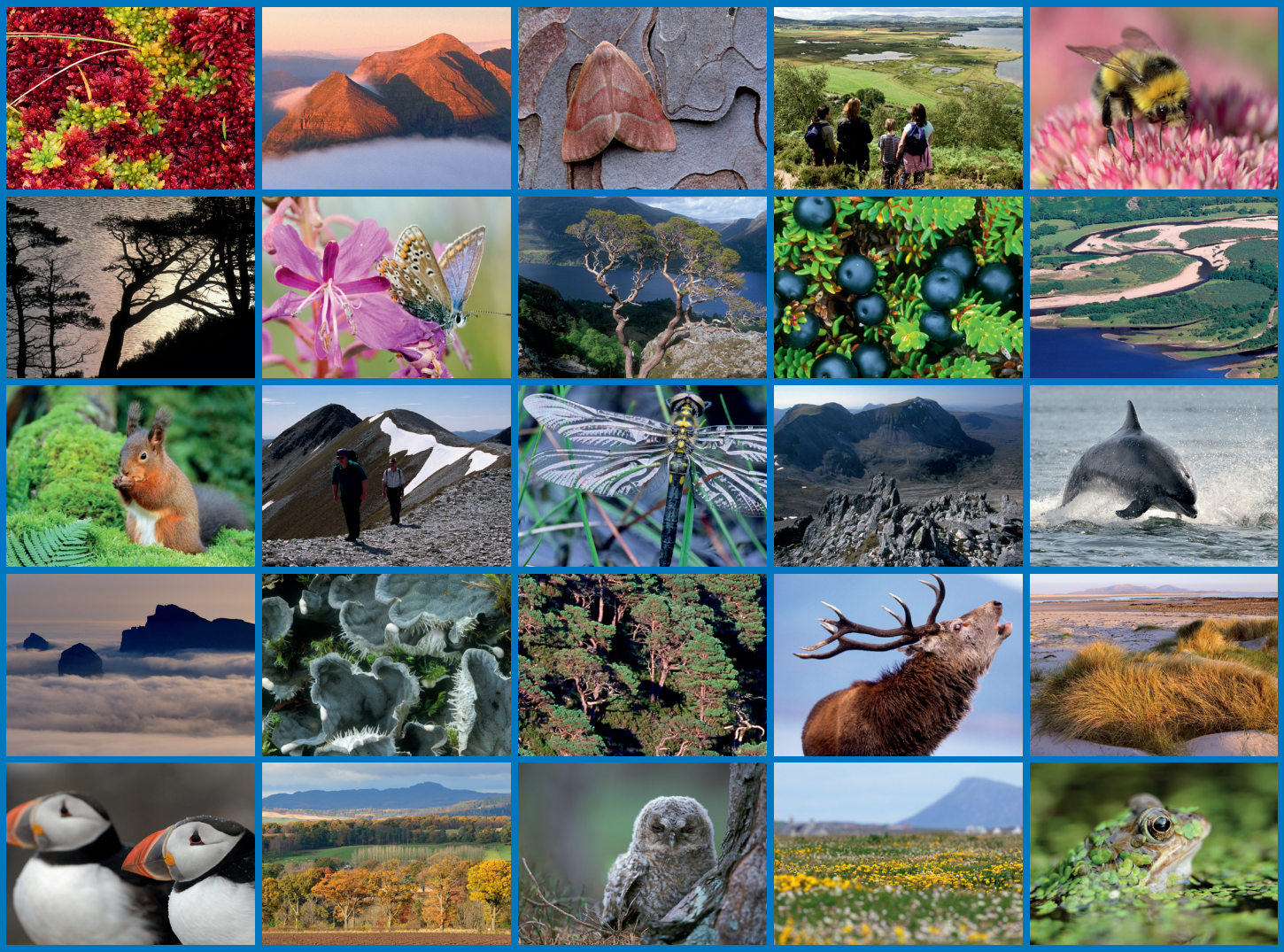
Scottish Natural Heritage
Research Report No. 1096

Seaweed hand-harvesting: literature review of disturbance distances and vulnerabilities of marine and coastal birds



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RESEARCH REPORT

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Seaweed hand-harvesting: literature review of disturbance distances and vulnerabilities of marine and coastal birds

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This report should be quoted as:

Goodship, N. & Furness, R.W. 2019. Seaweed hand-harvesting: literature review of disturbance distances and vulnerabilities of marine and coastal birds. *Scottish Natural Heritage Research Report No. 1096.*

RESEARCH REPORT

Summary

Seaweed hand-harvesting: literature review of disturbance distances and vulnerabilities of marine and coastal birds

Research Report No. 1096
Project No: 017229
Contractor: MacArthur Green
Year of publication: 2019

Keywords

Seaweed; bird disturbance; harvesting; Flight Initiation Distance; Alert Distance; Minimum Approach Distance

Background

The number of companies and individuals consulting Scottish Natural Heritage (SNH) for advice on potential impacts relating to seaweed hand-harvesting in the intertidal zone around the Scottish coastline is increasing rapidly. However, it is recognised that there is little information available to inform the assessment of potential disturbance caused by seaweed hand-harvesting on Scotland's protected marine and coastal bird species.

SNH commissioned MacArthur Green to undertake a literature review to identify distances at which disturbance to a number of protected UK bird species using the shoreline, intertidal area or nearshore waters could be caused by seaweed hand-harvesting related activities. Potential impact pathways causing bird disturbance during seaweed hand-harvesting include people walking along a beach as well as the use of boats in nearshore waters. The literature was searched for disturbance distances that were measured in terms of Alert Distance (AD), Flight Initiation Distance (FID) and Minimum Approach Distance (MAD), and for qualitative evidence on bird disturbance. These disturbance distances were collated into a Bird Disturbance Response database for 50 bird species that are either designated under the Birds Directive and/or listed as designated features of Marine Protection Areas (MPAs). This report provides an account for each species summarising the reliance on seaweed for foraging/habitat requirements, the quality of the studies providing quantitative information in terms of AD/FID and MAD and the likely sensitivity of each species to seaweed hand-harvesting activities.

Main findings

- A total of 8 species (great cormorant, European shag, red knot, sanderling, purple sandpiper, ruddy turnstone, dunlin and black guillemot) out of the 50 bird species included in this review, appear to have a high reliance on seaweed. These eight species indirectly use seaweed for foraging either by feeding on fish living in kelp forests or by feeding on benthic infauna associated with seaweed. Cormorants and shags also use

seaweed as part of their nest construction although, for other species, there is no evidence for additional habitat requirements on seaweed other than foraging.

- For the majority of bird species (32 out of 50 species), this review identified a medium reliance on seaweed, meaning that for the majority of species, seaweed is used to a degree in some aspect of their foraging/habitat requirements although they are not reliant on seaweed as a food source or habitat type.
- A total of 16 out of 50 species were judged as having good quality information available on quantitative disturbance distances in terms of AD, FID and MAD. The rest were judged as having either poor quality (19 out of 50 species) or moderate quality (15 out of 50) information available on quantitative disturbance distances. Generally, species for which quantitative data were scarce or lacking tended to be species with medium or low sensitivity to human disturbance (e.g. gulls, terns and auks), as published studies have tended to focus on the species of high sensitivity.
- A total of 13 out of 50 species were assessed as having a high sensitivity to disturbance from seaweed hand-harvesting activities. Impact assessments for seaweed hand-harvesting will require to give greatest consideration to potential disturbance impacts for these species with high sensitivity to disturbance, and to apply appropriate mitigation in areas where these species are likely to be present.
- Half of the species included in this review (25 out of 50 species) were assessed as having a medium sensitivity to disturbance. This means that these species may tolerate some disturbance caused by hand-harvesting seaweed, but the extent of disturbance caused to individual birds could depend on a wide range of factors including levels of habituation to disturbance.
- It is important to note that all bird species assessed in this review (including high, medium and low sensitive species) are likely to vary in their response to hand-harvesting seaweed disturbance in different areas depending on habituation to disturbance and other factors. Therefore, each assessment for future hand-harvesting related activities will need to be on a site-specific basis.
- A number of data gaps in the bird disturbance distance database are identified in this report and recommendations for future research are provided.
- This report provides a guide to the information that should be recorded at the time of a disturbance distance study. Future studies collecting disturbance distances would be appropriate as a Citizen Science project to build up a more detailed picture of sensitivity of birds to human disturbance. Alternatively, studies of disturbance responses would make excellent undergraduate or Masters research projects.
- This literature review and the associated recommendations for further analysis will contribute to guidance and best practice for seaweed hand-harvesters. This will ensure any potential impacts resulting from harvesting are considered and minimised as part of a sustainable harvesting approach.

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Acknowledgements

We would like to thank SNH, especially Lucy Quinn, for the clear guidance with earlier drafts of this report. Our thanks also to P. Thompson, D. Johnston and B. Zonfrillo for their comments in the species accounts.

1. INTRODUCTION

Scottish Natural Heritage (SNH) commissioned MacArthur Green to undertake a literature review to provide information on the effects of disturbance caused by seaweed hand-harvesting on protected marine and coastal bird species. Specifically, the review was to take the form of a database providing distances at which disturbance to birds could be caused by hand-harvesting seaweed activities, relative to recreational and other activities around Scotland's coasts.

This report provides a written summary to the database review and summarises for each bird species key conclusions about disturbance distances according to the source of the disturbance, and the level of confidence in these conclusions within a Scottish context. Knowledge gaps identified during the review process are also presented in this report. Recommendations for potential future monitoring programmes and research are provided.

1.1 Background

1.1.1 Requirement for this project

The number of companies and individuals consulting SNH for advice on potential impacts relating to hand-harvesting seaweed in the intertidal zone around the Scottish coastline is increasing rapidly. This includes proposals for harvesting within or adjacent to Marine Protected Areas (MPAs), including Special Protected Areas (SPAs). SNH provides advice to Crown Estate Scotland (CES) to inform seaweed hand-harvesting licence decisions to ensure impacts on wildlife and habitats are minimised.

However, it is recognised that there is little information available to inform the assessment of potential disturbance caused by seaweed hand-harvesting on Scotland's protected marine and coastal bird species. This is particularly the case when trying to assess the sustained nature of seaweed harvesting, with potential impacts occurring over extended periods of time, as most evidence to date relates to discrete or seasonal disturbance impacts, such as recreational use of beaches or boats. This lack of relevant evidence makes it challenging to assess the potential impacts of proposals, including cumulative impacts, and to provide clear and proportionate advice for harvesters, and advise on mitigation measures.

1.1.2 Definition of seaweed hand-harvesting

Technically, seaweed 'harvesting' (either by hand or by machine) refers to the removal of part or all of a living seaweed from its position of growth; seaweed 'picking' is a form of harvest of small algae by hand cutting (Angus, 2017). Seaweed 'gathering' is the collection of any seaweed that is no longer in the position of growth; this typically refers to beach-cast seaweed (Angus 2017). The disturbance distances stated in this report are applicable to all three approaches of collecting seaweed, on the condition that seaweed is hand-collected rather than collected for commercial purposes through the use of machinery.

Scotland has a long history involving the collection and use of seaweed. In the past, seaweed has been used for a range of purposes including: livestock fodder, fertilizer, stabilizing land, bleaching and soap and glass manufacture, production of alkaline ash and alginates (Barber, 2003; Orr, 2013; Angus, 2017). Production of seaweed products peaked in Scotland between 1770-1825; production declined after this period although it continued to be marketed into the 1920s, principally as a source of iodine (Bumstead, 2005), but this trade ceased in 1933 (Bailey, 1997; Angus, 2017).

Currently, there is a renewed and growing interest in seaweed collection in Scotland. This interest extends from the level of individuals foraging for their own meals to that of large-scale harvesting and onward industrial processing (Angus, 2017).

1.1.3 Potential impact pathways causing bird disturbance during seaweed hand-harvesting

There are a range of activities involved with hand-harvesting seaweed at the coast, some or all of which can potentially cause disturbance to marine and coastal birds. The potential pathways identified in this report through which seaweed hand-harvesting could cause disturbance include, but are not limited to, the following:

- pedestrians walking along the beach, particularly in the intertidal zone at low tide when harvesters can collect from the living plants;
- motorized and non-motorized boats from which harvesters collect seaweed in shallow waters;
- motorized and non-motorized boats to drop off/pick up harvesters and to load seaweed;
- use of vehicles close to the coast line, although these should be restricted to existing tracks and not directly on the beach.

These potential impact pathways may cause disturbance to birds both during the breeding and nonbreeding seasons. Furthermore, birds may be disturbed whilst occupied in difference behavioural activities including the following:

- intertidal foraging;
- nearshore foraging;
- at nest; and
- at roost.

Human disturbance may result in birds increasing their energy expenditure (for example if birds fly away from a source of disturbance); or disturbance may reduce energy intake by causing birds to switch from foraging to alert behaviour or flight (Gill *et al*., 2001, Beale & Monaghan, 2004). A broad relationship between human disturbance distance and bird size has been identified, whereby larger birds tend to be disturbed at greater distances than smaller birds (Mikula *et al*., 2018). However, a great many other factors influence the disturbance responses of birds, a few of these include: frequency of disturbance; birds can habituate to regular human activity (Baudains & Lloyd, 2007; Vincze *et al*., 2016), time of year; responses of breeding birds may differ from responses of the same birds in the nonbreeding season (Mikula *et al.,* 2018) and the extent of persecution; for example birds show stronger disturbance responses where they are subject to hunting than in locations where no hunting occurs (Madsen, 1998a,b). For other factors influencing disturbance distances, refer to section 4.2.

1.1.4 Definition of disturbance response (AD/FID/MAD)

There are three ways disturbance responses are typically measured, as defined below. As part of the literature review process, evidence of these three responses for each species was collated, where it was available.

AD: Alert Distance (AD) is defined as the distance at which a bird or group of birds starts to show alert behaviour (rather than sleeping, foraging or preening behaviour) when approached by a disturbance agent (such as a person, or powerboat) (Livezey *et al*., 2016).

FID: Flight Initiation Distance (FID) is defined as the distance at which a bird or group of birds starts to escape (by walking away, running away, swimming away, taking flight, or diving) when approached by a disturbance agent (such as a person, or powerboat). This distance is assumed to reflect the trade-off between costs of escape (energetic costs of flight plus loss of food intake during the period of disturbance) and the risk associated with staying put (inferred predation risk) (Mikula *et al*., 2018).

MAD: Minimum Approach Distance (MAD) is defined as the distance at which humans should be separated from wildlife to avoid any disturbance to the behaviour of the wildlife (Livezey *et al*., 2016). This distance should be such that the wildlife does not show an alert response to the presence of human activity and does not show flight initiation. Estimates of MAD can therefore be informed by measurement of AD and/or FID. MAD is commonly referred to as a buffer distance and is a distance determined by management.

1.1.5 Bird species potentially affected by seaweed hand-harvesting

The 50 bird species at the focus of this report are those which use the shoreline, intertidal area or nearshore waters and are designated under the Birds Directive (EC Directive on the conservation of wild birds (2009/147) Article 4.1, listed in Annex 1 as being rare or vulnerable, as well as those birds listed under Article 4.2 as being regularly occurring migratory species. These bird species are afforded protection within Natura 2000 sites (including SPAs). Black guillemot was added as an additional species; although this species is not included in the Birds Directive, it is listed as designated feature of MPAs and for this reason it was included in this report. The scientific name along with the common name of each species is listed in Annex 1, 2 and 3; scientific names are not repeated in the text of this report.

Protected bird species which may potentially be affected by seaweed hand-harvesting activities covered in this report include: divers (family Gaviidae), wildfowl (family Anatidae), waders (families Haematopodidae, Charadriidae and Scolopacidae), coastal raptors (families Accipitridae and Falconidae) and seabirds including both coastal and marine species (families Podicipedidae, Procellariidae, Phalacrocoracidae, Laridae, Sternidae and Alcidae). These family groups include both breeding and nonbreeding UK species and they use coastal habitats in at least one of the following ways:

- foraging or loafing on the shoreline, intertidal and nearshore areas;
- nesting on the upper section of the beach, in dunes or nearby cliff ledges; and
- roosting on the shoreline or nearshore areas.

1.2 Study aims

The aim of this study was to carry out a detailed review of academic and grey literature to collate information relating to the distances at which disturbance could be caused by seaweed hand-harvesting related activities, relative to recreational and other activities around Scotland's coasts.

The outputs of this project will be used to enable a more objective and evidence-based approach to seaweed hand-harvesting impact assessment and mitigation for birds. Outputs will also be used to enable SNH to better assist CES in de-risking licence applications, to inform decisions on applications and ensure hand-harvesting practices are sustainable.

2. METHODS

2.1 The Bird Disturbance Response database

A literature search for information on quantitative disturbance response distances measured worldwide in terms of ADs, FIDs and MADs (see section 1.1.4) of focal UK marine and coastal bird species (see section 1.1.5) was extracted from academic scientific publications as well as 'grey literature' reports monitoring disturbance distances. Data were obtained not only from Scottish/UK studies but also from other European and worldwide studies (including those taking place in North America, Australia, Asia and Africa). Information was sought from the following sources:

- academic literature search on Web of Science (WoS): Key words including: "bird disturbance", "disturbance distance", "disturbance buffer", "flight initiation distance", "FID", "alert distance", "AD", "minimum approach distance", and "MAD" were entered into the WoS search engine, ranking outputs by numbers of citations. Searching was then continued by examining references cited by relevant identified papers, and in particular by examining subsequent citations of these papers;
- Marine Scotland's data publishing portal;
- British Trust for Ornithology (BTO) publications;
- SNH publications;
- Joint Nature Conservation Committee (JNCC) publications;
- general internet search, including Google Scholar and ResearchGate; and
- consulting experts for their opinion on disturbance distances on bird species where information from other sources was lacking; this was particularly the case for seabird and sawbill duck species (red-breasted merganser and goosander), a total of four experts were consulted.

Copies of publications were obtained and then searched for specified quantitative disturbance distances (AD, FID and MAD) relating to all human disturbances which could be considered analogous to the process of hand-harvesting seaweed, both during the harvesting itself and through the access to the beach by harvesters. The following activities were included in the search:

- Recreational pedestrian disturbance (including: walking, running, cycling, climbing, horse riding, bait digging, egg collecting and hunting) on beaches, along the shoreline, in the intertidal area or sea cliff area;
- Recreational use of near-shore waters (including both motorized and non-motorized watercraft e.g. kayak and jet skis close to shore);
- Small working vessels (e.g. fishing vessels) in near shore waters or entering the water from the shoreline;
- Small commercial ferries in near shore waters;
- Animal disturbance (e.g. cattle and dogs on the beach);
- Tractors and other vehicles driven onto the beaches; and
- Aircraft and drone disturbance over coastal sites.

Information for all 50 focal bird species was collated into an Excel database termed the 'Bird Disturbance Response' (BDR) database. The main objective of the BDR database was to collate quantitative studies (i.e. studies supplying AD/FID or MAD values); in total, 72 quantitative study references are supplied in the database, many of these references contained quantitative data for multiple species (see Annex 1 for the number of quantitative studies used for each species).

In addition to quantitative studies, non-quantitative studies are provided in the species accounts of this report (see section 1), primarily to help with assessing sensitivity to

disturbance where quantitative data were lacking or assessed as being poor quality (see section 2.2.3). In total, 57 non-quantitative study references are supplied in the species accounts under the title of 'Non-quantitative information on disturbance responses', several of these references are used for multiple species (see Annex 1 for the number of non-quantitative studies found for each species). The number of non-quantitative study references used for each species in this report is also provided in the 'Foraging & Habitat Requirements' spreadsheet in the BDR database (see below for database composition).

The BDR database is composed of two main spreadsheets plus two supplementary spreadsheets:

1) 'Records of AD, FID & MAD' spreadsheet: Collates all quantitative records of AD/FID and MAD for each species;
2) 'Foraging & Habitat Requirements' spreadsheet: Collates foraging and habitat requirements of each species. This spreadsheet also states the reliance on seaweed that each species has for foraging and habitat requirements (see section 2.2.1), the data quality of the disturbance response studies recording AD/FID/MAD (see section 2.2.2) and the likely sensitivity of each species to disturbance through hand-harvesting of seaweed (see section 2.2.3), as calculated from two supplementary spreadsheets within the database. The summaries of these two additional spreadsheets are provided in Annex 2 and Annex 3, respectively.

It should be noted that not all of the quantitative references provided in the BDR database were used for the species accounts in this report; references to studies carried out solely offshore were deemed less relevant to the current literature study on seaweed hand-harvesting disturbance distances, but offshore references are retained within the database for future use if required.

Two non-UK species were included in the BDR database to supply additional quantitative data for two UK species with little available quantitative data. These species were bald eagle as a stand-in species for white-tailed eagle and least tern as a stand in species for little tern. In addition, pigeon guillemot was used as a stand-in species for common guillemot in the species account section of this report to provide some seaweed relevant foraging information (see section 2.2.1). All three stand-in species belong to the same family and have similar ecologies compared with their UK counterparts.

2.2 Assessing 'reliance on seaweed', 'data quality' and 'sensitivity to disturbance'

2.2.1 Reliance on seaweed for foraging / habitat requirements

The known ecology of each species was used to investigate whether seaweed, either directly or indirectly, is used for foraging and/or habitat requirements. Previous studies which have demonstrated the usage of seaweed for each species, as well as more general ecological information (not necessarily seaweed specific), on diet, breeding and roosting activity was used to assess the likely reliance on seaweed. In part based on the general literature on the ecology of each species, expert opinion by the authors of this report was also used to evaluate whether each species had a 'high', 'medium' or 'low' reliance on seaweed.

2.2.2 Quality of quantitative information on disturbance response distances (AD/FID/MAD)

The quality of the quantitative information recording AD/FID/MAD disturbance response distances was assessed in order to determine the level of confidence that should be placed in the conclusions of these studies within a Scottish context. For each species, a study quality score was constructed using four factors as follows (see Annex 2):

- Total number of AD, FID of MAD records:
- >15 records = score 4;
- 8 to 14 records = score 3;
- 4 to 7 records = score 2;
- 1 to 3 records = score 1; and
- Zero records = score 0.

- Number of named sources of disturbance (e.g. pedestrian, motorized watercraft, aircraft etc.) providing a record of AD, FID or MAD:
- >4 named sources = score 4;
- 2 to 3 named sources = score 3;
- 1 named source = score 2;
- Unknown source = score 1; and
- Zero sources = score 0.

- Number of named seasons (breeding, nonbreeding, migratory) providing a record of AD, FID or MAD:
- 3 seasons = score 4;
- 2 seasons = score 3;
- 1 season = score 2;
- Unknown season = score 1; and
- Zero seasons = score 0.

- Record of whether a site was 'disturbed' or 'undisturbed' (i.e. indicating habituation to disturbance) prior to recording AD, FID or MAD:
- Records for disturbed plus undisturbed sites = score 3
- Records of disturbed OR undisturbed sites (but not both) = score 2;
- Habituation to disturbance unknown = score 1; and
- Zero studies = score 0.

The study quality score for each species was calculated by adding together a single value from each of the four quality factors above. The quality score was then used to categorise the collected studies for each species as 'good', 'moderate' or 'poor' quality using the following criteria:

- Study quality score category:
- Study quality score > 11 = Good quality;
- Study quality score 9 or 10 = Moderate quality; and
- Study quality score <8 = Poor quality.

2.2.3 Likely sensitivity to disturbance whilst hand-harvesting seaweed

Data on the maximum recorded AD or FID in the bird disturbance response database was used to help assess the likely sensitivity of each species to disturbance during seaweed hand-harvesting. The maximum recorded value of AD/FID for each species was generally used to assign a sensitivity category of 'high', 'medium' or 'low' sensitivity as follows (see Annex 3):

- Sensitivity score category:
- Maximum recorded AD/FID value > 500m = High sensitivity;
- Maximum recorded AD/FID value between 500 to 50m = Medium sensitivity; and
- Maximum recorded AD/FID value <50m = Low sensitivity.

However, in addition to the maximum recorded AD/FID value, non-quantitative information on disturbance response was also used to assess likely sensitivity to disturbance. Non-

quantitative information was especially used in the assessment of species where quantitative data were lacking or assessed as being poor quality (see section 2.2.2). Using a combination of quantitative and non-quantitative information, the overall likely sensitivity of each species to disturbance during seaweed hand-harvesting was evaluated by the authors of this report. Species for which quantitative data were scarce tended to be species with low sensitivity to human disturbance, as published studies have tended to focus on the species of high sensitivity.

2.3 Species accounts

This report summarises the data held in the BDR database in a collection of species account tables (see section 1). Each table provides summarised data for each individual species and includes the following headings and content:

- **Conservation status:**
- UK conservation status (Eaton *et al.,* 2015)[1].
- European conservation status (BirdLife International, 2017)[2].
- Schedule 1 of the Wildlife and Countryside Act 1981 (Scottish Government, 2018)[3].

- **UK status:**
- Breeding/wintering/migration status in the UK (BTO BirdFacts)[4].
- Scottish status was also added to this section if different from UK status (Forrester *et al*., 2012).

- **UK and Scottish population estimate:**
  The UK and Scottish population estimates were obtained from a variety of sources for different species, as specified below. In a select few instances, the Scottish population estimate encompasses a wider range than the UK population estimate, due to a difference between the data sources used.
- Breeding and wintering numbers of seabirds in the UK (SNH, 2018a; Scottish marine Special Protection Area network assessment)[5].
- Breeding and wintering numbers of waders and wildfowl in the UK (RSPB wildlife guides)[6].
- Breeding and wintering numbers of birds in Scotland (Forrester *et al*., 2012).
- Breeding numbers of white-tailed eagle in Scotland (Challis *et al.,* 2018: Scottish Raptor Monitoring Scheme Report 2017)[7].
- Breeding numbers of golden eagle in Scotland (Hayhow *et al.,* 2017a: Status of golden eagle in Britain in 2015)[8].
- Breeding numbers of peregrine falcon in the UK (Wilson *et al*., 2018)[9].

[1] Eaton *et al.,* 2015 available at: https://britishbirds.co.uk/wp-content/uploads/2014/07/BoCC4.pdf
[2] BirdLife International, 2017 available at:http://www.birdlife.org/europe-and-central-asia/European-birds-of-conservation-concern
[3] Scottish Government, 2018 available at: https://www.gov.scot/Topics/Environment/Wildlife-Habitats/InvasiveSpecies/legislation
[4] BTO BirdFacts available at: https://www.bto.org/about-birds/birdfacts
[5] SNH, 2018a available at: https://www.nature.scot/sites/default/files/2018-09/Scottish%20Network%20Assessment%20-%20All%20Species%20Assessments%20-%20September%202018_1.pdf
[6] RSPB wildlife guides available at: https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/
[7] Challis *et al*., 2018 available at: http://raptormonitoring.org/wp-content/uploads/2018/10/SRMS_Report17.pdf
[8] Hayhow *et al*., 2017a available at: https://www.tandfonline.com/doi/abs/10.1080/00063657.2017.1366972
[9] Wilson *et al*., 2018 available at: https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F00063657.2017.1421610

- **UK long-term trend:**
  The best available current trend information was obtained from a variety of sources for different species, as specified below:
- UK long-term trend for seabirds and waterbirds (DEFRA, 2018: Wild Bird Populations in the UK, 1970 to 2017)[10].
- UK long-term trend for red-throated diver, black-throated diver, Slavonian grebe, common scoter and black-headed gull (Hayhow *et al.,* 2017: The state of the UK's birds 2017b)[11].
- UK long-term trend for great northern diver, velvet scoter, long-tailed duck, (Frost *et al.,* 2018)[12].
- UK long-term trend for common gull and lesser black-backed gull (JNCC, 2016: Seabird Monitoring Programme)[13].
- UK long-term trend for Greenland white fronted goose and pink-footed goose (WWT, 2015: Waterbird Monitoring)[14].
- Scotland long-term trends (if different from UK long-term trends above) for herring gull, great black-backed gull, common gull, lesser black-backed gull, sandwich tern, Arctic tern, black guillemot and common guillemot (SNH, 2012: Trend Note 2012; SNH, 2018b: Scottish Biodiversity Indicator – Seabird Numbers and Breeding Success)[15][16].
- Scottish trend for white-tailed eagle (Humphreys *et al.,* 2015a)[17].
- Scottish trend for golden eagle (Humphreys *et al.,* 2015b)[18].
- Scottish trend for peregrine falcon (Humphreys *et al.,* 2015c)[19].

- **Scottish distribution & habitat, within a UK context:**
- Distribution and habitat choice in Scotland (Forrester *et al*., 2012).
- Distribution and habitat choice in the UK (Snow & Perrins 1998; BirdLife International, 2019 IUCN Red List for birds, Data Zone[20]; JNCC, 2012 Species Accounts[21] and RSPB, 2019 wildlife guides[22]).
- References with specific information for white-tailed eagle and golden eagle are available in the text of the appropriate species accounts (3.22 and 3.23 respectively).

- **Reliance on seaweed for foraging/habitat requirements:**
- Collected evidence that was used to classify foraging/habitat reliance on seaweed (section 2.2.1). References are provided in the text and at the end of the report.

[10] DEFRA, 2018 available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/754432/UK_Wild_birds_1970-2017_FINAL__002_.pdf.
[11] Hayhow *et al*., 2017b available at: https://monitoring.wwt.org.uk/wp-content/uploads/2017/12/SUKB-2017.pdf.
[12] Frost *et al*., 2018 available at: https://britishbirds.co.uk/article/population-estimates-of-wintering-waterbirds-in-great-britain/
[13] JNCC, 2016 available at: http://www.jncc.defra.gov.uk/page-3201
[14] WWT, 2015 available at: https://monitoring.wwt.org.uk/our-work/goose-swan-monitoring-programme/species-accounts/
[15] SNH, 2012 available at: https://www.nature.scot/sites/default/files/B1163280%20-%20Trend%20note%20-%20biodiversity%20-%20Seabirds%20in%20Scotland%20-%20October%202012%20-%20PDF%20for%20website.pdf
[16] SNH, 2018b: Scottish Biodiversity Indicator – Seabird Numbers and Breeding Success. SNH data, unpublished
[17] Humphreys *et al*., 2015a available at: http://www.swbsg.org/images/7_Haliaeetus_albicilla.pdf
[18] Humphreys *et al*., 2015b available at: http://www.swbsg.org/images/9_Aquila_chrysaetos.pdf
[19] Humphreys *et al*., 2015c available at: http://www.swbsg.org/images/12_Falco_peregrinus.pdf
[20] BirdLife International, 2019 Data Zone available at: http://datazone.BirdLife.org/home
[21] JNCC, 2012 Species Accounts available at: http://jncc.defra.gov.uk/page-1419
[22] RSPB, 2019 Wildlife guides available at: https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/

- **Season(s) and behaviour(s) with potential impact pathway**
- Identification of which season (breeding and/or nonbreeding) and which behaviour(s) (intertidal foraging; nearshore foraging; at nest; at roost) could be potentially impacted by seaweed harvesting (see section 1.1.3).

- **Quantitative information on disturbance response distances (AD/FID):**
- Disturbance distances (AD & FID) detailed in the BDR database. References are available in each table, at the end of the report and in the BDR database.

- **Quantitative information on MAD or buffer distances:**
- MADs and buffer distances provided in the BDR database. References are available in each table, at the end of the report and in the BDR database.

- **Quality of quantitative information on disturbance response distances (AD/FID/MAD):**
- Classification of quality of the quantitative information held within the BDR database (section 2.2.2).

- **Non-quantitative information on disturbance responses:**
- Non-quantitative information on disturbance response was used to assess sensitivity to disturbance when quantitative data were lacking or assessed as being poor quality. References are provided in the text and at the end of the report.

- **Likely sensitivity to disturbance whilst hand-harvesting seaweed:**
- Classification of the likely sensitivity to disturbance (section 2.2.3).

- **Knowledge gaps:**
- Reference to what data is unavailable for each species.

- **References to quantitative information on disturbance response distances (AD/FID/MAD):**
- References for quantitative information held in the BDR database.

A summary of the bird species considered in this report, and the classification of their sensitivity is provided in Table 1 at the start of the results section, immediately before the individual species accounts, with full details presented in the BDR database (section 2.1).

