**).

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Table 1: Species in scope of MMO assessment listed by functional group. An X indicates whether each species is a qualifying SPA feature for the breeding season, non-breeding season, or both, within the SPAs prioritised for MMO assessment. This reflects only the SPA populations relevant to this document and does not represent the breeding status of each species within England. Conservation status of species is shown by Global and European IUCN and BOCC 5 status. (a) IUCN Red List Status: NE = Not Evaluated, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered (IUCN, 2026). (b) BoCC 5 status: R = Red, A = Amber, G = Green, (Stanbury et al., 2021).

Functional group	Common name	Scientific name	Breeding	Non-breeding	Global IUCN Status (a)	European IUCN Status (a)	GB Status (BoCC5) (b)
Seabirds	Arctic tern	*Sterna paradisaea*	X		LC	LC	A
	Common tern	*Sterna hirundo*	X	X	LC	LC	A
	Guillemot	*Uria aalge*	X		LC	LC	A
	Herring gull	*Larus argentatus*	X		LC	LC	R
	Lesser black-backed gull	*Larus fuscus*	X	X	LC	LC	A
	Kittiwake	*Rissa trydactyla*	X		VU	VU	R
	Little tern	*Sternula albifrons*	X		LC	LC	A
	Mediterranean gull	*Ichthyaetus melanocephalus*	X	X	LC	LC	G
	Atlantic puffin	*Fratercula arctica*	X		VU	VU	R
	Roseate tern	*Sterna dougallii*	X		LC	LC	R
	Sandwich tern	*Thalasseus sandvicensis*	X	X	LC	LC	A
	Gannet	*Morus bassanus*	X		LC	LC	A

Functional group	Common name	Scientific name	Breeding	Non-breeding	Global IUCN Status (a)	European IUCN Status (a)	GB Status (BoCC5) (b)
	Razorbill	*Alca torda*	X		NT	NT	A
	Storm petrel	*Hydrobates pelagicus*	X		LC	LC	A
	Great black-backed gull	*Larus marinus*	X		LC	LC	R
	Little gull	*Hydrocoloeus minutus*		X	LC	LC	G
	Shag	*Phalacrocorax aristotelis*	X		LC	LC	A
Waders	Avocet	*Recurvirostra avosetta*	X	X	LC	LC	A
	Bar-tailed godwit	*Limosa lapponica*		X	LC	LC	G
	Bittern	*Botaurus stellaris*	X	X	LC	LC	A
	Black-tailed godwit	*Limosa limosa*		X	NT	NT	R
	Curlew	*Numenius arquata*		X	NT	NT	R
	Dunlin	*Calidris alpina*		X	LC	LC	R
	Golden plover	*Pluvialis apricaria*		X	LC	LC	G
	Grey plover	*Pluvialis squatarola*		X	LC	LC	A
	Knot	*Calidris canutus*		X	LC	LC	A
	Little egret	*Egretta garzetta*		X	LC	LC	G
	Eurasian oystercatcher	*Haematopus ostralegus*		X	LC	LC	A

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Functional group	Common name	Scientific name	Breeding	Non-breeding	Global IUCN Status (a)	European IUCN Status (a)	GB Status (BoCC5) (b)
	Redshank	*Tringa totanus*		X	LC	LC	A
	Ringed plover	*Charadrius hiaticula*	X	X	LC	LC	A
	Ruff	*Calidris pugnax*	X	X	LC	LC	R
	Sanderling	*Calidris alba*		X	LC	LC	A
	Turnstone	*Arenaria interpres*		X	LC	LC	A
	Purple sandpiper	*Calidris maritima*		X	LC	LC	R
Waterfowl	Bewick's swan	*Cygnus bewickii*		X	LC	LC	R
	Dark-bellied brent goose	*Branta bernicla bernicla*		X	LC	LC	A
	Gadwall	*Mareca strepera*	X	X	LC	LC	G
	Greater white-fronted goose	*Anser albifrons*		X	LC	LC	A
	Pink-footed goose	*Anser brachyrhynchus*		X	LC	LC	G
	Pintail	*Anas acuta*		X	LC	LC	A
	Shelduck	*Tadorna tadorna*		X	LC	LC	A
	Shoveler	*Spatula clypeata*	X	X	LC	LC	A
	Slavonian grebe	*Podiceps auritus*		X	LC	LC	R
	Spoonbill	*Platalea leucorodia*		X	LC	LC	G
	Teal	*Anas crecca*	X	X	LC	LC	A

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Functional group	Common name	Scientific name	Breeding	Non-breeding	Global IUCN Status (a)	European IUCN Status (a)	GB Status (BoCC5) (b)
	Whooper swan	*Cygnus cygnus*		X	LC	LC	A
	Wigeon	*Mareca penelope*		X	LC	LC	A
	Greylag goose	*Anser anser*		X	LC	LC	A
	Light-bellied brent goose	*Branta bernicla hrota*		X	LC	LC	A
Birds of prey	Marsh harrier	*Circus aeruginosus*	X		LC	LC	A
	Hen harrier	*Circus cyaneus*		X	LC	NT	R
	Montagu's harrier	*Circus pygargus*	X		LC	T	R
Crepuscular insectivore	Nightjar	*Caprimulgus europaeus*	X		LC	LC	A
Divers and seaducks	Black-throated diver	*Gavia arctica*		X	LC	LC	A
	Common scoter	*Melanitta nigra*		X	LC	LC	R
	Goldeneye	*Bucephala clangula*		X	LC	LC	A
	Great northern diver	*Gavia immer*		X	LC	LC	A
	Red-breasted merganser	*Mergus serrator*		X	LC	LC	A
	Long-tailed duck	*Clangula hyemalis*		X	VU	VU	R
	Pochard	*Aythya ferina*	X		VU	VU	R
	Common eider	*Somateria mollissima*		X	NT	NT	A
Songbirds	Aquatic warbler	*Acrocephalus paludicola*		X	VU	VU	R

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3 mNLA detail of activities

Within MMO remit there are eight types of mNLA which are listed and defined below. This literature review considers five of these activities. Each has the potential to impose one or more pressures on bird features of the SPAs in scope of this review. Anchoring activity and diving and snorkelling activity are not considered within this review as they are unlikely to impose pressures on SPA bird features. The relevant section below provides more detail regarding the exclusion of these activities.

1. Anchoring
2. Diving and snorkelling
3. Hovercraft
4. Motorised personal watercraft
5. Motorised watercraft
6. Non-motorised watercraft
7. Sailing
8. Wildlife watching from the sea (commercial)

Non-motorised watercraft and sailing without an engine have been grouped together in this literature review due to their comparable potential to disturb birds through noise and visual disturbance. They will be collectively referred to as non-motorised watercraft.

MPW and motorised watercraft have also been grouped together in this literature review due to their comparable potential to disturb birds through noise and visual disturbance. They will be collectively referred to as motorised watercraft.

There may be additional activities or categories of activities identified at a site level, which would be considered and included in a site assessment.

3.1 Anchoring

This activity involves the dropping of an anchor by any powered or sailing vessel (with or without an engine) to secure the vessel to the seabed, temporarily, in order to prevent it drifting with the wind or current (Griffiths et al., 2017). Anchors are generally heavy metal objects designed to dig into or hook onto the seabed. To create hold, the anchor is dropped, and a length of chain is laid out on the seabed to hold it horizontally on the seabed (Griffiths et al., 2017). The anchor is “set” (fixed in position) as some pulling force is exerted on the chain but not enough to drag it and break it free (Griffiths et al., 2017). As the vessel drifts, the dragging anchor carves furrows into the seabed, scrapes on the surface of firm seabed, or the anchor may move sideways along the benthos (Griffiths et al., 2017). In addition, vessels at anchor in the intertidal area will impact the seabed when the hull or keel rests on the

seabed as the tide goes out. Anchoring activity has been scoped out of this review as its interaction with the seabed and the presence of a stationary vessel are pressures unlikely to have a significant direct impact on birds. Any disturbance that may arise from a stationary vessel will be covered in **section 3.5** and **3.6**.

3.2 Diving and snorkelling

Diving and snorkelling refer to swimming, either underwater or on the surface, using self-contained underwater breathing apparatus (scuba) or snorkelling equipment. This activity excludes the extraction of sea fisheries resources during the activity (such as spearfishing). Diving and snorkelling have been scoped out of this review as they are considered to pose minimal disturbance to birds. This is primarily because the activity takes place underwater, largely out of sight and auditory range of birds. Divers entering the water directly from land often enter at safe access points where birds are unlikely to be roosting/nesting. The impact of a vessel carrying divers will be covered in the pressures from motorised watercraft.

3.3 Hovercraft

A hovercraft, also known as an air-cushion vehicle, is a craft capable of travelling over land, water, mud or ice and other surfaces. Hovercraft are primarily used in sheltered environments, typically with large expanses of flat, intertidal areas such as mudflats or sandflats (Natural England, 2017).This activity has the potential to interact with birds at the surface and beneath the surface, through above and underwater noise, collisions, litter, introduction of light, introduction or spread of invasive non-indigenous species (INIS) and visual disturbance.

3.4 Motorised personal watercraft

A motorised personal watercraft (MPW) is a recreational watercraft that the rider sits or stands on. Some models have an inboard engine driving a pump jet that has a screw-shaped impeller to create thrust for propulsion and steering. These craft are often referred by the brand names such as Jet Ski. The MPW category includes e-foils, “jet ski” and electric-powered personal vessels. This can also include hydroflying. A hydroflyer is a water sports device that allows a person to "fly" above the water, propelled by the force of water jets. It connects to a MPW, like a jet ski, via a long hose, and the rider controls the thrust and direction by shifting their weight. The high-pressure water jets propel the person on the hydroflyer above the water and below. MPW have the potential to interact with birds at the surface and beneath the surface, through above and underwater noise, collisions, litter, introduction of light, introduction or spread of INIS and visual disturbance.

3.5 Motorised watercraft

The use of motorised vessels, including motorboats (powerboats), sailing vessels and yachts in marine and estuarine waters. The motorised watercraft category includes water sports that involve being towed behind a motorised vessel such as

wakeboarding, waterskiing, parascending and parasailing as well as the impact of vessels carrying participants for other mNLA such as diving and snorkelling. This activity has the potential to interact with birds at the surface and beneath the surface, through above and underwater noise, collisions, litter, introduction of light, introduction or spread of INIS and visual disturbance.

