NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

Conservation and Management Advice

MORAY FIRTH SPA

UK SITE: 9020313

NOVEMBER 2021

This document provides advice to Public Authorities and stakeholders about the activities that may affect the protected features of Moray Firth Special Protection Area (SPA). It provides advice from Scottish Natural Heritage (SNH) (operating under the name of and hereinafter referred to as NatureScot) under Regulation 33(2) of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) to other relevant authorities on the Conservation Objectives for the Moray Firth SPA, and any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the site has been designated. It covers a range of different activities and developments but is not exhaustive. It focuses on where there is a risk to achieving the Conservation Objectives. The paper does not attempt to cover all possible future activities or eventualities (e.g. as a result of accidents), and does not consider cumulative effects.

Further information on marine protected areas and management is available at -

https://www.gov.scot/policies/marine-environment/marine-protected-areas/

For the full range of MPA site documents and more on the fascinating range of marine life to be found in Scotland's seas, please visit -

www.nature.scot/mpas or https://jncc.gov.uk/advice/marine-protected-areas/

Document version control			
Version	**Date**	**Author**	**Reason / Comments**
1	18-Feb-2020	Lucy Quinn	First draft.
2	09-July-2020	Lucy Quinn	Second draft to address Area comments.
3	08-Feb-2021	Lucy Quinn	Revisions for consistency with other documents.
4	15-Mar-2021	Emma Philip	Review of draft
5	02-Aug-2021	Lucy Quinn	Addressing comments from Marine Scotland.

Distribution list			
Format	**Version**	**Issue date**	**Issued to**
Electronic	1	19-Feb-2020	Sally Ward, David Patterson, Shirley Reid, Ben Leyshon.
Electronic	2	10-July-2020	Emma Philip
Electronic	3	2-Mar-2021	Emma Philip
Electronic	3	19-Mar-2021	John Mouat, Lily Burke (Marine Scotland)
Electronic	5	30-Sep-2021	Ben Ross, Chris Donald.

Contents

1 Overview of document

This document provides details of the Conservation and Management Advice for Moray Firth Special Protection Area (SPA) and it is divided into eight main sections. The introduction in section 2 gives an overview of Moray Firth SPA and its contribution in terms of conservation and wider benefits. Section 3 provides an overview of the roles of the various bodies involved with advising, regulating and managing the SPA. Section 4 describes the protected features and their condition, and section 5 introduces the Conservation Objectives for the site. Section 6 describes the threats and pressures to which the protected features are sensitive, and section 7 provides the management advice for these activities. Section 8 identifies what further research and surveys may be required to increase our understanding of how the protected features utilise the marine protected area.

Annex 1 sets out the Moray Firth SPA Conservation Objectives. Annex 2 provides supporting information relating to the protected features.

Throughout this document the term Special Protection Area (SPA) is used in relation to the site name, e.g. Moray Firth SPA or in discussion of the specific legislation relating to the site. Otherwise the term Marine Protected Area (MPA) is used when discussing the site or the MPA network generally. The term *qualifying features* is used in the Conservation Objectives to refer to those Annex 1 and regularly occurring migratory bird species that the Moray Firth SPA has specifically been designated to protect. Within the wider document text, the term *protected features* is used to refer both to these specific site features and more generally to species or habitats protected through MPA designations.

2 Introduction

2.1 Purpose statement

The Moray Firth SPA has been designated to protect 10 species of inshore wintering waterfowl, non-breeding and breeding European shags, and their supporting habitats. By doing so it contributes to the Scottish, UK and OSPAR MPA networks, the conservation of the wider marine environment around Scotland, and progress towards Good Environmental Status within the North-East Atlantic marine region.

The main purpose of the Moray Firth SPA is to contribute to the Favourable Condition Status of the protected features in the Atlantic Biogeographic Region. The Conservation Objectives form the framework for establishing appropriate management measures and assessing all future plans and projects that have the potential to affect the protected features of the MPA.

2.2 Conservation benefits

The conservation benefits for the Moray Firth SPA are:

- Protecting the largest GB wintering populations of long-tailed duck (approximately 46%) and velvet scoter (approximately 60%) and the third largest GB wintering population of greater scaup (approximately 18%).
- Protecting the largest Scottish wintering populations of common scoter (approximately 6% of GB wintering population) and common goldeneye (approximately 5% of GB wintering population).
- Protecting important numbers of Annex 1 rare and vulnerable species: great northern diver (approximately 6% of GB wintering population), red-throated diver (approximately 2% of GB wintering population) and Slavonian grebe (approximately 4% of GB wintering population).

- Protecting around 3% of the common eider GB wintering population and around 2% of the red-breasted merganser GB wintering population, both of which regularly winter in this area and some of which may remain and use the area during the breeding season.
- Protecting the largest breeding and non-breeding aggregations of European shag in Scotland, with important numbers of the European shag GB wintering and breeding populations using the SPA.
- Protecting sheltered waters with rich marine habitats that support a diversity of pelagic and demersal fish, crustaceans and bivalve molluscs where the qualifying features can feed, moult and roost.

2.3 Wider benefits

The protected features of the Moray Firth SPA contribute to ecosystem services locally and across the wider marine environment. We describe these ecosystem services in terms of their functions and the natural resources they comprise, which can in turn lead to benefits for people. Consequently, achieving the Conservation Objectives will also enable continuation of these wider benefits.

Figure 1 illustrates how the protected features of Moray Firth SPA contribute to benefits for people. There can be many complex interactions and dependencies amongst the protected features, their functions, associated natural resources and the benefits we gain from them.

The protected features together, especially when taken within the context of the whole MPA and/or local ecosystem, contribute to certain functions (e.g. biomass production and nutrient cycling) more than others. The contributions made by the protected features to these functions are fundamental to the continued supply of natural resources and benefits associated with this MPA, and to the long-term health of the protected features themselves.

In terms of resources, the MPA is a funnel-shaped body of sea where most of the Firth is shallow (less than 20m) over a sandy substrate, apart from a 50m deep channel running east to west through muddy substrate. Rocky outcrops are also frequent along the coast. The Firth is relatively sheltered and hosts relatively weak tidal flows, combined with stronger currents especially associated with fresh water outflows. The site has a maximum tidal range of 3m. In winter, both salinity and temperature increase along a south-west to north-east gradient due to the considerable input of fresh water from rivers flowing into the Moray Firth. These marine habitats support a variety of natural resources including important spawning grounds for fish, several shellfish species (including juveniles), marine mammal (including cetaceans and seals) and bird species, in particular high densities of wintering waterfowl and breeding European shags.