3. RESULTS – SPECIES ACCOUNTS

A summary of the bird species considered in this report as well as the classification of their foraging/habitat reliance on seaweed (section 2.2.1), quality of the quantitative information held within the BDR database (section 2.2.2) and the likely sensitivity to disturbance (section 2.2.3) is provided in Table 1. Individual species accounts, summarising the data held for each species in the BDR database, are presented in sections 3.1 to 3.50.

Table 1. Summary of reliance on seaweed, quality of quantitative data and likely sensitivity for key protected coastal and marine bird species.

Common name	Latin name	Foraging/ Habitat reliance on seaweed	Quality of quantitative information (AD/FID/MAD)	Likely sensitivity to disturbance
Red-throated diver	*Gavia stellata*	Medium	Moderate	High
Black-throated diver	*Gavia arctica*	Medium	Moderate	High
Great northern diver	*Gavia immer*	Medium	Moderate	High
Great crested grebe	*Podiceps cristatus*	Medium	Good	Medium
Slavonian grebe	*Podiceps auritus*	Medium	Poor	Medium
Northern fulmar	*Fulmarus glacialis*	Low	Poor	Low
Great cormorant	*Phalacrocorax carbo*	High	Moderate	Medium
European shag	*Phalacrocorax aristotelis*	High	Poor	Medium
Greenland white fronted goose	*Anser albifrons*	Low	Poor	High
Pink-footed goose	*Anser brachyrhynchus*	Low	Moderate	High
Common shelduck	*Tadorna tadorna*	Medium	Good	High
Mallard	*Anas platyrhynchos*	Low	Good	Medium
Eurasian wigeon	*Anas penelope*	Medium	Moderate	High
Greater scaup	*Aythya marila*	Medium	Poor	High
Common eider	*Somateria mollissima*	Medium	Good	Medium
Common scoter	*Melanitta nigra*	Medium	Good	High
Velvet scoter	*Melanitta fusca*	Medium	Poor	High
Long-tailed duck	*Clangula hyemalis*	Medium	Moderate	Low
Common goldeneye	*Bucephala clangula*	Medium	Good	High
Goosander	*Mergus merganser*	Low	Poor	High
Red-breasted merganser	*Mergus serrator*	Medium	Poor	Medium
White-tailed eagle	*Haliaeetus albicilla*	Low	Good	Medium
Golden eagle	*Aquila chrysaetos*	Low	Moderate	Medium
Peregrine falcon	*Falco peregrinus*	Low	Moderate	Medium
Eurasian oystercatcher	*Haematopus ostralegus*	Medium	Good	Medium
Ringed plover	*Charadrius hiaticula*	Medium	Good	Medium
Grey plover	*Pluvialis squatarola*	Medium	Moderate	Medium
Golden plover	*Pluvialis apricaria*	Low	Moderate	Medium

Common name	Latin name	Foraging/ Habitat reliance on seaweed	Quality of quantitative information (AD/FID/MAD)	Likely sensitivity to disturbance
Northern lapwing	*Vanellus vanellus*	Low	Moderate	Medium
Red knot	*Calidris canutus*	High	Poor	Medium
Sanderling	*Calidris alba*	High	Good	Medium
Purple sandpiper	*Calidris maritima*	High	Poor	Low
Ruddy turnstone	*Arenaria interpres*	High	Moderate	Medium
Dunlin	*Calidris alpina*	High	Good	Medium
Common redshank	*Tringa totanus*	Medium	Good	Medium
Bar-tailed godwit	*Limosa lapponica*	Medium	Good	Medium
Eurasian curlew	*Numenius arquata*	Medium	Good	High
Black-headed gull	*Larus ridibundus*	Medium	Poor	Low
Common gull	*Larus canus*	Medium	Poor	Low
Herring gull	*Larus argentatus*	Medium	Good	Low
Lesser black-backed gull	*Larus fuscus*	Medium	Poor	Low
Great black-backed gull	*Larus marinus*	Medium	Moderate	Low
Black-legged kittiwake	*Rissa tridactyla*	Medium	Poor	Low
Little tern	*Sternula albifrons*	Medium	Poor	Medium
Sandwich tern	*Thalasseus sandvicensis*	Medium	Poor	Low
Common tern	*Sterna hirundo*	Medium	Good	Medium
Arctic tern	*Sterna paradisaea*	Medium	Moderate	Medium
Black guillemot	*Cepphus grylle*	High	Poor	Medium
Common guillemot	*Uria aalge*	Medium	Poor	Low
Razorbill	*Alca torda*	Medium	Poor	Low

3.1 Red-throated diver (*Gavia stellata*)

Conservation Status	UK: Green; Schedule 1 European: Depleted
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: Scotland only = 1,300 pairs (935-1,500 pairs) Wintering: UK = 17,000 individuals; Scotland = over 2,270 individuals
UK long-term trend	Increase
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely in winter. **Breeding:** Red-throated divers breed on freshwater pools or lochs in open moorland, blanket bogs or open and wet peatland habitats. This species nests on pools 10-20m long to lochs up to 5ha, preferentially treeless areas that have well-vegetated margins and low islets or promontories on which to nest. Scotland holds 100% of the UK breeding population with nests located in the north and west of Scotland as far south as the Mull of Kintyre (Argyll). Shetland is the UK stronghold (almost half of the population now breeds in Shetland) with other key populations on Orkney, the Outer Hebrides and the northern Scottish mainland. **Nonbreeding:** Frequents inshore marine waters along sheltered coasts, only rarely occurring inland on lakes, pools, reservoirs and rivers. Numerous along the UK's south-east coast especially in the Thames and Wash areas and occurs patchily along the west coast. In Scotland, the main wintering sites are along the east coast with concentrations in the Firth of Forth, St Andrews Bay, from Carnoustie to St Cyrus, between Donmouth and Cruden Bay, in Spey Bay and the Inner Moray Firth. Large counts also come from the north-east Scottish coast between the Don and the Ythan Estuaries, the highest being during passage periods. Counts are generally lower on the west coast, although there are notable concentrations at Islay, the Inner Firth of Clyde, the Ayrshire coast and the Solway Firth.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Red-throated diver is assessed to have a medium reliance on seaweed for foraging requirements. Divers may indirectly use seaweed for foraging as they commonly feed on fish found in kelp forests in inshore waters (Kelly, 2005). The diet of red-throated diver consists predominantly of fish as well as crustaceans, molluscs, frogs, fish spawn, aquatic insects, annelid worms and plant matter (Snow & Perrins, 1998; BirdLife International, 2019). Whilst red-throated divers may still forage in their chosen breeding loch, they feed primarily in coastal waters, typically within a range of 10km from their breeding site (Black *et al*., 2015). During the winter when red-throated diver is predominantly a coastal species often preferring sandy bays with open water, principal prey items include cod (*Gadus morhua*), herring (*Clupea harengus*) and sprats (*Sprattus sprattus*) (Kelly, 2005).

	Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging) Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Median AD = 225m, Range of AD 150 to 750m; Median FID = 125m, Range of FID = 10 to 750m (RH-5,6). **Nonbreeding season:** Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 1200m (RH-2). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 1400m (RH-3).
Quantitative information on MAD or buffer distances	**Unknown season:** Range of safe working distances at a site where level of habituation to disturbance is unknown: Range of MAD = 200 to 900m (RH-4).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Three studies investigating disturbance from pedestrian activity and watercraft during the breeding and nonbreeding season present three groups of AD/FID values. One study provides a range of MAD buffer distances.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on red-throated diver show that this species has a high sensitivity to human disturbance. This species has been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013). Red-throated diver has also been assessed as having a very high sensitivity to boat disturbance; this species is very likely to take flight in the 200-300m distance band from a passing ferry (Jarrett *et al*., 2018). Marine activity may also increase the number of red-throated diver flights; relative to the other two diver species, red-throated divers are much more likely to take flight in response to disturbance, but they have also been recorded flying more in the absence of disturbance than the other two diver species (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Red-throated diver is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Divers have some of the highest AD/FID/MAD values recorded in the bird disturbance response database, although only values recorded during the nonbreeding season are relevant to seaweed hand-harvesting as red-throated diver only breed at freshwater sites. The maximum FID recorded for red-throated diver during the nonbreeding season is 1400m for non-motorized watercraft disturbance; therefore, this species may be easily disturbed on foraging grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.

Knowledge gaps	Lack of studies measuring AD/FID for a range of disturbance activities, especially pedestrian activity on the beach during the nonbreeding season and watercraft activity during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	RH-2,3: Laursen *et al*. (2017) RH-4: Ruddock & Whitfield (2007) RH-5,6: Whitfield *et al*. (2008)

3.2 Black-throated diver (*Gavia arctica*)

Conservation Status	UK: Amber; Schedule 1 European: Declining
UK status	Migrant/Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: (Scotland only) 200 pairs Wintering: UK = 560 individuals; Scotland = 700-800 individuals
UK long-term trend	Increase
Scottish distribution & habitat, within a UK context.	Present around the UK coastline outside the breeding season. **Breeding:** Black-throated divers breed beside clear, shallow, productive, freshwater lochs or extensive pools with islets and peninsulas. Scotland holds 100% of the UK breeding population with the breeding range extending across the western, northern and central mainland areas and the Outer Hebrides. Breeding abundance mainly reflects the availability of suitable lochs. The main strongholds occur on the loch-rich upland landscapes of west Sutherland and western Ross & Cromarty, the Flow Country of east Sutherland and Caithness and the peat-lands of the Outer Hebrides. **Nonbreeding:** Black throated divers spend the winter around sheltered coasts, mostly around the Moray Firth and west coast of Scotland but also north-eastern and south-western coasts of England. This species is sometimes seen at inland reservoirs during the nonbreeding season, occasionally frequenting large inland freshwater bodies.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Similar to red-throated diver, black-throated diver may indirectly use seaweed for foraging as they commonly feed on fish found in kelp forests in inshore waters (Kelly, 2005), but only in the nonbreeding season as this species feeds only on freshwater lochs while breeding. Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Range of median AD = 310 to 400m, Range of AD 100 to 750m; Median FID = 225m, Range of FID = 50 to 500m (BV-4,5). Motorized watercraft at an undisturbed site: Range of mean FID = 189 to 278m, range of median FID = 80 to 310m, Range of FID = 0 to 750m (BV-2,3).
Quantitative information on MAD or buffer distances	**Breeding season:** MAD should >100m around islands where divers are nesting to

	avoid disturbance by boats (BV-2,3).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Two studies investigating disturbance from pedestrian activity and watercraft during the breeding season present two groups of AD/FID values. One study provides a minimum MAD buffer distance around islands with nesting divers.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on black-throated diver show that this species has a high sensitivity to human disturbance. Black-throated diver at sea have been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013) and Garthe & Hüppop (2004) ranked black-throated diver and red-throated diver as the most sensitive species to offshore wind farm impacts. Black-throated diver swim or dive in the 200-300m distance band from a passing ferry and have been described as having a very high sensitivity to boat disturbance (Jarrett *et al*., 2018). It seems likely that this species may avoid areas where marine activity takes place, making data gathering for this species difficult. Black-throated divers are unlikely to take flight in response to marine activity, instead this species favours a swim or dive response, similar to great northern diver (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Black-throated diver is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Divers have some of the highest AD/FID/MAD values recorded in the bird disturbance response database, although as these quantitative values are only recorded during the breeding season, they may not be relevant to seaweed hand-harvesting as black-throated diver breed at freshwater sites. Non-quantitative disturbance studies also show that black-throated diver is sensitive to human disturbance, especially boat traffic at sea and it is considered that this species may be easily disturbed on foraging grounds during the nonbreeding season whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies measuring AD/FID during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	BV-2,3: Götmark *et al*. (1989) BV-4,5: Whitfield *et al*. (2008)

3.3 Great northern diver (*Gavia immer*)

Conservation Status	UK: Amber; Schedule 1 European: Vulnerable
UK status	Extremely scarce Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: Scotland only with 1 possible record Wintering: UK = 2,500 individuals; Scotland = 1,000-3,000 individuals
UK long-term trend	Increasing
Scottish distribution & habitat, within a UK context.	Present around the UK coastline outside the breeding season. **Breeding**: Great northern diver breeds in large, deep freshwater lakes in coniferous forest or on open tundra in Iceland and Greenland. One potential breeding pair was recorded on Loch Maree, Wester Ross in 1970. **Nonbreeding**: Great northern diver winters along the coast on exposed rocky shores, sheltered bays, channels and sheltered inlets, preferring shallow inshore waters. May also be found inland on lakes and reservoirs, although this is largely influenced by the weather. This species is a common coastal winter visitor to Scotland, found mostly in the north and west, with small numbers in the east and a tiny number of inland records. Largest winter numbers are recorded around the Outer Hebrides, Shetland and Orkney. In England they are recorded off the Cornish coast. Birds wintering in Scotland represent a significant proportion of the western Palearctic population.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Great northern divers may indirectly use seaweed for foraging as they commonly feed on fish found in kelp forests in inshore waters (Foster & Schiel, 1985). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Motorized watercraft at a disturbed site: Range of FID = 64 to 29m (ND-1) Motorized watercraft at an undisturbed site: Mean FID = 200m (ND-7) Non-motorized watercraft at a disturbed site: Mean FID = 27.8m, Range of FID = 3 to 90m (ND-2) **Unknown season:** Motorized watercraft at a disturbed site: Range of mean FID = 10 to 35m (ND-5,6).

Quantitative information on MAD or buffer distances	**Breeding season:** Motorized watercraft at a disturbed site: Mean MAD = 137m (ND-1). Motorized watercraft at a site where level of habituation to disturbance is unknown: 150m (ND-4). **Unknown season:** Range of safe working distances at a site where level of habituation to disturbance is unknown: Range of MAD = 67 to 900m (ND-3).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Three studies investigating disturbance from watercraft during the breeding and an unknown season present four sets of FID values. Two studies produced MAD buffer distances for the breeding season and an unknown season.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on great northern diver show that this species has a moderate/high sensitivity to human disturbance during the breeding season, although the response can vary depending on the source of disturbance and habituation to disturbance (Ruddock & Whitfield, 2007). During the breeding season, great northern diver disturbance limits may be lower than that of red-throated or black-throated diver species. Great northern diver at sea have been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013) although another study indicated that this species tolerated boat traffic to within 10 to 20m during the nonbreeding season and displayed a disturbance response at a shorter distance compared with red-throated diver (Gittings *et al*., 2015). Great northern diver has also been assessed as having a high sensitivity to boat disturbance; this species is quite likely to swim or dive in the 200-300m distance band from a passing ferry, and this species was also recorded swimming out of the path of ferries up to 4km away (Jarrett *et al*., 2018). Great northern divers also respond to other marine activity, particularly slow vessels/craft (including motorized and non-motorized boats for pleasure and commercial activities) by swimming or diving; in Orkney, they are frequently found in areas where regular marine activity takes place, although rarely recorded close to shore (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Great northern diver is assessed to have a moderate/high sensitivity to human disturbance whilst hand-harvesting seaweed. Divers have some of the highest AD/FID/MAD values recorded in the bird disturbance response database, although quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as great northern diver do not breed in the UK. Non-quantitative disturbance studies indicate that great northern diver can be sensitive to boat traffic at sea and it is considered that this species may be easily disturbed on foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies measuring AD/FID for a range of disturbance

	activities, especially pedestrian activity on the beach during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	ND-1: Kelly (1992) ND-2: Titus & VanDruff (1981) ND-3,4,5,6,7: Ruddock & Whitfield (2007)

3.4 Great crested grebe (*Podiceps cristatus*)

Conservation Status	UK: Green European: Least Concern
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 4,600 pairs; Scotland = 240-365 pairs Wintering: UK = 19,000 individuals; Scotland = 900-1,500 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context.	Present around the UK coastline during outside the breeding season, but relatively scarce in Scottish waters. **Breeding:** Great crested grebe breeds on fresh or brackish waters with abundant emergent and submerged vegetation, showing a preference for non-acidic eutrophic waterbodies. Suitable habitats include small pools or lakes, backwaters of slow-flowing rivers and artificial waterbodies (e.g. reservoirs, fish-ponds, gravel pits and ornamental lakes). This species is widespread in England, but in Scotland it is a relatively scarce breeder with scattered distribution on suitable waters in the central Lowlands, with a few in the Southern Uplands and elsewhere. **Nonbreeding:** During the winter, a few great crested grebes may remain on breeding waters on large exposed ice-free lakes and reservoirs, but the majority move to sheltered coastal inshore waters less than 10m deep such as brackish estuaries, deltas, tidal channels and tidal lagoons. Similar distribution to breeding season, but in Scotland this species mostly winters in larger east coast estuaries, particularly the Firth of Forth. Scotland holds a very small proportion of the wintering (especially coastal) population of great-crested grebe (nonbreeding) in the UK, which is at the northern edge of the UK wintering range.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** During the nonbreeding season, great crested grebes may indirectly use seaweed for foraging as they commonly feed on fish found in kelp forests in inshore waters (Kelly, 2005). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Non-motorized watercraft at a disturbed site: Range of Median FID = 2 to 4m, Range of FID = 0 to 20m (GG-3,4). Non-motorized watercraft at an undisturbed site: Range of FID = 50 to 100m (GG-2). **Nonbreeding season:** Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 90 to 340m (GG-

	5,6) Vehicle (bus) at a disturbed site: Mean FID = 70m (GG-8) Unknown source of disturbance at a disturbed site: Median FID = 100m, Range of FID = 20 to 100m (GG-7) **Unknown season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of FID = 8 to 30m (GG-9) Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 6.4m (GG-10)
Quantitative information on MAD or buffer distances	No records of MAD for great crested grebe.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Five studies investigating a range disturbance during the breeding, nonbreeding and unknown seasons present seven sets of FID values. There are no studies recording MAD buffer distances.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Great crested grebe is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Great crested grebe has a maximum FID value of 340m recorded during the nonbreeding season and has potential to be disturbed on foraging grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies measuring AD/FID for pedestrian activity on the beach during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GG-2,3,4: Keller (1989) GG-5,6: Laursen *et al*. (2017) GG-7: Liley *et al*. (2010) GG-8: McLeod *et al*. (2013) GG-9,10: Ruddock & Whitfield (2007)

3.5 Slavonian grebe (*Podiceps auritus*)

Conservation Status	UK: Red; Schedule 1 European: Near Threatened
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: Scotland only = 30 pairs (30-80 pairs) Wintering: UK = 1,100 individuals; Scotland = 300-500 individuals
UK long-term trend	Decrease
Scottish distribution & habitat, within a UK context.	Present around the UK coastline during outside the breeding season. **Breeding**: Slavonian grebes breed on a wide variety of lochs including small, shallow fresh, brackish or slightly alkaline waters between 0.5 and 2m deep and between 1-20ha in area with rich floating, submerged and emergent vegetation. Habitats include small pools, marshes with patches of open water and secluded sections of larger lochs and rivers. The UK breeding population is limited to Scotland where it is a rare breeding bird located mostly in the Highland sub-area of Inverness. **Nonbreeding**: In the winter, Slavonian grebe move to coastal inshore waters up to 10-20m in depth including sheltered bays, lagoons and estuaries, joining immigrants from other breeding areas. It may also occur on large lake and river systems south of its breeding range, spread widely across the UK coastline. In Scotland, large wintering numbers are found in Scapa Flow and Loch of Harray (Mainland Orkney), Moray Firth and Firth of Forth.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** During the nonbreeding season, Slavonian grebes may indirectly use seaweed for foraging as they commonly feed on fish found in kelp forests located in inshore waters (Foster & Schiel, 1985; Kelly, 2005). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Unknown source of disturbance at a disturbed site: Median AD = 50m, Range of AD = 50 to 50m, Range of FID = 30 to 30m (SZ-1).
Quantitative information on MAD or buffer distances	**Unknown season:** Preliminary safe working buffer for forestry workers: Range of MAD = 150 to 300m (SZ-2)
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance from an unknown source during the nonbreeding season presents one set of AD/FID values. One study produced a range of MAD buffer distances for forestry workers.
Non-quantitative	Breeding Slavonian grebes are relatively tolerant of human

information on disturbance responses	presence, and although they are threatened by predation at nests, by flooding and wave damage, human disturbance of nesting birds is not considered to be a threat (Forrester *et al*., 2007). Nonbreeding Slavonian grebes on the sea do not normally come ashore. They forage in shallow marine habitat, so could be disturbed by people on the shore, but in areas where Slavonian grebes occur regularly, there can be considerable human activity. For example, in Argyll, Orkney and Shetland, Slavonian grebes overwinter in areas with frequent ferry and fishing vessel traffic, salmon and mussel farming activity (Argyll Bird Reports volumes 12 to 29, Upton *et al*., 2018; Jackson, 2018), and these populations appear to be tolerant of these practices. Slavonian grebe has been assessed as having a very high sensitivity to boat disturbance; this species is very likely to respond to a passing ferry at a distance of 200-300m (third highest response after black-throated and red-throated divers) by flying away (Jarrett *et al*., 2018). Slavonian grebe rarely appears to be present in areas of sea around Orkney where regular marine activity takes place; in response to marine activity, the evasive flights of Slavonian grebe are longer/further than for other species (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Slavonian grebe is assessed to have a low/medium sensitivity to human disturbance whilst hand-harvesting seaweed. Slavonian grebe has a maximum AD value of 50m recorded during the nonbreeding season. Non-quantitative studies indicate that Slavonian grebe could be disturbed by people on the shore and in boats in areas where this species feeds in shallow marine areas. Therefore, this species has potential to be disturbed on foraging grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	General lack of studies measuring AD/FID for a range of disturbance activities, especially pedestrian activity on the beach during nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	SZ-1: Liley *et al*. (2011) SZ-2: Ruddock & Whitfield (2007)

3.6 Northern fulmar (*Fulmarus glacialis*)

Conservation Status	UK: Amber European: Endangered
UK status	Migrant/Resident Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 500,000 pairs; Scotland = 486,000 Apparently Occupied Sites Wintering: UK = 1,125,103 individuals; Scotland = c 1 million individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the breeding season, but largely pelagic outside the breeding season. **Breeding:** Fulmar typically breeds on cliffs and rock faces, but also occasionally on flatter ground sometimes up to 1km inland. It will also breed near human habitation, for example in quarry and road cut rock faces in Shetland. Most abundant along the Scottish coastline, especially the Northern Isles and Outer Hebrides. Least common along the east, south and north-west coasts of England. **Nonbreeding:** This species winters usually far out at sea from the North Atlantic up to the Arctic Ocean and across to the west Atlantic. Individuals frequently return to their breeding colony site during the nonbreeding period.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Fulmars generally forage in offshore waters (Snow & Perrins, 1998) and are not known to use seaweed for foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging) Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for fulmar.
Quantitative information on MAD or buffer distances	**Breeding:** Aircraft (twin-engine monoplane) flying over a disturbed site: MAD = 100m (FF-2)
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are currently no studies providing AD/FID values; one study provides a MAD value for disturbance from aircraft.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on fulmar show that this species has a low sensitivity to human disturbance. Vulnerability of fulmars at sea to disturbance by boats was scored as very low (1) by Furness *et al*. (2013). Mendel *et al.* (2008) considered human disturbance not to be a

	significant threat to fulmars at sea. Fulmars do not come to shore during the nonbreeding period, except at nest sites, so away from colonies this species would not be at risk of human disturbance from people on the shore. Fulmar nest in loose colonies on high, steep coastal sea cliffs where the nests tend to be in locations safe from human disturbance. Fulmar generally show little concern about presence of people unless approached closely; although this species can potentially be disturbed by people walking along a beach, the distance at which they are disturbed and the length of time they are away from the nest varies between individuals (Paul Thompson 2019, *pers. comm.*). When people are within about 10m, fulmars that are not attending an egg or chick may take off from their site (Ollason & Dunnet, 1980; Bob Furness 2019, *pers. comm.*). Adults attending an egg or chick may spit at intruding people over a range of 3-4 meters, but they generally remain at the nest (Walsh *et al.*, 1995). Risk of disturbance of nesting fulmars by people hand-harvesting seaweed is therefore very low.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Fulmar is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed. Non-quantitative disturbance studies show that fulmars generally breed and forage in areas that are not likely to be disturbed whilst hand-harvesting seaweed.
Knowledge gaps	Lack of any studies measuring AD/FID during the breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	F.-2: Dunnet (1977)

3.7 Great cormorant (*Phalacrocorax carbo*)

Conservation Status	UK: Green European: Least Concern
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 6,820 pairs; Scotland = 3,600 Apparently Occupied Nests Wintering: UK = 33,123 individuals; Scotland = 9,000-11,500 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the year. **Breeding:** Great cormorants generally breed in marine environments in sheltered coastal areas on estuaries, coastal lagoons, deltas, and coastal bays, requiring rocky shores, cliffs and islets for nesting but generally avoiding deep water and rarely extending far offshore. It also inhabits fresh, brackish or saline inland wetlands including lakes, reservoirs, wide rivers, flood waters, deep marshes with open water, swamps and oxbow lakes, requiring trees, bushes, reedbeds or bare ground for nesting and avoiding overgrown, small, very shallow or very deep waters. This species is largely resident around the British coastline and central England. In Scotland, this is a relatively scarce local breeding species found in fewer than 100 colonies scattered around the coast of Scotland. **Nonbreeding:** Similar to breeding, but distributed more evenly around coasts and more widespread inland over the winter. In Scotland, estuarine populations are confined to the south (e.g. Solway, Clyde and Forth).
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Cormorants and shags indirectly use seaweed for foraging as they have been shown to preferentially feed on fish in kelp forests and perform more dives in unharvested kelp areas (Foster & Schiel, 1985; Lorentsen *et al*., 2004; Kelly, 2005). Cormorants nest on cliff ledges, trees and reedbeds and their nests are often composed of heaps of seaweed (Snow & Perrins, 1998).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 74.0 to 77.9m (CA-6,8) Vehicle (car) at a disturbed site: Range of mean FID = 17.7 to 23.5m (CA-5,7) **Unknown season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 32.3 to 32.3m

	(CA-1,2)
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running during the breeding season at a site where level of habituation to disturbance is unknown: Range of MAD = 50 to 100m (CA-3).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Five studies investigating disturbance from watercraft during the breeding and an unknown season present three sets of FID values. One study recorded a MAD value for the breeding season.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Great cormorant is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Cormorant has a maximum AD value of 77.9m and a maximum MAD value of 100m recorded for pedestrian disturbance during the nonbreeding and breeding seasons respectively. This species has potential to be disturbed on breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies measuring AD/FID for pedestrian activity on the beach during the breeding season as well as a lack of studies involving watercraft disturbance during the breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	CA-1: Blumstein (2003) CA-2: Blumstein (2006) CA-3: Carney & Sydeman (1999) CA-5,6: Guay *et al*. (2014) CA-7,8: McLeod *et al*. (2013)

3.8 European shag (*Phalacrocorax aristotelis*)

Conservation Status	UK: Red European: Declining
UK status	Resident Breeder
UK and Scottish population estimate	Breeding: UK = 27,667 pairs; Scotland = 21,500-30,000 pairs Wintering: UK = 110,000 individuals; Scotland = 60,000-80,000 individuals
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the year. **Breeding:** Occupies marine habitats, but does not usually occur far from land. It shows a strong preference for rocky coasts and islands with adjacent deep, clear water, and forages over sandy and rocky seabeds. Half the UK population is found at fewer than 10 sites, with the largest colonies in Scotland found in Orkney, Shetland, the Inner Hebrides and the Firth of Forth. Elsewhere they can be found around the coasts of Wales and south west England, especially Devon and Cornwall. **Nonbreeding:** In winter, numbers of shags move between Scotland and England and a few cross the North Sea to Norway. The winter distribution closely resembles that during the breeding season, but not localised to breeding colonies.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Cormorants and shags indirectly use seaweed for foraging as they have been shown to preferentially feed on fish in kelp forests and perform more dives in unharvested kelp areas (Foster & Schiel, 1985; Lorentsen *et al*., 2004; Kellly, 2005). Shags nest on cliff ledges and their nests are often composed of heaps of seaweed (Snow & Perrins, 1998).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Motorized watercraft at a disturbed site: Mean AD = 500m (SA-3)
Quantitative information on MAD or buffer distances	**Breeding season:** Aircraft (twin-engine monoplane) flying over a disturbed site: Mean MAD = 100m (SA-2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance from watercraft during the breeding season presents one group of AD values. One study recorded a MAD value for aircraft disturbance during the breeding season.
Non-quantitative information on disturbance responses	Breeding shags vary enormously in their responses to presence of humans. Some individuals leave the nest when people are 20m away, while others remain on the nest until touched by hand

	(Bob. Furness 2019, *pers. comm.*). Nonbreeding shags forage in shallow sea, and will come ashore to roost and to dry their wings, so they be more susceptible to human disturbance at those times. Shags often roost on harbour walls, and will roost on structures such as offshore wind turbine bases and buoys. Although they may avoid vessels, they tend to show low response to presence of people at the coast, although shags resting on the shore will return to the water when people approach. Their behavioural responses appear to be very similar to those of cormorants (Bob Furness 2019, *pers. comm*.). European shag has been assessed as having a medium sensitivity to boat disturbance; this species responds to marine activity, particularly slow vessels/craft (including motorized and non-motorized boats for pleasure and commercial activities) by significantly flying away more often (Jarrett *et al*., 2018). Shags have a very low flight response rate within the 200-300m distance band from a passing ferry; this species typically takes flight or dives in response to approaching vessels and are less likely to swim evasively. The likelihood of shag flight responses to passing ferries increases strongly and significantly in rougher sea states (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** European shag is assessed to have a medium to high sensitivity to human disturbance whilst hand-harvesting seaweed. Shag has a maximum AD value of 500m for motorized watercraft disturbance and a maximum MAD value of 100m for aircraft disturbance during the breeding season. Non-quantitative information indicates that cormorants and shags are similar in their response to disturbance. Shag has potential to be disturbed on breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies measuring AD/FID for pedestrian activity on the beach during the breeding and nonbreeding seasons as well as a lack of studies involving watercraft disturbance during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	SA-2: Dunnet (1977) SA-3: Velando & Munilla (2011)

3.9 Greenland white fronted goose (*Anser albifrons*)

Conservation Status	UK: Red European: Least Concern
UK status	Winter Migrant
UK and Scottish population estimate	Wintering: UK = 2,400 individuals from the European population and 13,000 individuals from Greenland; Scotland = *c.* 16,000 individuals
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context.	Winter migrant to the UK with some association with coastal habitat. **Breeding:** Breeds on open tundra of south west Greenland. This species does not breed in the UK. **Nonbreeding:** Winters on open country on steppe and agricultural land (e.g. improved grassland, stubble fields, and wet meadows), or in brackish and freshwater marshy habitats (such as upland bogs, peatlands and floodlands). Two races visit the UK in winter - birds which breed in Greenland and birds which breed in Siberia. Greenland breeding birds overwinter in Ireland and west Scotland. Greenland white fronted goose is a very localised winter visitor to Scotland, present at about 30 locations at the beginning of the 21st century, all in the north and west of the country with the bulk of the population in the Inner Hebrides and on mainland Argyll. Siberian breeding birds overwinter in south England especially the Severn estuary in Gloucestershire and the Swale estuary in Kent.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Greenland white fronted goose is an herbivorous species (Snow & Perrins, 1998); feeding traditionally occurred on bogland, but in recent years geese have increasingly used intensively managed grassland, especially in the most important wintering areas of Wexford and Islay (WWT, 2015). Tracking data from the Dyfi Estuary in Wales has shown that Greenland white fronted goose feeds and roosts on the intertidal salt marsh which suggests that this species has a greater reliance on the intertidal environment than previously thought (GWGS, 2019). Although in Scotland this species is not defined as being reliant on intertidal habitat, there is a potential that this species may still make use of intertidal habitat. There is no further evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Hunting at a disturbed site: Range of mean FID decreased from 500 to 200m following the closure of the hunting season (WG-1,2).