3.6 Non-motorised watercraft

Non-motorised watercraft covers a wide variety of paddle or wind propelled sports. This includes canoeing (all types), kayaking (all types), kitesurfing, kiteboarding, kite foiling, windsurfing, wingsurfing, wingfoiling, winging, kite winging, dinghies, stand up foil boarding and stand-up paddleboarding (SUP). These activities have the potential to interact with birds at the surface through above water noise, collisions, litter, introduction or spread of INIS, and visual disturbance.

3.7 Sailing

This category includes sailing vessels without a motor as well as sailing vessels with motors that remain unused while under sail. Sailing boats include dinghies, day boats, keelboats, or yachts which may or may not be taken out of the water at end of use. This activity has the potential to interact with birds at the surface, through above water noise, collisions, litter, introduction of light, introduction or spread of INIS, and visual disturbance.

3.8 Wildlife watching from the sea (commercial)

This category covers wildlife watching from any commercial organised trip at sea from any vessel, this includes organised trips and excursions and refers to paid-for activities undertaken for the purpose of observing, photographing, or experiencing marine and coastal wildlife in its natural environment. These activities are typically delivered by a commercial operator using a motorised or non-motorised vessel and may target species such as cetaceans, birds, seals, basking sharks or other marine fauna. These trips can often access remote locations such as offshore islands or remote cliffs where birds seek sanctuary from disturbance. Repeated wildlife watching tours can impact birds especially through disturbance, particularly when vessels approach too closely, visit colonies frequently, or operate during sensitive periods such as breeding or overwintering. Wildlife watching has the potential to interact with birds especially, both at the surface and beneath the surface, through above and underwater noise, and visual disturbance.

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4 Bird responses to disturbance: mechanisms, influencing factors, and impacts

4.1 Measuring bird disturbance

Disturbance refers to any event or stimulus that alters an animal's behaviour or physiological state (Collop et al., 2016). In the context of birds this is defined by the African-Eurasian Waterbird Agreement as any human-induced stimulus that mimics a predation threat and disrupts normal behaviour or distribution (Lewis, 2019). This can stem from natural causes, such as predator encounters, or from human activities, including recreational use of coastal areas (Collop et al., 2016). As visual and noise disturbance mimic a predation threat, birds typically respond in ways similar to how they respond to predators. The risk-disturbance hypothesis states that animals weigh the perceived threat against the need to carry out essential activities such as mating, feeding or caring for their young (Peters and Otis, 2005). These trade-offs result in varying responses to disturbance depending on the species, the individual's condition, and the environmental context.

There are several methods to study and quantify bird responses to disturbance (**Figure 2**) (Brooker et al., 2024). The first is the no-response distance (ND), which is the distance beyond which no behavioural response is observed. The detection distance (DD) refers to the point at which an individual bird first detects a potential threat. The physiological-initiation distance (PID) is the distance at which a measurable physiological response occurs, while the alarm-initiation distance (AD) marks the point at which individuals exhibit an alarm behaviour such as movement and vocalisation. The flight-initiation distance (FID) is the distance at which a bird takes flight in response to an approaching threat (Brooker et al., 2024).

Among these measures, FID is the most widely used method for assessing bird disturbance (**Figure 2**). It varies between species and can be influenced by site level features, the type of disturbance activity, and the nature of the stimulus. However, it is important to note that FID does not account for the full energetic and temporal costs incurred from the moment a bird detects a threat to when it resumes normal behaviour (Scarton, 2018).

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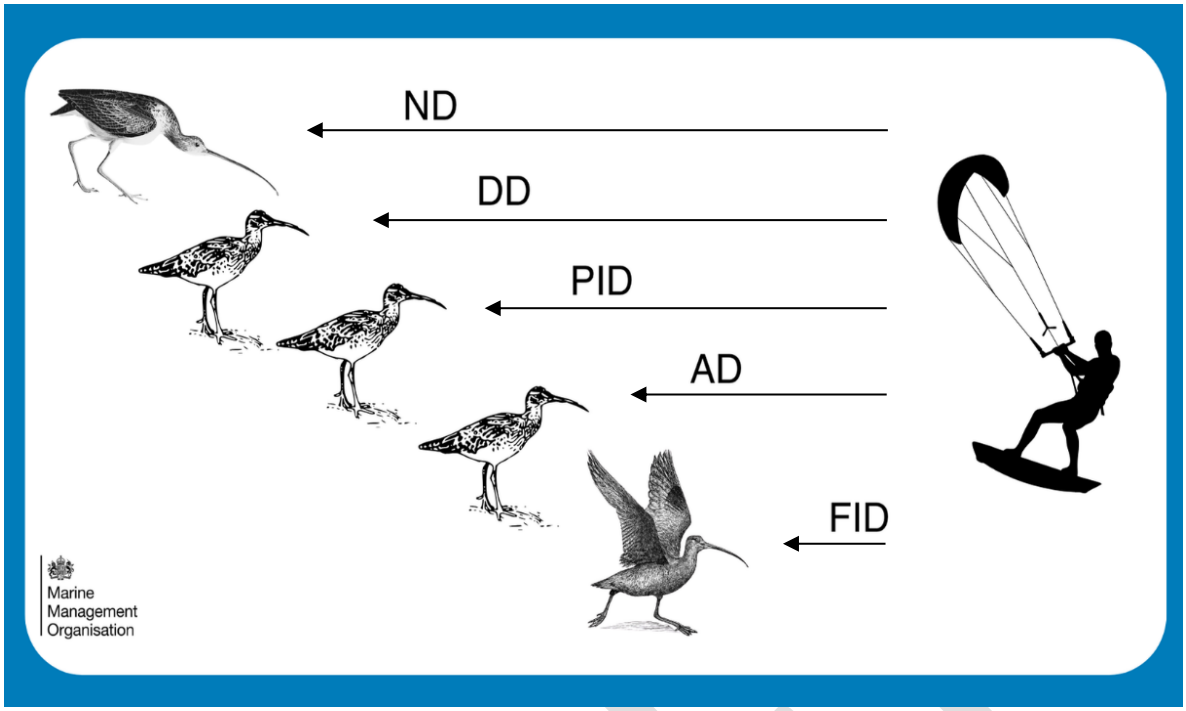

Figure 2: Diagram adapted from (Brooker et al., 2024), showing the relationship between distance to stimulus and escalating response by shorebirds. ND = no-response distance, DD = detection distance, PID = physiological-initiation distance, AD = alarm-initiation distance.

4.2 Factors influencing bird response to disturbance

There are various factors influencing bird responses to disturbance including species traits, flock size, nesting, habituation to human presence, environmental conditions, and the type, speed, and proximity of the disturbance (Borgmann, 2010). These variables help explain why some birds tolerate human activity while others are highly sensitive and underscores the importance of context-specific management strategies (Collop et al., 2016; Goodship and Furness, 2022). In this section, studies focusing on particular species or functional groups are cited to illustrate key factors influencing bird responses to disturbance. These examples are used to demonstrate general processes and should be considered applicable to birds more broadly, rather than limited to the species or groups specifically studied.

4.2.1 Species traits

The likelihood of birds flushing (flying away) can be influenced by species-specific traits (**Annex 2**). Larger birds often initiate flight at greater distances, likely due to their need for more space to take off (Rodgers and Schwikert, 2002). Average flush distances can range from 49m in smaller species such as the snail kite *(Rostrhamus sociabilis)* to around 172m in larger raptors like the bald eagle *(Haliaeetus leucocephalus).* Similarly, among herons, flush distances increase from 65m in smaller species such as the tricoloured heron *(Egretta tricolor)* to over 110m in larger species like the great egret *(Ardea alba)* (Rodgers and Schwikert, 2002). Migratory

species are often less tolerant of disturbance than resident birds, which make them particularly vulnerable during wintering periods (Klein, Humphrey and Percival, 1995).

An experimental study on the Wash Embayment, UK, assessed the responses of 10 wintering wader species to pedestrian disturbance, including curlew (*Numenius arquata*), Eurasian oystercatcher (*Haematopus ostralegus*), and redshank (*Tringa totanus*). Larger species generally exhibited stronger responses, with greater FIDs and longer flight times, particularly under milder weather conditions. This supports the risk-disturbance hypothesis that birds are more likely to flee when energetic demands are lower (Collop et al., 2016). Despite these behavioural changes, the energetic cost of individual disturbance events was relatively low compared to daily requirements. Most species could tolerate up to 5% to 10% reduction in feeding time without significant impacts, which would require dozens of disturbance events per day, far exceeding observed visitor levels in most of the embayment (Collop et al., 2016).

4.2.2 Flock size

Flock size has a direct impact on bird disturbance, with larger aggregations of rafting ducks for example flushing more readily than non-rafting birds as a result of one bird triggering the group (Evans, 2007). This heightened sensitivity arises because behavioural responses can move quickly through a dense group of birds, where the escape reaction of one bird can increase alertness and prompt a collective flight response (Beauchamp, 2013). In larger flocks there is a higher probability of at least one bird detecting a perceived threat, leading to earlier and sometimes unnecessary disturbance responses (Beauchamp, 2013). This can result in repeated flushing which is energetically costly particularly in bird species that rely on rafting behaviour for feeding and predator avoidance (Beauchamp, 2013). Conversely, some species such as sanderling *(Calidris alba)* show little variation in response based on flock size, likely due to differences in foraging strategy, habitat use, and baseline vigilance levels (Roberts and Evans, 1993). These dynamics suggest that larger zones to exclude mNLA may be necessary in areas where birds flock together in high numbers.

4.2.3 Nesting

Nesting birds or birds that have offspring can respond differently to disturbance compared to non-nesting birds. Although the perceived risk and habituation may be unchanged, nesting can cause a reluctance to respond to disturbance. Kittiwake (*Rissa trydactyla*) and Guillemot (*Uria aalge*) have shown a decrease in likelihood to move away from the nest when breeding to protect their eggs or chicks. Their breeding success has also increased when surrounded by protective parameters such as walls or nesting higher and out of reach of human disturbance (Beale and Monaghan, 2004).

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Nest age (the stage of development of the eggs or chicks in the nest) is an important factor influencing how long little terns (*Sternula albifrons*) stay away from the nest after being disturbed. Birds returned more quickly when their eggs were close to hatching or when chicks were already present, resulting in shorter flight durations. This likely occurs because older eggs and chicks have a higher chance of survival, making it more important for adults to return quickly after a disturbance (Briel, Felgueiras and Hof, 2025).

Different species can also have different defensive reactions, such as the Malaysian plover acting as a distraction to try and lead predators towards them and away from the nest, thus creating a longer time away from the nest (Gómez-Serrano and López-López, 2017). Little terns are more directly aggressive and will dive repeatedly at a threat, a costly and potentially harmful response but one that can result in less time away from a nest. These responses are also affected by nest age (Briel, Felgueiras and Hof, 2025).