The rich and varied natural resources present within the MPA give rise to a wide range of benefits to people. The unique seascapes and wildlife within the MPA provide opportunities for tourism, recreation and wildlife watching, all of which encourage local jobs and businesses. Fisheries and supporting businesses from local communities within and around the MPA utilise and benefit from the wildlife and the area's fish and shellfish resources. The sheltered waters also make it an attractive place for marine users, and for ports and harbours. The MPA is a socially valued place by the local community. Further benefits relating to health and well-being, food and nutrition also arise from the site's natural resources, resulting in a place where communities and visitors can spend time connecting with and enjoying nature.

The benefits that arise from the functions and natural resources of the MPA are typically small in the context of the whole of Scotland, but some are of greater importance for this MPA and the people that use it. There is potential for benefits to be enhanced. This may be achieved by improving the quantity or quality (health) of the protected features themselves

and/or through promoting, for example, more recreational enjoyment or use of natural resources that is compatible with the site's Conservation Objectives.

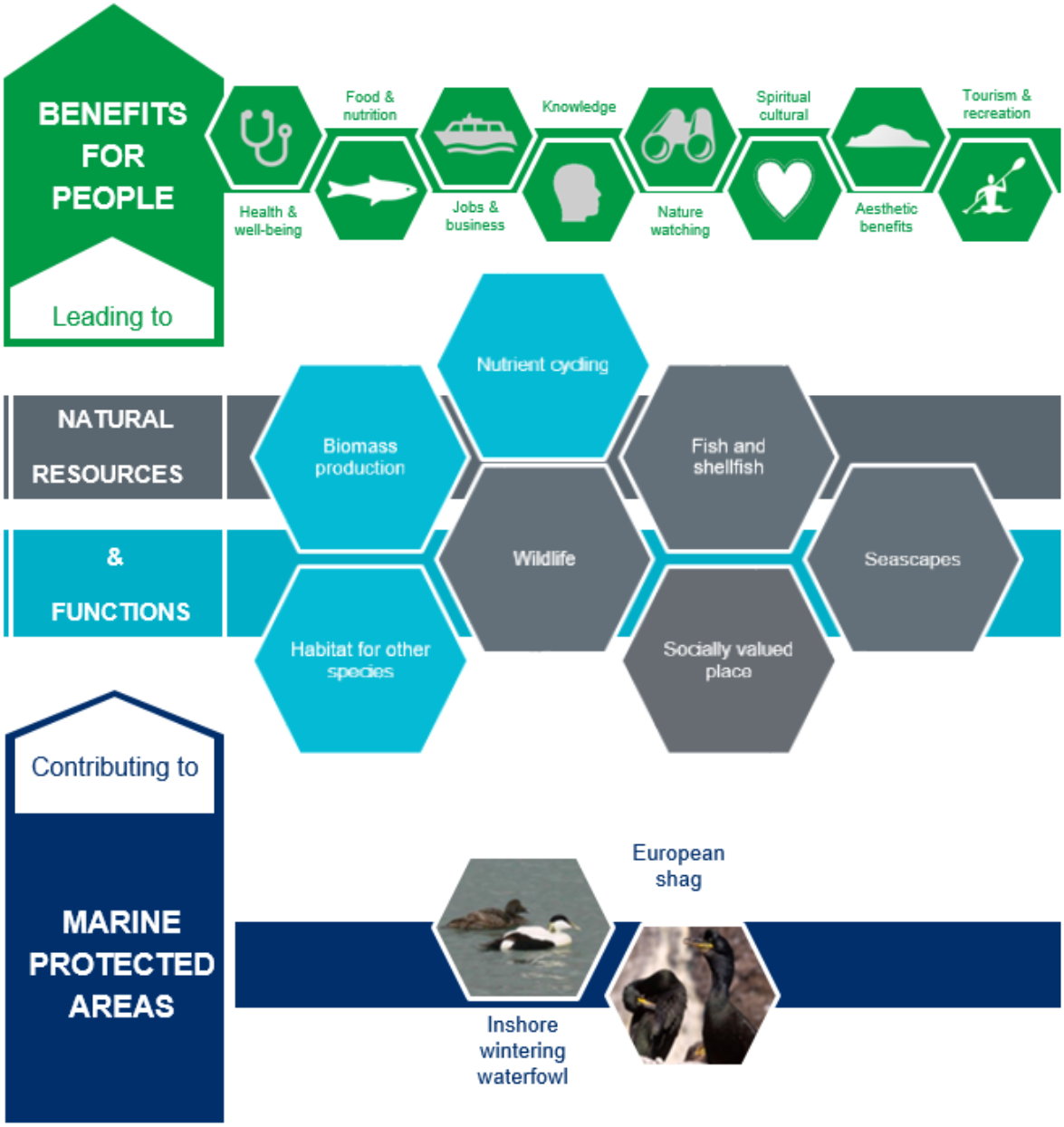

Figure 1 *Benefits to people associated with protected features of the Moray Firth SPA.*

2.4 Contribution to policy commitments

Managing this MPA to maintain the protected features in favourable condition, will ensure the continued provision of the benefits above as well as the site's contribution to:

- An ecologically coherent network of MPAs which are well managed under the OSPAR convention and national legislation.
- Achieving Favourable Conservation Status for the protected features in the Atlantic Biogeographic Region.
- Progress towards achieving Good Environmental Status in relation to maintaining biological diversity, and ensuring marine food web abundance and diversity.

- Making a significant contribution to the protection, enhancement and health of the marine area under the National Marine Plan.
- Restoring marine and coastal ecosystems and increasing the environmental status of our seas under the Scottish Biodiversity Strategy.
- Helping to adapt to climate change under The Scottish Climate Change Adaptation Programme.

3 Roles

This document provides advice for Moray Firth SPA in relation to activities that may affect the protected features. More detailed advice can be provided to relevant authorities to inform their decision making as required. In doing this, our aim is to ensure the Conservation Objectives for the protected features are met.

In Scottish territorial waters the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) (the "Habitats Regulations) and, the Wildlife and Countryside Act 1981 (as amended) are the main legislation that transposes the EC Directive 2009/147/EC on the conservation of wild birds (codified version) (termed Birds Directive) into domestic legislation. Regulation 33(2) makes special provisions for the protection of European marine sites, requiring Scottish Natural Heritage (now referred to as NatureScot) to advise other relevant authorities of the Conservation Objectives for a site, and also of the operations which may cause deterioration of the habitats or species, or disturbance of species protected in the SPA.