Quantitative information on MAD or buffer distances	No records of MAD for Greenland white fronted goose.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance from hunting provides an FID value before and after hunting. There are currently no studies providing MAD buffer distances.
Non-quantitative information on disturbance responses	Greenland white-fronted geese often forage on agricultural land (Fox *et al*., 2012), but they tend to select fields that are distant from roads or houses, showing slightly stronger aversion to human activity than shown by grey-lag or pink-footed geese, and it is considered that this population is sensitive to human disturbance (Fox & Stroud, 2002; Forrester *et al*., 2007). Roost sites include coastal waters, estuarine sandbanks and lakes, and tend to be close to foraging areas (Cramp & Simmons, 1977). In Scotland, Greenland white-fronted geese roost mainly on estuaries and large waterbodies (Forrester *et al*., 2012), therefore, there is potential for disturbance at roost sites during seaweed hand-harvesting.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Greenland white fronted goose is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. White fronted goose has a maximum FID value of 500m when disturbed by hunting activities during the nonbreeding season and as this species roosts in coastal areas it has the potential to be disturbed on roosting and foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies measuring AD/FID for pedestrian activity on the beach and in watercraft at roost sites during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	WG-1,2: Fox & Madsen (1997)

3.10 Pink-footed goose (*Anser brachyrhynchus*)

Conservation Status	UK: Amber European: Least Concern
UK status	Winter Migrant
UK and Scottish population estimate	Wintering: UK = 360,000; Scotland = 200,000 in October, 100,000-150,000 in winter/spring
UK long-term trend	Strong Increase
Scottish distribution & habitat, within a UK context.	Present around the UK coastline outside the breeding season. **Breeding:** Breeds in Iceland and the east coast of Greenland. This species does not breed in the UK. **Nonbreeding:** Overwinters on extensive areas of saltmarsh in estuaries and on flat agricultural land (e.g. improved or fertilised grasslands, stubble fields, pastures and newly sown cereal fields). Scotland is a key wintering area for the Pink-footed goose population from Iceland and Greenland, with large feeding and roosting flocks in the eastern and central parts of the country, especially autumn and early winter. Elsewhere, large flocks can be seen on the Wash, the Ribble and the Solway.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Feeds primarily in agricultural habitats during the winter, selecting stubbles, managed grasslands, cereals and root crops (Mitchell & Hearn, 2004). During the summer breeding months, eats green parts, roots and fruits of wide variety of tundra plants (Snow & Perrins, 1998). There is no evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 41.7 to 175.0m (PG-3,4,5,6). **Migratory season:** Hunting at a disturbed site: Range of mean FID decreased from 500 to 350m following the closure of the hunting season (PG-1,2).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean MAD = 1000m (PG-7).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Two studies investigating disturbance from pedestrian and hunting activity during the breeding and migratory seasons present two sets FID values. One study recorded a MAD value for pedestrian disturbance during the breeding season.

Non-quantitative information on disturbance responses	Overwintering roost sites in the UK include estuaries, large lakes and reservoirs, usually close to feeding grounds. Pink-footed geese are sensitive to disturbance (JNCC, 2012) and there is potential for disturbance at roost sites during seaweed hand-harvesting in the winter. In Scotland favoured winter daytime roosting sites include estuarine mudflats, lochs and reservoirs (Forrester *et al.,* 2012).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Pink-footed goose is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Pink-footed goose has a maximum FID value of 500m when disturbed by hunting activities during the nonbreeding season and as this species also roosts in coastal areas it has the potential to be disturbed on roosting and foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies measuring AD/FID for pedestrian activity on the beach and in watercraft at roost sites during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	PG-1,2: Madsen (1985) PG-3,4,5,6,7: Madsen *et al*. (2009)

3.11 Common shelduck (*Tadorna tadorna*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant/Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 15,000 pairs; Scotland = 1,750 pairs Wintering: UK = 61,000 individuals; Scotland = 7,000 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the year. **Breeding:** The species shows a preference for saline habitats and frequents mudflats and muddy or sandy estuaries in coastal regions. Widespread around the estuaries and coasts of the UK. In Scotland, large breeding numbers are found in the Outer Hebrides and Orkney although they are widespread right around the Scottish coast. **Nonbreeding:** European populations are largely sedentary (apart from a moult-migration) and UK nonbreeding habitat and distribution similar to breeding. Many Scottish birds emigrate after breeding during the summer to moult in Germany, though some move instead to the upper Forth and possibly the Mersey Estuary in Cheshire. All return to Scotland in early autumn to winter. Internationally important winter sites in Scotland are the Solway and Forth estuaries. The Solway birds occur mainly at Caerlaverock and Torduff, while the Firth of Forth concentrations are principally at Kinneil and Torryburn. Nationally, the Montrose Basin is an important site.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Shelducks may indirectly use seaweed for foraging as they feed mainly on invertebrates of intertidal areas, especially molluscs, insects and crustaceans present in saline habitats such as mud flats and muddy or sandy estuaries (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 36.30 to 48.57m (SU-9,10). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID: 148 to 250m, Range of FID = 55 to 700m (SU-3,11,12). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 220 to 400m (SU-1,2).

	Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 50m, Range of AD = 50 to 70m, Range of median FID: 40 to 77.5m, Range of FID = 25 to 140m (SU-4,5,6,7,8).
Quantitative information on MAD or buffer distances	No records of MAD for common shelduck.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Six studies investigating disturbance from pedestrians and watercraft during the breeding and nonbreeding seasons present four groups of AD/FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	A study in the UK by Burton *et al.* (2002) indicated that shelducks are sensitive to disturbance as it was shown that counts were significantly lower on estuarine count sectors that were closer to footpaths.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Common shelduck is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Shelduck has a maximum FID value of 700m when disturbed by pedestrians during the nonbreeding season and it has the potential to be disturbed on breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies investigating habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	SU-1,2: Laursen *et al*. (2017) SU-3: Laursen *et al*. (2005) SU-4,5,6,7,8: Liley *et al*. (2011) SU-9: Møller (2008b) SU-10: Møller & Erritzøe (2010) SU-11,12: Smit & Visser (1993)

3.12 Mallard (*Anas platyrhynchos*)

Conservation Status	UK: Amber European: Least Concern
UK status	Introduced/Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 61,000-146,000 pairs; Scotland = 17,000-43,000 Wintering: UK = 710,000 individuals; Scotland = 65,000-90,000
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context.	Present around the UK coastline outside the breeding season. **Breeding:** Mallards breed in almost every wetland type, but avoids fast-flowing flowing, oligotrophic, deep, exposed, rockbound waters and hard unvegetated areas such as rocky ground, sand dunes and artificial surfacing. Ubiquitous across the UK. In Scotland, highest densities are found in areas scattered around the country, from Orkney and the Outer Hebrides to the Southern Uplands, but small numbers nest almost everywhere. **Nonbreeding:** During winter, mallards are also found in saline habitats along the coast where water is shallow, fairly sheltered and within sight of land (e.g. brackish lagoons, brackish estuaries and bays). In Scotland, there is some retreat from the north and west of the country and from higher ground to lower, but the species is still very widely distributed. Main concentrations occur in similar areas to those during the breeding season but with greater emphasis on estuaries.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Mallards are omnivorous and opportunistic in their feeding habits, with wide range of food and feeding methods either in saline or fresh water or grazing on land (Snow & Perrins, 1998). There is no evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 13.42m to 14.60m (MA-13,14). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 12.8 to 236m (MA-2,9), Range of FID = 60 to 400m (MA-9). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 110 (MA-6). Non-motorized watercraft at a disturbed site: Range of mean FID = 99.30 to 100m (MA-1,15).

	Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 40 to 280m (MA-3,4,5,7,8). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Range of median FID = 25 to 40m, Range of FID = 10 to 50m (MA-10,11,12).
Quantitative information on MAD or buffer distances	No records of MAD for mallard.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Seven studies investigating a disturbance from pedestrians and watercraft during the breeding and nonbreeding seasons present six groups of FID values. There are no studies recording MAD buffer distances.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Mallard is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Mallard has a maximum FID value of 400m when disturbed by pedestrians during the nonbreeding season and it has the potential to be disturbed on breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies providing AD/FID for a range of disturbance types (e.g. watercraft activity) during the breeding season. Few studies specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	MA-1: Batten (1977) MA-2: Weston *et al*. (2012) MA-3,4,5,6,7,8: Laursen *et al*. (2017) MA-9: Laursen *et al*. (2005) MA-10,11: Liley *et al*. (2011) MA-12: Liley *et al*. (2010) MA-15: Mori *et al*. (2001)

3.13 Eurasian wigeon (*Anas penelope*)

Conservation Status	UK: Amber European: Least Concern
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 400 pairs; Scotland = 240-400 pairs Wintering: UK = 440,000 individuals; Scotland = 76,000-96,000 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** Eurasian wigeon breeds in lowland freshwater marshes, slow-flowing large rivers and shallow lakes and lagoons with ample submerged, floating and emerging vegetation. In Scotland, this species is an uncommon and localised breeder throughout the country with main populations in the Central Highlands, north Scotland and Orkney. In England, breeding is largely limited to the Swale estuary, Suffolk and the North Pennines. **Nonbreeding:** Much more widespread in its large wintering UK population with preference for coastal salt-marshes, freshwater, brackish and saline lagoons, flooded grasslands, estuaries, intertidal mudflats, and other sheltered marine habitats. Wigeon is an abundant and widespread passage winter visitor to Scotland and the wintering population is much larger compared to the breeding population. Sites associated with the Moray Firth hold the greatest concentrations of nationally important numbers and the Dornoch Firth also holds internationally important numbers. Other important sites are Loch of Harray (Mainland Orkney), the Solway Firth, Montrose Basin and lochs on the Isle of Bute.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** In winter, wigeons forage mainly on aquatic leaves and grasses, mainly leaves, stems, stolons, bulbils, rhizomes but also algae (e.g. the green seaweed Enteromorpha) (Owen & Williams, 1976; Jacobsen, 1993; Snow & Perrins, 1998). On summer breeding grounds, wigeons may also feed on insects (Jacobsen, 1991). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging; at roost) Nonbreeding (nearshore foraging; at roost
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 269m, Range of FID = 150 to 1000m (WN-7). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 205 (WN-5).

	Non-motorized watercraft at a disturbed site: Mean FID = 67.70m (WN-8). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 230 to 500m (WN-4,6). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Range of median FID = 60 to 75.5m, Range of FID = 20 to 125m (WN-9,10). **Unknown season:** Motorized watercraft at a disturbed site: Range of mean FID = 200 to 700m (WN-2,3). Non-motorized watercraft at a disturbed site: Mean FID = 100m (WN-1).
Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 250m (WN-11).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Seven studies investigating disturbance from pedestrian and watercraft activity during the nonbreeding and unknown seasons present seven sets FID values. One study recorded a MAD buffer value for pedestrian disturbance around conservation wildlife areas during the nonbreeding season.
Non-quantitative information on disturbance responses	Wigeons generally roost on the coast close to feeding grounds. Wigeons can feed both during the day and night; where the feeding grounds are subject to daytime disturbance the birds spend the day on the roost (Owen & Williams, 1976). Therefore, there is potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Eurasian wigeon is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Wigeon has a maximum FID value of 1000m and a MAD buffer of 250m when disturbed by pedestrians during the nonbreeding season. This species has the potential to be disturbed on roosting and foraging grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	Few studies specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	WN-1,2,3: Fox & Madsen (1997) WN-4,5,6: Laursen *et al.* (2017) WN-7: Laursen *et al*. (2005) WN-8: Mori *et al*. (2001) WN-9: Liley *et al*. (2011) WN-10: Liley *et al*. (2010) WN-11: Mathers *et al*. (2000)

3.14 Greater scaup (*Aythya marila*)

Conservation Status	UK: Red; Schedule 1 European: Vulnerable (winter population)
UK status	Scarce Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 1-2 pairs; Scotland = c. 25 records Wintering: UK = 5,200 individuals; Scotland = 4,000-8,000
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context.	Present around the UK coastline outside the breeding season. **Breeding:** Very scarce breeder in the UK, greater scaup breeds on Arctic and sub-Arctic tundra, wooded tundra and moorland regions in the high Arctic. There have been several breeding records in Scotland particularly in base-rich or brackish waters in Orkney and the Outer Hebrides, but none since at least 1989. **Nonbreeding:** Greater scaup winters on shallow coastal waters generally less than 10m deep (especially in the vicinity of sewage outlets), as well as sheltered bays, estuaries and brackish waters. It is also found inland on large lakes and reservoirs during the nonbreeding season. Wintering strongholds in the UK include the Dee, the Solway Firth, Loch Ryan, Ayrshire coast, Islay, the Firth of Forth and the Moray Firth and Lough Neagh. There are also important concentrations in Orkney and on the east coast in the Moray Firth, especially the Inner Moray Firth and Cromarty Firth and from Montrose Basin to the Firth of Forth.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Scaup may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. Scaups are omnivorous and in wintering areas the diet consists predominantly of molluscs such as muscles, cockles and clams while in coastal habitats and Hydrobia snails while in brackish waters (Marchowski *et al*., 2015; BirdLife International 2019). Other food sources include insects, aquatic insect larvae, crustaceans such as amphipods, worms, small fish, and the roots, seeds and vegetative parts of aquatic plants such as sedges and water weeds (BirdLife International, 2019). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for scaup.
Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 146.4m (SP-1).

Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no records of AD/FID for scaup. One study provides a MAD buffer for pedestrian disturbance during the nonbreeding season, for scaup spp. (*Aythya affinis and A marila*).
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on scaup show that this species has a high sensitivity to human disturbance. Human disturbance has been identified as one of the key threats to this species in the UK (Furness, 2016) and scaup at sea have also been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013). Mendel *et al*. (2008) has also identified scaup as highly sensitive to human disturbance and boat activity in coastal areas. Scaup feed mainly at night and tend to flock together to roost on the sea during the day (Marchowski *et al*., 2015; Rare Breeding Birds Panel, 2018); there is a small potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Scaup is assessed to have a high sensitivity to sensitivity to human disturbance whilst hand-harvesting seaweed, as suggested by non-quantitative disturbance studies. This species may be easily disturbed on foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies providing AD/FID for a range of disturbance types during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	SP-1: Trulio & White (2017)

3.15 Common eider (*Somateria mollissima*)

Conservation Status	UK: Amber European: Vulnerable
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 26,000 pairs; Scotland = 20,000 nesting females Wintering: UK = 60,500 individuals; Scotland = 64,500 individuals
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context.	Present around the UK coastline throughout the year. **Breeding:** A true sea duck, common eider is rarely found far from the coast. It always nests on the ground, and usually in areas free of mammalian predators, including coastal islands and islets along low-lying rocky coasts, on coastal shores and spits, on islets in brackish and freshwater lagoons, coastal lakes and rivers close to the coast. In Scotland, this is a common widely distributed resident breeding bird all around the coasts and major island groups of Scotland, with exception of the Solway Firth. In England, eider stronghold around the Northumberland coast. **Nonbreeding:** During the winter, eider have a similar habitat to breeding but more widespread around the UK coastline. The premier site in the British Isles for wintering eider has long been the Abertay Sands in Scotland. Other important wintering sites in Scotland include the Firth of Forth, Firth of Clyde and Orkney. In England, wintering eider can be found on the Yorkshire coast and around the east and south coast of England as far as Cornwall. Belfast Lough is a Northern Ireland stronghold and some are also found off the Welsh coast.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Common eider may indirectly rely on seaweed for foraging requirements as they have been shown to preferentially feed in kelp forests in shallow water very close to the shore (Bustnes & Lønne, 1997; Kelly, 2005; Merkel & Mosbech, 2008). Eiders feed chiefly on immobile or slow-moving, bottom-living marine invertebrate species, primarily molluscs and to a lesser extent crustaceans and echinoderms, obtained benthically by surface-diving and in shallow water head-dipping (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 16m, Range of FID = 13 to 70m (E.-14). **Nonbreeding season:** Motorized watercraft (large commercial ship) at a disturbed site: Median FID = 208m (E.-15).

	Commercial ferry watercraft at a disturbed site: Range of FID = 0 to 1500m (E.-3,4,5,6,7,8,9,10,11). Aircraft (helicopter) flying over a disturbed site: Mean FID = 500m (E.-13).
Quantitative information on MAD or buffer distances	**Breeding season:** Motorized watercraft at a disturbed site: Mean MAD = 200m (E.-1).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Four studies investigating disturbance from pedestrians, watercraft and aircraft during the breeding and nonbreeding seasons present four groups of FID values. One study provides a MAD for motorized watercraft disturbance at a disturbed site during the nonbreeding season.
Non-quantitative information on disturbance responses	Eider roost in open water away from feeding areas in shallow water (Merkel & Mosbech, 2008) where they are less likely to be disturbed at roost sites whilst hand-harvesting seaweed. Common eider has been assessed as having a medium sensitivity to boat disturbance; flight activity increases in the presence of marine activity including slow vessels/craft (including motorized and non-motorized boats for pleasure and commercial activities) and fast powerboats (Jarrett *et al.,* 2018). Eider have a very low response rate within the 200-300m distance band from a passing ferry; this species favours swim responses over flight or dive responses to passing ferries. The likelihood of eider flight responses to passing ferries increases strongly and significantly in rougher sea states (Jarrett *et al.,* 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Common eider is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Although a maximum FID value of 1500m has been recorded for eider from commercial ferry disturbance during the nonbreeding season, the maximum FID value for pedestrian disturbance is 208m and a MAD of 200m has been recorded for watercraft disturbance during the nonbreeding season. During the breeding season, eider has a maximum FID value of 70m when disturbed by pedestrians. This species has the potential to be disturbed on both breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	More studies required to record AD/FID during the breeding season and for pedestrian activity on the beach during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	E.1: Ahlund & Gotmark (1989) E.3,4,5,6,7,8,9,10,11: Larsen & Laubek (2005) E.13,14: Mallory (2016) E.15: Schwemmer *et al*. (2011)

3.16 Common scoter (*Melanitta nigra*)

Conservation Status	UK; Red; Schedule 1 European: Least Concern
UK status	Resident/Migrant Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: Scotland only = 95 pairs Wintering: UK = 100,000 individuals; Scotland = 25,000-30,000
UK long-term trend	Decrease
Scottish distribution & habitat, within a UK context.	UK breeding population is small and limited to Scotland. Present around the UK coastline outside the breeding season. **Breeding:** Most Common scoters breed on tundra, often near lakes and pools, but also further south around lakes and lochs. This species nests in tall vegetation, such as heather, with small islands often used, but sometimes a long way from fresh water. Scotland holds 100% of the UK breeding population where it is a scarce breeder at the southern end of its world distribution. It is restricted to the Highlands and Inner Hebrides, although it bred in other parts of Scotland in the 20th century. **Nonbreeding:** Although common scoter may use freshwater lakes on migration, the majority moult and overwinter at sea on shallow inshore waters less than 20m deep (optimally 5-15m) with abundant benthic fauna, generally between 500m and 2km from the shore. In Scotland, an important nonbreeding area is the Moray Firth, where the largest flocks usually congregate between Spey Bay and Nairn Bar or in the Dornoch Firth. Common scoter can be found around most of the Scottish coasts, with large flocks congregating mainly of the east coast. Elsewhere around the UK, common scoters are widely distributed with concentrations in Carmarthen and Cardigan Bays and along the North Norfolk Coast.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Common scoter may indirectly rely on seaweed for foraging requirements as they have been shown to preferentially feed in inshore waters particularly at low tide when the bottom is easier to reach (Kelly, 2005). Common scoters feed on marine bottom dwelling invertebrates, mainly molluscs, obtained by diving sometimes with partially spread wings. In freshwater this species will also feed on aquatic insects and fish eggs, occasionally small fish (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Range of median AD = 40 to 310m, Range of AD = <10 to 500m, Range of median FID = 5 to 125, Range of FID =

	<10 to 300m (CX-10,11). **Nonbreeding season:** Motorized watercraft (large commercial ship) at a disturbed site: Median FID = 804m, Maximum FID = 3200m (CX-9). Commercial ferry watercraft at a disturbed site: Range of FID = 0 to 1500m (CX-2,3,4,5,6,7,8).
Quantitative information on MAD or buffer distances	No records of MAD for common scoter.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Three studies investigating a disturbance from pedestrians and watercraft during the breeding and nonbreeding seasons present three groups of AD/FID values. AD/FID values recorded for pedestrian disturbance during the breeding season have been formed from expert opinion. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Common scoter is rarely seen on land except for breeding. Common scoters roost communally at sea and they also periodically loaf on water during the day and, rarely, on islets or sandbanks (Cramp & Simmons, 1977). Therefore, there is very little potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Common scoter is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Common scoter has a maximum FID value of 3200m when disturbed by commercial shipping during the nonbreeding season. In the breeding season, the maximum AD value for pedestrian disturbance is 500m, although quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as common scoter mostly do not breed in the UK and where they do, they breed at freshwater sites. This species may be easily disturbed on foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach during the nonbreeding season
References to quantitative information on disturbance response distances (AD/FID/MAD)	CX-2,3,4,5,6,7,8: Larsen & Laubek (2005) CX-9: Schwemmer *et al*. (2011) CX-10,11: Whitfield *et al*. 2008

3.17 Velvet scoter (*Melanitta fusca*)

Conservation Status	UK: Red; Schedule 1 European: Vulnerable (winter population)
UK status	Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 2,500 individuals; Scotland = 2,500-3,500
UK long-term trend	Increasing
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Velvet scoter breeds in Scandinavia, from Norway and Sweden into Finland and Estonia and western Russia. This species does not breed in the UK. A very few birds occasionally oversummer on freshwater and breeding has been suspected in Scotland, although never proven. **Nonbreeding:** The majority of velvet scoters winter at sea on shallow inshore coastal waters, especially in estuaries or inlets where there are large mussel-beds. The species may also occur on freshwater lakes and estuaries during migration. In Scotland, the largest wintering flocks are found on the east coast from Orkney to Lothian, they are uncommon elsewhere. Precise locations of winter flocks vary from year to year, but the biggest concentrations are in the eastern firths including the Moray Firth of the Nairn and Culbin Bars, Burghead and Spey Bars, Firth of Tay and St Andrews Bay, Firth of Forth off Methil and at Largo Bay and at Musselburgh and Gosford Bay. In England, this species winters off the east coast including Norfolk and north-east England.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Velvet scoter may indirectly rely on seaweed for foraging requirements, they have a diet that is similar to common scoter, but they more often feed near the coast (Snow & Perrins, 1998; Kelly, 2005). Velvet scoters feed on marine bottom dwelling invertebrates, chiefly molluscs, obtained by surface-diving with partially opened wings (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for velvet scoter relevant for hand-harvesting seaweed.
Quantitative information on MAD or buffer distances	No records of MAD for velvet scoter.
Quality of quantitative information on disturbance response	**Poor quality of quantitative information** There are no records of MAD/AD/FID for velvet scoter that are relevant for assessing seaweed hand-harvesting disturbance in

distances (AD/FID/MAD)	the coastal and nearshore waters. However, a study recording velvet scoter behaviour offshore has indicated that this species shows some avoidance to offshore wind turbines at a distance of >2km (VS-1).
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on velvet scoter show that this species has moderate to high sensitivity to both human and boat disturbance (Mendel *et al*., 2008; Schwemmer *et al*., 2011). This species has been given a very high sensitivity to disturbance by boats score in previous studies (Furness *et al.* 2013). Velvet scoter may have a high flight response rate to marine activity in Orkney, although few records makes it difficult to assess the sensitivity of this species (Jarrett *et al*., 2018). Similar to common scoter, velvet scoters roost communally at sea a few kilometres off the coast (Cramp & Simmons, 1977; Hartley, 2007). Therefore, there is very little potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Velvet scoter is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed, as suggested by non-quantitative disturbance studies. This species may be easily disturbed on foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of any studies recording AD/FID.
References to quantitative information on disturbance response distances (AD/FID/MAD)	VS-1: Dierschke *et al*. 2016 (this study relates to offshore wind farm avoidance behaviour; this study was used for velvet scoter only because there are no other sources of AD/FID/MAD studies for this species).

3.18 Long-tailed duck (*Clangula hyemalis*)

Conservation Status	UK: Red; Schedule 1 European: Vulnerable (winter population)
UK status	Scarce Breeder, Winter Visitor
UK and Scottish population estimate	Wintering: UK = 11,000 individuals; Scotland = 15,000 individuals
UK long-term trend	Increasing
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Long-tailed duck breeds on marshy grass tundra in the high Arctic. This species does not breed in the UK. **Nonbreeding:** Winters at sea, generally far offshore in waters 10-35m deep, as well as in saline, brackish or fresh estuarine waters, brackish lagoons, and inland (very rarely) on large, deep freshwater lakes. In the UK, this species is most commonly recorded from Northumberland to northern Scotland. In Scotland, long-tailed duck is a localised but fairly common winter visitor. It winters principally in the Moray Firth, but there are also major concentrations around the coasts of Shetland and Orkney, and lesser numbers in the Firth of Forth.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Like other members of the Anatidae family, long-tailed duck may indirectly rely on seaweed due to the association of seaweed with benthic infauna (Orr, 2013). Long-tailed duck feed predominantly on benthic invertebrates, especially crustaceans and molluscs which are obtained by surface-diving (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 3m, Maximum FID = 10m (LN-2). **Nonbreeding season:** Motorized watercraft (large commercial ship) at a disturbed site: Median FID = 293m (LN-3).
Quantitative information on MAD or buffer distances	No records of MAD for long-tailed duck.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Two studies investigating disturbance from pedestrian and watercraft activity during the breeding and nonbreeding seasons present two groups of FID values. There are no studies recording MAD buffer distances.

Non-quantitative information on disturbance responses	Scottish long-tailed ducks have been shown to move on a daily basis up to 12km from feeding areas inshore to night-time roost sites in much deeper waters (Hope Jones 1979). During the nonbreeding season, long-tailed duck favour exposed offshore waters for roosting and is the only species of seaduck that regularly occurs in waters deeper than 20m (JNCC, 2012). Therefore, there is very little potential for disturbance at roost sites whilst hand-harvesting seaweed. Long-tailed duck show a high sensitivity to shore-bound activity (Jarrett *et al*., 2018). Long-tailed duck has also been assessed as having a high sensitivity to boat disturbance; flight activity increases in the presence of marine activity including slow vessels/craft (motorized and non-motorized boats for pleasure and commercial activities) as well as fast powerboats, and abundance of this species decreases in an area following marine activity (Jarrett *et al*., 2018). Long-tailed duck is far more likely to fly in response in to passing ferries compared to swim/dive responses and the likelihood of flight responses to passing ferries increases significantly in rougher sea states, although the sea state effect is not as strong as it is for European shag, black guillemot and common eider (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Long-tailed duck is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed. A maximum FID value of 293m has been recorded for long-tailed duck when disturbed by commercial ferries during the nonbreeding season, however, non- quantitative studies suggest that this species is unlikely to be disturbed at roost sites during the nonbreeding season. Although quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as long-tailed duck do not breed in the UK, recorded FID values caused by pedestrian disturbance during the breeding season are very low (<10m). It is considered that this species is unlikely to be disturbed on foraging grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	More studies required to record AD/FID for pedestrian activity on the beach during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	LN-2: Mallory (2016) LN-3: Schwemmer *et al*. (2011)

3.19 Common goldeneye (*Bucephala clangula*)

Conservation Status	UK: Amber; Schedule 1 - Part II European: Least Concern
UK status	Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 200 pairs; Scotland = 150 pairs Wintering: UK = 20,000 individuals; Scotland = 10,000-12,000
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Common goldeneyes have a preference for oligotrophic lakes devoid of fish but with abundant invertebrate life, and requires tree-holes for nesting (greatly facilitated by the provision of nestboxes). Suitable habitats include freshwater lakes, pools, rivers and deep marshes surrounded by coniferous forest. In summer, this species is mainly restricted to the Central Highlands of Scotland. **Nonbreeding:** Common goldeneye winters mainly at sea on inshore waters, shallow bays, estuaries and coastal lagoons, especially in the vicinity of sewage outfalls. The highest numbers can be seen in the north and west of the UK. Further to the south and on migration, the species may also be found at large rivers, lakes and reservoirs. In Scotland, this species is widely distributed in the winter with large wintering numbers arriving from more northerly European breeding areas. The highest numbers occur off the east coast, especially in the Firth of Forth and the Moray Firth, although numbers in these areas are now lower than they were in the late 1960s and 1970s when the birds concentrated at effluent discharges of domestic sewage, distillery waste etc.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Like other members of the Anatidae family, common goldeneye may indirectly rely on seaweed due to the association of seaweed with benthic infauna (Orr, 2013). Goldeneye feed primarily on molluscs, crustaceans and insect larvae obtained during daytime, mainly by surface-diving, rarely by dabbling. Mobile and immobile items are taken from bottom and mid-water at depths of up to 4m (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Range of median AD = 5 to 125m, Range of AD = <10 to 300m, Range of median FID = 5 to 75m, Range of FID = <10 to 150m (GN-9,10) **Nonbreeding season:**

	Pedestrian walking/running at a disturbed site: Range of FID = 100 to 200m (GN-3). Motorized watercraft at a disturbed site: Range of FID = 550 to 700m (GN-1). Motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 640 to 765m (GN-6,8), Range of FID = 700 to 830m (GN-8). Non-motorized watercraft at a disturbed site: Range of FID = 350 to 400m (GN-2). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of FID = 360 to 740m (GN-4,5,7).
Quantitative information on MAD or buffer distances	No records of MAD for common goldeneye.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Three studies investigating a disturbance from pedestrians and watercraft during the breeding and nonbreeding seasons present six groups of AD/FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	There is no evidence for dependence on seaweed for habitat requirements. In the winter, goldeneyes congregate at communal roost sites overnight. They roost on open water at the coast, on standing water or on rivers (Duncan & Marquiss, 1993), so there is a limited potential for disturbance at roost sites whilst hand-harvesting seaweed if activities persist into dusk/night. In Orkney, common goldeneye is largely present in very sheltered areas and inland lochs where marine activity is unlikely and therefore this species rarely comes into contact with marine activity in Orkney (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Common goldeneye is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. Goldeneye has a maximum FID value of 830m when disturbed by motorized watercraft and a maximum FID of 200m when disturbed by pedestrians during the nonbreeding season. Quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as goldeneye breed at freshwater sites. This species may be easily disturbed on foraging grounds and potentially roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	More studies required to record AD/FID during the breeding season and for pedestrian activity on the beach during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GN-1,2,3: Hume (1976) GN-4,5,6,7,8: Laursen *et al*. (2017) GN-9,10: Whitfield *et al*. (2008)

3.20 Goosander (*Mergus merganser*)

Conservation Status	UK: Green European: Least Concern
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 3,100-3,800 pairs; Scotland = 2,000-3,000 Wintering: UK = 12,000 individuals; Scotland = 2,600-12,200
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season, particularly during harsh winters. **Breeding:** Goosander breeds on large clear freshwater lakes, pools, the upper reaches of rivers and streams in the boreal, montane and temperate forest zones. It requires waters with a fairly high productivity of fish surrounded by mature hard-wood trees with holes excavated by woodpeckers or natural cavities for nesting in. Goosanders can be seen in the upland rivers of northern England, Scotland and Wales in summer. In Scotland, goosander is a common resident species on the largest of mainland river systems; its numbers vary with the richness of fish communities. Numbers are most abundant in southern Scotland where the fish fauna is rich. This species is rather scarce north and west of the Highland Boundary Fault, where salmonids predominate. **Nonbreeding:** The species winters on large unfrozen lakes, rivers, lagoons, brackish waters and marshes, generally avoiding highly saline waters although it may move to estuaries, coastal lagoons and sheltered sea coasts with waters less than 10m deep in particularly harsh winters. Goosanders breed and winter in broadly similar regions, but individuals can move large distances, to take advantage of changes in fish availability, and on migration to moulting sites. In Scotland, by midwinter, birds settle on the lower reaches of rivers, in small estuaries and inner Firths and on small lochs, where small fish are abundant.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Goosanders are unlikely to rely on seaweed for foraging requirements. Goosander primarily feed on fish obtained by foraging from surface diving using only legs for propulsion; this species is only a sea-duck to a minor degree, preferring upper basins or rivers (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 315 to 540m (GD-1,2), Range of FID = 280 to 540m (GD-1).