4.2.4 Habituation

Habituation is when an animal gradually stops reacting to something because it happens often and is no longer perceived as a threat (Dissegna, Turatto and Chiandetti, 2021). Birds occupying marine environments frequented by humans will experience disturbance that may or may not present a mortality risk. Both non-lethal and predation disturbances require birds to balance the need to respond to potential threats with the need to carry out essential activities like feeding or caring for offspring. To minimise the costs of frequent, non-dangerous disruptions, birds are likely to become habituated to repeated stimuli that do not pose a direct threat to survival (Baudains and Lloyd, 2007; Chatwin, Joy and Burger, 2013).

In areas with high human disturbance, some waders have habituated to frequent, non-threatening human presence. Plovers have been shown to tolerate closer approaches and returned to their nests more quickly, reducing the time eggs were left unattended (Baudains and Lloyd, 2007). Additionally, plovers often cover their eggs with sand when leaving the nest, which may help buffer temperature changes. Similar habituation was observed in plover chicks, which resumed activity sooner after disturbance. This behavioural adaptation likely helps maintain normal development despite frequent human interaction, though responses may vary across species depending on their sensitivity and ability to habituate (Baudains and Lloyd, 2007).

Divers, cormorants and grebes have been reported to exhibit moderate habituation responses to marine recreation and tourism activities, although confidence in these findings is low (MMO, 2018). Despite this capacity to habituate, grebes were assessed as having high overall sensitivity due to their high displacement rates, while divers and cormorants were considered to have moderate sensitivity, reflecting both moderate displacement and habituation responses (MMO, 2018). In contrast, seaducks were identified as having high displacement sensitivity but lack evidence

regarding habituation, representing an evidence gap. For most other seabird groups, insufficient information on both displacement and habituation limits understanding of their overall sensitivity to disturbance (MMO, 2018), highlighting the need for further research and site level assessments.

Factors such as intensity of mNLA can affect the rate and levels of habituation. When disturbance from mNLA is less intense, birds are more likely to habituate, which can lead to more frequent disturbances because they react less strongly each time. In addition, more frequent disturbance events can also lead to faster habituation. Habituation is not permanent and full sensitivity can return after a disturbance-free period (Blumstein, 2016). Given that habituation to mNLA can differ across species, site level surveys at each SPA may be required to provide a comprehensive basis for ecological assessments.

4.2.5 Environmental conditions

Environmental conditions, such as poor weather or low food availability can further increase birds' susceptibility to disturbance (Goss-Custard et al., 2006). Disturbance may be more problematic during extreme weather conditions as the energetic cost of fleeing and relocating may have bigger implications. Additionally, physiological stress responses, such as elevated heart rate, may occur even without visible behavioural changes, though these are less well understood and likely to be less impactful compared to flight and lost feeding time (Collop et al., 2016). Further research is needed to assess disturbance impacts and cumulative effects under changing environmental conditions (Collop et al., 2016).

Wind direction and speed can significantly affect how birds perceive acoustic disturbances from boats. Wind can alter sound transmission by dispersing or masking acoustic cues, potentially reducing the effectiveness of auditory detection (Dehnhard et al., 2020). Despite this, visual cues appear to play a more dominant role in triggering flight responses. For example, eiders often show alert behaviour directed toward the boat prior to escape (Dehnhard et al., 2020). Given that natural predators typically approach silently, the reliance on visual detection may be an adaptive response. The influence of wind on boat noise has been considered minimal, suggesting that wind-related acoustic interference had limited impact on displacement and recovery behaviour (Dehnhard et al., 2020). Wind speed can also affect wave height and therefore increase the energy required to swim or fly away from an approaching boat as well as reducing the visibility of a boat (Dehnhard et al., 2020).

Since sound travels faster and farther in water than in air, especially under calm conditions, diving birds like eiders may detect approaching vessels through underwater noise before visual contact.

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4.2.6 Type, speed, and proximity of disturbance

Fast and loud activities, such as high-speed motorboats, are generally more likely to cause birds to flush (Bellefleur, Lee and Ronconi, 2009). However, quieter, slower activities such as non-motorised watercraft can also be disruptive. FID and flight duration can also vary due to group size of approaching humans, speed of approach, and type of stimulus, (Briel, Felgueiras and Hof, 2025). This literature review will explore type, speed, and proximity of disturbance in more detail at an activity specific level further in **sections 5** to **8** of this document.

4.3 Effects of disturbance on birds

Understanding how birds perceive and respond to disturbance is essential for assessing the impacts of mNLA and for developing effective management measures. This section explores these dynamics across all functional groups, drawing on available evidence to evaluate how different types of disturbance affects their behaviour. Where little is known surrounding the impacts of marine specific activities on birds, evidence relating to terrestrial disturbance will be examined as an indicator of disturbance impacts.

4.3.1 Breeding bird response

The consequences of disturbance on breeding birds go beyond immediate behavioural responses. Birds might not return to a disturbed site, especially if they are not breeding or if food is scarce (Borgmann, 2010). However, breeding birds often return quickly to nests to care for their young (Borgmann, 2010). Western snowy plovers have been observed returning to their nests within four minutes following pedestrian disturbance (Borgmann, 2010). However, repeated or intense disturbance can potentially cause site abandonment and long-term habitat avoidance (Borgmann, 2010) .

Breeding birds are particularly vulnerable to disturbance events. Studies have shown golden plovers (*Pluvialis apricaria*) delay returning to nests when disturbed, risking chick survival, while common sandpipers *(Actitis hypoleucos)* avoided disturbed lake sections, resulting in fewer territories and a smaller overall population, although breeding success was similar to disturbed areas (Yalden and Yalden, 1990).

Breeding birds such as the ringed plover (*Chardrius hiaticula*) and Eurasian oystercatcher have also been shown to change breeding site locations due to pre-nesting disturbance. This can be energetically costly and reduce reproductive success due to nesting in less favourable areas (Tratalos et al., 2021).

4.3.2 Energetic costs

Disturbance can have significant energetic costs, with increased flushing and reduced foraging time elevating energy expenditure (Schummer and Eddleman, 2003). Repeated disturbance from human activity can raise daily energy demands in species such as canvasbacks and American coots (*Fulica americana*) (Korschgen,

George and Green, 1985), and experimentally disturbed mallards have shown notable weight loss (Zimmer et al., 2010). In great knots (*Calidris tenuirostris*), a 30 minute increase in alarm flights led to a 13% rise in energy expenditure (Rogers, Piersma and Hassell, 2006). Similarly, snow geese have shown increased hourly energy use and reduced foraging time in response to frequent disturbance (Belanger and Bedard, 1990). Similar responses have been documented in seabirds, which have been observed fleeing, escape-diving, and exhibiting heightened vigilance (Fliessbach et al., 2019). These energetic costs, if uncompensated, can lead to poorer body condition and subsequently lower reproductive success.

A study by Guillemain et al. (2007) found that waterfowl exposed to birdwatching tours spent less time resting and more time foraging and moving, likely to offset energy lost through disturbance. Although birds remained in disturbed areas, behavioural responses persisted, indicating partial habituation without full tolerance (Guillemain et al., 2007). Similarly, waterfowl in protected areas did not show increased tolerance to pedestrians over a season (Trulio and White, 2017). Pedestrian presence has also been linked to increased vigilance and reduced sleep in waterfowl (Fernández-Juricic et al., 2007).

During long-distance migration, many birds undergo temporary gut atrophy, reducing digestive capacity to lower metabolic costs and body mass (McWilliams and Karasov, 2005). As a result, birds arriving at, or preparing to leave, stopover sites, such as Farlington Marshes and Langstone Harbour, are limited in how efficiently they can process food, making them particularly vulnerable to energy deficits if disturbed. Frequent disturbance from mNLA can force birds to expend energy through repeated flight responses and reduce feeding efficiency, with studies suggesting that as few as 10 disturbance events per day may push shorebirds into negative energy balance (McWilliams and Karasov, 2005). Such energetic stress can increase the risk of mortality during subsequent migratory flights, although deaths often occur away from the disturbance site, making direct attribution difficult (McWilliams and Karasov, 2005).

The cost of disturbance also extends beyond the energetic expenditure of fleeing from the source of disturbance and subsequently returning. It also includes the loss of time that may otherwise have been spent foraging, resulting in reduced energy intake compared to undisturbed conditions (van de Wolfshaar et al., 2023).

4.3.3 Reproductive impacts

Few studies have directly examined mNLA disturbance impacts on reproductive success. The available evidence suggests that disturbance during the breeding season can lead to nest abandonment or increased predation risk (Carney and Sydeman, 1999). Human presence near brown pelican (*Pelecanus occidentalis*) and double-crested cormorant (*Nannopterum auritum*) colonies caused incubating birds to flush, exposing eggs to predators (Anderson and Keith, 1980). In western gulls (*Larus occidentalis*), egg loss and hatching failure were positively associated with

disturbance frequency (Robert and Ralph, 1975), while western snowy plover chick mortality was higher on weekends, coinciding with increased beachgoer activity (Ruhlen et al., 2003).

Research on reproductive impacts is limited, and further studies are needed to assess long-term consequences of mNLA on bird populations, particularly in coastal and intertidal habitats (Meyer et al., 2021).

4.3.4 Displacement

Bird displacement is not always as obvious as other disturbance reactions like flushing or alarm calls. It can be subtle and delayed, which makes it harder to detect in field surveys. Birds may simply avoid areas of human activity or areas where human activity has recently taken place without dramatic behaviour.

At the community level, across multiple species within a habitat, recreational disturbance has been associated with reduced raptor species richness and abundance along riparian corridors (strips of land that run alongside a body of freshwater), although some species, such as the red-tailed hawk *(Buteo jamaicensis),* appear less sensitive to human presence (Fletcher, Mckinney and Bock, 1999). Overall, most studies report individual-level behavioural changes rather than population-level impacts. Reduced nesting and feeding time may affect individual fitness, but without clear evidence of effects on reproduction or population size, ecological significance remains uncertain (Bateman and Fleming, 2017). Displacement can therefore be seen as a key process that connects individual behavioural responses to wider ecological impacts.

Displacement distance is the extent to which birds move away following a disturbance event and offers a valuable complement to the FID in assessing behavioural responses. Research on passerines (also known as perching birds or songbirds) has shown a positive correlation between FID and displacement distance in heavier species, suggesting that displacement may reflect species-specific escape strategies and energetic constraints. While this relationship may not hold across all bird groups, displacement distance remains an informative and independent metric for evaluating the impact of human disturbance on wildlife behaviour (Dehnhard et al., 2020).