It is the role of the relevant and competent authorities[1] to ensure that the activities they regulate, permit or license do not hinder the achievement of the Conservation Objectives of the Moray Firth SPA. The management advice in this document is provided to assist authorities in managing the activities outlined in Table 2, section 7, and undertaking Habitats Regulations Appraisals of plans and projects.

Stakeholders can provide additional evidence to support the development of management including local knowledge of the environment and of activities. This will contribute to the development of well-designed and effective management measures.

4 Protected features and status

The Moray Firth SPA has been selected to become part of the UK's SPA network, contributing to Scotland's MPA network, which in turn has been established to help conserve and recover a range of Scotland's important marine habitats, wildlife, geology and landforms. Table 1 provides a summary of the protected features within the MPA, their condition within the site (where known) based on the latest NatureScot Site Condition Monitoring assessment, and the broader conservation status of the protected features.

---

[1] A relevant authority is a body or authority that has a function in relation to land or waters within or adjacent to the site (Regulation 5) and include: a nature conservation body; a local authority; water undertakers; a navigation authority; a harbour authority; a lighthouse authority; a river purification board (SEPA); a district salmon fishery board; and a local fisheries committee. All relevant authorities are competent authorities. A competent authority is defined in Regulation 6 as "any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office". In the context of a plan or project, the competent authority is the authority with the power or duty to determine whether or not the proposal can proceed.

All qualifying features are protected throughout the whole site, throughout the year. This means that irrespective of the season for which they are designated, the qualifying features are protected during both their breeding and non-breeding seasons when using the SPA.

Table 1. Protected features and status for the Moray Firth SPA. Feature condition refers to the condition of the protected feature at a site level[2]. Broader conservation status is the overall conservation status of the feature within the UK and Europe. No assessment on the condition of the feature at the Marine Atlantic Biogeographic Region scale is available.

Protected Feature	Feature condition at site	Assessment date	Broader conservation status	
			UK[3]	European region[4]
Great northern diver (non-breeding season)	Favourable	*Not yet assessed*	Amber	Vulnerable
Red-throated diver (non-breeding season)	Favourable	*Not yet assessed*	Green	Depleted
Slavonian grebe (non-breeding season)	Favourable	*Not yet assessed*	Red	Near Threatened
Greater scaup (non-breeding season)	Favourable	*Not yet assessed*	Red	Vulnerable
Common eider (non-breeding season)	Favourable	*Not yet assessed*	Amber	Vulnerable
Long-tailed duck (non-breeding season)	Favourable	*Not yet assessed*	Red	Vulnerable
Common scoter (non-breeding season)	Favourable	*Not yet assessed*	Red	Least Concern
Velvet scoter (non-breeding season)	Favourable	*Not yet assessed*	Red	Vulnerable
Common goldeneye (non-breeding season)	Favourable	*Not yet assessed*	Amber	Least Concern

[2] The protected features have not been assessed since designation, however corroborative evidence suggests there is no reason to suspect deterioration in condition since site selection (SNH, 2019). Hence, the feature condition is provided as condition at site selection.
[3] Based on Birds of Conservation Concern 4 (BoCC), for further details on definitions see Eaton *et al.* 2015.
[4] Based on BirdLife International, 2017.

Protected Feature	Feature condition at site	Assessment date	Broader conservation status	
			UK[3]	European region[4]
Red-breasted merganser (non-breeding season)	Favourable	*Not yet assessed*	Green	Near Threatened
European shag (breeding and non-breeding season)	Unfavourable at breeding colony SPA Favourable (non-breeding season)	*June 2015* *Not yet assessed*	Red	Declining

5 Setting Conservation Objectives

5.1 Background

Under Regulation 33(2) of the Habitats Regulations, NatureScot have responsibility for providing the Conservation Objectives for European marine sites in Scottish territorial waters. These site-level Conservation Objectives seek to define the contribution that each SPA should make to achieving Favourable Condition Status for the protected features. They provide the framework for the setting of site conservation measures (management) and for the Habitats Regulations Appraisal of projects and plans.

Annex 1 sets out the Conservation Objectives for Moray Firth SPA.

5.2 Relationship between feature condition and Conservation Objectives

The Conservation Objectives seek to *maintain* protected SPA features where evidence exists that a feature is in favourable condition in the site, or where there is uncertainty concerning the assessed condition of a feature (see section 4) but no reason to suspect deterioration in condition since designation. Where evidence exists that a feature is declining and/or damaged and therefore not in a favourable condition in the site, the Conservation Objectives will seek to *restore* the protected feature.

Moray Firth SPA was designated in 2020. The waterfowl species have not been assessed since designation however corroborative evidence suggests there is no reason to suspect deterioration in their condition since designation. Therefore, the Conservation Objectives for Moray Firth SPA seek to *maintain* this condition.

Feature condition with respect to breeding seabird features within the marine SPAs is based primarily on the feature's population size at the relevant linked breeding seabird colonies. Seabirds foraging in the marine SPA will be from breeding colony SPAs (and smaller non-designated colonies) within foraging range of the Moray Firth SPA and are therefore the same populations. Where features are unfavourable at the colony SPA and factors relating to functionally linked sea (i.e. within foraging range of the colony SPA) are identified as potentially affecting feature condition at the colony then the feature is also considered unfavourable within the marine SPA.

Breeding European shag are in unfavourable condition at the East Caithness Cliffs SPA due to a decline of over 50% of the population since designation (27 March 1996). The reasons for the decline are uncertain but are potentially associated with poor weather conditions (shags are prone to large population crashes 'wrecks' as a result of extreme weather events) and off-colony factors such as reduction in prey in foraging areas. Studies have demonstrated factors relating to prey availability (including sandeel and saithe) correlate with breeding success (e.g. Bustnes *et al.* 2013). The condition of European shag at the Moray Firth SPA is therefore considered to be unfavourable and consequently, the Conservation Objectives seek to *restore* favourable condition.

5.3 Conservation priorities

On the rare occasion where the need to favour the management of one protected feature of a site over another, conservation priority will be given to the most important species/habitats to take action for and/or the most important or urgent measures to be taken.

For the Moray Firth SPA, great northern diver, red-throated diver and Slavonian grebe are Annex 1 species and considered rare and vulnerable. The conservation requirements for Annex 1 species should take precedence over the regularly occurring migratory species (greater scaup, common eider, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser and European shag). There are currently no apparent management conflicts between the protected features.

5.4 Overlapping Marine Protected Areas

The following MPAs overlap with Moray Firth SPA:

- Dornoch Firth and Morrich More SAC
- Moray Firth SAC
- East Caithness Cliffs SAC, SPA and MPA
- Southern Trench MPA

Conservation measures in the overlapping marine areas need to ensure the Conservation Objectives of Moray Firth SPA and the overlapping SACs/MPA are met. Priority would be given to the SPA and SAC features. There are currently no known management conflicts between the protected features of the MPAs.