Quantitative information on MAD or buffer distances	No records of MAD for goosander.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating a non-motorized disturbance during the nonbreeding seasons presents one group of FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Sawbill ducks (goosanders and mergansers) are shot under licence in some areas, and birds in those areas are much more easily disturbed by human presence than in areas where no shooting occurs (McKay *et al*., 1999). Nonbreeding mergansers and goosanders will habituate to humans, perhaps especially where mute swans and mallards are present and birds are fed by people, as on ponds in urban areas. In such locations, mergansers may approach within 10m of people, though they tend to remain further away than mute swans and mallards (Bernie Zonfrillo, *pers. comm*.).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Goosander is assessed to have a high sensitivity to human disturbance whilst hand-harvesting seaweed. A maximum FID value of 540m has been recorded for goosander disturbed by motorized watercraft during the nonbreeding season, although non-quantitative studies suggest that FID may be lower than this for pedestrian disturbance, especially in areas where birds are habituated to human presence. Quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as goosander breed at freshwater sites. This species is likely to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach during the nonbreeding season and any source of disturbance during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GD-1,2: Laursen *et al*. (2017)

3.21 Red-breasted merganser (*Mergus serrator*)

Conservation Status	UK: Green European: Near Threatened
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 2,800 pairs; Scotland = c. 2,000 pairs Wintering: UK = 9,000 individuals; Scotland = c.8,500 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** Red-breasted mergansers are found year-round in coastal regions, breeding around wooded shorelines of deep lakes, small rivers and streams with moderate currents, as well as on more saline waters such as sheltered shallow bays, inlets, straits or estuaries with sandy rather than muddy substrates. It shows a preference for narrow channels rather than open expanses of water, with islands or islets and spits, projecting rocks or grassy banks. In Scotland, this species is widely distributed during the breeding season, densities are highest in areas with sea lochs, estuaries and brackish lagoons, particularly in the north and west such as Kintyre and the Argyll islands, Wester Ross, Outer Hebrides, Orkney and Shetland. In the east, the largest numbers are found in the Firth of Tay, Montrose Basin, Spey Bay and the Findhorn Estuary and Loch Fleet. Elsewhere, breeding birds can be found in north Wales, north west England and Northern Ireland. **Nonbreeding:** The majority of the species winters at sea, frequenting both inshore and (occasionally) offshore waters, estuaries, bays and brackish lagoons, but showing a preference for clear, shallow waters not affected by heavy wave action. It will also utilise large freshwater lakes on passage. Winter distribution is widespread around the UK coastline. In Scotland, resident birds are joined by immigrants, particularly those breeding in Iceland. Wintering birds are widely distributed around the Scottish coastline; high numbers are found in the Moray Firth, on the Tay/St Andrews coast, in the Firth of Forth, on the west coast and around Shetland.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Like other members of the Anatidae family, red-breasted merganser may indirectly rely on seaweed due to the association of seaweed with benthic infauna (Orr, 2013). Red-breasted merganser feed primarily on fish during the day obtained by foraging from the surface with head and eyes immersed and subsequent diving, but they also eat aquatic invertebrates (including insects, molluscs, crustaceans, and worms), frogs, small mammals, birds, and plants (Snow & Perrins, 1998). They forage in inshore waters particularly at low tide when the bottom is easier to reach (Kelly, 2005). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.

Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging) Nonbreeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median FID = 50 (RM-2).
Quantitative information on MAD or buffer distances	No records of MAD for red-breasted merganser.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance pedestrian and watercraft activity presents one median FID value. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Sawbill ducks (goosanders and mergansers) are shot under licence in some areas, and birds in those areas are much more easily disturbed by human presence than in areas where no shooting occurs (McKay *et al*., 1999). Nonbreeding mergansers and goosanders will habituate to humans, perhaps especially where mute swans and mallards are present and birds are fed by people, as on ponds in urban areas. In such locations, mergansers may approach within 10m of people, though they tend to remain further away than mute swans and mallards (Bernie Zonfrillo, *pers. comm.*). Mendel *et al*. (2008) identified red-breasted merganser as moderately sensitive to human disturbance and boat activity in coastal areas of Germany, but also subject to hunting which is likely to increase their sensitivity to human presence. Red-breasted merganser has been assessed as having a very high sensitivity to boat disturbance; this species is very likely to take flight in the 200-300m distance band from a passing ferry and this species may be more sensitive than other species to engine noise (Jarrett *et al*., 2018). Red-breasted merganser prefer habitat closer to shore and are rarely found on open water where there is likely to be regular marine traffic; this species shows sensitivity to shore-bound disturbance and may be disturbed at greater distances compared with other species (Jarrett *et al*., 2018). There is no evidence for dependence on seaweed for habitat requirements, outside of the breeding season large flocks come together to roost on open water at night sometimes numbering several thousand birds (BirdLife International, 2019), but there is very little potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting	**Medium sensitivity to disturbance** Red-breasted merganser is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting

seaweed	seaweed. One median FID value of 50m has been recorded for pedestrian/watercraft disturbance during the nonbreeding season and non-quantitative information suggests mergansers may be moderately sensitive to human disturbance. This species has the potential to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	RM-2: Liley *et al*. (2011)

3.22 White-tailed eagle (*Haliaeetus albicilla*)

Conservation Status	UK: Red; Schedule 1 European: Least Concern
UK status	Re-introduced Resident Breeder, Accidental
UK and Scottish population estimate	Breeding: Scotland only = 122 pairs Wintering: In Scotland the number of adults is same as breeding population.
UK long-term trend	In Scotland there has been a strong increase following re-introductions starting in the 1970s.
Scottish distribution & habitat, within a UK context	Present in Scotland throughout the year. This species went extinct in the UK during the early 20th century, the last breeding pairs in the UK had been lost by 1916. The present population is descended from reintroduced birds of Norwegian stock, the first successful breeding attempt occurred in northwest Scotland in 1983. **Breeding:** White-tailed eagles nest at relatively low altitudes (below 150m) and require large and open expanses of lake, coast or river valley nearby to undisturbed cliffs or open stands of large, old-growth trees for nesting. This species shows a preference for tree nests where trees are available, but many will nest on crags and cliffs. The breeding population was previously confined to the west coast of Scotland but with the new releases in eastern Scotland (Fife and Angus) between 2007 and 2012, the population growth and range expansion in Scotland continues to grow. Highest breeding numbers are still located on the Isle of Skye, Rum, Mull and on the west coast of Scotland. **Nonbreeding:** Outside the breeding season, white-tailed eagles remain in Scotland, with adult birds often roosting on or close to nest sites (SNH, 2014). As well as breeding adults, the population includes a large number of "floating" immature and sub-adult birds, which can roam widely from 18 to 200km in areas away from the core breeding range (Whitfield *et al*., 2009a & 2009b).
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** White-tailed eagle is predator, scavenger, and kleptoparasite, taking fish, waterbirds, mammals, and carrion (Snow & Perrins 1998). This species feeds on vertebrates (fish, mammals and especially birds), from marine, freshwater and terrestrial environments. There is no evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging) Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Median AD = 510m, Range of AD 150 to 1000m; Range of median FID = 125 to 225m, Range of FID = 50 to 1000m (WE-1,2).

	Vehicle disturbance at a disturbed site: Mean FID = 200m, Range of FID = 50 to 990m (Bald eagle-1). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of FID = 183 to 268m (Bald eagle-10,11). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 136 to 276m (Bald eagle-6,7). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of FID = 111 to 202m (Bald eagle-8,9). Fishing boat disturbance at a site where level of habituation to disturbance is unknown: Mean FID = 127 to 137m (Bald eagle-4,5). Bank angler at a site where level of habituation to disturbance is unknown: Mean FID = 201 to 293m (Bald eagle-12,13). Aircraft disturbance at a site where level of habituation to disturbance is unknown: Mean FID = 625 to 800m (Bald eagle-2,3).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running or camping at a disturbed site: Recommended buffer = 500-1000m (WE-3,4). Forestry work at a disturbed site: Recommended buffer = 500m (WE-5). Forestry work at a site where level of habituation to disturbance is unknown: Recommended buffer = 50 to 500m (WE-7,11). Vehicle disturbance at a disturbed site: Recommended buffer = 1000m. No roads to be built within 1000m (WE-6). Industrial development at a site where level of habituation to disturbance is unknown: Recommended buffer = 2000m (WE-8). Onshore wind farm exclusion zone at a site where level of habituation to disturbance is unknown: Recommended buffer = 3000m (WE-9) General buffers used to avoid disturbance by people: Recommended buffer = 300 to 600m (WE-10,12,13). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Recommended buffer = 120 to 600m (Bald eagle-14). Motorized watercraft at a site where level of habituation to disturbance is unknown: Recommended buffer = 200 to 800m

	(Bald eagle-15). Vehicle disturbance at a site where level of habituation to disturbance is unknown: Recommended buffer = 450 to 850m (Bald eagle-16). **Nonbreeding season:** Pedestrian walking/running, motorized watercraft or vehicle disturbance at a site where level of habituation to disturbance is unknown: Recommended buffer = 250 to 600m (Bald eagle-17,18,19). **Unknown season:** Buffer for gunshot noise: Recommended buffer = 1000m (Bald eagle-20). Buffer for aircraft: Recommended buffer = 625m (Bald eagle-21).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Two studies investigating disturbance from a range of sources on white-tailed eagle and bald eagle (*Haliaeetus leucocephalus)* during the breeding and nonbreeding seasons present eight groups of FID values. Bald eagle is the same genus and has a similar ecology to white-tailed eagle and is used as a stand-in species for white-tailed eagle. One study presents MAD buffer distances for a range of disturbance during the breeding and nonbreeding seasons.
Non-quantitative information on disturbance responses	Wallgren (2003) suggested that there has been a decreased fear of humans in Finnish white-tailed eagles although there was little evidence of habituation over three decades (1970s, 80s and 90s). White-tailed eagles are much more approachable and more tolerant of human presence than golden eagles, which makes them particularly vulnerable to persecution (Forrester *et al.,* 2012). White-tailed eagles form communal roosts either in trees or on crags and cliffs, in Scotland roosts can hold 10-15 birds. These roosts are mainly composed of immature and non-breeding birds and are considered important for social interaction and pair formation (SNH, 2014). Adult birds from nearby nesting pairs sometimes join such roosts but they often roost on or close to nests throughout the year. Over time, nest sites can sometimes become established at or near roost sites (SNH, 2014) and therefore there is potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** White-tailed eagle is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Although white-tailed eagle may be easily disturbed at nest sites and a maximum AD and FID value of 1000m has been recorded for this species during the breeding season, this species is scarce and is unlikely to be encountered by people hand-harvesting seaweed. This species has the potential to be disturbed at the coast (most likely at nest sites during the breeding season but also potentially

	in nearshore foraging areas during the nonbreeding season) whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	WE-1,2: Whitfield *et al*. (2008) WE-3,4,5,6,7,8,9,10,11,12,13: Ruddock & Whitfield (2007) Bald eagle- 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21: Ruddock & Whitfield (2007)

3.23 Golden eagle (*Aquila chrysaetos*)

Conservation Status	UK: Green; Schedule 1 European: Least Concern
UK status	Resident Breeder
UK and Scottish population estimate	Breeding: Scotland only = 508 pairs Wintering: Scotland = *c.*1,000 individuals
UK long-term trend	Approximately stable in Scotland
Scottish distribution & habitat, within a UK context	All UK golden eagles breed in Scotland, this species is currently absent from England and Wales. Present in the wild, open moorlands and mountains of Scotland, favouring islands and remote glens. **Breeding:** Golden eagle occupies a wide range of flat or mountainous, largely open habitats, often above the tree line, from sea level to 4000m. It is most often seen flying high over the Scottish Highlands. Nesting occurs in trees or on cliff ledges and the nest is a substantial structure of branches, twigs and heather; lined grass wool and green foliage. The highest numbers of golden eagle are found in the Outer Hebrides, Mull, west and northwest Highlands. **Nonbreeding:** In winter, both adult and young golden eagles occupy similar areas that are similar to the breeding season, except that immature birds especially can be highly mobile with large home ranges and can potentially travel very long distances. A study in Sweden on satellite tagged birds showed that golden eagle home range size can be highly variable, between 60-605km^2, and a couple of individuals travelled between 600 and 700km away from their home territory (Moss *et al.,* 2014). In Scotland, satellite tagged eagles range widely over most of upland Scotland, especially the Highlands (Whitfield & Fielding, 2017).
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Golden eagle is a predator and a scavenger feeding on a range of prey depending on regional availability (BirdLife International, 2019). Principally the diet is composed of mammals and birds, but also reptiles and occasionally fish and insects are taken. There is no evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging) Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Range of median AD = 400 to 625m, Range of AD = 100 to 1000m; Range of median FID = 225 to 400m, Range of FID = 10 to 1500m (EA-2,3). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of FID = 105 to 390m (EA-6).

	Vehicle disturbance at a disturbed site: Range of FID = 14 to 190m (EA-7).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian leisure activity at a disturbed site: Recommended buffer = 800m (EA-4). Vehicle disturbance (simulated results from a model) at a disturbed site Mean MAD = 600m (EA-1). Forestry work at a disturbed site: Recommended buffer = 500m (EA-5). **Nonbreeding season:** Pedestrian walking/running or vehicle disturbance at a disturbed site: Recommended buffer = 300m (EA-6,7).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Three studies estimating disturbance distances from expert opinion as well as empirical studies on pedestrian walking/running and vehicle disturbance during the breeding and nonbreeding seasons. Four MAD buffer distances are provided for pedestrian leisure activity, forestry work and vehicle disturbance from simulated model results at a disturbed site during the breeding and nonbreeding seasons.
Non-quantitative information on disturbance responses	Scottish golden eagles show a preference for nesting on cliffs which may allow greater visibility of their surroundings compared to forest nesting birds in Europe, therefore protection buffers may need to be greater for Scottish breeding golden eagles compared with their European counterparts (McGrady *et al.,* 2004; Ruddock & Whitfield, 2007). There is a range of expert opinion on disturbance distances for golden eagle, but it may be generally concluded that active disturbance typically occurs at an upper limit of 750 to 1000m; although upper limits revealed by the expert survey opinion may be overly cautious (Ruddock & Whitfield, 2007).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Golden eagle is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Although golden eagle may be easily disturbed at nesting sites during the breeding season and a maximum FID value of 1500m has been recorded for this species from expert opinion, it is possible that these upper disturbance limits may be overly cautious (Ruddock & Whitfield, 2007). Furthermore, this species is scarce and unlikely to be encountered in Scotland. This species has the potential to be disturbed on foraging grounds during the breeding season and nonbreeding season whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding and non-breeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	EA-1: D'Acunto *et al*. (2018) EA-2,3: Whitfield *et al*. (2008) EA-4: Ruddock & Whitfield (2007) EA-5: McGrady *et al*. (2004) EA-6,7: Holmes *et al*. (1993)

3.24 Peregrine falcon (*Falco peregrinus*)

Conservation Status	UK: Green; Schedule 1 European: Least Concern
UK status	Resident Breeder
UK and Scottish population estimate	Breeding: UK = 1,769 pairs; Scotland = *c.* 600 pairs Wintering: UK = minimum is twice the breeding population; Scotland = 2,000 – 2,500 individuals.
UK long-term trend	Weak Increase (Weak Decrease in Scotland)
Scottish distribution & habitat, within a UK context	Can be present around the UK coastline throughout the year. **Breeding:** Peregrine falcons breed in a variety of habitats and they can often be found above rocky sea cliffs and upland areas. This species was formerly confined to upland and coastal areas during the breeding season, but by the late 20th century it had expanded into the lowlands, including cities. Nesting occurs on cliff ledges; no nest is built and eggs are laid directly onto bare rock faces. In Scotland, peregrine falcon is a scarce, though widespread resident breeder. Numbers have declined on upland areas and since 1991, whereas, coastal populations in the Outer Hebrides, Orkney, south of the Moray (Moray & Nairn/north-east Scotland) and on the east and south-west coasts of mainland Scotland have increased. In contrast, most coastal populations in Argyll and the north and west Highlands have declined. Peregrines breed throughout the UK, most of the recent increase in numbers can be attributed to increases in lowland England where there is a rising uptake of breeding sites on human structures. **Nonbreeding:** In the winter, peregrines may be seen anywhere in the UK; they can be highly mobile and may leave their breeding sites between August and November, and return between March and May. This species is frequently found at estuaries and other areas with large concentrations of suitable prey. Some migrants from Fennoscandia overwinter in the UK with most birds traveling singularly or in pairs. Scottish breeding birds mostly remain in Scotland and there have been no ringing recoveries of Scottish birds found outside the British Isles. Wintering grounds are often at coastal sites, wetlands and estuaries where wildfowl and shorebirds congregate.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Peregrine is a predator mainly on birds, most of the diet is composed principally of pigeons and doves (BirdLife International, 2019). This species can feed on waders or seabirds when foraging at the coast. There is no evidence for dependence on seaweed for either foraging or habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest, nearshore foraging) Nonbreeding (nearshore foraging)

Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Disturbance is estimated by expert opinion at a site where level of habituation to disturbance is unknown: Range of median AD = 225 to 310m, Range of AD = 10 to 750m; Range of median FID = 125 to 225m, Range of FID = 10 to 500m (PE-1,2).
Quantitative information on MAD or buffer distances	**Breeding season:** Aircraft disturbance at a site where level of habituation to disturbance is unknown: Recommended disturbance buffer = 500m (PE-3). Forestry work at a site where level of habituation to disturbance is unknown: Recommended disturbance buffer = 400 to 1000m (PE-4,5). Pedestrian rock climbing at a site where level of habituation to disturbance is unknown: Recommended disturbance buffer = 200m (PE-6). Pedestrian leisure activity at a site where level of habituation to disturbance is unknown: Recommended disturbance buffer = 400 to 800m (PE-7).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** One study estimating disturbance from expert opinion provides AD/FID values for the breeding season. Four buffers for a range of disturbance are available for the breeding season.
Non-quantitative information on disturbance responses	Breeding peregrines are most likely disturbed by activities taking place above their nest and it has been suggested peregrines could tolerate any number of people in the nesting haunt provided the eyrie is inaccessible (Ruddock & Whitfield, 2007). The heights of nesting cliffs could therefore be interpreted as distances at which the nearest human activity could occur without incurring serious disturbance, although this may be confounded by the fact that nests are not necessarily at the top of cliffs; rock climbing can suppress breeding success and occupancy (Ruddock & Whitfield, 2007). Water-skiing was tolerated at 50m on coastal or river-cliff eyries with no noticeable effects on falcons, and anglers stopping near nests were more disruptive (Olsen & Olsen, 1980). Birds nesting in working quarries also appear to be more tolerant of disturbance although their reactions depend on whether disturbance occurs inside or outside quarry-working hours (Ruddock & Whitfield, 2007). The peregrine is one of several species that can become inured to the effects of at least some human disturbance, as witnessed by its occupation of disturbed nest sites such as working quarries and urban centres, both historically and as recovering populations expand. Tolerance in this species is highly likely therefore, although is probably dependent on the regularity and form of disturbance which occurs as 'background' (Ruddock & Whitfield, 2007).

Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Peregrine is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. Although peregrine may be disturbed at nesting sites and a maximum FID value of 750m has been recorded for this species during the breeding season, non-quantitative studies have shown that this species can tolerate human disturbance and the distance at which any individual bird may be disturbed depends on the level of habituation at specific sites. This species has the potential to be disturbed at the nest and nearshore foraging grounds during the breeding and nonbreeding seasons whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies recording AD/FID for pedestrian activity on the beach and in watercraft during the breeding and non-breeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	PE-1,2: Whitfield *et al*. (2008) PE-3,4,5,6,7: Ruddock & Whitfield (2007)

3.25 Eurasian Oystercatcher (*Haematopus ostralegus*)

Conservation Status	UK: Amber European: Vulnerable
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 110,000 pairs; Scotland = 84,500-116,500 Wintering: UK = 340,000 individuals; Scotland = 80,000-120,000
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year. **Breeding:** Oystercatcher breeds on coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water. This species is widespread and breeds on almost all UK coasts. In Scotland, particularly high breeding densities are observed throughout north-east Scotland, Orkney, Shetland and the Outer Hebrides. **Nonbreeding:** In winter, oystercatcher is chiefly a coastal species, frequenting estuarine mudflats, saltmarshes and sandy and rocky shores. Oystercatchers breeding in Scotland generally move south and west, juveniles move further than adults, where they overwinter on the south and west coasts of the British Isles and northern France and a few as far as Iberia. Birds remaining in Scotland are joined by immigrants from further north in Fennoscandia, Iceland and the Faeroe Islands. Large numbers of oystercatcher overwinter in the Moray Firth, Firth of Forth and the Solway Firth.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Oystercatcher foraging behaviour varies according to habitat. In the Uists, this species feeds both in marine and terrestrial habitats and on beaches with high and low abundance of wrack, predominantly on bivalve molluscs, particularly cockles, mussels and Baltic tellin (Orr, 2013). When foraging at low tide on soft intertidal substrates, bivalves and gastropods are the most important food items for this species. When foraging in estuaries, polychaetes and crustaceans are more important, while on rocky shores molluscs (e.g. mussels, limpets and whelks) are most important (BirdLife International, 2019). When inland, prey items such as earthworms and insect larvae (e.g. caterpillars and cranefly larvae) are also taken (BirdLife International, 2019). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Range of FID = 15 to 105m (OC-13). Motorized watercraft at a disturbed site: Range of FID = 15 to

	105m (OC-12). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 26 to 123m (OC-1,2,14,27,28,29,30), Range of FID = 30 to 228m (OC-14,27). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 82 to 136m (OC-1,22,25,26), Range of FID = 25 to 300m (OC-25,26). Pedestrian egg collector at a site where level of habituation to disturbance is unknown: Mean FID = 46m (OC-23). Motorized watercraft at a disturbed site: Mean FID = 74m, Range of FID = 32 to 115m (OC-15). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 60 to 160m, Range of FID = 50 to 180m (OC-3,4,5). Vehicle (car) at a site where level of habituation to disturbance is unknown: Mean FID = 106m (OC-20). Aircraft (fixed-winged aircraft) flying over a site where level of habituation to disturbance is unknown: Mean FID = 500m (OC-16). Agricultural activities close to a site where level of habituation to disturbance is unknown: Mean FID = 60m (OC-21). Cattle at a site where level of habituation to disturbance is unknown: Mean FID = 10m (OC-24). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 40m (OC-7), Range of AD = 20 to 80m (OC-7), Range of median FID = 32.55 to 50m (OC-7,8,9,10,11), Range of FID = 0 to 200m (OC-8,9,10,11).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 82m. Conservative buffer distance of 100m is proposed. (OC-13). Motorized watercraft at a disturbed site: Mean MAD = 85m. Conservative buffer distance of 100m is proposed (OC-12). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 121m, Maximum MAD = 267m (OC-14). Motorized watercraft at a disturbed site: Mean MAD = 124m but this MAD would increase to 267m if curlew is present in the group (OC-14,15).

Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** 11 studies investigating a wide range of disturbance present 12 groups of FID values. Four MAD buffer distances are provided for pedestrian and watercraft disturbance.
Non-quantitative information on disturbance responses	Oystercatchers usually roost on the coast at high tide, although they can also roost communally inland (Goss-Custard, 1981). Therefore, the potential exists to disturb oystercatchers on both their foraging as well as their roosting grounds whilst hand-harvesting seaweed. Several studies suggest that Oystercatcher is less sensitive to disturbance than other species, allowing a closer approach and showing habituation to recreational activity and construction work (see literature review in Woodward *et al*., 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Oystercatcher is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. A maximum FID value of 500m has been recorded for disturbance from aircraft and the maximum FID value for pedestrian disturbance is 300m during the nonbreeding season. This species has the potential to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft, especially during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	OC-1: Collop *et al*. (2016) OC-2: Fitzpatric & Bouchez (1998) OC-3,4,5: Laursen *et al*. (2017) OC-6: Laursen *et al*. (2005) OC-7,8,9,10: Liley *et al*. (2011) OC-11: Liley *et al*. (2010) OC-12,13: Scarton (2018a) OC-14,15: Scarton (2018b) OC-16,20,21,22,23,24,25,26: Smit & Visser (1993) OC-27: Stillman & (Goss-Custard 2002) OC-28,29,30: Urfi *et al*. 1996

3.26 Ringed plover (*Charadrius hiaticula*)

Conservation Status	UK: Red European: Least Concern
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 5,400 pairs; Scotland = 4,900-6,700 pairs Wintering: UK = 34,000 individuals; Scotland = 23,000-25,000 individuals
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** In the UK, ringed plovers nest on sand or shingle beaches either along the coast or coastal pools or lakes, but also inland, on muddy plains with stones and pebbles, on shores and sandbars of inland rivers, lakes, gravel pits and reservoirs, or on short grassland, farmland and other well-drained sites. Patchy but widespread distribution in the UK. In Scotland, breeding occurs in most coastal areas; the most important breeding areas are on the Outer Hebrides and high numbers are also present on Orkney and Shetland. **Nonbreeding:** Wintering birds are restricted to coastal areas around the UK where they inhabit muddy, sandy or pebbly coasts including estuaries, tidal mudflats, and sandflats. This species also frequents mudbanks or sandbanks along rivers and lakes, lagoons, saltmarshes, short grassland, farmland, flooded fields, gravel pits, reservoirs, and sewage works during this season. In Scotland, large winter numbers are found on the Uists, Tiree, Orkney, Firth of Forth, Moray Firth, Dornoch Firth, the Tay and Solway Estuaries.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Ringed plover may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. On breeding grounds ringed plovers forage in both terrestrial and coastal habitats, outside the breeding season this species principally feeds on marine polychaete worms, crustaceans, and molluscs. In the Uists, ringed plovers feed both in marine and terrestrial habitats and on beaches with high and low abundance of wrack (Orr, 2013). A study on the island of Papa Westray, Orkney, has shown that small waders are associated with areas of beach containing stranded and attached seaweed; in warm windless weather, ringed plovers, with smaller numbers of dunlin, turnstone and purple sandpiper, appeared to predate insects and arachnids emerging from the top of the dead seaweed (Douthwaite *et al*., *in prep*). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)

Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 22.5m (RP-13). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 41.1 to 47.7m, Range of FID = 20 to 76m (RP-1,14). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID: 15.7 to 121m, Range of FID = 9 to 162m (RP-2,6,7,8,9,10,11,12,15). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Range of median FID = 30 to 100m, Range of FID = 30 to 100m (RP-3,4,5).
Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 77m, but this MAD would increase to 267m if curlew is present in the group (RP-14).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Seven studies investigating pedestrian and watercraft disturbance present four groups of FID values. One MAD buffer distance is recorded for pedestrian disturbance during the nonbreeding season.
Non-quantitative information on disturbance responses	Ringed plovers roost communally, close to feeding sites along the shoreline, on sandbanks or bare arable fields, and in low vegetation (JNCC 2012). Therefore, the potential exists to disturb ringed plovers on both their foraging ground as well as their roosting ground while hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Ringed plover is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for ringed plover is 162m for pedestrian disturbance during the nonbreeding season. This species has the potential to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies recording AD/FID during the breeding season. More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft, especially during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	RP-1: Collop *et al*. (2016) RP-2: Laursen *et al*. (2005) RP-3,4,5: Liley *et al*. (2011) RP-6,7,8,9,10,11,12: Mikula *et al*. (2018) RP-13: Møller (2008b) RP-14: Scarton (2018b) RP-15: Smit & Visser (1993)

3.27 Grey plover (*Pluvialis squatarola*)

Conservation Status	UK: Amber European: Least Concern
UK status	Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 43,000 individuals; Scotland = 1,700-2,800 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Uplands and valleys of the Russian and Canadian high Arctic. This species does not breed in the UK. **Nonbreeding:** Wintering birds are restricted to coastal areas around the UK where they frequent intertidal mudflats, saltmarshes, sandflats and beaches of oceanic coastlines, bays and estuaries. During migration it may also be found inland on lakes, pools or grasslands. Widespread wintering and passage distribution around the UK coastline but mostly on large areas of open estuarine habitat. In Scotland, some of the largest numbers are to be found on the Eden Estuary, Firth of Forth, Solway, Orkney, Outer Hebrides, Tay and Tyninghame estuaries.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Grey plovers may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. Outside breeding season grey plovers feed chiefly on polychaete worms, molluscs, and crustaceans on sea coasts in the intertidal zone, on broad mudflats (Snow & Perrins, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 77.1 to 132.3m, Range of FID = 35 to 251m (GV-2,8). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean MAD = 37 to 132m, Range of FID = 32 to 400m (GV-3,4,6,7,10). Motorized watercraft at a disturbed site: Mean FID = 75.8m, Range of FID = 46 to 167m (GV-9). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median FID = 75m, Range of FID = 30 to 125m (GV-5).

Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 148m, but increase to 267m if curlew is present in the group (GV-8). Motorized watercraft at a disturbed site: Mean MAD = 139m, but this will increase to 267m if curlew is present in the group (GV-9). **Unknown season:** Pedestrian walking/running at a disturbed site in an unknown season of the year: Mean MAD = 47m (GV-1).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Seven studies investigating disturbance from pedestrian and watercraft activity during the nonbreeding season present four groups of FID values. Three MAD buffer distances are recorded for pedestrian and watercraft disturbance during the nonbreeding and an unknown season.
Non-quantitative information on disturbance responses	Grey plovers are usually solitary or occur in small flocks while foraging. They do form large flocks at communal roosts, often with other waders along the coastline. They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments such as estuaries or lagoons (Avibirds, 2019). Therefore, the potential exists to disturb grey plover on both their foraging ground as well as their roosting ground while hand-harvesting seaweed. Grey plover was among the species noted to be sensitive to disturbance by walkers and dogs on the Dee (see literature review in Woodward *et al*., 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Grey plover is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for grey plover is 400m for pedestrian disturbance during the nonbreeding season. This species has the potential to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GV-1: Boer & Longamane GV-2: Collop *et al*. (2016) GV-3: Glover *et al*. (2011) GV-4: Laursen *et al*. (2005) GV-5: Liley *et al*. (2010) GV-6,7: Mikula *et al*. (2018) GV-8,9: Scarton (2018b) GV-10: Smit & Visser (1993)

3.28 European golden plover (*Pluvialis apricaria*)

Conservation Status	UK: Green European: Least Concern
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 38,000-59,000 pairs; Scotland = 15,000 pairs Wintering: UK = 420,000 individuals; Scotland = 25,000-35,000 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context	An upland breeding bird with limited distribution around the UK coastline outside the breeding season. Mostly associated with lowland fields during the nonbreeding season. **Breeding:** Golden plover breeds in highland areas and upland bogs, moors, and swampy highland heaths with high abundances of sphagnum moss and heather. This species is a widespread breeding bird in the uplands of Scotland, particularly in the Highlands and Islands. They tend to breed at altitudes above 300m, although they can breed down at sea level; the upper altitudinal limit in much of Scotland is summit level. Golden plover also breeds in upland areas of the Peak District, North Yorkshire, Wales and Devon. **Nonbreeding:** When on passage and in its winter quarters, golden plover frequents freshwater wetlands, moist grasslands, pastures, agricultural land (e.g. stubble, ploughed or fallow fields) and highland steppe, also foraging on tidal shores, coastal rocky outcrops, intertidal flats and saltmarshes in shallow bays and estuaries. This species has a widespread distribution around the UK's lowland fields in winter, often in the company of lapwings. Birds breeding in Scotland move mostly short distances to their wintering grounds, the majority remain in the country. Resident birds are joined by immigrants, mainly from Iceland. Highest numbers have been recorded around the coast at the following locations: Solway Estuary, Dumfries & Galloway coast, Ayrshire coast, Angus & Dundee coast, north-east and inland, Lothian coast, Montrose Basin, Moray coast, Wigtown Bay and the Ythan Estuary.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Compared with other plover species, golden plover inhabits a more terrestrial environment, although they are present at the coast during the nonbreeding season. Golden plover tends to neglect tidal flats of mud or sand to prefer open ground above foreshore (Snow & Perrins, 1998). Grassland is the most important feeding habitat, with earthworm-rich permanent pastures preferred over leys and arable, although in Fenland and north Northumberland most winter flocks occur on stubbles, recently ploughed or sown fields. The intertidal zone is also an important feeding habitat, especially in Scotland, Ireland and northern England (JNCC, 2012). In the Uists, golden plovers typically feed in terrestrial environments or estuarine mudflats, but wrack beach foraging

	habitat may be important when energy demands are high (Orr, 2013). There is no evidence for dependence on seaweed for habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Range of FID = 1 to 200m (GP-4). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 143m, Range of FID = 45 to 450m (GP-3).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 200m (GP1,4). Pedestrian walking/running at an undisturbed site: Mean MAD = 50m (GP2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Two studies investigating disturbance from pedestrian activity during the breeding and nonbreeding season present two groups of FID values. Two MAD buffer distances are recorded for pedestrian disturbance at disturbed and undisturbed sites during the breeding season.
Non-quantitative information on disturbance responses	Golden plovers prefer to roost on ploughed arable land and damp grassland, but will use tidal flats, rocky shores and saltmarshes in intertidal areas (JNCC, 2012; Forrester *et al*., 2012) and there is potential for disturbance to roosting birds while hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Golden plover is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for golden plover is 450m for pedestrian disturbance during the nonbreeding season. Quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as golden plover breed at inland sites. This species has the potential to be disturbed on foraging and roosting grounds at the coast (more likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	More studies required to record watercraft disturbance during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GP-1,2: Finney *et al*. (2005) GP-3: Laursen *et al*. (2005) GP-4: Yalden & Yalden (1990)

3.29 Northern lapwing (*Vanellus vanellus*)

Conservation Status	UK: Red European: Vulnerable
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 140,000 pairs; Scotland = 71,500-105,600 pairs Wintering: UK = 650,000 individuals; Scotland = 65,000-69,000 individuals
UK long-term trend	Weak Increase
Scottish distribution & habitat, within a UK context	Limited distribution around the UK coastline outside the breeding season, but mostly associated with lowland fields. **Breeding:** Lapwing breeds on wet natural grasslands, meadows and hay meadows with short swards and patches of bare soil at low altitudes (less than 1,000m). It will also breed on grassy moors, swampy heaths, bogs and arable fields. This species is common in lowland areas throughout the UK especially northern England and Scotland. This species is common and widespread in Scotland; the highest breeding densities are to be found on Orkney and Shetland and the Inner and Outer Hebrides especially on Uist machair. **Nonbreeding:** The winter population is bolstered by migratory individuals from Fennoscandia and eastern Europe, and flocks have a widespread distribution around the UK's lowland fields and large estuaries. The highest known winter concentrations of lapwings are found at the Somerset Levels, Humber and Ribble estuaries, Breydon Water/Berney Marshes, the Wash and Morecambe Bay. In Scotland, the highest counts have been recorded on the Solway and Firth of Forth, Tiree, Islay and between Gretna and Southerness.
Reliance on seaweed for foraging/habitat requirements	**Low reliance on seaweed** Northern lapwing is predominantly a terrestrial species, feeding mostly on ground-living invertebrates largely on agricultural land (Snow & Perrins, 1998) and, during winter, lapwings tend to be more concentrated on pasture rather than arable fields (JNCC, 2012). In the Uists, lapwings typically feed in terrestrial environments or estuarine mudflats, but wrack beach foraging habitat may be important when energy demands are high (Orr, 2013). There is no evidence for dependence on seaweed for habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 41.32 to 39.47m (L.-3,4).