Common eider *(Somateria mollissima)* flocks in shallow habitats showed shorter displacement distances following disturbance events but took longer to resume normal behaviour, likely due to optimal foraging strategies (Dehnhard et al., 2020). Returning to a high-quality foraging site may be preferable to relocating to a less productive area, even if vigilance remains elevated post-disturbance. This aligns with observations that eiders responded to hunting pressure by adjusting flocking behaviour, regrouping in larger flocks during autumn or dispersing into smaller ones in winter (Laursen, Møller and Holm, 2016). Offshore displacement was considered suboptimal, as birds in these areas had poorer body condition compared to those in disturbed coastal zones (Dehnhard et al., 2020).

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Furthermore, the longer birds are displaced from their nests, the decreased likelihood of reproductive success (Carney and Sydeman, 1999), the longer time spent away from resources such as food, and the higher energetic costs of sustained flight (Schummer and Eddleman, 2003). Long-tailed ducks (*Clangula hyemalis*) and red-breasted mergansers (*Mergus serrator*) were found to have shorter displacement times as they forage on a fixed food source, such as shellfish beds, whereas diving ducks and grebes had longer displacement times as their food source (fish) is more mobile (Burger et al., 2019). Displacement type can also be linked to species type, as some species are more likely to dive, where others are more likely to take flight. Some species may be unable to take flight due to moulting in the winter breeding months (Jarrett et al., 2021).

In addition to maintaining and restoring bird populations, SPA conservation objectives require the extent, distribution and availability of supporting habitats to be maintained or restored. mNLA disturbance can result in the temporary occupation of habitat, leading to the displacement of birds, reduced access to important foraging areas, and a decrease in the availability of supporting habitat (Collop et al., 2016). These effects may become particularly pronounced in areas with seasonal increases in human activity. For example, bays and harbours that experience high densities of recreational boating during summer months may become unsuitable for birds during this period. Although the physical footprint of these activities may be temporary, repeated or prolonged disturbance can limit habitat use over time, reducing the extent and quality of available foraging or resting areas (Collop et al., 2016).

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5 Hovercraft

Natural England's Advice on Operations was used to identify potential pressures from hovercraft and to inform the understanding of feature sensitivity to the pressure. Where a sensitivity assessment has not been undertaken or the evidence base is insufficient to assess sensitivity, the activity-pressure-feature combination has been included to capture all possible evidence that may impact the features. Marine Non-Licensable Activity Impacts Evidence: Methodology[1] details the process of how MMO judgement refined pressures for assessment.

High risk pressures associated with this activity with the potential to impact birds are:

- above water noise;
- underwater noise changes; and
- visual disturbance.

These high risk pressures have been included in this review as they have been determined to be pressures commonly induced by hovercraft at a level that has the potential to cause significant impacts on the bird features. This is because a single hovercraft is likely to result in these pressures at a damaging level, regardless of any site specific factors.

High risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement.

The following pressures were identified as low risk and are therefore not included in this document:

- collision above water with static or moving objects not naturally found in the marine environment;
- collision below water with static or moving objects not naturally found in the marine environment;
- introduction of light;
- introduction or spread of INIS; and
- litter.

Low risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement. These low risk pressures have not been included in this review as these pressures generally do not occur at a level of concern, as a result of hovercraft activity. Should site specific factors increase the risk of these pressures, these would be considered in an individual site assessment.

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5.1 Summary of the effects of visual and noise disturbance from hovercraft

Hovercraft activity has been shown to cause disturbance responses in a variety of coastal bird species (Gaál, 2014). This disturbance primarily comes from visual, noise and physical stimuli. Observational studies in areas such as Langstone and Chichester Harbours and Lindisfarne National Nature Reserve (NNR) have documented flushing behaviour in waterfowl, waders, and gulls. Flushing distances ranged from 75 to 500m, with an average of 200m, indicating that hovercraft have a significant impact (Scott, Watts and Craggs, 2010). Wigeon *(Anas penelope)*, gulls, light-bellied brent geese *(Branta bernicla)* and pink-footed geese *(Anser brachyrhynchus)* all showed responses to disturbance, but it was geese that displayed the strongest response to the point where they did not feed for over an hour and a half (Scott, Watts and Craggs, 2010). These species are likely to have experienced considerable energetic demands during their migration, similar to those documented in barnacle geese (*Branta leucopsis*) migrating from Svalbard to Scotland (Butler, Woakes and Bishop, 1998). Given their recent arrival, it is possible that these geese were in a nutritionally depleted state, requiring immediate access to food to replenish energy reserves. Therefore, hovercraft disturbance may have interrupted important feeding opportunities which are critical for maintaining good physiological condition (Scott, Watts and Craggs, 2010).

At the time of the observational study by Scott, Watts and Craggs (2010), there were approximately 1,900 light-bellied brent geese present and between 350 to 400 of these geese were disturbed for an extended period by the hovercraft with a further 200 also affected. This suggests at least 20% of the newly arrived overwintering population experienced disturbance. Although the survey was based on a small sample size and qualitative observations, the scale of disturbance raises concerns. Relying on the assumption that birds may eventually habituate to hovercraft activity is not a precautionary approach, particularly when managing internationally important populations of bird species. The potential for significant impacts on the condition and survival of these geese, especially during the energetically demanding post-migration period, underscores the need for careful regulation of hovercraft use in sensitive areas such as Lindisfarne NNR (Scott, Watts and Craggs, 2010).

Damaj (2013) notes that across Portsmouth, Southampton, and the Isle of Wight, waterfowl species consistently flushed in reaction to both hovercraft and motorboats. Gull species, which were the most numerous in the study areas, exhibited a higher flushing rate in response to hovercraft compared to motorboats. Notably, gulls and shorebirds that flushed often relocated to nearby habitats after flying only short distances. Overall, the findings suggest that waterfowl and other birds respond to hovercraft in a manner comparable to their reactions to motorboats. The tendency of flushed birds to resettle in adjacent areas indicates that, while complete displacement may be limited, repeated disturbance and short-distance movements

may still impose cumulative energetic costs and have consequential long-term effects on waterfowl behaviour and ecological functioning (Damaj, 2013) .

Studies examining the acoustic footprint of hovercraft have found that, at any speed, their underwater noise emissions are significantly lower than those produced by vessels with screw or water-jet propulsion systems (Vedenev et al., 2023). However, airborne noise levels from hovercraft tend to be higher than those of conventional propeller-driven vessels. Despite this, when operating at cruising speeds between 7 and 15m per second, the noise levels recorded just beyond the shoreline remain below the 80 decibel (dB) threshold commonly associated with negative behavioural responses in birds (Vedenev et al., 2023). Another commonly cited threshold for the onset of noise-related disturbance is 50dB, with evidence indicating that impacts may begin at or above this level depending on contextual factors (Cutts, Hemingway and Spencer, 2013). A precautionary approach would therefore adopt 50dB as the basis for predicting potential noise disturbance associated with mNLA.

Research conducted in the Ural river estuary in Western Kazakhstan suggests that large hovercraft, when operated within this optimal speed range, may pose minimal acoustic disturbance to bird species (Vedenev et al., 2023). These findings are particularly relevant in designated wildlife conservation areas, where maintaining low levels of anthropogenic noise is critical. The recommendation to maintain hovercraft speeds within the 7 to 15m per second interval is based on observed reductions in acoustic impact, supporting the notion that hovercraft, when properly managed, can be compatible with bird conservation objectives in sensitive estuarine environments (Vedenev et al., 2023).

Frequency of disturbance is a key determinant of impact. Models suggest that Eurasian oystercatchers can tolerate up to three disturbances per hour under good feeding conditions, but only one every two hours when food is scarce. Given that recreational hovercraft use is minimal during the critical overwintering period (November to March), the risk of cumulative disturbance may be lower (Hockin et al., 1992). However, as noted in **section 4.2**, there are a range of factors that can cumulatively impact bird sensitivity to disturbance. Therefore, even at lower disturbance frequencies, variables such as species-specific traits, flock size, breeding or overwintering status, habituation, environmental conditions, and the type, speed and proximity of disturbance should be considered when assessing potential impacts.

In summary, hovercraft activity can cause significant behavioural responses in sensitive bird species, particularly migratory waterfowl. While modern designs and limited seasonal use may mitigate some impacts, precautionary management such as designated zones and seasonal restrictions may be required to protect vulnerable populations.

MMO concludes that the impacts of hovercraft on birds may result in a significant risk of hindering achievement of the conservation objectives of the

MPA, dependent on site specific sensitivities and the level of activity within a site. This is because of the impacts of above water noise, underwater noise changes, and visual disturbance caused by this activity. A site level assessment will determine whether the activity is hindering the achievement of MPA conservation objectives.

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6 Motorised watercraft and motorised personal watercraft

Natural England's Advice on Operations was used to identify potential pressures from motorised watercraft and MPW and to inform the understanding of feature sensitivity to the pressure. Where a sensitivity assessment has not been undertaken or the evidence base is insufficient to assess sensitivity, the activity-pressure-feature combination has been included to capture all possible evidence that may impact the features. Marine Non-Licensable Activity Impacts Evidence: Methodology[1] details the process of how MMO judgement refined pressures for assessment. High risk pressures associated with this activity with the potential to impact birds are:

- above water noise;
- underwater noise changes; and
- visual disturbance.

These high risk pressures have been included in this review as they have been determined to be pressures commonly induced by motorised watercraft at a level that has the potential to cause significant impacts on the features. This is because a single motorised watercraft and MPW is likely to result in these pressures at a damaging level, regardless of any site specific factors.

High risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement.

The following pressures were identified as low risk and are therefore not included in this section:

- collision above water with static or moving objects not naturally found in the marine environment;
- collision below water with static or moving objects not naturally found in the marine environment;
- introduction of light;
- introduction or spread of INIS; and
- litter.

Low risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement. These low risk pressures have not been included in this review as these pressures generally do not occur at a level of concern, as a result of motorised watercraft activity. Should site level factors increase the risk of these pressures, these would be considered in an individual site assessment.