There are a number of neighbouring estuarine and coastal SPAs that support the same protected features as the Moray Firth SPA. Due to the mobile nature of the protected features there will be interchange between the neighbouring SPAs and the Moray Firth SPA. Therefore any assessment on neighbouring SPAs should take account of the Conservation Objectives for the relevant protected features in the Moray Firth SPA, and vice versa. These include:

Greater scaup is a protected feature of the following adjacent SPAs:

- Inner Moray Firth SPA
- Cromarty Firth SPA
- Dornoch Firth and Loch Fleet SPA

Red-breasted merganser is a protected feature of the following adjacent SPAs:

- Inner Moray Firth SPA
- Cromarty Firth SPA.

Common scoter, long-tailed duck, red-breasted merganser and velvet scoter are protected features of the following adjacent SPA:

- Moray and Nairn Coast SPA

For new plans or projects occurring adjacent or close to these SPAs, protection will extend to both the marine and intertidal areas of the neighbouring SPAs.

Site information for the MPAs overlapping Moray Firth SPA, including the Conservation Objectives for the SACs and SPAs mentioned above are available on SiteLink.

6 Feature sensitivity

The following section provides an overview of the pressures associated with human activities that are most relevant to the qualifying interests. Further information on feature sensitivity, will be made available on Marine Scotland's Feature Activity Sensitivity Tool (FeAST)[5]. The information in FeAST will reflect our current understanding of the interactions between activities, pressures and features. It highlights that activities can give rise to a range of pressures, which the protected features may be sensitive to. Our assessment of sensitivity is based on a feature's tolerance (response to change) and its ability to recover.

6.1 Great northern diver (non-breeding)

Great northern diver populations are considered sensitive to mortality through entanglement as incidental bycatch (Furness, 2016) and collision. There is evidence of great northern divers being sensitive to above water collision with physical structures (Furness, Wade & Masden, 2013) and potentially sensitive to underwater collision (Furness *et al.* 2012). Great northern divers are susceptible to mortality arising from oil spills, and in some instances this has had long-term impacts on local wintering populations, which may reflect poor recruitment in associated breeding populations (Heubeck, 1997). There is limited information on disturbance and displacement, although great northern divers have been recorded as taking evasive avoidance action at distances of several kilometres from approaching vessels (Jarrett *et al.* 2018) and have been identified as potentially sensitive to displacement associated with marine development (Furness *et al.* 2012, 2013). The habitat associations and prey preferences of great northern divers are poorly understood, but loss or damage of prey supporting habitat and/or reduction in food resources could have an impact on great northern divers.

6.2 Red-throated diver (non-breeding)

Red-throated divers are considered sensitive to mortality through entanglement in various types of fishing gears and incidental bycatch (Mendel *et al.* 2008; Dierschke *et al.* 2012). Red-throated divers exhibit behavioural sensitivity to visual disturbance (Jarrett *et al.* 2018). During the breeding season they are known to exhibit strong displacement associated with various marine developments (Furness *et al.* 2013, Cook & Burton, 2010) which may also be a sensitivity exhibited during the non-breeding season. Red-throated divers are also sensitive to pressures affecting prey availability (Guse *et al.* 2009). (*See also Sandeel sensitivity assessment in FeAST).*

6.3 Slavonian grebe (non-breeding)

Slavonian grebes are considered sensitive to mortality through entanglement in fishing gears and incidental bycatch (Mendel *et al.* 2008, Bradbury *et al*. 2017). They are also considered to be sensitive to above water collision with physical structure (Furness *et al.* 2013). Slavonian grebes are also highly susceptible to oil pollution which has been shown to cause high winter mortality (Thom, 1986). A number of sources highlight the behavioural sensitivity

[5] http://www.marine.scotland.gov.uk/feast/

of Slavonian grebe to vessel movements (Mendel *et al*. 2008; Jarrett *et al.* 2018) and they are assessed as having high potential vulnerability to disturbance and displacement due to marine development (Furness *et al.* 2013). They are also assessed as vulnerable to disturbance and changes in water clarity associated with aggregate extraction or dredging (Cook & Burton, 2010). The habitat associations and prey preferences of Slavonian grebes are poorly understood, but loss or damage of prey supporting habitat or reduction in food resources at a site level could have an impact on Slavonian grebes.

6.4 Common eider (non-breeding)

Eider are sensitive to mortality through collisions with marine developments and physical structures (e.g. Dierschke & Garthe, 2006; Larsen & Guillemette, 2007), entanglement as bycatch (Mendel *et al.* 2008; Žydelis *et al.* 2013) particularly near the seabed (Bradbury *et al.* 2017) and exposure to pollutants (Carboneras *et al.* 2017), including oil spills (Mendel *et al.* 2008). Eider are also sensitive to physical disturbance including displacement by built structures (Furness *et al.* 2013) and are frequently recorded taking evasive flights in association with vessel movements (Jarret *et al*. 2018). The level to which eider can become habituated to vessel movements is uncertain (Garthe & Hüppop, 2004; Schwemmer *et al.* 2011; Larsen & Laubek, 2005). The impact of some of these pressures may be greatest during their flightless moult period between July and mid-September, when large flocks aggregate in favoured locations and it is difficult for them to move away (Waltho & Coulson, 2015). Eider populations are also vulnerable to changes in availability of favoured bivalve prey (Cervencl *et al*. 2015; Mendel *et al.* 2008). *(See also Horse mussel bed sensitivity assessment in FeAST).* Studies in the Wadden Sea showed that eider can switch to a secondary prey source (surf clams), when blue mussel and common cockle numbers were severely reduced and eiders will move between foraging areas in response to prey depletion (Camphuysen *et al.* 2002). However, the ability to switch prey successfully may be limited. Loss of body condition and mortality are associated with loss of prey resources (Camphuysen *et al.* 2002, Beukema 1993, Laursen *et al*. 2009).

6.5 Common goldeneye (non-breeding)

Goldeneye are a legal quarry species in GB but population level impacts of this threat is unknown (Furness, 2016). Goldeneye have been reported as bycatch in set net fisheries in the Baltic (ICES, 2013). Goldeneye populations at some major freshwater wintering sites have been impacted by nutrient enrichment (Allen *et al.* 2004; Tománková *et al.* 2013) and such pressures could potentially increase the importance of coastal sites in some areas. The species is vulnerable to pollution incidents from both marine and terrestrial sources. Any activity which would cause a reduction in their favoured shellfish prey items would have a subsequent effect on the goldeneye.