	Nonbreeding season: Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 142m, Range of FID = 45 to 450m (L.-1). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median FID = 75m, Range of FID = 18 to 125m (L.-2).
Quantitative information on MAD or buffer distances	No records of MAD for northern lapwing.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Four studies investigating disturbance from pedestrian and watercraft activity during the breeding and nonbreeding seasons present three groups of FID values. There are no recorded MAD buffer distances.
Non-quantitative information on disturbance responses	Lapwings often roost in large open arable fields or wet grassland (Snow & Perrins, 1998) which reduces the potential for disturbance to roosting birds while hand-harvesting seaweed. Lapwings are believed to be relatively tolerant to disturbance compared to other species (see literature review in Woodward *et al*., 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Northern lapwing is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for lapwing is 450m for pedestrian disturbance during the nonbreeding season. Quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as lapwing breed at inland sites. This species has the potential to be disturbed on foraging and roosting grounds at the coast (more likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	More studies to specify habituation to disturbance when recording AD/FID. More studies required to record watercraft disturbance during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	L-1: Laursen *et al*. (2005) L-2: Liley *et al*. (2010) L-3: Møller (2008) L-4: Møller (2008b)

3.30 Red knot (*Calidris canutus*)

Conservation Status	UK: Amber European: Secure
UK status	Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 320,000 individuals; Scotland = 20,400-25,800
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Red knot breeds in the high Arctic on dry upland tundra. This species does not breed in the UK, although in Scotland birds can be found throughout the year due to birds on passage and failed breeders returning to wintering grounds early. **Nonbreeding:** Knot has a widespread wintering distribution along the UK coastline. Overwintering birds and birds on migration can be found in large muddy estuaries, but only rarely on small beaches. Knot is the least site faithful and most mobile of al Scotland's wintering waders, frequently changing foraging and roosting sites. The main sites and estuaries are the north shore of the Solway, Grangemouth-Kinneil, Cramond, Gosford and Aberlady Bays in the Forth Estuary, Montrose Basin, Whiteness Head and Nairn Bars on the Inner Moray Firth and Inver Bay, Nigg Bay, Morrich Mor and Munlochy bay. Elsewhere, greatest numbers are found on The Wash, Morecambe Bay, Thames, Humber and Dee estuaries and Strangford Lough.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Knot may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. On tundra breeding grounds, knot feed on varying proportions of insects and plant material. Outside of the breeding season, this species feeds on a small range of intertidal invertebrates, chiefly molluscs (Snow & Perrins, 1998). A study on the island of Papa Westray, Orkney, has shown that small waders including knot are associated with areas of beach containing stranded and attached seaweed suggesting that the invertebrates associated with seaweed provide an important food resource (Douthwaite *et al*., *in prep*). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean FID = 71.8m, Range of FID = 20 to 240m (KN-1). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 200m (KN-3).

	Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 260m (KN-2).
Quantitative information on MAD or buffer distances	No records of MAD for Red knot.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** Two studies investigating disturbance from pedestrian and watercraft activity during the nonbreeding season present three groups of FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Knot is strictly a coastal species outside of the breeding season and inhabit tidal mudflats or sandflats, sandy beaches of sheltered coasts, rocky shelves, bays, lagoons and harbours, occasionally also oceanic beaches and saltmarshes (BirdLife International, 2019). Knot mostly occur in very large flocks on large open estuaries, and only occur occasionally on small beaches, usually during migration. Brown & Grice (2005) identify this species as highly vulnerable to human disturbance at their main estuarine areas; numbers fell by 79% at roosts on the Dee Estuary and birds moved to disturbance-free sites on the Alt Estuary. Like other members of the Scolopacidae family, knot roost together at high tide on undisturbed rocks, sandy spits or offshore islets (Snow & Perrins, 1998). Several studies indicate that this species is sensitive to disturbance, especially at roost sites (see literature review in Woodward *et al*., 2015). Therefore, there is potential for disturbance at roost sites during seaweed hand-harvesting. However, numbers of knots in areas likely to be used for seaweed hand-harvesting are likely to be much smaller in comparison with the main aggregations of this species on large estuaries.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Red knot is assessed to have a medium sensitivity to human disturbance. The maximum FID recorded for knot is 260m for non-motorized watercraft disturbance and 240 for pedestrian disturbance during the nonbreeding season. This species has the potential to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	KN-1: Collop *et al*. (2016) KN-2,3: Laursen *et al*. (2017)

3.31 Sanderling (*Calidris alba*)

Conservation Status	UK: Amber European: Least Concern
UK status	Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 16,000 individuals; Scotland = 2,800-5,500 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** High Arctic tundra of Greenland, Russia and Canada. This species does not breed in the UK. **Nonbreeding:** Sanderling winter on wave-washed sandy shores and estuaries. On passage, this species occurs rarely on inland freshwater or saline lakes, but it is largely coastal during the winter, inhabiting open sandy beaches exposed to the sea, the outer reaches of estuaries, rocky and muddy shores, and mudflats. Sanderling has a widespread distribution across the UK coastline except on the mainland west coast of Scotland. In Scotland, the Uists hold one of the largest wintering populations in Britain. The outer Tay and the Moray Basin can also hold large numbers.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Sanderling may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. On breeding grounds in the Arctic, sanderling feed primarily on insects (especially adult and larval Diptera, Coleoptera and Lepidoptera) as well as spiders, crustaceans and some terrestrial plant matter. Outside of the breeding season, sanderling feed on small molluscs, crustaceans, polychaete worms and adult, larval and pupal insects (e.g. Diptera, Coleoptera, Lepidoptera, Hemiptera and Hymenoptera), as well as occasionally fish and carrion (BirdLife International, 2019; Snow & Perrins, 1998). Sanderlings regularly pick through wrack and in the Uists this species showed a positive correlation with wrack cover on the beach (Orr, 2013). Removal of wrack could negatively impact migrating and overwintering waders by reducing their foraging habitat (Orr, 2013). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 18m (SS-8). Motorized watercraft at a disturbed site: Mean FID = 39.6m, Range of FID = 21 to 58m (SS-12).

	Nonbreeding season: Pedestrian walking/running at a disturbed site: Mean FID = 25m (SS-1), Median FID = 12m (SS-2), Range of FID = 6 to 51m (SS-1,9). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean MAD = 13.73 to 32m (SS-2,6,7,11), Range of FID = 13 to 39m (SS-2,6,7). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Range of FID = 40 to 70m (SS-4,5). Vehicle (all-terrain vehicle) at a site where level of habituation to disturbance is unknown: Mean FID = 14.97m (SS-10). **Migratory season:** Pedestrian walking/running at a disturbed site: Mean FID = 14m (SS-13).
Quantitative information on MAD or buffer distances	**Breeding season:** Motorized watercraft at a disturbed site during the breeding season: Mean MAD = 60m (SS-12). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean MAD = 67m (SS-11). Vehicle (all-terrain vehicle) at a site where level of habituation to disturbance is unknown during the nonbreeding season: Mean MAD = 69m (SS-10). **Migratory season:** Pedestrian walking/running at a disturbed site: Range of mean MAD = 30 to 86m (SS-3,13).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Nine studies investigating a wide range of disturbance present seven groups of FID values recorded during the breeding, nonbreeding and migratory seasons. Four MAD buffer distances are recorded for pedestrian, watercraft and vehicle disturbance during the breeding, nonbreeding and migratory seasons.
Non-quantitative information on disturbance responses	Sanderling is largely a coastal species during the winter, inhabiting open sandy beaches exposed to the sea, the outer reaches of estuaries, rocky and muddy shores, mudflats. This species has been described to be sensitive to disturbance from recreation on sandy beaches, particularly when large numbers of people and/or free running dogs are present (see literature review in Woodward *et al*., 2015). At high tide, sanderlings roost together in small flocks on undisturbed rocks, sandy spits or offshore islets, often with other waders such as dunlin (Snow & Perrins, 1998). Therefore, there is potential for disturbance at roost sites during seaweed hand-harvesting.

Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Sanderling is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for sanderling is 70m for pedestrian/watercraft disturbance during the nonbreeding season. Quantitative values recorded during the breeding season may not be as relevant to seaweed hand-harvesting as sanderling do not breed in the UK. This species has the potential to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.
References to quantitative information on disturbance response distances (AD/FID/MAD)	SS-1: Collop *et al*. (2016) SS-2: Glover *et al*. (2011) SS-3: Koch and Paton (2015) SS-4,5: Liley *et al*. (2011) SS-6,7: Mikula *et al*. (1994) SS-8: Møller and Erritzøe (2010) SS-9: Roberts and Evans (1993) SS-10,11: Rodgers and Smith (1997) SS-12: Scarton (2018a) SS-13: Thomas *et al*. (2003)

3.32 Purple sandpiper (*Calidris maritima*)

Conservation Status	UK: Amber; Schedule 1 European: Least Concern
UK status	Scarce Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: Scotland only = 1-5 pairs Wintering: UK = 13,000 individuals; Scotland = 16,000 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** A couple of pairs breed in Scottish mountain heathland habitats above 1,000m, but the locations are confidential to protect the birds from disturbance. Main breeding range is on the Arctic coasts and uplands of Greenland, Scandinavia and Russia. **Nonbreeding:** Purple sandpiper spends the nonbreeding season on almost any rocky coast in Scotland. Most are found in Orkney, Shetland, and along the east coast of Scotland and northern England - it is scarce south of Yorkshire, other than Devon and Cornwall.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Purple sandpiper indirectly relies on seaweed for foraging requirements due to the association of seaweed with benthic infauna. In the Arctic breeding grounds, the diet of purple sandpiper consists largely of insects (e.g. adult, larval and pupal Diptera, Ichneumon wasps and aphids) and Collembola (springtails), as well as spiders, gastropods, annelid worms and some plant material (e.g. leaves, buds, berries and seeds) (BirdLife International, 2019). Outside of the breeding season purple sandpiper is strongly associated with feeding on insects in kelp on the tideline along the coast. In addition to insects, the nonbreeding season diet also includes molluscs, small crustaceans, annelid worms, small fish as well algae (Enteromorpha spp.) (BirdLife International, 2019). In the Uists, purple sandpiper showed a positive correlation with wrack cover (Orr 2013) and Summers *et al*. (1990) found that Diptera larvae and pupae comprised up to 67% of the diet of purple sandpipers on coastlines with rotting seaweed in Orkney, Scotland. Some seaweed is eaten directly (Summers *et al*., 1990). A study on the island of Papa Westray, Orkney, showed that purple sandpiper associate strongly to the presence of seaweed (especially stranded supra-littoral and inter-tidal cast weed), suggesting that the invertebrates associated with seaweed provide an important food resource (Douthwaite *et al*., *in prep*). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response	No records of FID/AD for purple sandpiper.

distances (AD/FID)	
Quantitative information on MAD or buffer distances	No records of MAD for purple sandpiper.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no records of AD/FID/MAD for purple sandpiper.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on purple sandpiper show that this species has a low sensitivity to human disturbance. Purple sandpiper has been described as 'tends to be very confiding' and 'not so readily disturbed as other waders' (Brown & Grice, 2005). This species can also be attracted to people including shellfish pickers on the beach (Bolam, 1912), crazy golf courses (Argyll Bird Reports) and high levels of human activity around harbour walls and jetties (Prater, 1981). Purple sandpiper shows a preference for rocky shores exposed to the sea. This species roosts at high tide along the shore, often utilising artificial structures such as concrete sea defences and breakwaters (BirdLife International, 2019). However, as purple sandpiper displays a high tolerance to human activity, the potential for disturbance at roost sites during hand-harvesting seaweed is low.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Purple sandpiper is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed, as suggested by non-quantitative disturbance studies. This species is unlikely to be disturbed whilst hand-harvesting seaweed.
Knowledge gaps	Lack of any studies recording AD/FID during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	None

3.33 Ruddy turnstone (*Arenaria interpres*)

Conservation Status	UK: Amber European: Least Concern
UK status	Scarce Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 48,000 individuals; Scotland = 35,300 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Breeds in the high Arctic on coastal plains, marshes and tundra. This species is not known to breed in the UK, although some nonbreeding birds spend the summer in Scotland. **Nonbreeding:** Turnstones are almost exclusively coastal outside of the breeding season and can be found fairly ubiquitously around the UK coastline on rocky and shingle shores, sandy beaches, estuaries and mudflats. In Scotland, the highest densities are found on the shorelines of the east mainland, Orkney, Shetland, Outer Hebrides and Ayrshire.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Turnstones indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. On tundra breeding grounds, turnstones feed primarily on insects including Diptera (especially adult and larval midges) as well as larval Lepidoptera, Hymenoptera, Coleoptera and spiders, though plant material and spiders may be important before insects become available (BirdLife International, 2019; Snow & Perrins, 1998). Outside of the breeding season, this species is mainly coastal feeding on insects, crustaceans, molluscs (especially mussels or cockles), annelids, echinoderms, small fish, carrion and bird eggs (Snow & Perrins, 1998; BirdLife International, 2019). Turnstones use seaweed during the nonbreeding season by turning it over and rolling it up in order to feed on invertebrates living within it (Snow & Perrins, 1998). In the Uists, turnstones show a positive correlation with wrack cover and removal of wrack could negatively impact migrating and overwintering birds by reducing their foraging habitat (Orr, 2013). A study on the island of Papa Westray, Orkney, showed that turnstone have a strong association with the presence of seaweed (especially stranded supra-littoral and inter-tidal cast weed); stranded seaweed at the high-water mark is known to provide a rich food supply for turnstone, dunlin and purple sandpipers in the form of kelp flies, their pupae and larvae (Douthwaite *et al*., *in prep*). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)

Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 12.5 to 31.5m (TT-1,2,3,10), Range of FID = 2 to 75m (TT-3,10). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: FID = 39m (TT-9). Motorized watercraft at a disturbed site: Mean FID = 36.4m, Range of FID = 9 to 86m (TT-11). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 20m (TT-4), Range of median FID = 15 to 50m, Range of FID = 5 to 100m (TT-5,6,7,8).
Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 74 (TT-10). Motorized watercraft at a disturbed site: Mean MAD = 79m (TT-11).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Five studies investigating disturbance from pedestrian and watercraft activity during the nonbreeding season present four groups of AD/FID values. Two MAD buffer distances are recorded for pedestrian and motorized watercraft disturbance at disturbed sites during the nonbreeding season.
Non-quantitative information on disturbance responses	Turnstone is largely a coastal species during the winter and like other members of the Scolopacidae family they roost together at high tide on undisturbed rocks, sandy spits or offshore islets (BirdLife International, 2019). Therefore, there is potential for disturbance at roost sites during seaweed hand-harvesting. This species is not particularly nervous compared to other wader species, allowing a closer approach than other species (see literature review in Woodward *et al*., 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Ruddy turnstone is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for turnstone is 100m for pedestrian/watercraft disturbance during the nonbreeding season. This species has the potential to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft, especially during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	TT-1,2: Beal & Monaghan (2004) TT-3: Collop *et al*. (2016) TT-4,5,6,7: Liley *et al*. (2011) TT-8: Liley *et al*. (2010) TT-9: Mikula *et al*. (1994) TT-10,11: Scarton (2018b)

3.34 Dunlin (*Calidris alpina*)

Conservation Status	UK: Amber European: Declining
UK status	Migrant Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 9,600 pairs; Scotland (*schinzii* subspecies = 8,000-10,000 pairs) Wintering: UK = 350,000 birds; Scotland (*alpina* subspecies) = 37,000-58,000 individuals
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Three subspecies of dunlin have been recorded in Scotland. The *alpina* subspecies winters in western Europe, including the UK and the Mediterranean, as well as the Indian subcontinent; this subspecies does not breed in the UK (breeds in northern Fennoscandia and north-west Russia, east as far as River Kolyma). The *schinzii* subspecies breeds in the UK as well as Greenland, Iceland and southern Fennoscandia; *arctica* subspecies has been recorded in passage in the UK. Both *schinzii* and *arctica* winter mainly in north-west Africa. This species breeds in the uplands of Scotland, Wales and northern England (Pennines). During the breeding season, *schinzii* are found on wet upland and montane heath, especially where pool systems occur, but also on the machairs of the Outer Hebrides and rarely on coastal saltmarsh. In Scotland, the greatest number of breeding dunlin can be found on peatland in Shetland, Orkney and the Outer Hebrides as well as the Grampian Mountains and the Flow Country of Caithness and Sutherland. Smaller populations of breeding dunlin are recorded elsewhere in Scotland on the Western Isles and upland areas of the mainland. **Nonbreeding:** Outwith the breeding season, dunlins are mainly found on open, muddy shores and estuaries, but also in smaller numbers on sandy beaches and rocky shores. In Scotland, *alpina* and *arctica* prefer wide, muddy beaches. Dunlins are widespread around British coasts in winter. The Wash in south-east England is an important post-breeding moulting site for migrating *alpina* (and other waders) before they disperse westward and northward. This subspecies is widespread on Scottish coats in winter, including the Outer Hebrides and Orkney, but the main concentrations are found on the large muddy estuaries of the east coast including the Cromarty Firth, Inner Moray Firth, Montrose Basin, Eden Estuary and inner Forth Estuary. In the west, large coastal concentrations can be found on the Clyde and the Solway Firth.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** An omnivorous species, dunlins indirectly rely on seaweed for foraging due to the association of seaweed with benthic infauna. On Arctic breeding grounds, dunlins feed mostly on adult and

	larval insects as well as spiders, mites, earthworms, snails, slugs and plant matter (usually seeds) (BirdLife International, 2019). Outside of the breeding season, dunlins frequently feed on mudflats consuming mostly polychaete worms and small gastropods, as well as insects, crustaceans, bivalves, plant matter and occasionally small fish (Snow & Perrins, 1998; BirdLife International, 2019). In the Uists during the spring migration, dunlin abundance showed the highest correlation with percentage of wrack cover (Orr, 2013). A study on the island of Papa Westray, Orkney, has shown that small waders are associated with areas of beach containing stranded and attached seaweed; with a falling tide, dunlin and ringed plover, along with smaller numbers of purple sandpiper and turnstone, were seen foraging in the recently exposed sand adjacent to the weed-covered boulders and stones where they probably fed on amphipods from the green seaweed (*Enteromorpha* spp). Dunlins were also occasionally observed poking their bills into holes in the dead stems and holdfasts of brown seaweed (*Laminaria* spp) (Douthwaite *et al*., *in prep*). Dunlins also benefit from foraging in wrack whilst migrating across Helgoland, the North Sea, where their daily energy expenditure could be met after only 5 hours of foraging in wrack (Dierschke, 1998). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (intertidal foraging) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 39 to 43.9m, Range of FID = 5 to 194m (DN-1,9). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 70 to 163m, Range of FID = 15 to 450m (DN-3,11,12). Motorized watercraft at a disturbed site: Mean FID = 52.3m, Range of FID = 9 to 175m (DN-10). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 8m (DN-4), Range of median FID = 35 to 75m, Range of FID = 8 to 300m (DN-5,6,7,8).

Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 82m (DN-4). Motorized watercraft at a disturbed site: Mean MAD = 124m (DN-10). **Migratory season:** Pedestrian walking/running at a disturbed site: Mean MAD = 89m (DN-2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Six studies investigating disturbance from pedestrian and watercraft activity present four groups of AD/FID values during the nonbreeding season. Three MAD buffer distances are recorded for pedestrian and motorized watercraft disturbance at disturbed sites during the nonbreeding and migratory seasons.
Non-quantitative information on disturbance responses	Dunlin mainly spend the winter on the coast, particularly on estuarine mudflats, but they can also frequent a wide variety of coastal and inland waterbodies including lagoons, muddy freshwater shores, tidal rivers, flooded fields, sewage farms, salt-works, sandy coasts, lakes and dams (BirdLife International, 2019). Reports of disturbance on this species are mixed; it has been found to be one of the more commonly disturbed species at roost sites on the Dee, although it has also been noted that it was the last species to fly when disturbed by walkers, though counts were still significantly lower at sites close to footpaths (see literature review in Woodward *et al.,* 2015). Similar to other waders, dunlins roost during high tides and at night, but this species prefers large fields of naturally fertilised short pasture or soil-based crops with few vertical structures that could be used by predators (Shepherd & Lank, 2004) which reduces the potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Dunlin is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for dunlin is 450m for pedestrian disturbance during the nonbreeding season. This species has the potential to be disturbed on foraging and roosting grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.
Knowledge gaps	Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.
References to quantitative information on disturbance response distances (AD/FID/MAD)	DN-1: Collop *et al*. (2016) DN-2: Koch and Paton (2014) DN-3: Laursen *et al*. (2005) DN-4,5,6,7: Liley *et al*. (2011) DN-8: Liley *et al*. (2010) DN-9,10: Scarton (2018b) DN-11,12: Smit and Visser (1993)

3.35 Common redshank (*Tringa totanus*)

Conservation Status	UK: Amber European: Declining
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 25,000 pairs; Scotland = 11,700-17,500 pairs Wintering: 130,000 individuals; Scotland = 4,000-25,000 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** Redshanks breed on inland wet grasslands with sufficiently short swards, grassy marshes, swampy heathlands, and swampy moors as well as coastal saltmarshes. In Scotland, this species breeds mainly on farmland, typically wet grassland and machair. Patchy breeding distribution in England, Northern Ireland and Scotland. In Scotland, the greatest numbers breed on Orkney, Shetland and the Outer Hebrides, particularly North and South Uist. Other significant populations breed in Caithness, Moray & Nairn, Perth & Kinross, Clyde, Lothian and Argyll, particularly on Islay. In England, the highest breeding densities are found on the East Anglian and north-western coasts of England where nesting occurs on saltmarshes and on adjacent wet grassland habitats. **Nonbreeding:** Nonbreeding, overwintering and passage redshank favour coastal habitats particularly estuaries and other sheltered intertidal areas around the UK. This species feeds on rocky, muddy, and sandy beaches, saltmarshes, tidal mudflats, saline and freshwater coastal lagoons; this species may frequent inland flooded grasslands on passage. Redshanks wintering in Britain and Ireland also include birds of the race *T .t. robusta* which breed in Iceland and the Faeroes, as well as locally breeding birds from within the UK. This species is much more widespread around the UK coastline outside the breeding season. The highest overwintering numbers in Scotland have recorded on the larger estuaries including the Firth of Forth, Solway, inner Moray Firth, Clyde, Montrose, Ythan and Cromarty Firth estuaries.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Redshank may indirectly rely on seaweed for foraging due to the association of seaweed with benthic infauna, especially during the nonbreeding season. Redshank foraging behaviour varies between breeding and nonbreeding seasons. In the breeding season when the species inhabits inland as well as coastal sites, the diet includes mostly insects, spiders and annelid worms, but during the nonbreeding season when redshank is largely coastal, the diet also includes molluscs, crustaceans (especially amphipods e.g. *Corophium* spp.) and occasionally small fish and tadpoles (BirdLife International, 2019). In the Uists, redshanks typically feed in terrestrial environments or estuarine mudflats, but wrack beach foraging habitat may be important when energy demands are high (Orr, 2013).

	Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean FID = 39m, Range of FID = 21 to 55m (RK-15). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 29.71m (RK-13,14). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 37 to 79.8m (RK-1,2), Range of FID = 28 to 187m (RK-1). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 24 to 137m, Range of FID = 22 to 450m (RK-5,11,12). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 175 to 260m (RK-3,4). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 60m (RK-6), Range of median FID = 30 to 70m, Range of FID = 10 to 150m (RK-6,7,8,9,10).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 55m (RK-15).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Ten studies investigating pedestrian and watercraft disturbance present six groups of FID values recorded during the breeding and nonbreeding seasons. One MAD buffer distance is recorded for pedestrian disturbance at a disturbed site during the breeding season.
Non-quantitative information on disturbance responses	Redshanks, as with all waders, usually roost on the coast at high tide (BirdLife International, 2019) so there is potential for disturbance at coastal roost sites whilst hand-harvesting seaweed. However, this species is also known to roost communally at inland sites including disturbed sites at a sport centre and an oil terminal complex (CAWOS, 2019), at such inland roost sites there is no potential for disturbance by seaweed harvesters. Flight distances of c.100 m was noted by Smit & Visser (1993). Susceptible to disturbance from construction and other activities as often feeds closer to shore than other waders (see literature review in Woodward *et al.*, 2015).
Likely sensitivity to disturbance whilst hand-harvesting	**Medium sensitivity to disturbance** Common redshank is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The

seaweed	maximum FID recorded for redshank is 450m for pedestrian disturbance during the nonbreeding season and 55m for pedestrian disturbance during the breeding season. This species has the potential to be disturbed on breeding and nonbreeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.
References to quantitative information on disturbance response distances (AD/FID/MAD)	RK-1: Collop *et al*. (2016) RK-2: Fitzpatric & Bouchez (1998) RK-3,4: Laursen *et al*. (2017) RK-5: Laursen *et al*. (2005) RK-6,7,8,9: Liley *et al.* (2011) RK-10: Liley et al. (2010) RK-11,12: Mikula et al. (1994) RK-13: Møller (2008b) RK-14: Møller and Erritzøe (2010) RK-15: Scarton (2018a)

3.36 Bar-tailed godwit (*Limosa lapponica*)

Conservation Status	UK: Amber European: Secure
UK status	Passage/Winter Visitor
UK and Scottish population estimate	Wintering: UK = 41,000 individuals; Scotland = 10,000-14,000
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline outside the breeding season. **Breeding:** Bar-tailed godwit breeds in the Arctic from northern Europe through Siberia to Alaska. This species does not breed in the UK, although in Scotland small numbers of immatures remain on the coastline through the summer. **Nonbreeding:** Bar-tailed godwit is a common winter visitor and passage migrant to the UK. During the nonbreeding season, this species is chiefly coastal present in intertidal areas along muddy coastlines, estuaries, inlets and sheltered bays. Bar-tailed godwits are fairly widespread around the UK coastline with the largest numbers occurring on large estuaries. In Scotland, the highest numbers can be found on the Moray Firth, Cromarty Firth, Firth of Forth, Dornoch Firth and the Tay Estuary. High numbers are also present on Orkney and the Outer Hebrides. Elsewhere in the UK, large numbers occur on the Wash, Thames, Ribble, Dee, Humber and Solway estuaries, and Lough Foyle for example.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Bar-tailed godwit may indirectly rely on seaweed for foraging due to the association of seaweed with benthic infauna. On Arctic breeding grounds, bar-tailed godwit feeds on insects, annelid worms, molluscs and occasionally seeds and berries, but during the winter when it commonly feeds at the tideline in intertidal areas along muddy coastlines and estuaries with tidal mudflats or sandbars, this species feeds on annelids (e.g. *Nereis* spp. and *Arenicola* spp.), bivalves and crustaceans, although it will also take cranefly larvae and earthworms on grasslands and occasionally larval amphibians (tadpoles) and small fish (BirdLife International, 2019; Snow & Perrins, 1998). In the Uists, bar-tailed godwits typically feed in terrestrial environments or estuarine mudflats, but wrack beach foraging habitat may be important when energy demands are high (Orr, 2013). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean FID = 84.4m, Range of FID = 32 to 225m (BA-8). Pedestrian walking/running at a site where level of habituation to

	disturbance is unknown: Range of mean FID = 22.1 to 219m (BA,2,3,4,5,6,7,9,12,17,21,22), Range of FID = 2.1 to 450m (BA-7,9,12,21,22). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean FID = 53.5m (BA-15). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 41.9 to 230m (BA-10,11,16). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Median AD = 30m (BA-13), Median FID = 25m (BA-14). **Unknown season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 22.1m (BA-1).
Quantitative information on MAD or buffer distances	No records of MAD for bar-tailed godwit.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Ten studies investigating pedestrian and watercraft disturbance present six groups of FID values recorded during the nonbreeding season and an unknown season. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	There is no evidence for dependence on seaweed for habitat requirements. Bar-tailed Godwits join mixed wader roosts at high tide (BirdLife International, 2019) so there is potential for disturbance at roost sites whilst hand-harvesting seaweed. This species has been described as relatively sensitive to disturbance compared to other wader species (see literature review in Woodward *et al.*, 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Bar-tailed godwit is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for godwit is 450m for pedestrian disturbance during the nonbreeding season. This species has the potential to be disturbed on foraging and roosting grounds whilst hand-harvesting seaweed during the nonbreeding season.
Knowledge gaps	Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.