6.1 Summary of the effects of visual and noise disturbance from motorised watercraft and motorised personal watercraft

Research into FID in waterbirds has predominantly focused on responses to pedestrians, with few studies examining the effects of boats (Scarton, 2018). In a

study that investigated how five species of breeding waders in a Mediterranean wetland responded to simulated disturbances from boats and pedestrians, it was found that on average boats did not elicit greater FIDs than pedestrians (Scarton, 2018). Redshank and black-winged stilt showed similar responses to both stimuli, Eurasian oystercatchers reacted more strongly to pedestrians, and pied avocets (*Recurvirostra avosetta*) were more sensitive to boats (Scarton, 2018). These results suggest that not all birds perceive boats as a greater threat than humans on foot, a pattern observed across other studies (Rodgers and Schwikert, 2002; Mayo, Paton and August, 2015). However, it is important to note that motorised watercraft and MPW are often able to access more remote locations, such as islands and cliff faces that are not accessible to pedestrians, therefore expanding the area over which potential disturbance may occur. In addition to visual disturbance, noise generated by these activities may mask natural environmental sounds, including vocal communication and cues used for predator detection, which may further affect bird behaviour and increase sensitivity to disturbance (Dooling et al., 2012).

The study by Scarton (2018) also noted seasonal variation in FID for Eurasian oystercatchers, with birds appearing more tolerant of boat traffic later in the breeding season. This may reflect habituation, particularly in areas where boat activity increases during the summer months (Erwin, 1989). Nesting locations may also influence sensitivity; for example, Eurasian oystercatchers often nest closer to boating channels, where frequent flushing may harm reproductive success. This proximity may drive a degree of behavioural adaptation or tolerance over time (Scarton, 2018). One study found no significant change in FID across different time periods in breeding waterbirds (Erwin, 1989), while another observed that the effects of disturbance varied depending on the stage of the breeding cycle in cormorants (*Phalacrocorax carbo*) (Buxton et al., 2017). In a separate study, no notable variation was found in the proportion of birds showing disturbance across three breeding periods within a single season (Chatwin, Joy and Burger, 2013). These findings underscore the complexity of bird responses to disturbance and the importance of considering both species-specific traits and temporal factors when developing management strategies.

An experimental study conducted in Northern Moreton Bay, Queensland, assessed human disturbance on roosting shorebirds and seabirds (Milton et al., 2011). The most frequently observed species were bar-tailed godwits (*Limosa lapponica*) and red-necked stints (*Calidris ruficollis*). Across the study period, 73 disturbance events were recorded, primarily linked to recreational activities. Jet skis accounted for 28 of these events, often causing birds to take flight or circle the area. Boats and canoes (canoes are assessed in **section 7** as part of non-motorised watercraft) also contributed to disturbance, affecting 25% of the observed birds, which responded by either walking away or flying from the site (Milton et al., 2011). Boat activity has also triggered an avoidance response in shags *(Phalacrocorax aristotelis),* leading to a decline in foraging behaviour as boat traffic intensified (Velando and Munilla, 2011). These findings highlight the varying degrees of sensitivity among species and the

potential for recreational watercraft to disrupt essential behaviours such as feeding and roosting (Kaldor, 2019).

A study of wintering waterbirds at a coastal Ramsar site in northern Spain examined behavioural responses to the regular passage of a small vessel used for birdwatching tours from 2006 to 2008 and from 2012 to 2015 (McFadden, Herrera and Navedo, 2017). On average impacts were proportionally greater for species of interest to observers due to their lower abundance. FID was used to derive recommended buffer distances, indicating an overall precautionary distance of approximately 100m, with species-specific ranges from 40m to over 200m. Disturbance was greatest in narrow tidal channels less than 200m wide, where vessels were constrained to pass closer to birds and were less able to maintain separation distances. These findings highlight that even low levels of repeated disturbance may have implications for behaviour and energy expenditure, and emphasise the importance of maintaining adequate buffer distances, particularly in confined waterways where avoidance is limited (McFadden, Herrera and Navedo, 2017).

Wildlife tour boats are frequently concentrated in proximity to coastal cliffs, where seabird colonies and marine mammals are often located and most visible to observers. Evidence indicates that flushing responses tend to increase in habitats that offer limited cover, as birds are more exposed and have fewer opportunities to remain concealed (Ronconi and St. Clair, 2002). For example, black guillemots *(Cepphus grylle)* may be particularly vulnerable when foraging close to cliff bases or further offshore in open water, where refuge is limited (Ronconi and St. Clair, 2002). Similarly, species that nest in more exposed locations, such as common terns, have been shown to exhibit heightened sensitivity to disturbance from watercraft operating in nearshore areas, particularly when vessels approach at close range (Burger, 2003). Differences in behavioural response may also reflect activity type, with foraging individuals more likely to flush than birds that are nesting or roosting, which may exhibit higher motivation to remain at a location to protect young (Ronconi and St. Clair, 2002).

Moulting eiders exhibited an average FID of 177m in response to boat approaches, with disturbances typically displacing flocks by approximately 771m (Dehnhard *et al.*, 2020). Around 75% of flocks resumed normal behaviour within 10 minutes after the disturbance ended, although a small number remained unsettled for up to 45 minutes. As boats approached, eiders displayed a progressive sequence of responses ranging from remaining undisturbed to becoming alert, swimming away, and ultimately diving while only a few individuals responded by flying or flapping away (Dehnhard et al., 2020). Because moulting eiders are flightless and energetically limited, they may reduce their flight initiation and displacement distances to remain close to foraging areas. However, their restricted ability to escape may also lead to earlier flight responses as a precaution against entrapment (Dehnhard et al., 2020).

Among motorised watercraft, PMW that are less than 5m in size, such as a jet ski, have shown significantly higher levels of disturbance than larger motorised watercraft such as powerboats, both in terms of a greater FID and more frequent and longer flight events in common terns. Across a three-year monitoring period in New Jersey's Barnegat Bay, there was no significant change to the reactions of the birds, showing a lack of habituation response (Burger, 2003). This stronger response to jet skis is likely attributable to several behavioural and operational differences: jet skis frequently strayed from designated boat channels, bringing them closer to nesting or resting birds; decreased police surveillance led to higher operating speeds; jet skis often travelled much faster than motorboats; and they were more commonly used by local individuals rather than rental groups, meaning operators were less likely to follow established guidelines designed to minimise wildlife disturbance (Burger, 2003).

MMO concludes that the impacts of motorised watercraft and MPW on birds may result in a significant risk of hindering achievement of the conservation objectives of the MPA, dependent on site specific sensitivities and the level of activity within a site. This is because of the impacts of above water noise, underwater noise changes, and visual disturbance caused by these activities. A site level assessment will determine whether the activity is hindering the achievement of MPA conservation objectives.

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7 Non-motorised watercraft and sailing

Natural England's Advice on Operations was used to identify potential pressures from non-motorised watercraft and sailing and to inform the understanding of feature sensitivity to the pressure. Where a sensitivity assessment has not been undertaken or the evidence base is insufficient to assess sensitivity, the activity-pressure-feature combination has been included to capture all possible evidence that may impact the features. Marine Non-Licensable Activity Impacts Evidence: Methodology[1] details the process of how MMO judgement refined pressures for assessment. These activities, while generally quieter than motorised watercraft, can still cause significant disturbance through visual presence, proximity, and unpredictability of movement. Non-motorised watercraft has been split into two categories: Paddle sports and Wind-powered sports.

High risk pressures associated with this activity with the potential to impact birds are:

- above water noise;
- visual disturbance; and
- introduction or spread of INIS.

INIS pressures will be addressed in Marine Non-Licensable Activity Impacts Evidence: Methodology[1] and not in this literature review.

The high risk pressures of above water noise and visual disturbance have been included in this review as they have been determined to be pressures commonly induced by non-motorised watercraft at a level that has the potential to cause significant impacts on the features. This is because a single non-motorised watercraft or sailboat is likely to result in these pressures at a damaging level, regardless of any site specific factors.

High risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement.

The following pressures were identified as low risk and are therefore not included in this section:

- collision above water with static or moving objects not naturally found in the marine environment;
- collision below water with static or moving objects not naturally found in the marine environment;
- underwater noise changes;
- introduction of light; and
- litter.

Low risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement. These low risk pressures have not been included in this review as these pressures generally do not occur at a

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level of concern, as a result of non-motorised watercraft activity. Should site level factors increase the risk of these pressures, these would be considered in an individual site assessment.

7.1 Summary of the effects of visual and noise disturbance from non-motorised watercraft: paddle sports

Non-motorised paddle sports include canoeing, kayaking, and SUP. Paddle sports are accessible recreational activities, particularly in calm, flat waters. While these activities offer a low-impact way to engage with nature, evidence suggests they can cause significant disturbance to waterbirds (Wegner and Wolter, 2024). These activities are becoming increasingly popular in English waters, raising their potential to cause disturbance to birds (Méndez-Roldan, 2013). Kayaks and other non-motorised watercraft can access ecologically sensitive areas that are often inaccessible to motorised vessels. This increased reach has the potential to amplify human disturbance, particularly as participation in these activities is largely unrestricted requiring neither a licence nor prior knowledge of the marine environment (Clausen et al., 2020).

SUP has been shown to elicit particularly strong flight responses. In some cases, birds flushed at distances up to 1.5km and flew over 1km before settling again. Compared to other water sports, SUP has been observed to cause a higher proportion of birds to evacuate entire waterbodies, indicating a medium to high disturbance potential (Bull and Rödl, 2018).

At Lake Starnberg in Bavaria, SUP was among the top three activities breaching protected zones, alongside motorboats and canoes. Species such as common coot (*Fulica atra*) were frequently disturbed by SUP users, and other highly responsive waterfowl species such as common goldeneye (*Bucephala clangula*) exhibited energy-intensive behaviours like flight. These responses, if frequent, may reduce survival and reproductive success, potentially impacting population dynamics over time (Bull and Rödl, 2018).

Kaldor (2019) found South Island pied oystercatchers (*Haematopus finschi*) and bar-tailed godwits have exhibited less behavioural disturbance in response to an approaching kayak compared to a single dog or a person, whether walking or running (Kaldor, 2019). The study concluded that non-motorised watercraft, such as kayaks, were unlikely to significantly alter the time budgets of these species, suggesting a relatively low disturbance potential (Kaldor, 2019). However, it has also been shown that reactions elicited by kayaks were notably stronger than those triggered by boats (De Blocq Van Sheltinga, 2017). This difference is likely attributable to their slower and less predictable speed, with the kayak being perceived as more threatening due to its narrow profile, low detectability, the visible presence of a paddler, and the rhythmic motion of paddling (De Blocq Van Sheltinga, 2017).