6.6 Common scoter and velvet scoter (non-breeding)

Both common and velvet scoters are considered sensitive to mortality through entanglement in fishing gears and incidental bycatch (Mendel *et al.* 2008; Bradbury *et al.* 2017). Common scoter are also highly vulnerable to chronic oil pollution and spills (Mendel *et al.* 2008). A number of sources highlight the behavioural sensitivity of scoters to vessel movements (Kaiser *et al.* 2006; Schwemmer *et al*. 2011). They are assessed as having high potential vulnerability to disturbance and displacement due to marine development (McCluskie *et al.* 2012; Dierschke *et al.* 2006). Both these scoter species are vulnerable to changes in availability of their favoured prey, driven by climate change, commercial fisheries, or other environmental pressures (Mendel *et al.* 2008; Baptist & Leopold, 2009).

6.7 European shag (breeding and non-breeding)

European shag are identified as among the most sensitive species to bycatch in surface gears, pelagic gears and at depth near the seabed in UK waters (Bradbury *et al*. 2017).

Vulnerability to pollutants (e.g. polyisobutylene) (Camphuysen *et al.* 2010) and local oiling events (e.g. Heubeck, 1997) can also cause mortality. Severe weather such as storms may cause mortality 'wrecks' in shags. There is also potential for impacts on shag through collision with above water or under water marine developments (Furness *et al.* 2012). Shags are sensitive to vessel disturbance (Jarrett *et al.* 2018), which can affect their foraging behaviour at sea (Cook & Burton, 2010). Any pressure which would result in a reduction of prey for the shag would also have the potential to affect their population. (*See also Sandeel sensitivity assessment in FeAST).*

6.8 Greater scaup (non-breeding)

Scaup populations have been identified as vulnerable to: changes in availability of favoured bivalve prey associated with harvesting or modification of benthic habits through dredging; chronic oil pollution and spills; and, disturbance of their near-shore roost sites associated with recreational activities (Mendel *et al*. 2008). Scaup populations are also vulnerable to impact through fatal entanglement in set net fisheries (Mendel *et al.* 2008; Žydelis *et al.* 2013). They are particularly vulnerable to bycatch at depth near the seabed, with some areas of relatively high potential vulnerability in the winter months encompassing areas with high scaup densities (Bradbury *et al.* 2017). Scaup show sensitivity to visual disturbance associated with vessel movements (Mendel *et al.* 2008).

6.9 Long-tailed duck (non-breeding)

Long-tailed ducks are considered sensitive to mortality through entanglement in fishing gears and incidental bycatch, and from chemical and oil pollution, including recurrent small-scale incidents (Mendel *et al.* 2008, Hearn *et al.* 2015). Long-tailed ducks are also sensitive to physical disturbance and habitat loss including barrier effects and displacement by built structures (Dierschke & Garthe, 2006, Furness *et al.* 2013) and exhibit behavioural sensitivity to visual disturbance associated with vessel movements (Jarrett *et al*. 2018). Benthic feeders such as long-tailed ducks are also assessed as being sensitive to death or injury by collision with artificial structure below water (Furness *et al.* 2012). Long-tailed duck are also sensitive to the introduction of microbial pathogens, having previously suffered heavy losses from an outbreak of avian cholera (Friend, 2006).

6.10 Red-breasted merganser (non-breeding)

Red-breasted mergansers are considered sensitive to mortality through entanglement in fishing gears and incidental bycatch (Mendel *et al.* 2008; Žydelis *et al.* 2013). A number of sources highlight the sensitivity of red-breasted mergansers to vessel movements (Mendel *et al.* 2008; Jarrett *et al.* 2018) and also appear more sensitive than other waterfowl to sudden loud noise (Jarrett *et al.* 2018). They are also considered potentially vulnerable to disturbance and displacement due to marine development (Furness, Wade & Masden, 2013). Red-breasted merganser may be particularly vulnerable to disturbance during post-breeding moult where they become flightless (e.g. Craik *et al.* 2011). The habitat associations and prey preferences of red-breasted mergansers are poorly understood, but loss or damage of prey supporting habitat or reduction in food resources at a site level could have an impact on red-breasted mergansers.

7 Management

7.1 Conservation Measures

The following conservation measures are currently in place for the Moray Firth SPA:

- The Habitats Regulations require all plans or projects that may cause an impact on the protected features of a SPA to be assessed against the Conservation Objectives

for that site. This process is known as a Habitats Regulations Appraisal (HRA). An HRA is a statutory procedure that ensures the integrity of the site is maintained. It also provides an opportunity to consider appropriate mitigation that can reduce impacts, avoid adverse effects and permit plans or projects to proceed, having taken full account of the qualifying features of an SPA. Further information is available in Habitats Regulations Appraisals in the Moray Firth - A Guide for developers and regulators.

Other relevant measures include:

- There is an existing year-round closure to mobile active gear covering almost all of the Dornoch Firth and Morrich More SAC. The Morrich More and Dornoch Firth Nature Conservation Order 1995 covers the southern shores and prohibits a) the killing or removal of any marine invertebrate animal by mechanical means; b) the fishing for or collection of shellfish by mechanical means; and c) the use of vehicles or craft by persons surveying the shellfish resource or collecting or transporting shellfish. Prevents extraction of shellfish (except mussels) by mechanical means. The Nature Conservation Order 1995 for Loch Fleet, Dornoch and Cuthill Sands prohibits cockle harvesting and bait digging. These orders overlap with a very small section of the Moray Firth SPA.
- There is an existing year round closure to mobile active gear covering the Inverness Firth part of the Moray Firth SAC. This does not apply to dredging for cockles and mussels, unless the cockles are being caught using a vehicle. There are also three areas which are restricted under The Inshore Fishing (Prohibition of Fishing and Fishing Methods) (Scotland) Order 2004 (SSI 2004/276). These are; Inverness Firth, Cromarty Firth, and Dornoch Firth. There is no mobile or active demersal gear permitted all year round in the three defined areas. All have a derogation permitting mechanical dredging. In the Inverness and Cromarty Firths the derogation applies to fishing for cockles and mussels. For the Dornoch Firth the derogation is for mussels only.
- Culbin Sands and Findhorn Bay Nature Conservation Order 1995/1996/2006 prevents: the killing or removal of any marine invertebrate animal (including mollusca, crustacea or annelid by mechanical means; the fishing for, or collection of shellfish by mechanical means; the use of vehicles or craft by persons surveying the shellfish resource or collecting or transporting shellfish other than for scientific purposes; or the collection, gathering or harvesting, by whatever means, of cockles for any purpose other than personal use or scientific purposes. The area over which this occurs is adjacent to the Moray Firth SPA.