References to quantitative information on disturbance response distances (AD/FID/MAD)	BA-1: Blumstein (2003) BA-2,3,4,5,6: Blumstein *et al*. (2012) BA-7: Blumstein *et al*. (2003) BA-8: Collop *et al*. (2016) BA-9: Glover *et al.* (2011) BA-10,11: Laursen *et al*. (2017) BA-12: Laursen *et al*. (2005) BA-13,14: Liley *et al.* (2011) BA-15,16,17: Paton *et al*. (2000) BA-21,22: Smit and Visser (1993)

3.37 Eurasian curlew (*Numenius arquata*)

Conservation Status	UK: Red European: Vulnerable
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 66,000 pairs; Scotland = *c.* 58,800 pairs Wintering: UK = 140,000 individuals; Scotland = *c.* 85,700 individuals
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but much more widely outside the breeding season. **Breeding:** Curlews generally prefer to breed in farmed habitats around and below the moorland edge, which comprise rush pastures with some enclosed heather moorland and unimproved grassland. Less preferred are the lower ground habitats of improved grassland. Curlew will also breed on unenclosed moorlands, mostly on the lower heather moors and blanket peatland. Only a few will nest on saltmarshes. Curlew is a widespread breeding species throughout much of Britain, but is absent from most parts of south-east England, and is sporadic in south-west England, north-west Scotland and parts of Ireland. It is most common in the North Pennines, the Southern Uplands of Scotland, parts of the east Highlands, Caithness, Orkney and Shetland. Smaller areas of high abundance also occur in northern and central parts of Ireland, north and central Wales, and on the west coast of Britain, between Anglesey and Islay. **Nonbreeding:** Curlews leave their upland breeding areas and most spend the winter on or near the coast. During the winter this species can be found on muddy coasts, bays and estuaries with tidal mudflats and sandflats rocky and sandy beaches with many pools, saltmarshes, coastal meadows and pasture and muddy shores of coastal lagoons, inland lakes and rivers. Curlew will also feed on wet grassland and arable fields during migration. Curlews wintering in UK also originate from Scandinavia, especially Finland and Sweden. This species is found around most of the UK coastline in the winter. In Scotland, the highest numbers can be found on the Solway, Forth and Inner Moray Firth and Clyde estuaries as well as the Cromarty Firth, Wigtown Bay, Shetland, Orkney and the Outer Hebrides. In England, the largest concentrations can be found at Morecambe Bay, the Wash, and the Dee, Severn, Humber and Thames estuaries.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** An omnivorous species, but feeding mainly on invertebrates, curlew indirectly relies on seaweed for foraging due to the association of seaweed with benthic infauna, especially during the nonbreeding season. In the breeding season when curlews move inland to upland moors and heathlands, the diet consists mainly of annelid worms and terrestrial insects, although spiders, berries, seeds, as well as occasionally small fish, amphibians, lizards, young birds and small rodents can be eaten (BirdLife International, 2019). During the nonbreeding season when

	curlews feed more often in coastal areas including mudflats, sandflats, rocky and sandy beaches, the diet also comprises of marine invertebrates including crustaceans, molluscs and polychaete worms (BirdLife International, 2019), although terrestrial invertebrates still form part of the diet during the nonbreeding season. In the Uists, curlews typically feed in terrestrial environments or estuarine mudflats, but wrack beach foraging habitat may be important when energy demands are high (Orr, 2013). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (intertidal foraging; at roost) Nonbreeding (intertidal foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 62.75m (CU-11). **Nonbreeding season:** Pedestrian walking/running at a disturbed site: Range of mean FID = 38 to 340.3m, Range of FID = 59 to 570m (CU-1,2,12). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of mean FID = 50 to 339m, Range of FID = 46 to 650m (CU-5,10,21,23,24). Pedestrian egg collector at a site where level of habituation to disturbance is unknown: Mean FID = 140m (CU-22). Motorized watercraft at a disturbed site: Mean FID = 140m, Range of FID = 70 to 205m (CU-13). Non-motorized watercraft at a site where level of habituation to disturbance is unknown: Range of mean FID = 220 to 400m (CU-3,4). Vehicle (car) at a site where level of habituation to disturbance is unknown: Mean FID = 188m (CU-19). Aircraft (helicopter) flying over a site where level of habituation to disturbance is unknown: Mean FID = 200m (CU-14). Agricultural activities close to a site where level of habituation to disturbance is unknown: Mean FID = 129m (CU-20). Dog(s) at a site where level of habituation to disturbance is unknown: Mean FID = 90m (CU-18). Disturbance from pedestrian leisure activity on land and in watercraft along a shoreline (specific source unknown) at a disturbed site: Range of median FID = 22.5 to 75m, Range of FID = 15 to 200m (CU-6,7,8,9).

Quantitative information on MAD or buffer distances	**Nonbreeding season:** Pedestrian walking/running at a disturbed site: Mean MAD = 267m (CU-12). Motorized watercraft at a disturbed site: Mean MAD = 219m (CU-13). **Unknown season:** Pedestrian walking/running at a disturbed site: Mean MAD = 100m (CU-25). Pedestrian walking/running at an undisturbed site: Mean MAD = 200m (CU-26).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Ten studies investigating a range of disturbance present 11 groups of FID values recorded during the breeding and nonbreeding seasons, but mostly the latter season. Four MAD buffer distances are recorded for pedestrian and motorized watercraft disturbance at disturbed sites during the nonbreeding and unknown seasons.
Non-quantitative information on disturbance responses	Curlews often roost on the coast at high tide with other waders (BirdLife International, 2019), so there is potential for disturbance at roost sites whilst hand-harvesting seaweed. However, large groups of curlews also roost on fields and marshland where they are less likely to be disturbed by seaweed harvesters. A study by Scarton (2018b), identified Eurasian curlew to be the most sensitive species to human approach compared with other species of roosting waders. Curlew is threatened by disturbance on intertidal mudflats by walkers and the flooding of mudflats and saltmarshes for tidal barrage construction probably through indirect mechanisms associated to reductions of food resources or access/ displacement from wintering grounds (see literature review in Woodward *et al*., 2015). May be at risk from improvements to water quality which has been found to cause reductions in benthic invertebrate densities at sites close to sewage outfalls (Burton *et al*., 2002, see literature review in Woodward *et al*., 2015).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**High sensitivity to disturbance** Eurasian curlew is assessed to have a high sensitivity to human disturbance. A maximum FID value of 650m has been recorded for curlew disturbed by pedestrian activity during the nonbreeding season and non-quantitative studies identify curlew to be a sensitive wader species to human disturbance. Quantitative values recorded during the breeding season may not be relevant to seaweed hand-harvesting as curlew breed at inland sites. This species is likely to be disturbed on foraging and roosting grounds at the coast (most likely during the nonbreeding season but also potentially during the breeding season) whilst hand-harvesting seaweed.

Knowledge gaps	Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	CU-1: Collop *et al*. (2016) CU-2: Fitzpatric & Bouchez (1998) CU-3,4: Laursen *et al*. (2017) CU-5: Laursen *et al*. (2005) CU-6,7,8: Liley *et al.* (2011) CU-9: Liley *et al.* (2010) CU-10: Mikula *et al*. (1994) CU-11: Møller and Erritzøe (2010) CU-12,13: Scarton (2018b) CU-14,18,19,20,21,22,23,24,25: Smit & Visser (1993)

3.38 Black-headed gull (*Larus ridibundus*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 140,000 pairs; Scotland = 43,200 Apparently Occupied Nests Wintering: UK = 2,155,147 individuals; Scotland = 155,500 individuals
UK long-term trend	Increase
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** Black-headed gulls chiefly breed inland and show a preference for shallow, calm, temporarily flooded wetland habitats with lush vegetation, although it does also breed on coastal dunes. In Scotland, this species is common and widespread throughout, with the exception of the north and west Highlands. The majority of the Scottish population is found in Perth & Kinross and the Borders. In 2000, the largest colony was recorded at Bemersyde Moss (Scottish Borders) and the second largest was on St Serf's Island in Loch Leven. Other notable Scottish populations are found in Strathspey, Angus & Dundee, Ayrshire, Clyde and Orkney. Elsewhere in the UK, black-headed gull has a widespread distribution in England (except for Devon and Cornwall) and Northern Ireland. **Nonbreeding:** During the winter, the black-headed gull is most common in coastal habitats and tidal inshore waters, showing a preference for inlets or estuaries with sandy or muddy beaches, and generally avoiding rocky or exposed coastlines. This species has a widespread winter distribution in the UK. A proportion of Scottish breeding birds overwinter in England and Ireland. Immigrants from Iceland, Fennoscandia, the Baltic and northern England join those that remain in Scotland. In Scotland, large winter flocks can be recorded at the Loch of Skene, on the Clyde Estuary, Firth of Clyde, Firth of Forth and in the Montrose Basin.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Black-headed gull is an opportunistic omnivorous scavenger and the diet consists of a variety of different foods, but it may use seaweed for foraging due to the association of seaweed with benthic infauna. Black-headed gull can be found at both inland and coastal sites throughout the year; this species generally spends more time inland compared with other members of the Laridae family. During the breeding season when black-headed gulls often nest inland including along the margins of lakes, marshes and slow-flowing rivers (but also at coastal sites along deltas and estuaries), the diet can consist of aquatic and terrestrial insects, earthworms and marine invertebrates although fish, rodents and agricultural grain can be eaten (Snow & Perrins, 1998; BirdLife International, 2019).

	During the nonbreeding season, black-headed gull is more common in coastal habitats and tidal inshore waters, but it also occurs inland. In addition to terrestrial prey items, black-headed gull is also attracted to washed-up seaweed, probably to feed on sandhoppers and the larvae and adults of shore flies (Vernon, 1972), although refuge tips and sewage farms are important additional foraging sites during the winter (BirdLife International, 2019). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements. The surface canopy of kelp forests or drifting kelp mats may possibly be used as gull resting/roosting sites (Foster & Schiel, 1985), but this is more likely to be the case for other more pelagic members of the Laridae family.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 41.20m (BH-3). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 116m, Range of FID = 50 to 450m (BH-2).
Quantitative information on MAD or buffer distances	No records of MAD for black-headed gull.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** Two studies investigating disturbance from pedestrian activity during the breeding and nonbreeding seasons present two groups of FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Black-headed gull can roost at coastal sites allowing some potential for disturbance at roost sites whilst hand-harvesting seaweed, but this species also often roosts on inland waterbodies (Hickling, 1954). Black-headed gulls feed behind tractors on agricultural land, and around bulldozers on refuse tips, so are not easily disturbed by vehicles. They also occur at urban ponds and lakes, feeding on bread at the feet of people, so can habituate to human activity.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Black-headed gull is assessed to have a low to medium sensitivity to human disturbance whilst hand-harvesting seaweed. The non-quantitative evidence suggests that black-headed gulls probably have low sensitivity to seaweed hand-harvesting activity, although the maximum FID recorded for black-headed gull is 450m for pedestrian disturbance during the nonbreeding season showing that the range of responses of individual birds may be large, and habituation to humans may only apply for part of the population. Quantitative values recorded during the breeding season may not be relevant to seaweed

	hand-harvesting as black-headed gull tends to breed inland. This species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values especially investigating disturbance from watercraft.
References to quantitative information on disturbance response distances (AD/FID/MAD)	BH-2: Laursen *et al*. (2005) BH-3: Møller and Erritzøe (2010)

3.39 Common gull (*Larus canus*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 49,000 pairs; Scotland = 48,100 Apparently Occupied Nests Wintering: UK = 669,581-721,158 individuals; 79,700 individuals
UK long-term trend	Increasing (Possible decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, but more widely outside the breeding season. **Breeding:** Common gulls breed along the coast and inland in a variety of sites not necessarily close to wetlands. On the coast it nests on grassy and rocky cliff-ledges, grassy slopes, inshore rocky islets, islands and stacks, and on sand and shingle beaches, banks and dunes amongst tide-wrack or flood debris. Inland this species nests on small islands in freshwater and saline lakes, shingle bars or small islets in streams or rivers, islets, artificial structures and shores of artificial waterbodies with short, sparse vegetation, and on bogs, marshes, meadows and grass or heather moorland near small pools or lakes. After the young fledge the species often disperses to coasts, tidal estuaries, agricultural land and reservoirs. Breeding in the UK mostly confined to Scotland (particularly the north-west) and Northern Ireland. Large numbers of breeding birds in Scotland can be found in Moray & Narin, Orkney, Shetland, the Outer Hebrides, Argyll, Perth & Kinross, Badenoch & Strathspey, Angus & Dundee and Sutherland. **Nonbreeding:** During the winter, large numbers of common gulls are found both on the coast and inland, particularly feeding in ploughed fields and areas of grassland. Increasingly, flocks are being observed in urban areas, feeding in parks and at refuge tips. This species may occur more frequently along the coast during the winter on estuaries with low salinities, sandy beaches and estuarine mudflats. Common gull is widespread across Britain in winter. In Scotland, the largest wintering flocks can be found in the east of the country such as at Munlochy (Ross & Cromarty), West Water Reservoir (Borders), Mersehead (Dumfries & Galloway), Musselburgh-Portobello, Loch Leven and Loch of Skene.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Common gull is omnivorous and the diet consists of a variety of different foods, but it may use seaweed for foraging due to the association of seaweed with benthic infauna. Common gull occupies both coastal and inland habitats. Outside of the breeding season it occupies similar habitats to when it is breeding, although it may occur more frequently along the coast during the winter on estuaries with low salinities, sandy beaches and estuarine mudflats (BirdLife International, 2019; Snow & Perrins, 1998). The diet consists of earthworms, insects, aquatic and terrestrial invertebrates, crayfish, molluscs and small fish (BirdLife International, 2019) and it is also attracted to

	washed-up seaweed, probably to feed on sandhoppers and the larvae and adults of shore flies (Vernon, 1972). In the spring, common gull will feed on agricultural grain and this species also often scavenges, including taking carrion from road kill (Jones, 1980). Common gulls breeding at the coast are known to sometimes nest amongst tide-wrack (Snow & Perrins, 1998), so there may be some reliance on seaweed for nesting habitat requirements. The surface canopy of kelp forests or drifting kelp mats may also possibly be used as gull resting/roosting sites (Foster & Schiel, 1985).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 59.94m (CM-3). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 120m, Range of FID = 70 to 350m (CM-2).
Quantitative information on MAD or buffer distances	No records of MAD for common gull.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** Two studies investigating disturbance from pedestrian activity during the breeding and nonbreeding seasons present two groups of FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Common gull can roost at coastal sites (BirdLife International, 2019) allowing some potential for disturbance at roost sites whilst hand-harvesting seaweed. Common gulls feed behind tractors on agricultural land, and around bulldozers on refuse tips, so are not easily disturbed by vehicles. They also occur at urban ponds and lakes, though usually only in small numbers, feeding on bread at the feet of people, so can habituate to human activity.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Common gull is assessed to have a low to medium sensitivity to human disturbance whilst hand-harvesting seaweed. The non-quantitative evidence suggests that common gulls probably have low sensitivity to seaweed hand-harvesting activity, although the maximum FID recorded for black-headed gull is 350m for pedestrian disturbance during the nonbreeding season showing that the range of responses of individual birds may be large, and habituation to humans may only apply for part of the population. This species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values especially investigating disturbance from watercraft.

References to quantitative information on disturbance response distances (AD/FID/MAD)	CM-2: Laursen *et al*. (2005) CM-3: Møller and Erritzøe (2010)

3.40 Herring gull (*Larus argentatus*)

Conservation Status	UK: Red European: Declining
UK status	Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 133,868 pairs; Scotland = 72,100 Apparently Occupied Nests Wintering: UK = 696,424-762,731; individuals; Scotland = 91,000 individuals
UK long-term trend	Stable (Probable Decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year. **Breeding:** Herring gull is a colonial breeder, with colonies around the entire UK coast; some inland scattered around the country. There is no specific breeding habitat for herring gull, but they may show a preference for rocky shores with cliffs, outlying stacks or islets, otherwise nesting on rocky and grassy islands, sandy beaches, dunes, gravel bars, saltmarshes, rocky outcrops, buildings, claypits, swampy lowlands near lakes and on river islands. When inland on migration, the species also shows a preference for large river valleys. Although herring gulls exploit refuse tips and farmland extensively all year round, their breeding distribution is extremely coastal compared to other *Larus* gulls (other than great black-backed gull). British distribution widespread around coastal areas. In Scotland, the highest numbers can be found in the Firth of Forth, north-east Scotland, the Moray Firth, Caithness, Orkney and Shetland with smaller numbers along the whole west coast and islands. Recently, substantial declines have been observed and this species is now red listed in the UK. There is an expanding use of urban areas for nesting, although in 2000 only 1% of the population nested inland in Scotland. **Nonbreeding:** Herring gull wintering habitat is similar to breeding habitat; it is widely distributed and occurs mainly in coastal areas. Outside of the breeding season this species is highly gregarious and gathers in large flocks in favoured sites, landfill sites bring increasing numbers inland. Individuals show some foraging site fidelity. In Scotland, herring gulls generally move southwards in winter, depending on age and sex (young and adult females in particular), with some moving further to England and a few to continental Europe. The largest Scottish roosts occur in central Scotland. Local birds are joined in winter by birds from colonies in the Barents Sea, mostly found in east Scotland.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Gulls belonging to the Laridae family may potentially forage within infralittoral reef kelp forests (Kelly, 2005) to feed on benthic infauna. Gulls may also forage on the surface canopy of kelp forests or floating kelp mats; previous studies have shown that Hermann's gulls (*Larus heermanni*), western gulls (*Larus occidentalis*) and Bonaparte's gulls (*Larus philadelphia*) scavenge on the surface kelp canopy (Foster & Schiel, 1985). Herring gull is an omnivorous opportunistic predator, scavenger and food-pirate, feeding on almost anything of suitable size or

	texture (Snow & Perrins, 1998). In both the breeding and nonbreeding seasons herring gulls can feed on fish, earthworms, crabs and other marine invertebrates (e.g. molluscs, starfish or marine worms), adult birds, bird eggs and young, rodents, insects, berries and tubers (e.g. turnips) (BirdLife International, 2019). Refuse tips are frequently exploited by foraging individuals (Pons & Migot, 1995) and botulism poisoning associated with some rubbish tips may be one causal factor for the reduction in herring gull numbers in some areas (Calladine, 2006). Herring gulls breeding at the coast will use tide wrack to construct their nests (Snow & Perrins, 1998), so there may be some reliance on seaweed for nesting habitat requirements as well as potential for disturbance at roost sites whilst hand-harvesting seaweed. The surface canopy of kelp forests or drifting kelp mats may also possibly be used as gull resting/roosting sites (Foster & Schiel, 1985).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Range of mean AD = 0.80 to 15.30m, Range of mean FID = 0.98 to 8.80m (HG-1,2,3,4,8,9,10,11,12). Pedestrian walking/running at an undisturbed site: Range of mean AD = 6.77 to 29m, Range of mean FID = 2.70 8.79m (HG-5,6,7).
Quantitative information on MAD or buffer distances	**Breeding season:** Aircraft (twin-engine monoplane) flying over a disturbed site: Mean MAD = 100m (HG-14).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Two studies investigating pedestrian disturbance present two groups of FID values recorded at disturbed and undisturbed sites during the breeding season. One MAD buffer distance is recorded for aircraft disturbance at a disturbed site during the breeding season.
Non-quantitative information on disturbance responses	Herring gulls are increasingly occurring in areas of high urbanisation, especially during the breeding season where rooftops may be used for nesting (Ross *et al*., 2016). Gulls that have habituated to urban areas, and therefore are more used to being in close proximity to humans, are unlikely to be disturbed by seaweed harvesters. Herring gulls may roost at coastal sites, allowing some potential for disturbance at roost sites whilst hand-harvesting seaweed.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Herring gull is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for herring gull is 29m for pedestrian disturbance during the breeding season and non-quantitative studies suggest a high

	tolerance to human disturbance. This species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values from watercraft disturbance and from the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	HG-1,2,3,4,5,6,7,8,9,10,11,12: Burger & Gochfeld (1981) HG-14: Dunnet (1977)

3.41 Lesser black-backed gull (*Larus fuscus*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant/Resident Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 117,000 pairs; Scotland = 25,000 Apparently Occupied Nests Wintering: UK = 80,473 individuals; Scotland = 200-600 individuals
UK long-term trend	Stable (Probable decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year. **Breeding:** Lesser black-backed gull breeds in colonies, showing a preference for level-ground that is well covered with fairly close, short vegetation, often nesting under heather, bracken or other vegetation (sometimes under pine trees). Suitable sites include flat, unbroken grassy slopes, sand-dunes, the tops and ledges of coastal cliffs, rocky offshore islands, saltmarshes, the margins of inland lakes, islands in lakes and rivers, and high moorland, although the species will also nest on buildings and rooftops. The biggest UK colony is on Walney Island in Cumbria which supports a third of the UK population. More than half the UK population is found at fewer than ten sites. They are increasingly common in urban habitats, even in inland locations such as the west Midlands. In Scotland, the largest breeding populations are in the Firth of Forth and the Firth of Clyde, with smaller numbers widely distributed throughout other coastal areas. **Nonbreeding:** Outside of the breeding season lesser black-backed gull chiefly inhabits inshore and offshore seas, as well as lagoons, estuaries, harbours and seashores. It may also frequent inland habitats during this season, such as large lakes and rivers, in England preferring flooded gravel pits and reservoirs, canals, river weirs, flood-lands and sewage treatment areas. As in the breeding season, it is often seen foraging on arable land, pasture land, and on refuse dumps. Widespread throughout England and the south of Scotland both coastal and inland, but scarce in northern Scotland, western and northern Isles. Most leave Scotland during the period from late November to early March, although a few hundred remain in the south, particularly in the Clyde area.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Gulls belonging to the Laridae family may potentially forage within infralittoral reef kelp forests (Kelly, 2005) to feed on benthic infauna. Gulls may also forage on the surface canopy of kelp forests or floating kelp mats; previous studies have shown that Hermann's gulls (*Larus heermanni*), western gulls (*Larus occidentalis*) and Bonaparte's gulls (*Larus philadelphia*) scavenge on the surface kelp canopy (Foster & Schiel, 1985). Like other members of the gull family, lesser black-backed gull is omnivorous and opportunistic. In the breeding season this species feeds in both coastal and inland habitats but in the nonbreeding season this species chiefly inhabits inshore and offshore seas (BirdLife International, 2019; Snow & Perrins,

	1998). The diet consists of small fish, aquatic and terrestrial invertebrates (e.g. beetles, flies and larvae, ants, moths, grasshoppers, crustaceans, molluscs, segmented worms and starfish), bird eggs and nestlings, carrion, offal, rodents, berries and grain (BirdLife International, 2019). It often follows fishing fleets, feeding on discarded bycatch (Tyson *et al*., 2015) and as with herring gull, lesser black-backed gull will feed at rubbish tips which is possibly a causal factor of botulism poisoning in this species (Calladine, 2006). Lesser black-backed gulls breeding at the coast will use tide wrack to construct their nests (Snow & Perrins, 1998), so there may be some reliance on seaweed for nesting habitat requirements. The surface canopy of kelp forests or drifting kelp mats may also possibly be used as gull resting/roosting sites (Foster & Schiel, 1985).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 25m (LB-2).
Quantitative information on MAD or buffer distances	No records of MAD for lesser black-backed gull.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance from pedestrian activity during the breeding season presents one FID value. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Similar to herring gull, an increasing number of lesser black-backed gull frequent areas of high urbanisation, especially during the breeding season where rooftops may be used for nesting (Ross *et al*., 2016). Gulls that have habituated to urban areas are unlikely to be disturbed by seaweed harvesters. Non-quantitative disturbance studies on lesser black-backed gull show that this species has a low sensitivity to human disturbance. Vulnerability of lesser black-backed gulls at sea to disturbance by boats was scored as low (2) by Furness *et al.* (2013). Mendel *et al.* (2008) identified lesser black-backed gulls as showing very low sensitivity to human disturbance and boat activity in coastal areas of Germany. As well as urban nesting gulls, lesser black-backed gulls may also roost at coastal sites allowing some potential for disturbance at roost sites whilst hand-harvesting seaweed. Where lesser black-backed gulls nest in loose colonies along a coastline, individual nests might be at risk of human disturbance if people approach within about 30 m (Bob Furness, 2019, *pers. comm.*). However, this species tends not to nest on mainland coasts, preferring to nest on islands or rocks off the coast where they are

	relatively safe from human disturbance and predators.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Lesser black-backed gull is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed, as suggested by non-quantitative disturbance studies. In addition, the one FID value recorded for lesser black-backed gull is 25m for pedestrian disturbance during the breeding season. This species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values during both the breeding and nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	LB-2: Møller (2008b)

3.42 Great black-backed gull (*Larus marinus*)

Conservation Status	UK: Amber European: Least Concern
UK status	Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 17,000 pairs; Scotland = 14,800 nests Wintering: UK = 143,521 individuals; Scotland = 7,500-10,000 individuals
UK long-term trend	Stable (Strong Decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year. **Breeding:** Great black-backed gulls breed mainly on small, usually uninhabited coastal islands, remote coasts and cliffs. This species may also occasionally breed on undisturbed inland sites including islets in large freshwater lakes and rivers, fields and open moorland; it is less common on inland rubbish tips than other large gulls. It generally nests in small, scattered groups but a few much larger colonies have been noted. In Scotland, the largest numbers are found in northern and western areas including Shetland, Orkney and North Rona (Outer Hebrides), but with a range extension down the east coast and in the south-west. Smaller numbers breed along the east coast and inland, both on rooftops in various cities (e.g. Aberdeen, Inverness and Greenock) and on islands in freshwater lochs. In England, this species breeds mainly on the western coast, some of the largest populations are found on the Isles of Scilly, Wales and the Isle of Man. **Nonbreeding:** In the nonbreeding season, great black-backed gulls are generally more widespread than they are during the breeding season. Scottish adults are largely sedentary and so wintering grounds are similar to breeding habitat. However, sub-adults disperse further in winter, usually southwards, but a few to the north. Birds ringed as chicks in Orkney have been found along the east coast of England south to Essex and Sussex, with one inland in Berkshire. Other Scottish recoveries are from Denmark, the Netherlands and Spain. In winter, migrants in Scotland are mainly from Norway or further east. The largest winter counts have been recorded on Shetland, Orkney Fair Isle, Outer Skerries, north Unst and Isle of May as well as mainland estuaries including Lossie, Ythan and Don and Loch of Strathbeg. Elsewhere, gatherings of 20-200 individuals can occur in almost any costal area where food is available. Scottish birds are joined in winter by birds from colonies in the Barents Sea, with most of these overseas birds wintering in the east of Scotland.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Gulls belonging to the Laridae family may potentially forage within infralittoral reef kelp forests (Kelly 2005) to feed on benthic infauna. Gulls may also forage on the surface canopy of kelp forests or floating kelp mats; previous studies have shown that Hermann's gulls (*Larus heermanni*), western gulls (*Larus occidentalis*) and Bonaparte's gulls (*Larus philadelphia*)

	scavenge on the surface kelp canopy (Foster & Schiel, 1985). Like other gulls, great black-backed gull is an omnivorous opportunistic scavenger. Great black-backed gull is the UK's largest breeding gull species and occurs at both inland sites and around coastal areas during the breeding and nonbreeding seasons, although this is a predominantly coastal and marine foraging species. The diet can consist of fish, bird eggs, small mammals, insects, marine invertebrates (molluscs), carrion and refuse (BirdLife International, 2019). Great black-backed gull is also a voracious predator and food-pirate; this species can kill both adult and young birds (e.g. Manx shearwater, puffin) by grabbing the neck, stabbing with the bill and shaking vigorously (Snow & Perrins, 1998). Great black-backed gulls breeding at the coast will use tide wrack to construct their nests (Snow & Perrins, 1998), so there may be some reliance on seaweed for nesting habitat requirements. The surface canopy of kelp forests or drifting kelp mats may also possibly be used as gull resting/roosting sites (Foster & Schiel, 1985).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging; at roost) Nonbreeding (intertidal foraging; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean AD = 8.20 to 27.80m, Mean FID = 2.80 to 22.20m (GB-4,5,6,7,8). Pedestrian walking/running at an undisturbed site: Mean AD = 10.18m to 20.30m, Mean FID = 4.88 to 11.20m (GB-1, 2, 3). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID: 68m (GB-10).
Quantitative information on MAD or buffer distances	No records of MAD for great black-backed gull.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** Three studies investigating disturbance from pedestrian activity during the breeding season present three groups of AD/FID values. There are no studies recording MAD buffer distances.
Non-quantitative information on disturbance responses	Great black-backed gulls may roost at coastal sites (BirdLife International, 2019), allowing some potential for disturbance at roost sites whilst hand-harvesting seaweed. However, this species prefers to nest on islands or rocks off the coast where they are relatively safe from human disturbance and predators (Bob Furness, 2019, *pers. comm.*).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Great black-backed gull is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed. Although the maximum FID recorded for great black-backed gull is 68m for pedestrian disturbance during the breeding season, the majority of studies record AD/FID at less than half this distance. This

	species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values during the nonbreeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	GB-1,2: Burger & Gochfeld (1981) GB-3,4,5,6,7,8: Burger & Gochfeld (1983) GB-10: Møller and Erritzøe (2010)

3.43 Black-legged kittiwake (*Rissa tridactyla*)

Conservation Status	UK: Red European: Vulnerable
UK status	Migrant/Resident Breeder, Passage/Winter Visitor
UK and Scottish population estimate	Breeding: UK = 366,800 pairs; Scotland = 282,200 Apparently Occupied Nests Nonbreeding: UK = 1,319,342-1,741,523 individuals; Scotland = up to 10,000 individuals inshore
UK long-term trend	Strong Decline
Scottish distribution & habitat, within a UK context	Present around the UK coastline during the breeding season. **Breeding:** Kittiwakes nest on high, steep coastal cliffs with narrow ledges, offshore stacks and occasionally man-made structures often in areas with easy access to freshwater. In Scotland, kittiwake is a common and widespread breeding species, the largest and most numerous UK colonies are found along the North Sea coasts, around Orkney and Shetland. The largest colonies are on Westray on Orkney, Berriedale in Caithness, Fowlsheugh in the north-east Scotland and St Abb's Head in the Borders. Other significant colonies in Scotland include the Firth of Forth, north-east Scotland, Sutherland, Shetland, the Outer Hebrides and Argyll. In England, kittiwake colonies are widespread around the coast where habitat is suitable, but the largest are on the east coast in east Yorkshire (Flamborough Head and Bempton Cliffs), Northumberland (Farne Islands), Tyne& Wear, Cleveland, and Humberside. **Nonbreeding:** After breeding kittiwakes move out into the Atlantic where they spend the winter. During the winter kittiwakes are highly pelagic, usually remaining out of sight of land. On passage, it may concentrate at sea on continental shelves, areas of upwelling and at rich fish banks. Most breeding black-legged kittiwakes leave Scotland in winter but significant numbers remain in coastal areas and in the North Sea. Birds tend to leave colonies by late August but feeding aggregations may be seen around the Scottish coast until late October/early November. Scottish breeding birds largely overwinter in the west Atlantic, with some birds wintering in the North Sea and the North Atlantic.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Kittiwake is omnivorous and this species may use seaweed for foraging due to the association of seaweed with benthic infauna. During the breeding season when kittiwakes are usually located in coastal habitats (except for a few notable inland breeding sites such as Tyne Bridge, Newcastle), this species feeds on small fish, especially sandeels, molluscs, crustaceans (BirdLife International 2019). During the nonbreeding season, kittiwake is predominately an oceanic forager and will take marine invertebrates (e.g. squid and shrimps, planktonic invertebrates as well as small fish, and it often exploits sewage outfalls and offal and fish scraps from fishing vessels (Snow & Perrins, 1998; BirdLife International, 2019).