While some studies suggest that kayaks elicit relatively low levels of behavioural disturbance in certain species and contexts (Kaldor, 2019), other evidence indicates that paddle sports can act as a significant disturbance source. In a study conducted at Poole Harbour, canoeing accounted for 15% of all bird flushing events and 8% of major flight responses, despite representing only 1% of all potential disturbance events (Liley and Fearnley, 2012).

Consistent with these findings kayaking has been shown to disturb diving birds and other waterfowl at average distances of 99m (Evans, 2007), and canoes have elicited longer FIDs than pedestrians (Glover, Guay and Weston, 2015). Disturbance may also arise from associated activities beyond on-water movement; for example, redshank, red-breasted merganser and avocet exhibited “major flight” responses when kayaks were lifted out of the water on the Exe Estuary (Liley et al., 2011). Moreover, species such as the great blue heron *(Ardea herodias)* have exhibited greater sensitivity to non-motorised watercraft than to motorised boats (Rodgers and Schwikert, 2002), suggesting that paddle sports may pose a more substantial disturbance risk than would be expected.

Non-motorised paddle sports are increasingly popular and can access sensitive habitats, increasing disturbance risk to waterbirds. Evidence shows variable responses, with SUP often causing strong disturbance, including flushing and displacement. While some studies suggest lower impacts from kayaks, others indicate paddle sports can cause disproportionate disturbance relative to their frequency. Overall, paddle sports can present a moderate to high disturbance risk, particularly in sensitive or heavily used areas.

7.2 Summary of the effects of visual and noise disturbance from non-motorised watercraft: wind-powered sports

Recreational wind-powered activities, such as kitesurfing, windsurfing, and sailing pose a range of potential disturbances to coastal and marine bird species. These craft are visually prominent, often appearing as large and fast-moving objects near shore. Kiteboards introduce an additional airborne element that moves independently, increasing their sensory footprint over the water column. Rapid and unpredictable movements, combined with shadows cast by sails or kites that mimic a predatory bird of prey, can trigger escape responses in birds, especially in sensitive intertidal zones (Brooker et al., 2024).

Bird responses were monitored during a three-hour kitesurfing event in the Netherlands, with recorded FIDs ranging from 500m to 1,000m (van Rijn, Krijgsveld and Strucker, 2016). When kitesurfers came within 200m of a high tide roosting site, nearly 10,000 waders and ducks took flight. Notably, it took 30 to 45 minutes for only 30% of dunlins (*Calidris alpina*) and grey plovers (*Pluvialis squatarola*) to return following disturbance, while red knots (*Calidris canutus*) and black-tailed godwits (*Limosa limosa*) did not return at all following disturbance (van Rijn, Krijgsveld and

Strucker, 2016). These findings highlight the potential for kitesurfing to cause significant and prolonged displacement to sensitive bird species.

Noise generated by wind-powered sports equipment and users can mask natural environmental sounds. This is especially prominent during windy conditions, when birds may already be stressed or less able to detect threats (Carr and Lima, 2010). These challenges are further exacerbated in colder climates, where conserving energy and maintaining body temperature are critical for survival (Brooker et al., 2024).

Birds typically respond to non-motorised watercraft activities by flushing from roosting or feeding areas, with FID varying by species, habitat type, and activity intensity (Brooker et al., 2024). In some cases, disturbance by non-motorised watercraft causes birds to avoid entire areas, leading to habitat exclusion. For example, regular kitesurfing at the Dee Estuary in the UK was associated with significant declines in species such as common redshank and Eurasian oystercatcher, with offshore flocks visibly altering flight paths to avoid kitesurfers (Brooker et al., 2024).

It can be challenging to isolate the specific impact of wind-powered activities from the broader cumulative effects of human disturbance. In some locations wind-powered activities may only marginally increase already high levels of disturbance caused by other human activities (Battley, 2018). However, in areas where other forms of disturbance are limited, wind-powered activities may represent the primary source of disturbance. In these cases, the novelty and unpredictability of these craft may provoke stronger responses from birds, particularly where habituation to human presence is low (Battley, 2018).

Overall, the impacts of wind-powered activities are multifaceted, affecting bird behaviour, habitat integrity, and ecosystem health (Brooker et al., 2024). These effects are highly context-dependent and influenced by species sensitivity, environmental conditions, and the scale and frequency of activity. Effective mitigation might require site level management, user education, and monitoring to minimise disturbance and ecological degradation.

MMO concludes that the impacts of non-motorised watercraft and non-motorised sailing on birds may result in a significant risk of hindering achievement of the conservation objectives of the MPA, dependent on site specific sensitivities and the level of activity within a site. This is because of the impacts of above water noise and visual disturbance caused by these activities. A site level assessment will determine whether the activity is hindering the achievement of MPA conservation objectives.

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8 Wildlife watching from the sea (commercial)

Natural England's Advice on Operations was used to identify potential pressures from wildlife watching from the sea (commercial) and to inform the understanding of feature sensitivity to the pressure. Where a sensitivity assessment has not been undertaken or the evidence base is insufficient to assess sensitivity, the activity-pressure-feature combination has been included to capture all possible evidence that may impact the features. Marine Non-Licensable Activity Impacts Evidence: Methodology[1] details the process of how MMO judgement refined pressures for assessment.

High risk pressures associated with this activity with the potential to impact birds are:

- above water noise;
- underwater noise changes; and
- visual disturbance.

These high risk pressures have been included in this review as they have been determined to be pressures commonly induced by wildlife watching from the sea at a level that has the potential to cause significant impacts on the features. This is because a single wildlife watching vessel is likely to result in these pressures at a damaging level, regardless of any site specific factors.

High risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement.

The following pressures were identified as low risk and are therefore not included in this section:

- collision above water with static or moving objects not naturally found in the marine environment;
- collision below water with static or moving objects not naturally found in the marine environment;
- introduction of light;
- introduction or spread of INIS; and
- litter.

Low risk pressures associated with this activity have been identified using Natural England's CAP (**Annex 1**) and MMO judgement. These low risk pressures have not been included in this review as these pressures generally do not occur at a level of concern, as a result of wildlife watching from the sea. Should site level factors increase the risk of these pressures, these would be considered in an individual site assessment.

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8.1 Summary of the effects of visual and noise disturbance from wildlife watching from the sea (commercial)

Commercial wildlife watching from the sea, including bird, seal and cetacean watching tours, typically rely on motorised vessels operating in proximity to areas where birds are feeding, roosting, moulting or breeding. As a result, the principal mechanisms of disturbance are visual disturbance associated with vessel approach and presence, together with above water and underwater noise. Although these activities are often conducted at relatively predictable speeds and routes, evidence indicates that they can still elicit behavioural responses in birds, particularly where vessels approach closely or operate repeatedly within sensitive habitats (Marcella et al., 2017; Mcfadden, Herrera and Navedo, 2017).

Despite sharing the same disturbance mechanisms associated with motorised watercraft, wildlife watching from sea is considered separately because the activity involves intentionally seeking out birds and other wildlife. This increases the likelihood of close approaches to birds and, consequently, the potential for disturbance through visual presence and noise. As a result, the frequency and intensity of disturbance may be greater than for recreational boating activities where birds are encountered incidentally.

A study of wintering waterbirds at a coastal Ramsar site in northern Spain found that regular birdwatching tour boats caused disturbance responses in several waterbird species, with impacts generally greatest for species specifically targeted by observers due to their lower abundance (Mcfadden, Herrera and Navedo, 2017). FIDs varied considerably between species, resulting in recommended buffer distances ranging from approximately 40m to over 200m, with an overall precautionary buffer of around 100m. Disturbance was particularly pronounced within narrow tidal channels where vessels were unable to maintain separation distances from birds (Mcfadden, Herrera and Navedo, 2017). These findings demonstrate that even well-managed wildlife watching operations may affect bird behaviour when vessel movements are constrained by local environmental conditions.

Wildlife watching vessels frequently operate close to seabird colonies and coastal cliffs to maximise viewing opportunities. Studies have shown that birds in exposed habitats can be particularly susceptible to approaching vessels as they have fewer opportunities to remain concealed, with disturbance responses influenced by vessel proximity, speed and the behaviour being undertaken by the bird at the time (Ronconi and St. Clair, 2002). For example, black guillemots were more likely to flush when boats approached foraging areas, and management measures including vessel setback distances were identified as effective means of reducing disturbance (Ronconi and St. Clair, 2002). Similarly, species that nest in more exposed locations, such as common terns, have been shown to exhibit heightened sensitivity to disturbance from watercraft operating in nearshore areas, particularly when vessels

approach at close range (Burger, 2003). Ship-based tourism has been shown to disturb marbled murrelets (*Brachyramphus marmortus*), with responses occurring at considerable distances from vessels, suggesting that the visual presence of vessels may be at least as important as noise in driving behavioural reactions (Marcella et al., 2017).

The available evidence suggests that disturbance arising from commercial wildlife watching at sea is highly dependent on vessel movement, frequency of operation, habitat characteristics and the sensitivity of species present. Maintaining appropriate distances, particularly around breeding colonies, roosting sites and confined waterways, is likely to reduce disturbance risk. However, where exposed bird populations occur, repeated vessel approaches may still result in displacement, interruption of feeding or resting behaviour, and increased energetic expenditure.

MMO concludes that the impacts of commercial wildlife watching from the sea on birds may result in a significant risk of hindering achievement of the conservation objectives of the MPA, dependent on site specific sensitivities and the level of activity within a site. This is because of the impacts of above water noise, underwater noise changes, and visual disturbance caused by this activity. A site level assessment will determine whether the activity is hindering the achievement of MPA conservation objectives.

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9 Conclusion

This document has reviewed and synthesised the available evidence on the impacts of mNLA and their pressures on bird features designated within MPAs. The review considered evidence relating to disturbance caused by hovercraft, motorised watercraft, MPW, non-motorised watercraft, non-motorised sailing, and commercial wildlife watching from sea.

The evidence base used in this literature review to assess the potential disturbance effects of mNLA on birds draws on studies of 43 bird species, of which 24 are UK-relevant species that occur regularly as breeding, wintering or passage migrants within UK coastal, estuarine and intertidal habitats (**Annex 3**). These cover 19 of the in-scope SPA species and all bird functional bird groups in-scope of this review: waterfowl, crepuscular insectivores, waders, divers and seaducks, seabirds, songbirds, and birds of prey (**Annex 3**). This diversity ensures that the assessment captures a range of ecological traits, sensitivities and behavioural responses relevant to designated site features. Evidence from non-UK species (17 species) has been included where UK-specific studies are limited, particularly to inform understanding of general disturbance mechanisms (for example, FID, displacement, energetic costs, and habituation). These non-UK examples are used cautiously as analogue evidence, applied only where species share comparable morphology, foraging strategies, habitat use, and exposure pathways to human disturbance. Overall, the literature provides a robust and precautionary evidence base, with sufficient coverage of UK-relevant species to support conclusions on disturbance sensitivity while enabling wider contextual interpretation through comparable international studies.