7.2 Advice to support management

Table 2 provides NatureScot's advice on management for activities where we consider this may be necessary to achieve the Conservation Objectives for the protected features. The advice is focused on the activities that cause an effect (a pressure) that a feature is sensitive to. Pressures can be physical (e.g. abrasion of the seabed), chemical (e.g. introduction of pollutants) or biological (e.g. removal of prey resources). Different activities may cause the same pressure, e.g. fishing using bottom gears and aggregate dredging both cause abrasion which can damage the surface of the seabed.

Our advice takes a risk-based approach, i.e. we are focusing on providing advice where we believe there is a risk to achieving the Conservation Objectives. We have identified risks to achieving the Conservation Objectives where there is an overlap between protected features and activities associated with pressures that the features are sensitive to. We have provided management advice to support public authorities and others in managing these risks. Our advice is based on existing data and information on protected features and relevant

activities, and our understanding of the relationships between the features and activities. We have identified a range of management advice:

- management to remove or avoid pressures;
- management to reduce or limit pressures; or
- no additional management required.

For our advice on fisheries management we have also stated where we think this should be 'considered.' This term is included to highlight that an issue exists, but circumstances mean that a specific recommendation for action cannot or need not be made at this point. However, there is sufficient cause to make fishery managers aware of the issue and for them to consider if a fishery management measure may be helpful in achieving Conservation Objectives – particularly where there may be a synergy between the benefits of management actions for the fishery and the Conservation Objectives for the feature. The term 'recommended' highlights that an issue of fishery-feature interaction exists, there is a reasonable evidence base and a specific recommendation can be made/ justified.

New or other activities not identified within the table would need to be considered on a case-by-case basis.

We recognise that stakeholders can provide local environmental knowledge and more detailed information on activities, including in relation to intensity, frequency and methods. This additional information will help public authorities and others develop more specific management, focussed on the interaction between features and activities. If new information becomes available our management advice may be revised. Where management measures are required, the development of these would be undertaken through discussion with the relevant stakeholders.

Table 2 describes the activities that are considered capable of affecting the protected features. Activities that are considered not likely to affect the protected features (other than insignificantly) are listed in Table 3. Spatial data relating to the location and extent of the activities listed can be accessed on Marine Scotland's National Marine Plan Interactive (where available).

7.3 Best Practice

In our management advice for activities in Table 2 we refer to the development, adoption or use of 'best practice' as a way of managing interactions between activities and the features. Best practice is taken to mean approaches or procedures that are developed and accepted by regulators and relevant stakeholders as being an effective way of dealing with an interaction between a habitat or species and the pressures created by an activity. Much of this best practice is already being implemented by sectors and regulators, e.g. pre-application discussions between developers and regulators, the Scottish Marine Wildlife Watching Code and Technical Standards for Scottish Finfish Aquaculture.

Table 2. NatureScot's advice to support management for Moray Firth SPA for activities which are considered capable of affecting the protected features.

The text under the 'Advice to support management' columns provides NatureScot's management advice for the features in relation to the activities (further details about the terminology used are provided in section 7.1). Where a cell is coloured grey this indicates that management is already in place, this includes where there are existing regulatory requirements for new proposals. Cells are also coloured grey where it is considered there is no additional management required to achieve the Conservation Objectives. An * has been used to highlight those activities to which the advice under '*Boat use associated with both commercial and recreational activities'* also applies. For some activities, the pressures associated with new proposals are considered unlikely to affect some the features either because these activities do not occur in the same locations as the features or the pressure is unlikely to be at levels that can affect the features (see also Table 3). In these cases, we have not provided advice however, where regulated; this does not exempt new plans or projects related to these activities undergoing a Habitats Regulations Appraisal (HRA).

Activities considered capable of affecting the protected features	**Advice to support management**		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
Aquaculture – shellfish*	**Reduce or limit pressures** (disturbance, displacement**)** associated with new shellfish farms and undeveloped consents, including the proposal to reintroduce native oysters.	**Reduce or limit pressures** (disturbance, displacement) associated with new shellfish farms and undeveloped consents, including the proposal to reintroduce native oysters.	**Reduce or limit pressures** (disturbance, displacement) associated with new shellfish farms and undeveloped consents, including the proposal to reintroduce native oysters.
Ballast	**Reduce or limit pressures** associated with the introduction of non-native species, diseases and toxic effects of algal blooms.		
Boat and aircraft use associated with both commercial (includes ship to ship) and recreational activities	**Reduce or limit pressures** (disturbance) associated with new boat and aircraft use during commercial and recreational activities through effective mitigation such as: • following the Scottish Marine Wildlife Watching Code (SMWWC). • seasonal and/or spatial restrictions to avoid sensitive time periods for those protected species most susceptible to disturbance and/or;		

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
	• production of vessel management plans associated with activities that require a marine licence. This may include agreed routes and for boats, potential seasonal speed restrictions.		
Cables and pipelines*	**No additional management** for existing cables and powerlines. **Reduce or limit pressures** associated with new construction works on sub-tidal areas through effective seasonal and temporal mitigation.		
Coastal development	**No additional management** for existing coastal protection and flood defences. **Reduce or limit pressures** (disturbance, loss of prey-supporting habitat) associated with new coastal development through effective seasonal and temporal mitigation.		
Commercial shipping*	**No additional management required** for established routes. **Reduce or limit pressures** (disturbance) for new routes or amendments to existing routes within the context of cumulative effects of all boat activity.		
Dredging/extraction of material (inc. maintenance dredging and capital dredging)*	**No additional management** for existing maintenance dredging (ports and harbours). **Reduce or limit pressures** (disturbance, damage of supporting habitat) associated with new capital dredging projects and associated maintenance dredging through appropriate mitigation such as: • spatial limitations to avoid damaging supporting habitat within foraging dive ranges of qualifying features and/or;	**No additional management** for existing maintenance dredging (ports and harbours). **Reduce or limit pressures** (disturbance, damage of supporting habitat) associated with new capital dredging projects and associated maintenance dredging through appropriate mitigation such as: • spatial limitations to avoid damaging supporting habitat within foraging dive ranges of qualifying features and/or;	**No additional management** for existing maintenance dredging (ports and harbours). **Reduce or limit pressures** (disturbance, damage of supporting habitat) associated with new capital dredging projects and associated maintenance dredging through appropriate mitigation such as: • spatial limitations to avoid damaging supporting habitat within foraging dive ranges of shag and/or;