	Kittiwakes will use tide-wrack as part of their nest construction (Snow & Perrins, 1998), so there may be some reliance on seaweed for nesting habitat requirements. The surface canopy of kelp forests or drifting kelp mats may also possibly be used as gull resting/roosting sites (Foster & Schiel, 1985).
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; intertidal foraging; nearshore foraging) Nonbreeding (intertidal foraging; nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for kittiwake.
Quantitative information on MAD or buffer distances	**Breeding season:** Aircraft (twin-engine monoplane) flying over a disturbed site: Mean MAD = 100m (KI-2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no studies presenting AD/FID values. One study presents a MAD buffer distance for kittiwake disturbed by a twin-engine monoplane during the breeding season.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on kittiwake show that this species has a low sensitivity to human disturbance. Vulnerability of kittiwakes at sea to disturbance by boats was scored as low (2) by Furness *et al.* (2013). Mendel *et al.* (2008) identified kittiwakes as showing very low sensitivity to human disturbance and boat activity in coastal areas of Germany. As kittiwakes generally nest on high, steep coastal cliffs with narrow ledges, the nests tend to be in locations safe from human disturbance. A very few colonies are located on harbour walls, buildings or bridges where risk of human disturbance can be high. In such situations, nesting kittiwakes usually tolerate human presence to within about 10m before showing alarm (giving alarm calls and sometimes flying off the nest) (Bob Furness, 2019 *pers. comm.*). Seaweed harvesters walking along the beach are unlikely to get very close to any kittiwake colony; kittiwake colonies are mostly on cliffs overhanging the sea and so are distant from beaches where seaweed hand-harvesting would be practical. A study investigating the impact of visitors on the kittiwake colony at St Abb's Head at the Scottish Borders coast, has indicated that cliff-top visitors do not negatively affect kittiwake nesting success, but the presence of boats in the water at the base of the cliff may disturb kittiwakes (Diele & White, 2018). Theoretically, people transiting to seaweed collection areas in a boat or harvesting seaweed directly from a boat could cause disturbance if the boat was close enough to the cliff, although, practically this is unlikely to be the case due to the potential danger of steering boats too close to cliffs. At roost sites kittiwakes are able to tolerate disturbance as they

	roost on harbour piers as well as rocky and sandy shores (Forrester *et al*., 2012).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Kittiwake is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed, as suggested by non-quantitative disturbance studies. This species is unlikely to be disturbed whilst hand-harvesting seaweed during the breeding and nonbreeding seasons.
Knowledge gaps	Lack of studies providing AD/FID values especially investigating disturbance from watercraft.
References to quantitative information on disturbance response distances (AD/FID/MAD)	KI-2: Dunnet (1977)

3.44 Little tern (*Sternula albifrons*)

Conservation Status	UK: Amber; Schedule 1 European: Depleted
UK status	Migrant Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 1,950 pairs; Scotland = 331 Apparently Occupied Nests
UK long-term trend	Stable
Scottish distribution & habitat, within a UK context	Present around the UK coastline during the breeding season. **Breeding:** Little tern breeds almost exclusively in coastal areas on barren or sparsely vegetated beaches, islands and spits of sand, shingle, shell fragments, pebbles, rocks or coral fragments on seashores or in estuaries, saltmarshes and rivers. It may also nest on dry mudflats in grassy areas, but shows a preference for islets surrounded by saline or fresh water, where small fish can be caught without the need for extensive foraging flights. During the breeding season, this species is rarely seen far from breeding sites or adjacent estuaries and coasts. In Scotland, little tern is an uncommon breeding species and it nests discontinuously on the east coast up to Orkney and on the west coast as far north as Lewis. In 2001, the largest numbers in Scotland were recorded at Sands of Forvie and the islands of Coll, Tiree and Islay. In England, little tern colonies can be found in Norfolk at sites including Blakeney Point and Great Yarmouth, Minsmere in Suffolk and Langstone Harbour in Hampshire. **Nonbreeding:** Outside of the breeding season, little tern frequents tidal creeks, coastal lagoons and saltpans of west Africa and central Asia. This species is very rarely seen in the UK outside the breeding season.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Generally, terns (family Sternidae) may potentially forage within infralittoral reef kelp forests (Kelly, 2005). During both the breeding and nonbreeding seasons, the diet of little tern consists predominantly of small fish and crustaceans 3-6cm long as well as insects, annelid worms and molluscs (BirdLife International, 2019). In Scotland, little terns feed mainly on small fish and invertebrates, including herring, sandeel, and shrimps (*Crangon vulgaris*) (Forrester *et al*., 2012). Terns may use the surface canopy of kelp forests as a foraging habitat, this behaviour has been recorded for elegant terns (*Sterna elegans*) in California which forage by surface plunging into the canopy to pick small fishes (Foster & Schiel, 1985). The surface canopy of kelp forests in California are also known to be used by elegant terns as a roost site (Foster & Schiel, 1985), so there may be some reliance on seaweed for roosting habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost)

Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: FID = 64m (Least tern-1). **Unknown season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 21.5m (AF-1).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of MAD = 100 to 154m (Least tern-2,3).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** Three studies investigating disturbance from pedestrian activity on little tern and least tern (*Sternula antillarum*, which has a similar ecology to little tern and is used as a stand-in species for little tern) during the breeding season and an unknown season present two groups of FID values. One study presents a MAD buffer distance for pedestrian disturbance during the breeding season.
Non-quantitative information on disturbance responses	Human disturbance is one of the main factors affecting breeding success and distribution of little tern colonies in England; birds avoid sites with regular human disturbance (Mitchell *et al.*, 2004; Brown & Grice, 2005). Colonies subject to frequent human disturbance have often been abandoned by little terns in favour of areas away from human activity. On the other hand, there have been examples of little terns taking to nest on flat gravel-covered roofs (where of course they avoid human disturbance despite people being active on the ground below and adjacent to the buildings). Foraging little terns often patrol along the shore a few meters from land, and in such situations can fly close to people without showing any strong response, so human disturbance of foraging little terns is less likely to be a problem than disturbance of birds at nests (Bob Furness, 2019, *pers. comm.*).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Little tern is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. As for all tern species, sensitivity to disturbance is likely to be high at breeding colonies. However, little tern is assessed to have a low/medium sensitivity to human disturbance when not on the nest. The maximum FID recorded for least tern is 64m for pedestrian disturbance during the breeding season, although for little tern, the maximum FID is 21.5m. The apparent relatively low sensitivity of individuals to disturbance compared to high impact of human disturbance at colonies probably arises because people are often unaware that they are walking into a little tern colony, because little terns do not attack people and nest in small numbers in scattered colonies. This species has the potential to be disturbed whilst hand-harvesting seaweed, but probably only if little terns are nesting on the beach where seaweed hand-harvesting is taking place.

Knowledge gaps	Lack of studies providing AD/FID values during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	AF-1: Blumstein (2006) Least tern-1,2: Erwin (1989) Least tern-3: Rodgers & Smith (1995)

3.45 Sandwich tern (*Thalasseus sandvicensis*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 10,540 pairs; Scotland = 1,100 Apparently Occupied Nests
UK long-term trend	Stable (Decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline during the breeding season. **Breeding:** Sandwich tern breeds at colonies on sandy islands, rocky calcareous islets, sand-spits, sand-dunes, shingle beaches and extensive deltas with immediate access to clear waters with shallow sandy substrates rich in surface-level fish. This species shows a preference for raised, open, unvegetated sand, gravel, mud or bare coral substrates for nesting. British colonies are widely spread around the British coastline (except south Wales and south west England). In Scotland, Sandwich tern breeds mostly in the Firth of Forth, north-east Scotland and Orkney. Large English colonies are located on the north Norfolk coast, Minsmere and Dungeness. **Nonbreeding:** This species winters around the coasts of Central Asia, Africa and South America. Very few are present around the UK in the winter.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Generally, terns (family Sternidae) may potentially forage within infralittoral reef kelp forests (Kelly, 2005). During both the breeding and nonbreeding seasons, the diet of sandwich tern consists predominantly of surface-dwelling marine fish 9-15 cm long as well as small shrimps, marine worms and shorebird nestlings (Snow & Perrins, 1998; BirdLife International, 2019). Terns may use the surface canopy of kelp forests as a foraging habitat, this behaviour has been recorded for elegant terns (*Sterna elegans*) in California which forage by surface plunging into the canopy to pick small fishes (Foster & Schiel, 1985). The surface canopy of kelp forests in California are also known to be used by elegant terns as a roost site (Foster & Schiel, 1985), so there may be some reliance on seaweed for roosting habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for sandwich tern.
Quantitative information on MAD or buffer distances	No records of MAD for sandwich tern.

Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no records of AD/FID/MAD for sandwich tern.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on sandwich tern show that this species has a high sensitivity to human disturbance at breeding colonies (Furness & Tasker, 1992; Walsh *et al*., 1995; Mendel *et al*., 2008). However, this species has few colonies in Scotland and these are mainly not in areas where seaweed hand-harvesting would be likely, although Sandwich terns tend to nest on exposed sand close to shorelines and may move colony location (often due to human disturbance or mammal predators). There are no Sandwich tern colonies in west Scotland or the Western Isles, or in Shetland. During the three national census periods (1969, 1985, 2000) the species nested in relatively small numbers in Orkney, but there have been none on mainland east Scotland except in Gordon and NE Fife/Lothian (Mitchell *et al*., 2004). Disturbance distance for nesting Sandwich terns may be around 50m from the colony edge (Bob Furness, 2019, *pers. comm.*), but is likely to be highly variable depending on colony location, the amount of human activity to which the birds are exposed, and the extent to which the birds are able to breed successfully at a particular site (birds tending to be more sensitive to human disturbance when conditions are generally adverse). Sandwich terns foraging or commuting over the sea show very little concern about presence of people *(*Bob Furness*, pers. obs.)* and vulnerability at sea to disturbance by boats was scored as low (2) by Furness *et al*. (2013).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Sandwich tern is assessed to have generally a low sensitivity to human disturbance whilst hand-harvesting seaweed, away from breeding colonies as suggested by non-quantitative disturbance studies, although sensitivity to disturbance is high at breeding colonies. Overall, the likely sensitivity to disturbance when hand-harvesting seaweed is low, as long as hand-harvesting is conducted in areas away from breeding colonies.
Knowledge gaps	Lack of studies providing AD/FID values during the breeding season.
References to quantitative information on disturbance response distances (AD/FID/MAD)	None

3.46 Common tern (*Sterna hirundo*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 10,300 pairs; Scotland = 4,800 Apparently Occupied Nests
UK long-term trend	Weak Decline
Scottish distribution & habitat, within a UK context	Present around the UK coastline during the breeding season. **Breeding:** Common terns breed in a wide variety of habitats in coastal and inland areas. Along the coast, it shows a preference for nesting on flat rock surfaces on inshore islands, open shingle and sandy beaches, dunes and spits, vegetated inter-dune areas, sandy, rocky, shell-strewn or well-vegetated islands in estuaries and coastal lagoons, saltmarshes, mainland peninsulas and grassy plateaus atop coastal cliffs. Inland, it may nest in similar habitats, including sand or shingle lakes shores, shingle banks in rivers, sandy, rocky, shell-strewn or well-vegetated islands in lakes and rivers, sand- or gravel-pits, marshes, ponds, grassy areas and patches of dredged soil. British colonies are widely spread around the coastline and areas inland (except south Wales and south west England), the largest British colony is at Coquet Island in Northumberland. In Scotland, the highest numbers breed in several widely spaced colonies on both the west and east coasts of the mainland and on offshore islands. The largest colonies can be found in the Sound of Mull and Leith Docks. **Nonbreeding:** Most British-breeding common terns winter along the west coast of tropical Africa north of the Equator.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Generally, terns (family Sternidae) may potentially forage within infralittoral reef kelp forests (Kelly, 2005). Common tern is an opportunistic forager, during both the breeding and nonbreeding seasons, the diet consists predominantly of small fish and occasionally planktonic crustaceans and insects (BirdLife International, 2019). Terns may use the surface canopy of kelp forests as a foraging habitat, this behaviour has been recorded for elegant terns (*Sterna elegans*) in California which forage by surface plunging into the canopy to pick small fishes (Foster & Schiel, 1985). The surface canopy of kelp forests in California are also known to be used by elegant terns as a roost site (Foster & Schiel, 1985), so there may be some reliance on seaweed for roosting habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost)

Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a disturbed site: Mean FID = 10m (CN-10). Pedestrian walking/running at an undisturbed site: Range of mean FID = 7.3 to 8.1m (CN-3,4). Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 142m (CN-8). **Nonbreeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean FID = 20.5m (CN-1).
Quantitative information on MAD or buffer distances	**Breeding season:** Motorized watercraft at a disturbed site: Mean MAD 100m (CN-2). **Unknown season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of MAD = 100 to 400m (CN-5). Motorized watercraft at a site where level of habituation to disturbance is unknown: Mean MAD = 100m (CN-6).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Good quality of quantitative information** Four studies investigating pedestrian disturbance present four groups of FID values recorded at disturbed and undisturbed sites during the breeding season. Three MAD buffer distances are recorded for pedestrian and motorized watercraft disturbance during the breeding and unknown seasons.
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Common tern is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for common tern is 142m for pedestrian disturbance during the breeding season, although the majority of recorded FID values are under 21m during both the breeding and nonbreeding seasons. The main concern is likely to be possible disturbance to nesting birds, as common terns may nest as small numbers of pairs on the upper part of beaches. This species has the potential to be disturbed on breeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Current studies provide a good range of FID values. Future studies should record AD/FID values during the breeding season and specify habituation to disturbance when recording AD/FID.
References to quantitative information on disturbance response distances (AD/FID/MAD)	CN-1: Weston *et al*. (2012) CN-2: Burger (1998) CN-3,4: Burger & Gochfeld (1988) CN-5,6: Carney & Sydeman (1999) CN-8: Erwin (1989) CN-10: Nisbet (2000)

3.47 Arctic tern (*Sterna paradisaea*)

Conservation Status	UK: Amber European: Least Concern
UK status	Migrant Breeder, Passage Visitor
UK and Scottish population estimate	Breeding: UK = 52,600 pairs; Scotland = 47,300 Apparently Occupied Nests
UK long-term trend	Weak Increase (Probable Decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline during the breeding season. **Breeding:** Arctic terns breed along northern coastlines and on inshore islands, as well as inland on tundra and forest-tundra. In the UK, most breeding colonies are coastal, often on small rocky islets and skerries, but also on beaches of larger islands and on the mainland. Preferred breeding substrates are sparsely vegetated rock, sand, shingle and to a lesser extent peat and pastureland. Arctic terns breeding in the UK have a predominantly northerly distribution with the majority of colonies found in Orkney, Shetland and the Outer Hebrides. In 2000, the largest colony recorded in the British Isles was at Dalsetter, Mainland Shetland. In England, a large colony can be found on the Farne Islands in Northumberland. **Nonbreeding:** Arctic terns winter in the Southern Ocean. UK breeding terns migrate along the coastlines of northwest Europe and Africa, feeding as they go. In Scotland, Arctic terns are usually last recorded during October until they arrive for breeding again in April of the following year, although some birds are occasionally seen in early to mid-November
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Generally, terns (family Sternidae) may potentially forage within infralittoral reef kelp forests (Kelly, 2005). During both the breeding and nonbreeding seasons, the diet of Arctic tern consists predominantly of fish as well as crustaceans (especially planktonic species), molluscs, insects (e.g. caterpillars, Chironomidae) and earthworms. It will also take berries in the early spring on arrival on its breeding grounds, but does not readily switch to other prey items when preferred prey supplies fail (BirdLife International, 2019). Terns may use the surface canopy of kelp forests as a foraging habitat, this behaviour has been recorded for elegant terns (*Sterna elegans*) in California which forage by surface plunging into the canopy to pick small fishes (Foster & Schiel, 1985). The surface canopy of kelp forests in California are also known to be used by elegant terns as a roost site (Foster & Schiel, 1985), so there may be some reliance on seaweed for roosting habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging; at roost)

Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Range of FID = 37 to 160m (AE-3,4). Aircraft (helicopter) flying over a disturbed site: Mean FID = 1000m (AE-2).
Quantitative information on MAD or buffer distances	**Breeding season:** Pedestrian walking/running at a site where level of habituation to disturbance is unknown: Mean MAD = 200m (AE-3,4). Aircraft (helicopter) flying over a disturbed site: Mean MAD = 2000m (AE-2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Moderate quality of quantitative information** One study investigating disturbance from pedestrian and aircraft activity during the breeding season presents two groups of FID values and two MAD buffer distances.
Non-quantitative information on disturbance responses	Arctic terns tend to nest in larger colonies than common terns, and also tend to be much more aggressive towards humans that approach their nests, swooping and pecking people on the head. Human disturbance of nesting Arctic terns is therefore less likely to cause problems than human disturbance of common terns, as people tend to be deterred from Arctic tern nesting areas by the birds' aggression (Bob Furness 2019, *pers. comm.*). However, there is some evidence to suggest that in a highly disturbed environment, human disturbance can have an effect on Arctic terns. It has been demonstrated on the Isle of May, that for Arctic terns, the presence of visitors substantially decreases chick provisioning rates compared to when visitors were not present on the island. The highest level of disturbance was found during the afternoon and evening, when peak chick provisioning occurred (Bogdanova *et al*., 2014). Foraging Arctic terns show very little or no behavioural response to the presence of people on the shoreline, so disturbance of foraging or commuting Arctic terns is unlikely. Arctic terns will roost on beaches when not breeding, mostly after the breeding season, and at that time may be displaced from a resting area by human disturbance. However, they are likely to simply move to a nearby undisturbed area (Bob Furness, 2019, *pers. comm.*).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Arctic tern is assessed to have a low/medium sensitivity to human disturbance whilst hand-harvesting seaweed. The maximum FID recorded for Arctic tern is 160m for pedestrian disturbance during the breeding season. As for all tern species, sensitivity to disturbance is likely to be high at breeding colonies. This species has the potential to be disturbed on breeding grounds whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies producing AD/FID values, especially during the nonbreeding season.

References to quantitative information on disturbance response distances (AD/FID/MAD)	AE-2,3,4: Mallory (2016)

3.48 Black guillemot (*Cepphus grylle*)

Conservation Status	UK: Amber European: Declining
UK status	Resident Breeder
UK and Scottish population estimate	Breeding: UK = 19,000 pairs; Scotland = 18,750 pairs Wintering: UK = 58–80,000 individuals; Scotland = 40-60,000 individuals
UK long-term trend	Stable in Scotland
Scottish distribution & habitat, within a UK context	Predominantly present around the Scottish coastline throughout the year and to a lesser extent in some coastal parts of England and Northern Ireland. **Breeding:** Black guillemot breeds mainly on predator-free islands with suitable boulder beaches, or at lower densities on cliffs inaccessible to mammals. Colonies are generally less than 50 pairs, more evenly distributed over a wider range than other Atlantic auks. This species nests in cavities among boulders near sea-level next to cliffs. In the UK, black guillemot predominantly breeds in Scotland where it is a common, resident species with a distribution largely restricted to the north and west. Highest numbers of black guillemot can be found on Shetland and Orkney and down the west coast of Scotland from Dumfries and Galloway and north to Sutherland and Caithness, including the west coast islands and in the Firth of Clyde. Smaller populations are more scarcely present in other parts of the UK including northwest England on the Cumbrian coast at St Bees Head, the Isle of Man, Wales and Northern Ireland. **Nonbreeding:** Black guillemots are mostly resident and during the winter, this species generally remains close to their breeding sites, though some wander, particularly along the North Sea coast. Winter distribution around the UK is similar to breeding distribution.
Reliance on seaweed for foraging/habitat requirements	**High reliance on seaweed** Black guillemots usually feed inshore and show a strong foraging correlation with kelp habitats, due to the association of seaweed with benthic infauna. Black Guillemots feed closer to the shore than other members of the auk (Alcidae) family and previous accounts highlight that this species forages within shallow sublittoral zones (Kelly, 2005). During both the breeding and nonbreeding seasons, black guillemot is primarily a benthic forager feeding on benthic fish including butterfish (Family Stromateidae), blennies (Family Blenniidae) and pipefish (Family Syngnathidae) together with a wide range of reef invertebrates including crustaceans (Kelly, 2005; BirdLife International, 2019). A study on pigeon guillemots (*Cepphus columba*), similar in ecology to black guillemots, has shown that this species dives for prey along the edges of kelp beds within the Puget Sound, Washington area (Foster & Schiel, 1985). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.

Season(s) and behaviour(s) with potential impact pathway	Breeding (at nest; nearshore foraging) Nonbreeding (nearshore foraging)
Quantitative information on disturbance response distances (AD/FID)	**Breeding season:** Motorized watercraft at a disturbed site: Mean FID = 260m, Range of FID = 32 to 675m (TY-1).
Quantitative information on MAD or buffer distances	**Breeding season:** Motorized watercraft at a disturbed site: Mean MAD = 600m (TY-1).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** One study investigating disturbance from motorized watercraft activity at a disturbed site during the breeding season presents one range of FID values and one MAD buffer distance.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on black guillemot show that this species has a low sensitivity to human disturbance. Black guillemots show a strong foraging association with kelp habitats, so are likely to breed near to many areas where seaweed hand-harvesting is possible. This species nests in loose colonies under boulders on the upper part of boulder beaches and in crevices. They will also nest in nest boxes and in artificial structures such as drainage pipes and jetties. The major threat to nesting black guillemots is predatory mammals, which strongly influence their breeding distribution and success, and human disturbance is not considered to be a major threat to this species (Johnston *et al*., 2018). Direct human disturbance at nests caused some birds to abandon breeding attempts, but this required daily visits where birds were deliberately disturbed by a researcher (Cairns, 1980). However, birds nesting in nest boxes or jetties appear to be highly tolerant of human activity and presence of boats (Greenwood, 2002), and it would appear that disturbance would be unlikely to affect black guillemots unless people deliberately looked under boulders into their nest cavities. Black guillemot adults seem reluctant to enter their nest sites when people are present on their colony, and so human presence could reduce chick provisioning. However, that impact requires people to be close to nest sites; it seems unlikely that birds would be adversely affected unless people were within about 30 m of the nest (Daniel Johnston, *pers. comm.*). The vulnerability of black guillemots at sea to disturbance by boats was scored as moderate (3) by Furness *et al*. (2013). Mendel *et al*. (2008) identified black guillemots as showing low sensitivity to human disturbance and boat activity in coastal areas of Germany. Black guillemot has also been assessed as having a low sensitivity to boat disturbance; this species is abundant in areas

	where regular marine activity takes place, including close to active piers and harbours, and it is unlikely to be displaced by boat activity (Jarrett *et al*., 2018). Black guillemot has a very low response rate within the 200-300m distance band from a passing ferry; this species favours dive responses over swim or flight responses to passing ferries. The likelihood of black guillemot flight responses to passing ferries increases significantly in rougher sea states despite their apparent low sensitivity (Jarrett *et al*., 2018).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Medium sensitivity to disturbance** Black guillemot is assessed to have a medium sensitivity to human disturbance whilst hand-harvesting seaweed At breeding sites the maximum FID recorded for black guillemot is 675m for motorized watercraft disturbance during the breeding season. Non-quantitative studies also suggest that black guillemot may be prevented from returning to their nests if there is prolonged human presence near a colony as a result of seaweed hand-harvesting. Outside of the breeding season, this species is less likely to be disturbed, but as this is an exclusively coastal species in Scotland, the potential remains for disturbance on foraging grounds both during the breeding and nonbreeding seasons whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies providing AD/FID values especially investigating disturbance from pedestrian activity in both breeding and nonbreeding seasons.
References to quantitative information on disturbance response distances (AD/FID/MAD)	TY-1: Ronconi & St. Clair (2002)

3.49 Common guillemot (*Uria aalge*)

Conservation Status	UK: Amber European: Near Threatened
UK status	Migrant/Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 890,000 pairs; Scotland = 780,000 pairs Nonbreeding: UK = 2,756,526 individuals; Scotland = 750,000 individuals
UK long-term trend	Was showing weak Increase (Possible more recent Decline in Scotland)
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year. Comes to land to breed and spends the rest of the year at sea. **Breeding:** Guillemots breed in colonies, often containing many thousands of pairs, in locations free from mammalian predators including: ledges on sheer cliffs, tops of stacks, among boulders and on flat ground on offshore islands. This species is widespread along Scottish coastal rocky cliffs except where there are no mainland cliffs or offshore islands. The main breeding concentrations in Scotland are in the north and west; there are large colonies at Fowlsheugh in Grampian and Marwick Head in Orkney with the largest colony being on Handa island. In the west, most colonies are located on the outer islands. There are a few scattered colonies down the east coast, but only a few breed in the Moray Firth or along the Fife coast. Elsewhere in the UK, guillemots are found on small areas of cliffs on the south coast of England, very locally on the coasts and islands of Wales and in a handful of places in the north of England (e.g. Bempton Cliffs) and Northern Ireland. **Nonbreeding:** Guillemots are more widespread around the UK coastline in winter but are usually well offshore. At the end of the breeding season in Scotland, concentrations of flightless adults and young build up off the north east of Scotland, in the Minch and in the northern Irish Sea. Some birds from Scottish colonies leave Scottish waters during the winter. The range for Scottish breeders extends from western Iberia to central Norway. Some guillemots from southern Britain, Ireland, the Faeroe Islands and Norway winter in Scottish waters. Guillemots will sometimes make dawn visits to their breeding ledges for up to a whole day during the winter; this winter attendance at colonies may be widespread throughout the UK.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Common guillemot may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. During both the breeding and nonbreeding seasons, common guillemots feed chiefly on fish, supplemented by some invertebrate prey items. Schooling pelagic fish species are the most important prey for adults during the breeding season, caught by encircling and herding shoals and catching fish at the periphery, though benthic species can also be important; bottom-dwelling fish can be taken from depths of up to 60m (BirdLife International, 2019; Snow & Perrins, 1998). In the UK, the main

	prey taxa are sandeel (*Ammodytes* spp.) and clupeids. Small gadoids are also important at some colonies (BirdLife International, 2019). Although no direct interactions with kelp forests have been described for common guillemot, auks commonly forage in inshore waters and may potentially forage within infralittoral reef kelp forests (Foster & Schiel, 1985; Kelly, 2005). Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for common guillemot.
Quantitative information on MAD or buffer distances	No records of MAD for common guillemot.
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no records of AD/FID/MAD for common guillemot.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on common guillemot show that this species has a low sensitivity to human disturbance. As common guillemots nest on ledges on steep cliffs, it is very unlikely that seaweed harvesters on the beach could cause disturbance to this species. A study investigating the impact of visitors on guillemots at the St Abb's Head colony on the Scottish Borders coast, has indicated that cliff-top visitors do not negatively impact guillemots, but boat presence in the coves significantly reduced the number of loafing guillemots, and distinct, presumably energetically very costly escape routes were observed (Diele & White, 2018). Theoretically, people transiting to seaweed collection areas in a boat or harvesting seaweed directly from a boat could cause disturbance if the boat was close enough to the cliff, although, practically this is unlikely to be the case due to the potential danger of steering boats too close to cliffs. Common guillemots at colonies show little response to presence of people until people approach to within about 50 meters of the colony. Then some birds will fly off from the colony, although many remain attending their egg or chick even until people are within about 10 meters. People can cause major loss of eggs or chicks if they approach close (within about 20m) to a guillemot colony, although guillemots nesting under boulders rather than on ledges may even be undisturbed by close approach (Bob Furness, *pers. obs.*). Census instructions for Seabird 2000 (Mitchell *et al.*, 2004), encouraged counters to select sub-

	colonies in boulder habitat and 'move carefully into and through each sub-colony, counting the actual number of individuals by direct observation and by flushing from crevices. Try to minimize the time spent in each sub-colony, especially where many eggs or small chicks are present'. This recognises that birds nesting in boulder colonies are at low risk of human disturbance even if people come close to nest sites. Common guillemots at sea show very little concern about presence of people, and during the nonbreeding period, common guillemots normally remain at sea so would not be subject to disturbance by people on the shore (Mendel *et al*., 2008; Bob Furness, *pers. obs.*). Vulnerability at sea to disturbance by boats was scored as moderate (3) by Furness *et al*. (2013).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Common guillemot is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed, away from breeding colonies as suggested by non-quantitative disturbance studies, although sensitivity to disturbance may be high at breeding colonies. Outside of the breeding season, this species is unlikely to be disturbed whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies providing AD/FID/MAD values.
References to quantitative information on disturbance response distances (AD/FID/MAD)	None

3.50 Razorbill (*Alca torda*)

Conservation Status	UK: Amber European: Near Threatened
UK status	Migrant/Resident Breeder, Winter Visitor
UK and Scottish population estimate	Breeding: UK = 110,000 pairs; Scotland = 93,300 pairs Nonbreeding: UK = 560,044 individuals; Scotland = 50,000-250,000 individuals
UK long-term trend	Weak Increase, possibly some decline in the last few years in the northern isles
Scottish distribution & habitat, within a UK context	Present around the UK coastline throughout the year, the largest breeding colonies are in northern Scotland. Comes to land to breed and spends the rest of the year at sea. **Breeding:** Razorbills breed on open rocky coastlines, from low cliffs and boulder scree slopes, particularly on offshore islands, to high precipitous cliffs. This species will lay its egg directly into rock crevices (such as those found in boulder fields at the base of cliffs) and small ledges; occasionally burrows that have been excavated by rabbits and Atlantic puffin may be used if the burrow is located on a cliff edge. Razorbills are present around the UK coastline. In Scotland, the largest numbers can be found in Orkney, Shetland, Outer and Inner Hebrides as well as on the north Scottish mainland coast. In England, none breed along the large stretch of coastline between the Humber and the Isle of Wight due to lack of suitable breeding habitat. **Nonbreeding:** Outside the breeding season, razorbills generally winter in the northern Atlantic. They disperse widely throughout offshore waters, generally moving southwards, reaching Morocco and the western Mediterranean in the eastern Atlantic. In Scotland, razorbills are less numerous than common guillemots in winter, but razorbills are widespread in the firths, larger estuaries and open coasts around Scotland. Concentrations can occur in shallow marine areas such as St Andrews Bay, Firth of Forth, the outer Firth of Clyde and the Solway Firth. The main wintering areas of Scottish breeders around the UK are along the coasts on the North Sea, western Britain, the English Channel and the Bay of Biscay.
Reliance on seaweed for foraging/habitat requirements	**Medium reliance on seaweed** Similar to common guillemot, razorbill may indirectly rely on seaweed for foraging requirements due to the association of seaweed with benthic infauna. During both the breeding and nonbreeding seasons, common guillemot feed chiefly on fish, supplemented by some invertebrate prey items; this auk species is capable of diving to 120m depth, but it mostly forages nearer the surface (BirdLife International, 2019). This species has been described as coastal rather than pelagic and birds tend to be concentrated within 10km of the shore (BirdLife International, 2000). Although no direct interactions with kelp forests have been described for razorbill, auks commonly forage in inshore waters and may potentially forage within infralittoral reef kelp forests (Foster & Schiel, 1985; Kelly, 2005).

	Other than foraging, there is no evidence for dependence on seaweed for additional habitat requirements.
Season(s) and behaviour(s) with potential impact pathway	Breeding (nearshore foraging; at roost)
Quantitative information on disturbance response distances (AD/FID)	No records of AD/FID for razorbill.
Quantitative information on MAD or buffer distances	**Breeding season:** Aircraft (twin-engine monoplane) flying over a disturbed site: Mean MAD = 100m (RA-2).
Quality of quantitative information on disturbance response distances (AD/FID/MAD)	**Poor quality of quantitative information** There are no records of AD/FID for razorbill. One study for aircraft disturbance at a disturbed site presents one MAD buffer value.
Non-quantitative information on disturbance responses	Non-quantitative disturbance studies on razorbill show that this species has a low sensitivity to human disturbance. Razorbills rarely nest close to areas where seaweed hand-harvesting is likely. Razorbills at colonies show little response to presence of people until people approach to within about 50m of the colony. Then some birds will fly off from the colony, although many remain attending their egg or chick even until people are within about 10m. People can cause major loss of eggs or chicks if they approach close (within about 20 m) to a razorbill colony where birds are nesting in the open, but the vast majority of razorbills nest under boulders or in crevices in cliffs rather than on ledges may even by undisturbed by close approach (Bob Furness, *pers. obs.*). Census instructions for Seabird 2000 (Mitchell *et al*., 2004) encouraged counters to select sub-colonies in boulder habitat and 'move carefully into and through each sub-colony, counting the actual number of individuals by direct observation and by flushing from crevices. Try to minimize the time spent in each sub-colony, especially where many eggs or small chicks are present'. This recognises that razorbills nesting in boulder colonies are at low risk of human disturbance even if people come close to nest sites. Razorbills at sea show very little concern about presence of people, and during the nonbreeding period razorbills normally remain at sea so would not be subject to disturbance by people on the shore (Mendel *et al*., 2008; Bob Furness, *pers. obs.*). Vulnerability at sea to disturbance by boats was scored as moderate (3) by Furness *et al*. (2013).
Likely sensitivity to disturbance whilst hand-harvesting seaweed	**Low sensitivity to disturbance** Razorbill is assessed to have a low sensitivity to human disturbance whilst hand-harvesting seaweed, away from breeding colonies as suggested by non-quantitative disturbance studies, although sensitivity to disturbance may be high at breeding colonies. Outside of the breeding season, this species

	is unlikely to be disturbed whilst hand-harvesting seaweed.
Knowledge gaps	Lack of studies providing AD/FID/MAD values.
References to quantitative information on disturbance response distances (AD/FID/MAD)	RA-2: Dunnet (1977)

4. DISCUSSION & CONCLUSIONS

This review identified from the literature, quantitative disturbance distances in terms of Alert Distances (ADs) and Flight Initiation Distances (FIDs) as well as Minimum Approach Distances (MADs, or buffer distances) for a number of bird species using the shoreline, intertidal area or nearshore waters. The overarching purpose of this review is that it can help inform impact assessments for seaweed hand-harvesting activities along the coast by identifying those bird species that may be more sensitive to hand-harvesting activities than others. As there is a lack of studies on any species directly measuring AD and FID values during hand-harvesting seaweed activities (see section 4.4), this review collated disturbance distances caused by human recreational activities and other occupations at the coast, on land and in nearshore waters, that were considered to provoke a similar level of disturbance that is likely during seaweed hand-harvesting. As this literature review provides disturbance distances for a range of human disturbance activities at the coast, this study has relevance not just for seaweed hand-harvesting casework but could also be used for other casework and consultations within the intertidal zone.