From the literature, it is evident that visual and noise disturbance impacts are often broadly similar across species groups, though there is variation in sensitivity. Therefore, any management measures should be designed around the most sensitive species, particularly those with the greatest FID, to ensure protection for the widest range of birds. FID and flight duration can vary due to multiple factors, such as species, body size, group size of approaching humans, speed of approach, nature and type of stimulus, stage of breeding, flock size, habituation, climatic conditions, level of urbanisation, and time of the year (Briel, Felgueiras and Hof, 2025). Although it is important to note flight is not the only indicator of disturbance.

Research indicates that management strategies should not assume birds will naturally habituate to human disturbance. Instead, a precautionary approach is recommended, particularly in ecologically sensitive areas. Hovercraft activity has been identified as potentially more disruptive than other motorised watercraft, likely due to the rarity, high noise levels, and speed. Similarly, due to the unpredictability of non-motorised watercraft and increasing use in previously undisturbed areas, activities such as SUP and kayaking can also have significant impacts on birds. Careful monitoring can indicate where disturbance may not be an issue (Goss-

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Custard et al., 2020) but, where species from a wide range of taxa with different sensitivities are present or where evidence is lacking, a more pragmatic or precautionary approach should be taken.

Evidence from voluntary programs, such as waterfowl avoidance areas, demonstrates that mNLA disturbance can be significantly reduced through cooperative management (Kenow et al., 2003). Despite challenges in standardising disturbance buffer zones due to species-specific and temporal variation, prioritising the most sensitive species and most disruptive activities provides a practical framework. Regular monitoring and evaluation to adjust disturbance buffer zones based on local data and species composition are essential for effective conservation.

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Annex 1: mNLA pressures on sensitive features - birds

This annex summarises the pressures resulting from mNLA and their potential impacts on bird features described in this document.

Natural England's CAPs provide generic information on pressures that may be exerted by marine industries and their potential impacts on designated features, as presented within the Advice on Operations (AoO) section. Natural England's AoO is an evidence-based product which can be used to guide MPA assessments, together with bespoke advice from JNCC and Natural England. This is explained further in Natural England's conservation advice guidance[3].

The sensitivities of designated features to mNLA pressures were derived using a staged approach.

Stage 1

Natural England's CAPs including Natural England's AoO have been used by MMO to determine the sensitivities of each feature to the potential pressures from mNLA, based on actual or representative sites to highlight subject areas for evidence gathering. This has been done by identifying the 98 MPAs that are in scope for this programme of work that contains bird features and reviewing the AoO available for each site. The information from the AoO was collated (**Table A1. 2** to **Table A1. 6**), with the highest sensitivity for each pressure-feature interaction being recorded (**Table A1.1** for the sensitivity categories). Natural England also provided additional guidance about pressure/feature interactions that should be considered.

Stage 2

An evidence-gathering activity was then carried out. Evidence gathering and analysis was focused on interactions that were deemed sensitive and high risk (presented as an "S" in **Table A1. 2** to **Table A1. 6**), as these are likely to be the most relevant interactions to be considered at each site level assessment. Interactions where there is insufficient evidence (IE) are not considered further here, but these interactions will be considered in site level assessments. In addition, site specific sensitivities for each pressure-feature interaction will be used at the site level assessment stage.

Uses of Stages 1 and 2 to inform Marine Non-Licensable Activities Impacts Evidence: Birds.

The Advice on Operations was used initially to identify a broad range of pressures requiring consideration (**Stage 1**). These pressures were then screened through

[3] Natural England MPA Conservation Advice – Guidance: www.designatedsites.naturalengland.org.uk/MarineGuidance.aspx#advice (Last accessed 11 September 2026)

targeted evidence gathering (**Stage 2**) to determine their relevance and risk profile. As a result, pressures were categorised as higher risk, lower risk, or not supported by the available evidence. Pressures that were identified in the Advice on Operations but did not emerge from the evidence-gathering exercise were either not taken forward or were considered to present low risk. However, the exclusion of a pressure from the literature review does not preclude its consideration at the site level assessment stage, where local activities, sensitivities, or evidence may indicate relevance. Within the Advice on Operations, pressures affecting bird features are not assigned a medium-high risk category, only low risk across all SPAs in scope of this programme of work. Consequently, any bird feature identified as sensitive to a low risk pressure has been treated as potentially medium-high risk for the purposes of this review and is highlighted within **Table A1. 2** to **Table A1. 6**. This is to avoid underestimating potential risks that may not be captured by the generic low risk classification in the Advice on Operations.

Table A1.1: Interaction sensitivity key for mNLA and designated features.

Key	
S	Indicates the feature is sensitive to pressure. This activity-pressure-feature combination should therefore be taken to further assessment.
IE	Indicates there is insufficient evidence to make sensitivity conclusions and therefore the feature may be sensitive to the pressure.
NA	Indicates that a sensitivity assessment has not been made for this interaction, this interaction should not, however, be precluded from consideration.
NS	Indicates feature is not sensitive to pressure.
	Indicates no pathway/no interaction between feature and pressure.

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Table A1. 2: Summary of the highest sensitivity levels of breeding seabirds (functional group 1) to potential pressures, as reported in Natural England's Advice on Operations, across all MPAs within MMO assessment. Pressures relate to anchoring, diving and snorkelling, hovercraft, MPW, motorised watercraft, sailing, and non-motorised watercraft.

Potential pressures from all mNLA	Arctic tern	Atlantic puffin	Common tern	Gannet	Great black-backed gull	Guillemot	Herring gull	Kittiwake	Lesser black-backed gull	Little tern	Mediterranean gull	Razorbill	Roseate tern	Sandwich tern	Shag	Storm petrel
Above water noise	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Collision BELOW water with static or moving objects not naturally found in the marine environment	S	S	S	S	NS	S	S	S	S	S	S	S	S	S	S	NS
Hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination	S	NA	NA	NA	IE	NA	NA	NA	NA	S	NA	NA	NA	NA	IE	NA
Introduction of light	IE	S	IE	S	IE	S	IE	IE	IE	IE	IE	S	IE	IE	S	IE
Introduction or spread of invasive non-indigenous species (INIS)	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Litter	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Synthetic compound contamination (including pesticides, antifoulants, pharmaceuticals)	NA	NA	NA	NA	IE	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA
Transition elements and organo-metal (such as tributyltin (TBT)) contamination	NA	NA	NA	NA	IE	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA
Underwater noise changes	IE	S	IE	S	IE	S	IE	IE	IE	IE	IE	S	IE	IE	NS	IE
Visual disturbance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

Table A1. 3: Summary of the highest sensitivity levels of non-breeding seabirds (functional group 2), breeding waders (functional group 3), breeding waterfowl (functional group 5), breeding birds of prey (functional group 7) and non-breeding birds of prey (functional group 8) to potential pressures, as reported in Natural England's Advice on Operations, across all MPAs within MMO assessment. Pressures relate to anchoring, diving and snorkelling, hovercraft, MPW, motorised watercraft, sailing, and non-motorised watercraft.

Potential pressures from all mNLA	Non-breeding seabirds					Breeding waders				Breeding waterfowl			Breeding birds of prey		Non-breeding birds of prey
	Common tern	Lesser black-backed gull	Little gull	Mediterranean gull	Sandwich tern	Avocet	Bittern	Ringed plover	Ruff	Gadwall	Shoveler	Teal	Marsh harrier	Montagu's Harrier	Hen harrier
Above water noise	S	S	S	S	S	S	S	S	S	S	S	S	IE		IE
Collision ABOVE water with static or moving objects not naturally found in the marine environment										S	S				
Collision BELOW water with static or moving objects not naturally found in the marine environment	S	S	S	S	S		S			NS	NS				
Introduction of light	IE	IE	IE	IE	IE	S	S	S	S	IE	IE	S	IE		IE
Introduction or spread of invasive non-indigenous species (INIS)	NS	NS	NS	NS	NS	S	S	S	S	NS	NS	S	IE		
Litter	S	S	S	S	S	IE	S	IE	IE	S	S	IE			
Underwater noise changes	IE	IE	IE	IE	IE		S			IE	IE	IE			IE
Visual disturbance	NS	NS	NS	NS	NS	S	S	S	S	S	NS	S	S		

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Table A1. 4: Summary of the highest sensitivity levels of non-breeding waders (functional group 4) to potential pressures, as reported in Natural England's Advice on Operations, across all MPAs within MMO assessment. Pressures relate to anchoring, diving and snorkelling, hovercraft, MPW, motorised watercraft, sailing, and non-motorised watercraft.

Potential pressures from all mNLA	Avocet	Bar-tailed godwit	Bittern	Black-tailed godwit	Curlew	Dunlin	Golden plover	Grey plover	Knot	Little egret	Eurasian oystercatcher	Purple sandpiper	Redshank	Ringed plover	Ruff	Sanderling	Turnstone
Above water noise	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Collision BELOW water with static or moving objects not naturally found in the marine environment			S														
Hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination	S	NA	NA	S	NA	S	S	S	S	NA	NA	NA	S	S	NA	NA	S
Introduction of light	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Introduction or spread of invasive non-indigenous species (INIS)	NS	NA	NS	S	NS	S	NS	S	S	NS	S	NS	S	NS	NS	NS	NS
Litter	IE	IE	S	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Underwater noise changes			S														
Visual disturbance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

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Table A1. 5: Summary of the highest sensitivity levels of non-breeding waterfowl (functional group 6) to potential pressures, as reported in Natural England's Advice on Operations, across all MPAs within MMO assessment. Pressures relate to anchoring, diving and snorkelling, hovercraft, MPW, motorised watercraft, sailing, and non-motorised watercraft.