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
	• seasonal restrictions.	• seasonal restrictions.	• seasonal restrictions (particularly in areas used for foraging by breeding shag, as they will have a restricted foraging range during this season).
Fishing - demersal mobile/active gear (inc. mechanical trawls and benthic trawls)*	Whilst we have limited understanding about the extent of interactions between benthic fisheries and prey supporting habitat within the site, we **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such disturbance to the benthic habitats that it adversely affects the abundance and availability of prey. **Reduce or limit pressures** (removal of prey species and abrasion of prey-supporting habitat) associated with fishing that has the potential to damage seabed habitat (in particular, sandeel habitat).	Whilst we have limited understanding about the extent of interactions between benthic fisheries and prey supporting habitat, we **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such damage to the benthic habitats that it adversely affects the availability of prey to bottom-feeding seaducks. The prey of seaducks are benthic species (particularly molluscs but also other marine invertebrates) which are associated with habitats within the site. Consideration of site-based management to avoid adverse impact on prey availability may be appropriate, particularly for blue mussels.	Whilst we have limited understanding about the extent of interactions between benthic fisheries and prey supporting habitat within the site, we **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such disturbance to the benthic habitats that it adversely affects the abundance and availability of prey. **Reduce or limit pressures** (removal of prey species and abrasion of prey-supporting habitat) associated with fishing that has the potential to damage seabed habitat (in particular, sandeel habitat).

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
Fishing – hydraulic dredges*	Hydraulic dredging has the potential to cause significant disturbance to the sediment habitats that support the prey species of the protected features, particularly for sandeel. We **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such disturbance to the benthic habitats that it adversely affects the abundance and availability of prey. **Remove or avoid pressures** (removal of prey species and disturbance of prey-supporting habitat) associated with hydraulic fishing that has the potential to damage seabed habitat (in particular, sandeel habitat).	Hydraulic dredging has the potential to cause significant disturbance to the sediment habitats that support the prey species of the protected features. We **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such disturbance to the benthic habitats that it adversely affects the abundance and availability of prey of bottom-feeding seaducks. **Remove or avoid pressures** (removal of prey species and disturbance of prey-supporting habitat) associated with hydraulic fishing that has the potential to damage seabed habitat.	Hydraulic dredging has the potential to cause significant disturbance to the sediment habitats that support the prey species of the protected features, particularly for sandeel. We **recommend** that a principal objective of the management of the relevant fisheries should be to ensure that the fishing activity does not cause such disturbance to the benthic habitats that it adversely affects the abundance and availability of prey. **Remove or avoid pressures** (removal of prey species and disturbance of prey-supporting habitat) associated with hydraulic fishing that has the potential to damage seabed habitat (in particular, sandeel habitat).
Fishing – cockle hand gathering and tractor dredging	**No additional management** for cockle harvesting by foot or vehicle with the current levels – *existing management in place.*		
Fishing – static gear (drift nets and bottom set nets inc. fyke nets)*	**Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of static nets in areas identified as being important for divers and grebes (as identified from	**Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of static nets in areas identified as being important for seaduck (as identified from habitat and dive depth	**Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of static nets in areas identified as being important for European shag (as identified from habitat and dive

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
	habitat and dive depth preferences) between mid-August and May each year **is recommended**. **Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of static nets in areas identified as being important for red-breasted merganser (as identified from habitat and dive depth preferences) **is recommended**.	preferences) between mid-August and May each year **is recommended**. **Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of static nets in areas identified as being important for eider (as identified from habitat and dive depth preferences) **is recommended**.	depth preferences) **is recommended**.
Fishing – hand gathering of mussels and oysters	**Reduce or limit pressures** (disturbance) associated with hand-harvesting of mussels and oysters **should be considered.**	**Reduce or limit pressures** (disturbance and loss of prey) associated with hand-harvesting of mussels and oysters **should be considered.**	**Reduce or limit pressures** (disturbance) associated with hand-harvesting of mussels and oysters **should be considered.**
Fishing – intertidal shellfish and bait digging	*Pressures unlikely to affect these features.*	**No additional management** for bait collecting by foot or vehicle with the current levels. **Reduce or limit pressures** (loss of prey) associated with new commercial or non-commercial harvesting of shellfish **should be considered**.	*Pressures unlikely to affect this feature.*

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
Fishing – pelagic*	**Remove or avoid pressures** (removal of key prey species) associated with fishing for sandeels. There is no current targeted sandeel fishery within the SPA, this position should be retained. Pelagic fishing for herring/sprat may occur within or around the SPA. We **recommend** that a principal objective of the management of the fishery should be ensuring that the fishing activity does not prevent or disrupt the availability of prey species for divers, Slavonian grebe or red-breasted merganser, i.e. it should be considered as part of a broader ecosystem-based approach to management of this fishery.	*Pressure unlikely to affect these features.*	**Remove or avoid pressures** (removal of key prey species) associated with fishing for sandeels. There is no current targeted sandeel fishery within the SPA, this position should be retained. Pelagic fishing for herring/sprat may occur within or around the SPA. We **recommend** that a principal objective of the management of the fishery should be ensuring that the fishing activity does not prevent or disrupt the availability of prey species for shag i.e. it should be considered as part of a broader ecosystem-based approach to management of this fishery.
Marine disposal sites*	**No additional management** for established licensed disposal sites (ports and harbours). **Reduce or limit pressures** (disturbance, smothering of prey supporting habitat, changes in water clarity) associated with new disposal sites within or adjacent to the SPA.		
Military activities	**No additional management** – *existing measures in place, see* Environmental Protection Guidelines (Maritime)(EPG(M))		
Oil and gas*	**No additional management** required for existing installations – *existing measures in place (oil contingency plan)* **Reduce or limit pressures** (disturbance) associated with new oil and gas development.		