4.1 General conclusions from the Bird Disturbance Response database

4.1.1 Reliance on seaweed for foraging / habitat requirements

The reliance on seaweed for foraging and additional habitat requirements was determined for each of the 50 bird species included in this review. Generally, relatively few species (16%; 8 out of 50 species) appear to have a high reliance on seaweed; species which show a high reliance on seaweed include coastal seabirds (great cormorant and European shag), waders (red knot, sanderling, purple sandpiper, ruddy turnstone and dunlin) and one species of auk (black guillemot). All of these high reliance species indirectly use seaweed for foraging either by feeding on fish living in kelp forests, such as cormorant, shag and black guillemot (Foster & Schiel, 1985; Lorentsen *et al*., 2004; Kelly, 2005) or by feeding on benthic infauna associated with seaweed, such as waders (Orr, 2013; Douthwaite *et al*., *in prep*). Cormorants and shags also use seaweed as part of their nest construction (Snow & Perrins, 1998) although, for other species, there is no evidence for additional habitat requirements on seaweed other than foraging.

Ten bird species (20%) included in this review were identified to have a low reliance on seaweed. These low reliance species included: marine seabirds (northern fulmar), wildfowl (Greenland white-fronted goose, pink-footed goose, mallard and goosander), coastal raptors (white-tailed eagle, golden eagle, peregrine falcon) and some waders (golden plover and northern lapwing); all have little or no usage of seaweed for foraging and habitat requirements.

The majority of bird species included in this review (64%; 32 out of 50 species) identified a medium reliance on seaweed, meaning that for the majority of species, seaweed is used to a degree in some aspect of their foraging/habitat requirements although they are not reliant on seaweed as a food source or habitat type.

4.1.2 Quality of quantitative information on disturbance response distances (AD/FID/MAD

The quality of quantitative information on disturbance distances (including AD, FID and MAD) available in the literature was evaluated for each species. Fewer than half of the species assessed (38%; 19 out of 50 species) were judged as having poor quality information available on quantitative disturbance distances, meaning that AD, FID and MAD values were either scarce or not available at all. Species with poor quality quantitative disturbance distance information were identified from a range of families; these included, coastal seabirds (Slavonian grebe, European shag), pelagic seabirds (fulmar), wildfowl (Greenland white fronted goose, greater scaup, velvet scoter, goosander and red-breasted

merganser), a couple of waders (red knot and purple sandpiper), gulls (black-headed gull, common gull, lesser black-backed gull and black legged kittiwake), terns (little tern and Sandwich tern) and auks (black guillemot, common guillemot and razorbill). The lack of information available for these species meant that non-quantitative disturbance studies were used to assess the likely sensitivity to hand-harvesting seaweed.

Generally, species for which quantitative data were scarce or lacking tended to be species with medium or low sensitivity to human disturbance (e.g. gulls, terns and auks), as published studies have tended to focus on the species of high sensitivity. However, there are some species with little quantitative data that were still assessed from non-quantitative data to have a high sensitivity to human disturbance (e.g. Greenland white fronted goose, greater scaup, velvet scoter and goosander) and these species represent a data gap that could be targeted by future studies on disturbance distances (see sections 4.3 and 4.4).

Sixteen species (32%) were judged as having good quality information on quantitative disturbance distances, meaning that sufficient quantitative information was available to judge whether it is likely that hand-harvesting seaweed could cause disturbance to these species. Good quality information was available for one coastal seabird (great crested grebe), one coastal raptor (white-tailed eagle), one gull (herring gull) one tern (common tern), a few wildfowl species (common shelduck, mallard, common eider, common scoter and common goldeneye) and a number of waders (Eurasian oystercatcher, ringed plover, sanderling, dunlin, common redshank, bar-tailed godwit and Eurasian curlew).

The remaining species (30%; 15 out of 50 species) were assessed as having moderate quality information available on quantitative disturbance distances, meaning that some information was available to assess sensitivity to disturbance, but future studies could improve the quantity and quality of information available. Species which had moderate quality quantitative information included divers (red-throated diver, black-throated diver and great northern diver), great cormorant, some wildfowl (pink-footed goose, Eurasian wigeon, long tailed duck), two coastal raptors (golden eagle and peregrine falcon), some waders (grey plover, golden plover, northern lapwing and ruddy turnstone) one gull (great black-backed gull) and one tern (Arctic tern).

4.1.3 Likely sensitivity to disturbance whilst hand-harvesting seaweed

The likely sensitivity of each species to disturbance during hand-harvesting seaweed was assessed. From information gathered from quantitative and non-quantitative studies, a total of 26% species (13 out of 50 species) were assessed as having a high sensitivity to disturbance. These species with high sensitivity included divers (red-throated diver, black-throated diver and great northern diver), a number of wildfowl (Greenland white fronted goose, pink-footed goose, common shelduck, Eurasian wigeon, greater scaup, common scoter, velvet scoter, common goldeneye and goosander) and one wader species (Eurasian curlew). Impact assessments for hand-harvesting will require to consider potential disturbance impacts for these species with high sensitivity to disturbance, and to apply appropriate mitigation in areas where these species are likely to be present.

A total of 24% of species (12 out of 50 species) were assessed as having a low sensitivity to disturbance, meaning that hand-harvesting seaweed is unlikely to affect these species unless it is carried out in very close proximity to nesting areas. Species which were judged to be tolerant to disturbance include: fulmar, long-tailed duck, sanderling, all gull species (black-headed gull, common gull, herring gull, lesser black-backed gull, great black-backed gull and black-legged kittiwake), Sandwich tern and two species of auk (common guillemot and razorbill). Although these species are generally assessed to have a low sensitivity to human disturbance, it is still important to avoid disturbance at breeding colonies as most species are easily disturbed on breeding grounds (as indicated in species accounts).

Half of the species included in this review (25 out of 50 species) were assessed as having a medium sensitivity to disturbance. This means that these species may tolerate some disturbance caused by hand-harvesting seaweed, but the extent of disturbance caused to individual birds could depend on a wide range of factors including: levels of habituation to disturbance (see section 4.2), whether it is the breeding or nonbreeding season, behaviour of the bird(s) at the time of seaweed harvesting and environmental variables etc.

4.2 Habituation to disturbance

It is important to note that all bird species assessed in this review (including high, medium and low sensitive species) are likely to vary in their response to hand-harvesting seaweed disturbance in different areas. An important factor to determine for any potential seaweed hand-harvesting location is the general level of disturbance on site. If birds are present in a highly disturbed area then it is likely that these birds will show a high degree of habituation to disturbance and tolerate a shorter disturbance distance (Keller, 1989; Baudains & Lloyd, 2007; Ellenberg *et al*., 2009; Ross *et al*., 2015; Vincze *et al*., 2016). Similarly, if seaweed hand-harvesting or gathering is proposed in a secluded site where there is little general disturbance, then birds are more likely to react to human presence at a greater distance.

The distance at which a focal bird may respond to a disturbance event depends upon a great many factors; some of these factors include: level of habituation to disturbance (Baudains & Lloyd, 2007; Vincze *et al*., 2016), species of the focal bird in the study (Blumstein, 2006); individual character of the focal bird, flock size and species construction in which focal bird is present (Mori *et al*., 2001); the size of the focal bird (Blumstein *et al*., 2004), behaviour of the focal bird at the time it is disturbed (Liley *et al*., 2011; Liley & Fearnley, 2012; Lilleyman *et al*., 2016), energetic requirements of focal bird (Gill *et al*., 2001; Beale & Monaghan, 2004), seasonal constraints (Mikula *et al*., 2018), what the source of disturbance is (Lethlean *et al*., 2017), whether the source of disturbance is visual or acoustic or both and whether the source of disturbance is novel to the focal bird (McLeod *et al*. 2013), disease status of the focal bird (Møller, 2008a), exposure of the birds to hunting pressures (Madsen, 1998a,b); to mention just a few. Therefore, although this review provides a guide to which species are likely to be disturbed by hand-harvesting seaweed activities, it should be remembered that even low sensitive species may be disturbed in some areas at certain times of the year and that medium/high sensitive species will also vary in their disturbance response depending upon the specific situation at the time of the disturbance event. Therefore, each assessment will still be on a site-specific basis.

4.3 Data gaps

One of the main data gaps identified from this literature review is that there are no available published studies recording quantitative disturbance distances during seaweed collection. Future studies should aim to collect and publish data on AD and FID values for a range of bird species using coastal habitats. The focus of future studies should especially be on those species identified in this review as having a likely high sensitivity to disturbance or in having a high reliance on seaweed as a resource.

This review has identified that for some species, there is a lack of quantitative information available on AD and FID values. These species have the potential to be present in coastal areas around Scotland where seaweed could be hand-harvested. For 19 out of 50 species covered in this review (38% of species), there were a lack of studies providing adequate AD and FID values on which to base an assessment of likely sensitivity to disturbance (see section 4.1.2). Some of these species with missing quantitative disturbance distance data have also been assessed to have a medium or high sensitivity to disturbance. These species therefore represent a data gap for studies investigating the impacts of seaweed hand-harvesting on bird disturbance.

European shag and black guillemot are two out of the 19 species for which there have been very few studies recording AD and FID; these two species represent a significant data gap in the Bird Disturbance Response database. Both of these species are judged to have a high reliance on seaweed and the non-quantitative studies suggest that these species are likely to have a medium sensitivity to disturbance. As the coast of Scotland is an important breeding location for these species and they are both likely to breed and forage in potential seaweed hand-harvesting areas, future studies should aim to collect quantitative disturbance distance information on these species.

Greenland white fronted goose is another of the 19 species with very little quantitative information available on disturbance distances; this species was assessed through non-quantitative studies as having a high sensitivity to disturbance. Scotland is an important area for overwintering Greenland white fronted goose (the subspecies *Anser albifrons flavirostris);* this subspecies breeds in Greenland and winters almost exclusively in Scotland and Ireland (Forrester *et al.,* 2012). There is potential for this species to be disturbed at roost sites on estuaries during seaweed hand-harvesting (GWGS, 2019) and the lack of AD/FID data in the bird disturbance database for this species represents a significant gap.

Greater scaup, velvet scoter and goosander are three out of the 19 species with very little quantitative information available on disturbance distances. These species have all been assessed through non-quantitative studies as having a high sensitivity to disturbance. Scotland is an important overwintering site in the UK for all three species and the breeding range for UK goosander is also largely limited to Scotland (apart from small populations in Wales and northern England) (Forrester *et al*., 2012). These species represent a significant data gap which future studies should aim to address.

Some of these 19 species with missing quantitative disturbance distances are judged through non-quantitative studies as having a low sensitivity to disturbance. These species with low sensitivity include: fulmar, purple sandpiper, black-headed gull, common gull, lesser black-backed gull, black-legged kittiwake; sandwich tern, common guillemot and razorbill. These species are unlikely to be disturbed by hand-harvesting seaweed activities either because their foraging and habitat requirements are unlikely to be in potential hand-harvesting seaweed areas (e.g. fulmar, common guillemot and razorbill) or because they show a high tolerance for human disturbance (e.g. purple sandpiper and gulls) and they therefore represent a smaller data gap compared with other species where quantitative data is missing. It is clear that published data on AD/FID tend to focus on species with high sensitivity to disturbance, and that leads to a deficit of quantitative data on AD/FIDs of bird species with low sensitivity.

There are other species that use coastal habitats during their breeding and/or nonbreeding seasons, but they were not the focus of this review (for an explanation of why species were chosen for this review, see section 1.1.5). For example, passerines (e.g. European starling, rock pipit, pied wagtail), corvids and other waders (e.g. whimbrel, greenshank, common sandpiper) were not covered in this review and yet they have the potential to be disturbed at the coast whilst hand-harvesting seaweed. These species are a data gap and quantitative disturbance distances for these species, if available in the literature, should be added to the database in the future. If, as it is likely, there are little or no quantitative data available for these species, future studies should aim to collect disturbance distance data on these species.

The state of the tide whilst hand-harvesting seaweed is likely to impact the level of disturbance caused to birds, although currently there few studies investigating this. Although seaweed harvesters generally conduct hand-harvesting at low tide, this is not always the case; for example, some boat and rake seaweed harvesting starts at low tide and is then

carried out on the rising tide. Future studies investigating bird disturbance at the coast should aim to record tide state at the same time as recording disturbance distance.

Habituation to disturbance is an important factor when attempting to determine the likely disturbance distance for any species during hand-harvesting seaweed activities. However, only a few quantitative studies report the level of habituation in their study areas when recording AD and FID values. All future studies that record quantitative disturbance distances should aim to record the likely level of habituation at the study location.

4.4 Recommendations for further research

Future disturbance distance studies investigating the impacts of seaweed hand-harvesting on bird disturbance should aim to record quantitative records of disturbance distances in terms of AD and FID for birds in coastal locations. AD and FID can be recorded by measuring the distance between a source of disturbance and the position of a focal bird when 1) the focal bird is first alerted to the source of disturbance (AD) and 2) when the focal bird first responds to the source of disturbance by moving away (FID). FID should still be recorded even if it is not possible to record AD; AD is usually more difficult to determine than FID, as alert behaviour is often cryptic compared with the FID response of physically moving away from the source of disturbance.

Disturbance distance studies do not necessarily involve sophisticated equipment or a particular knowledge of disturbance-based research. Disturbance distance studies can be carried out by anybody who can use a measuring device (e.g. a measuring tape) and who has a good knowledge of bird species identification. This would, therefore, be highly appropriate as a Citizen Science project to build up a more detailed picture of sensitivity of birds to human disturbance. Alternatively, studies of disturbance responses would make excellent undergraduate or Masters research projects.

Opportunities should be sought to work with harvesting companies during their harvesting operations. This could provide the opportunity to observe the direct response of potential bird disturbance for the specific harvesting method and area.

Standardised data should be collected in order to efficiently compare data recorded in different disturbance distance studies. The following list provides a guide to basic information that should be recorded at the time of a disturbance distance study:

- focal bird species, and age/sex of bird where that can be determined from plumage;
- study location;
- date;
- weather conditions;
- details of the source of disturbance (e.g. person walking, person hand-harvesting seaweed, dog running, rock climber, motorboat, canoe, drone etc. moving towards focal bird);
- whether the source of disturbance is visual or acoustic or both;
- AD distance (if it is possible to identify);
- FID distance; and
- whether the study location is likely to be disturbed or undisturbed; if it is disturbed then what the likely source of disturbance is (e.g. is the study location frequented by people/boats/aircraft etc., or is it a remote and relatively undisturbed site).

Secondary factors that would be useful to record at the time of a disturbance distance study include the following:

- the initial distance between the source of disturbance and the focal bird (i.e. the study starting distance before the point of AD or FID has been reached);
- a record of whether the focal bird is likely to be breeding or nonbreeding;
- specific habitat of the study location (e.g. sandy beach, cliffs, estuary mudflats etc.);
- time of day;
- tidal state;
- type of behaviour focal bird is displaying before the disturbance event (e.g. foraging/roosting/nesting/loafing);
- type of AD behaviour (e.g. head-up, alarm calling, aggressive display, unknown);
- type of FID behaviour (e.g. walk/run away, fly away <50m, fly away >50m, swim/dive away from source of disturbance);
- whether the focal bird is alone or with other birds (if it is the latter, then record the identity of other bird species and the flock size); and
- length of time spent flying away from the source of disturbance.

To directly investigate the impacts of hand-harvesting seaweed on bird disturbance, the most relevant source of disturbance to investigate when measuring AD/FID values is a person hand-harvesting seaweed either on the land or in the water. If it is not possible for the source of disturbance to be a seaweed harvester, then an activity closely resembling the motion of seaweed harvesting would be preferable (e.g. a person walking in the intertidal zone, motorized or non-motorized boat activity close to shore etc.).

As the level of habituation to disturbance can strongly influence the distance at which a bird may respond to a disturbance event, it is necessary to record disturbance distances for focal birds in a range of study locations. By recording disturbance distances in a range of areas, the combined studies are more likely to show the realistic range of natural disturbance distances. The same is true with environmental variables, data should be collected in a variety of seasons and in different weather conditions in order to investigate the range of possible disturbance distances for each species.

Gaps have been identified in the bird disturbance response database for a number of species where there is either little or no quantitative information on disturbance response distances (AD/FID) (see section 4.3). A total of 19 out of 50 species were identified as having poor quality quantitative data and out of these 19 species, 10 were assessed as having a medium or high sensitivity to disturbance. Some of these species with poor quality quantitative data and medium/high sensitivity to disturbance are also known to have significant breeding or overwintering populations present in Scotland; these species include European shag, black guillemot, Greenland white fronted goose, greater scaup, velvet scoter and goosander. It is for these species in particular that future studies should aim to record AD and FID values.

However, there are no specific studies in the published literature that record disturbance distances for birds when the source of disturbance is seaweed hand-harvesting. Therefore, it would be beneficial to record disturbance distances for any species encountered during seaweed hand-harvesting activities.

Data collected during disturbance distance studies should be used to update the Bird Disturbance Response database. Collating disturbance responses into one database will help to build a clearer picture of the potential impacts of disturbance on birds caused by hand-harvesting seaweed.

This literature review and the associated recommendations for further analysis will contribute to guidance and best practice for seaweed hand-harvesters. This will ensure any potential impacts resulting from harvesting are considered and minimised as part of a sustainable harvesting approach.

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ANNEX 1: NUMBER OF QUANTITATIVE AND NON-QUANTITATIVE STUDIES ON DISTURBANCE RESPONSES

Common name	Latin name	Number of quantitative studies on disturbance responses (providing AD/FID/MAD values)	Number of non-quantitative studies on disturbance responses
Red-throated diver	*Gavia stellata*	3	2
Black-throated diver	*Gavia arctica*	2	3
Great northern diver	*Gavia immer*	3	4
Great crested grebe	*Podiceps cristatus*	5	0
Slavonian grebe	*Podiceps auritus*	2	5
Northern fulmar	*Fulmarus glacialis*	1	6
Great cormorant	*Phalacrocorax carbo*	5	0
European shag	*Phalacrocorax aristotelis*	2	2
Greenland white fronted goose	*Anser albifrons*	1	6
Pink-footed goose	*Anser brachyrhynchus*	2	2
Common shelduck	*Tadorna tadorna*	6	1
Mallard	*Anas platyrhynchos*	7	0
Eurasian wigeon	*Anas penelope*	7	1
Greater Scaup	*Aythya marila*	1	5
Common eider	*Somateria mollissima*	4	2
Common scoter	*Melanitta nigra*	3	1
Velvet scoter	*Melanitta fusca*	0	6
Long-tailed duck	*Clangula hyemalis*	2	3
Common goldeneye	*Bucephala clangula*	3	2
Goosander	*Mergus merganser*	1	2
Red-breasted merganser	*Mergus serrator*	1	5
White-tailed eagle	*Haliaeetus albicilla*	2	3
Golden eagle	*Aquila chrysaetos*	5	2
Peregrine falcon	*Falco peregrinus*	2	2
Eurasian Oystercatcher	*Haematopus ostralegus*	11	2
Ringed plover	*Charadrius hiaticula*	7	1
Grey plover	*Pluvialis squatarola*	8	2
Golden plover	*Pluvialis apricaria*	3	2
Northern lapwing	*Vanellus vanellus*	4	2
Red knot	*Calidris canutus*	2	4
Sanderling	*Calidris alba*	10	2
Purple sandpiper	*Calidris maritima*	0	5
Ruddy turnstone	*Arenaria interpres*	6	2
Dunlin	*Calidris alpina*	7	2
Common redshank	*Tringa totanus*	10	3
Bar-tailed godwit	*Limosa lapponica*	10	2
Eurasian curlew	*Numenius arquata*	10	3
Black-headed gull	*Larus ridibundus*	2	1
Common gull	*Larus canus*	2	1
Herring gull	*Larus argentatus*	2	1
Lesser black-backed gull	*Larus fuscus*	1	4

Common name	Latin name	Number of quantitative studies on disturbance responses (providing AD/FID/MAD values)	Number of non-quantitative studies on disturbance responses
Great black-backed gull	*Larus marinus*	3	2
Black-legged kittiwake	*Rissa tridactyla*	1	5
Little tern	*Sternula albifrons*	3	3
Sandwich tern	*Thalasseus sandvicensis*	0	6
Common tern	*Sterna hirundo*	6	0
Arctic tern	*Sterna paradisaea*	1	2
Black guillemot	*Cepphus grylle*	1	7
Common guillemot	*Uria aalge*	0	5
Razorbill	*Alca torda*	1	4

ANNEX 2: DATA QUALITY SCORE

Common name	Latin name	Score based on number of AD, FID or MAD records*	Score based on number of named sources of disturbance (e.g. pedestrian, motorized watercraft, aircraft etc.)**	Score based on the number of named seasons (breeding, nonbreeding, migratory) providing a record of AD, FID or MAD***	Score based on whether the study was a 'disturbed' or 'undisturbed' site (i.e. indicating habituation to disturbance) prior to recording AD,FID or MAD****	Study quality total score number	Study quality score description*****
Red-throated diver	*Gavia stellata*	2	3	3	1	9	Moderate
Black-throated diver	*Gavia arctica*	2	3	2	2	9	Moderate
Great northern diver	*Gavia immer*	2	3	2	3	10	Moderate
Great crested grebe	*Podiceps cristatus*	3	4	3	3	13	Good
Slavonian grebe	*Podiceps auritus*	1	1	2	2	6	Poor
Northern fulmar	*Fulmarus glacialis*	1	1	2	2	6	Poor
Great cormorant	*Phalacrocorax carbo*	2	3	3	2	10	Moderate
European shag	*Phalacrocorax aristotelis*	1	3	2	2	8	Poor
Greenland white fronted goose	*Anser albifrons*	1	2	2	2	7	Poor
Pink-footed goose	*Anser brachyrhynchus*	2	2	3	3	10	Moderate
Common shelduck	*Tadorna tadorna*	3	3	3	2	11	Good
Mallard	*Anas platyrhynchos*	4	3	3	2	12	Good
Eurasian wigeon	*Anas penelope*	3	3	2	2	10	Moderate
Greater Scaup	*Aythya marila*	1	2	2	2	7	Poor
Common eider	*Somateria mollissima*	3	4	3	2	12	Good
Common scoter	*Melanitta nigra*	3	3	3	2	11	Good
Velvet scoter	*Melanitta fusca*	0	0	0	0	0	Poor
Long-tailed duck	*Clangula hyemalis*	1	3	3	2	9	Moderate
Common goldeneye	*Bucephala clangula*	3	3	3	2	11	Good
Goosander	*Mergus merganser*	1	2	2	1	6	Poor
Red-breasted merganser	*Mergus serrator*	1	1	2	2	6	Poor
White-tailed eagle	*Haliaeetus albicilla*	4	4	3	2	13	Good
Golden eagle	*Aquila chrysaetos*	2	3	3	2	10	Moderate
Peregrine falcon	*Falco peregrinus*	2	4	2	1	9	Moderate
Eurasian Oystercatcher	*Haematopus ostralegus*	4	4	3	2	13	Good

Common name	Latin name	Score based on number of AD, FID or MAD records*	Score based on number of named sources of disturbance (e.g. pedestrian, motorized watercraft, aircraft etc.)**	Score based on the number of named seasons (breeding, nonbreeding, migratory) providing a record of AD, FID or MAD***	Score based on whether the study was a 'disturbed' or 'undisturbed' site (i.e. indicating habituation to disturbance) prior to recording AD,FID or MAD****	Study quality total score number	Study quality score description*****
Ringed plover	*Charadrius hiaticula*	4	2	3	2	11	Good
Grey plover	*Pluvialis squatarola*	3	3	2	2	10	Moderate
Golden plover	*Pluvialis apricaria*	2	2	3	3	10	Moderate
Northern lapwing	*Vanellus vanellus*	2	3	3	2	10	Moderate
Red knot	*Calidris canutus*	1	3	2	2	8	Poor
Sanderling	*Calidris alba*	4	3	4	2	13	Good
Purple sandpiper	*Calidris maritima*	0	0	0	0	0	Poor
Ruddy turnstone	*Arenaria interpres*	3	3	2	2	10	Moderate
Dunlin	*Calidris alpina*	3	3	3	2	11	Good
Common redshank	*Tringa totanus*	4	3	3	2	12	Good
Bar-tailed godwit	*Limosa lapponica*	4	3	2	2	11	Good
Eurasian curlew	*Numenius arquata*	4	4	3	2	13	Good
Black-headed gull	*Larus ridibundus*	1	2	3	1	7	Poor
Common gull	*Larus canus*	1	2	3	1	7	Poor
Herring gull	*Larus argentatus*	3	3	2	3	11	Good
Lesser black-backed gull	*Larus fuscus*	1	2	2	1	6	Poor
Great black-backed gull	*Larus marinus*	3	2	2	3	10	Moderate
Black-legged kittiwake	*Rissa tridactyla*	1	2	2	2	7	Poor
Little tern	*Sternula albifrons*	2	2	2	1	7	Poor
Sandwich tern	*Thalasseus sandvicensis*	0	0	0	0	0	Poor
Common tern	*Sterna hirundo*	3	3	3	3	12	Good
Arctic tern	*Sterna paradisaea*	2	3	2	2	9	Moderate
Black guillemot	*Cepphus grylle*	1	2	2	2	7	Poor
Common guillemot	*Uria aalge*	0	0	0	0	0	Poor
Razorbill	*Alca torda*	1	2	2	2	7	Poor

*Score based on the number of AD, FID or MAD records: >15 records = score 4; 8-4 records = score 3; 4-7 records = score 2; 1-3 records = score 1 and zero records = score 0.
**Score based on number of named sources of disturbance: >4 named sources = score 4; 2-3 named sources = score 3; 1 named source = score 2; Unknown source = score 1 and zero sources = score 0.
***Score based on the number of named seasons: 3 seasons = score 4; 2 seasons = score 3; 1 season = score 2; Unknown season = score 1; and zero seasons = score 0.
****Score based on whether the study was a ‘disturbed’ or ‘undisturbed’ site: records for disturbed + undisturbed sites = score 3; records of disturbed OR undisturbed sites (but not both) = score 2; habituation to disturbance unknown = score 1; and zero studies = score 0.
*****Study quality score description: study quality total score > 11 = ‘Good’ quality; study quality total score 9 or 10 = ‘Moderate’ quality; and study quality total score <8 = ‘Poor’ quality.

ANNEX 3: SENSITIVITY SCORE

Common name	Latin name	Maximum AD/FID recorded*	Assessment made from non-quantitative information on High, Medium or Low sensitivity**	Description of sensitivity score***
Red-throated diver	*Gavia stellata*	1400	High	High
Black-throated diver	*Gavia arctica*	750	High	High
Great northern diver	*Gavia immer*	200	High	High
Great crested grebe	*Podiceps cristatus*	340	No studies	Medium
Slavonian grebe	*Podiceps auritus*	50	Medium	Medium
Northern fulmar	*Fulmarus glacialis*	No studies	Low	Low
Great cormorant	*Phalacrocorax carbo*	77.9	No studies	Medium
European shag	*Phalacrocorax aristotelis*	500	Medium	Medium
Greenland white fronted goose	*Anser albifrons*	500	High	High
Pink-footed goose	*Anser brachyrhynchus*	500	High	High
Common shelduck	*Tadorna tadorna*	700	High	High
Mallard	*Anas platyrhynchos*	400	No studies	Medium
Eurasian wigeon	*Anas penelope*	1000	High	High
Greater Scaup	*Aythya marila*	no studies	High	High
Common eider	*Somateria mollissima*	208	Medium	Medium
Common scoter	*Melanitta nigra*	3200	High	High
Velvet scoter	*Melanitta fusca*	No studies	High	High
Long-tailed duck	*Clangula hyemalis*	293	Low	Low
Common goldeneye	*Bucephala clangula*	765	High	High
Goosander	*Mergus merganser*	540	High	High
Red-breasted merganser	*Mergus serrator*	50	Medium	Medium
White-tailed eagle	*Haliaeetus albicilla*	1000	Medium	Medium
Golden eagle	*Aquila chrysaetos*	1500	Medium	Medium
Peregrine falcon	*Falco peregrinus*	750	Medium	Medium
Eurasian Oystercatcher	*Haematopus ostralegus*	500	Medium	Medium
Ringed plover	*Charadrius hiaticula*	162	Medium	Medium
Grey plover	*Pluvialis squatarola*	400	Medium	Medium
Golden plover	*Pluvialis apricaria*	450	Medium	Medium
Northern lapwing	*Vanellus vanellus*	450	Medium	Medium
Red knot	*Calidris canutus*	260	Medium	Medium

Common name	Latin name	Maximum AD/FID recorded*	Assessment made from non-quantitative information on High, Medium or Low sensitivity**	Description of sensitivity score***
Sanderling	*Calidris alba*	70	Medium	Medium
Purple sandpiper	*Calidris maritima*	No studies	Low	Low
Ruddy turnstone	*Arenaria interpres*	100	Medium	Medium
Dunlin	*Calidris alpina*	450	Medium	Medium
Common redshank	*Tringa totanus*	450	Medium	Medium
Bar-tailed godwit	*Limosa lapponica*	450	Medium	Medium
Eurasian curlew	*Numenius arquata*	650	High	High
Black-headed gull	*Larus ridibundus*	450	Low	Low
Common gull	*Larus canus*	350	Low	Low
Herring gull	*Larus argentatus*	29	Low	Low
Lesser black-backed gull	*Larus fuscus*	25	Low	Low
Great black-backed gull	*Larus marinus*	68	Low	Low
Black-legged kittiwake	*Rissa tridactyla*	No studies	Low	Low
Little tern	*Sternula albifrons*	64	Medium	Medium
Sandwich tern	*Thalasseus sandvicensis*	No studies	Low	Low
Common tern	*Sterna hirundo*	142	No studies	Medium
Arctic tern	*Sterna paradisaea*	160	Medium	Medium
Black guillemot	*Cepphus grylle*	675	Medium	Medium
Common guillemot	*Uria aalge*	No studies	Low	Low
Razorbill	*Alca torda*	No studies	Low	Low

*If maximum AD/FID > 500m, sensitivity = ‘High’; If maximum AD/FID was 500 to 50m, sensitivity = ‘Medium’; If maximum AD/FID <50m, sensitivity = ‘Low’. Species for which there are ‘no studies’ with AD/FID values means that the assessment of sensitivity was based entirely on non-quantitative studies.
** Species for which there are ‘no studies’ with non-quantitative information means that the assessment of sensitivity was based entirely on quantitative studies.
***The sensitivity score was generally assessed from a combination of quantitative and non-quantitative studies except where there were ‘no studies’ and then the assessment was based entirely on quantitative or non-quantitative information (see * and **).

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ISBN: 978-1-78391-591-0

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