Potential pressures from all mNLA	Bewick's swan	Dark-bellied brent goose	Gadwall	Greater white-fronted goose	Greylag goose	Light-bellied brent goose	Pink-footed goose	Pintail	Shelduck	Shoveler	Slavonian grebe	Spoonbill	Teal	Whooper swan	Wigeon
Above water noise	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Collision BELOW water with static or moving objects not naturally found in the marine environment			NS							NA	S				
Hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination	NA	S	NA	NA	NA	NA	NA	S	S	NA	NA	NA	S	NA	NA
Introduction of light	S	S	IE	S	S	S	S	S	S	IE	S	S	S	S	S
Introduction or spread of invasive non-indigenous species (INIS)	IE	IE	NS	IE	IE	IE	IE	S	S	NS	NS	NS	S	IE	IE
Litter	IE	IE	S	IE	IE	IE	IE	IE	IE	S	S	IE	IE	IE	IE
Underwater noise changes	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	S		IE	IE	IE
Visual disturbance	S	S	S	S	S	S	S	S	S	NS	S	S	S	S	S

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Table A1. 6: Summary of the highest sensitivity levels of breeding crepuscular insectivore (functional group 7), breeding divers and seaducks, non-breeding divers and seaducks (functional group 10) and non-breeding songbirds (functional group 11) to potential pressures, as reported in Natural England's Advice on Operations, across all MPAs within MMO assessment. Pressures relate to anchoring, diving and snorkelling, hovercraft, MPW, motorised watercraft, sailing, and non-motorised watercraft.

Potential pressures from all mNLA	Breeding crepuscular insectivore	Breeding divers and seaducks	Non-breeding divers and seaducks							Non-breeding songbirds
	Nightjar	Pochard	Black-throated diver	Common scoter	Common eider	Goldeneye	Great northern diver	Long-tailed duck	Red-breasted merganser	Aquatic warbler
Above water noise	NA	S	S	S	S	S	S	S	S	IE
Collision BELOW water with static or moving objects not naturally found in the marine environment	NA	S	S	S	S	S	S	S	S	
Introduction of light	NA	S	S	S	S	S	S	S	S	IE
Introduction or spread of invasive non-indigenous species (INIS)	NA	S	NS	NS	NS	NS	NS	NS	NS	
Litter	NA	S	S	S	S	S	S	S	S	
Underwater noise changes	NA	S	S	NS	NS	NS	S	NS	S	
Visual disturbance	NA	S	S	S	S	S	S	S	S	IE

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Annex 2: Species-specific sensitivity to disturbance

Table A2. 1: A summary of likely sensitivity to disturbance, the quality of quantitative information in terms of Alert Distance (AD) and Flight Initiation Distance (FID), and suggested buffer zones during the breeding (BR) and nonbreeding (NBR) seasons considered for some of the bird species included in Marine Non-Licensable Activity Impacts Evidence: Birds document (adapted (Goodship and Furness, 2022)). This table does not include every bird species in scope of this review as it is limited to those species for which sensitivity information was available in the study.

Functional group	Species	Likely sensitivity to disturbance	Quality of quantitative information (AD or FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Waterfowl	Whooper swan (*Cygnus cygnus)*	Medium	Medium agreement Limited evidence	NBR: 200 to 600m
	White-fronted goose (*Anser albifrons)*	High	Medium agreement Limited evidence	NBR: 500 to 1,000m
	Pink-footed goose (*Anser brachyrhychus)*	High	Low agreement Limited evidence	BR: less than or equal to 1,000m NBR: 500 to1000m
	Common shelduck (*Tadorna tadorna)*	High	Medium agreement Medium evidence	BR: 100 to 400m NBR: 100 to 400m
	Gadwall (*Anas strepera)*	Medium	Medium agreement Limited evidence	BR: 100 to 200m NBR: 100 to 200m
	Pintail (*Anas acuta)*	Medium	Low agreement Limited evidence	BR: 100 to 200m NBR: 100 to 200m
	Shoveler (*Anas clypeata)*	Medium	Medium agreement Limited evidence	BR: 100 to 200m NBR: 100 to 200m
	Eurasian wigeon (*Anas penelope)*	High	Low agreement Medium evidence	BR: 100 to 200m NBR: 200 to 500m
	Slavonian grebe (*Podiceps auritus)*	Medium	Low agreement Limited evidence	BR: 150 to 350m NBR: 150 to 350m

Functional group	Species	Likely sensitivity to disturbance	Quality of quantitative information (AD or FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Divers and Seaducks	Common scoter *(Melanitta nigra)*	High	Medium agreement Limited evidence	BR: 300 to 500m
	Common goldeneye *(Bucephala clangula)*	High	Low agreement Medium evidence	BR: 100 to 150m NBR: 150 to 800m
	Red-throated diver *(Gavia stellata)*	High	Medium agreement Medium evidence	BR: 500 to 750m NBR: less than or equal to 1,000m
	Black-throated diver *(Gavia arctica)*	High	Medium agreement Limited evidence	BR: 500 to 750m NBR: less than or equal to 1,000m
	Great northern diver *(Gavia immer)*	Medium to High	Medium agreement Medium evidence	NBR: 100 to 350m
Birds of Prey	Marsh harrier *(Circus aeruginosus)*	Medium	Low agreement Limited evidence	BR: 300 to 500m NBR: 300 to 500m
	Hen harrier *(Circus cyaneus)*	Medium	Medium agreement Limited evidence	BR: 300 to 750m NBR: 300 to 750m
Waders	Eurasian oystercatcher *(Haematopus ostralegus)*	Medium	Medium agreement Robust evidence	BR: 50 to 100m NBR: 150 to 300m
	Ringed plover *(Charadrius hiaticula)*	High	Medium agreement Medium evidence	BR: 100 to 200m NBR: 100 to 300m
	Grey plover *(Pluvialis squatarola)*	Medium	Medium agreement Medium evidence	NBR: 150 to 300m
	Golden plover *(Pluvialis apricaria)*	Medium	Medium agreement Medium evidence	BR: 200 to 500m NBR: 200 to 500m
	Dunlin *(Calidris alpina)*	Medium	Medium agreement Medium evidence	BR: 100 to 200m NBR: 150 to 300m

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Functional group	Species	Likely sensitivity to disturbance	Quality of quantitative information (AD or FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
	Red knot *(Calidris canutus)*	Medium	Medium agreement Medium evidence	NBR: 100 to 300m
	Common redshank *(Tringa totanus)*	Medium	Medium agreement Robust evidence	BR: 100 to 200m NBR: 200 to 300m
	Black-tailed godwit *(Limosa limosa)*	Medium	Medium agreement Medium evidence	BR: 100 to 200m NBR: 100 to 200m
	Bar-tailed godwit *(Limosa lapponica)*	Medium	Medium agreement Medium evidence	NBR: 200 to 300m
	Eurasian curlew *(Numenius arquata)*	High	Medium agreement Robust evidence	BR: 200 to 300m NBR: 200 to 650m
Seabirds	Little tern *(Sternula albifrons)*	Medium	Medium agreement Limited evidence	BR: 100 to 300m
	Sandwich tern *(Thalasseus sandvicensis)*	High	No quantitative evidence	BR: greater than or equal to 200m
	Common tern *(Sterna hirundo)*	Medium to High	Medium agreement Medium evidence	BR: 200 to 400m
	Arctic tern *(Sterna paradisaea)*	Medium	Low agreement Limited evidence	BR: greater than or equal to 200m
	Roseate tern *(Sterna dougallii)*	High	Low agreement Limited evidence	BR: greater than or equal to 200m

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Annex 3: Birds considered in this literature review

Table A3. 1: Bird species represented within the disturbance evidence base used for this literature review (n = 43). The table identifies species relevance to the UK and distinguishes between in scope SPA feature species (n = 19) and proxy species (n = 24) used as analogue evidence where direct species-specific studies are limited.

Species (common name)	Scientific name	UK relevance	In scope or proxy
Eurasian curlew	*Numenius arquata*	UK-relevant	In scope
Eurasian oystercatcher	*Haematopus ostralegus*	UK-relevant	In scope
Redshank	*Tringa totanus*	UK-relevant	In scope
Sanderling	*Calidris alba*	UK-relevant	In scope
Kittiwake	*Rissa tridactyla*	UK-relevant	In scope
Guillemot	*Uria aalge*	UK-relevant	In scope
Little tern	*Sternula albifrons*	UK-relevant	In scope
Golden plover	*Pluvialis apricaria*	UK-relevant	In scope
Ringed plover	*Charadrius hiaticula*	UK-relevant	In scope
Common eider	*Somateria mollissima*	UK-relevant	In scope
Barnacle goose	*Branta leucopsis*	UK-relevant	In scope
Pied avocet (Avocet)	*Recurvirostra avosetta*	UK-relevant	In scope
Shag	*Phalacrocorax aristotelis*	UK-relevant	In scope
Common tern	*Sterna hirundo*	UK-relevant	In scope
Common goldeneye	*Bucephala clangula*	UK-relevant	In scope
Dunlin	*Calidris alpina*	UK-relevant	In scope
Grey plover	*Pluvialis squatarola*	UK-relevant	In scope
Red knot	*Calidris canutus*	UK-relevant	In scope
Black-tailed godwit	*Limosa limosa*	UK-relevant	In scope
Malaysian plover	*Anarhynchus peronii*	Non-UK	Proxy
Western snowy plover	*Anarhynchus nivosus*	Non-UK	Proxy
Common sandpiper	*Actitis hypoleucos*	UK-relevant	Proxy
Canvasback	*Aythya valisineria*	Non-UK	Proxy
American coot	*Fulica americana*	Non-UK	Proxy
Mallard	*Anas platyrhynchos*	UK-relevant	Proxy
Great knot	*Calidris tenuirostris*	Non-UK	Proxy

Species (common name)	Scientific name	UK relevance	In scope or proxy
Snow goose	*Anser caerulescens*	Non-UK	Proxy
Western gull	*Larus occidentalis*	Non-UK	Proxy
Brown pelican	*Pelecanus occidentalis*	Non-UK	Proxy
Double-crested cormorant	*Nannopterum auritum*	Non-UK	Proxy
Red-tailed hawk	*Buteo jamaicensis*	Non-UK	Proxy
Black-winged stilt	*Himantopus himantopus*	UK-relevant	Proxy
Red-necked stint	*Calidris ruficollis*	Non-UK	Proxy
Common (Eurasian) coot	*Fulica atra*	UK-relevant	Proxy
South Island pied oystercatcher	*Haematopus finschi*	Non-UK	Proxy
Great blue heron	*Ardea herodias*	Non-UK	Proxy
Snail kite	*Rostrhamus sociabilis*	Non-UK	Proxy
Bald eagle	*Haliaeetus leucocephalus*	Non-UK	Proxy
Tricoloured heron	*Egretta tricolor*	Non-UK	Proxy
Great egret	*Ardea alba*	UK - relevant	Proxy
Black Guillemot	*Cepphus grylle*	UK - relevant	Proxy
Cormorant	*Phalacrocorax carbo*	UK - relevant	Proxy
Marbled murrelet	*(Brachyramphus marmortus)*	Non-UK	Proxy

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