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
Ports and harbours (inc. development and ship-to-ship transfer)	**No additional management** for established activities at ports and harbours within the Moray Firth SPA. **Reduce or limit pressures** (disturbance, displacement, loss or damage to prey-supporting habitat) associated with new development proposals or expansion of ports and harbours within or adjacent to the SPA. Appropriate mitigation may include: • spatial limitations to avoid damaging supporting habitat within foraging dive range of the qualifying features and/or; • seasonal restrictions during construction to avoid periods when birds are present. **Reduce or limit pressures** (mortality risk, disturbance, loss or damage to prey-supporting habitat) associated with new ship to ship transfer proposals in the Moray Firth SPA, and the potential for oil-spill risk.		
Renewable energy (inc. wave and wind)	**Reduce or limit pressures** (disturbance, displacement, collision) for new wave proposals in areas identified as being important for all the qualifying species. **No additional management** for operational and for consented, but not yet constructed, offshore wind developments. This is providing mitigation measures as agreed at Moray Firth Regional Advisory Group (MFRAG) and on a project specific basis are deployed. **Reduce or limit pressures** (disturbance, displacement, collision) for new wind proposals through effective mitigation measures.		
Tourism & recreation (inc. jet-skiing, kite surfing, rowing, wildfowling, angling, boating, diving, kayaking)	**No additional management** for existing recreational activities (includes kite surfing, rowing, angling, boating, diving, kayaking) providing the Scottish Marine Wildlife Watching Code (SMWWC) is followed by water-borne recreational users. The SMWWC highlights why birds are sensitive to disturbance and offers practical advice on how to avoid disturbance. **Reduce or limit pressures** (disturbance) of qualifying features from jet-skiing and wildfowling.		

Activities considered capable of affecting the protected features	Advice to support management		
	Great northern diver, red-throated diver, Slavonian grebe, red-breasted merganser	**Eider, goldeneye, common scoter, scaup, long-tailed duck, velvet scoter**	**European shag**
	Reduce or limit pressures (disturbance) where an increase by water-borne recreational activities demonstrates there is evidence of impacts at particular locations and/or if there is a major increase in intensity of these pursuits within the SPA. There would be potential for some zonation of measures across the site given that some qualifying features exhibit behavioural sensitivity to disturbance.		
Seaweed harvesting	**No additional management** for existing seaweed harvesting activities for hand-harvesting. **Reduce or limit pressures** (disturbance) associated with new seaweed harvesting developments. **Remove or avoid pressures** (disturbance, removal of prey supporting habitat) associated with mechanical harvesting of seaweed (in particular, of kelp).		
Seaweed cultivation/farming*	**Reduce or limit pressures** (disturbance, displacement) associated with new proposed seaweed farms through appropriate mitigation and careful siting of any new farm.		
Wildlife tour operators*	**No additional management for existing wildlife tours** providing the Scottish Marine Wildlife Watching Code is followed by Wildlife tour operators. The Scottish Marine Wildlife Watching Code (SMWWC) should be followed by water-borne recreational users. The SMWWC highlights why birds are sensitive to disturbance and offers practical advice on how to avoid disturbance. **Reduce or limit pressures** (disturbance) associated with an increase in wildlife tour operators if in the future there is evidence of impacts at particular locations and/or if there is an increase in intensity of these pursuits within the SPA. There would be potential for some zonation of measures across the site given that some qualifying features exhibit behavioural sensitivity to disturbance.		

Table 3. Activities that are considered not likely to affect the protected features (other than insignificantly) [6]

Activity	Comments
Anchorages & moorings	Beyond pressures associated with the vessel traffic (covered in Table 2), we are not aware of any further pressures that have the potential to cause an adverse effect on the protected features.
Discharges - sewage	The existing outfalls have been in existence for a considerable number of years, with varying levels of discharge all within regulation standards. We consider this activity to pose a low risk to the conservation objectives.
Fishing – static gear – Creels (including lobster, crabs and *Nephrops*)*	Creels (including lobster, crabs and *Nephrops*). Fishing using creels is widespread throughout the MPA. Whilst there is the potential for entanglement for the protected features, the occurrence is thought to be rare and therefore we consider this method poses a low risk to the protected features. Pressures associated with the vessel traffic from this pressure is covered under Table 2.
Fishing – mobile gear – line fishing (including jigging)*	Pelagic long-line and bottom-set long line fisheries are largely restricted to offshore waters and therefore at present pose a low risk to the protected features within Moray Firth SPA. Pressures associated with the vessel traffic from this pressure is covered under Table 2.

[6] Only the specific examples of activities listed in the table have been excluded, rather than the broad activity types. New plans or projects will still need to be considered by the relevant competent authority (see Annex 1 for further details).

8 Research and survey

We recognise that there are still important gaps in our understanding and knowledge of the features of this site. We will identify research and survey projects to inform our understanding of these aspects. The knowledge gaps identified below are not a commitment to undertake this work. However, by highlighting these gaps we hope to inform future discussions with parties interested in undertaking research in this site and/or on these features, to help direct research and improve understanding of monitoring needs. The following list of research and survey needs is not prioritised and is not exhaustive.

- Establish adequate baseline information for supporting habitats and prey species and gain an understanding of which prey items are the most important at a local scale within the SPA for all protected features.
- Additional research is required to better understand the relationships between the impact of dredging and benthic trawling on supporting habitats, their ability to support suitable prey and any consequential effect this may have on the protected features. This is particularly relevant to benthic feeding seaducks.
- Further ecological studies of all protected features habitat preferences and use, and movements within the Moray Firth SPA.
- Studies of the energetic/survival consequences of behavioural sensitivity to visual disturbance, at an individual and a population level, for all diver species, Slavonian grebe and red-breasted merganser, including within Moray Firth SPA.
- Better understanding of migratory pathways of the protected features.
- Improve understanding of diurnal (e.g. between feeding grounds and roost sites) and seasonal movements (e.g. in response to changing prey abundance/quality), particularly for the seaduck species.
- Establish a marine bird monitoring programme that informs changes in species populations and distributions at a site and SPA network level, and which may include monitoring of the supporting prey, habitats and processes within the SPA.
- Oceanographic studies, such as sea temperature and acidity levels, how these might change in future, and the effects of such changes on prey availability for birds.
- Studies of food availability and competition for food between different fish predators (e.g., birds, seals, dolphins, porpoises, whales) in relation to fisheries policy.
- Studies of potential benefits (such as providing enhanced foraging opportunities in ‘artificial reefs’) and disadvantages (such collision risk or avoidance behaviour) of offshore wind turbines.
- Studies of the numbers, distribution, productivity, diet and foraging range of shags breeding in the SPA and whether this changes in future.
- What impact the increase in frequency and severity of storms (as predicted by climate change models) will have on the protected features, in particular for shags that are prone to ‘wreck events’, and the subsequent effects on their abundance or distribution.

Annex 1. Moray Firth SPA Conservation Objectives

The box below provides the high-level Conservation Objective statements for the Moray Firth SPA.

The full Conservation Objectives, which includes site-specific advice and information on the qualifying features that form part of this SPA, are provided in the tables that follow. The site-specific advice and information provides more detail in relation to each of the high level Conservation Objective statements for each feature, e.g. detail on the seasonal timings and what the supporting habitats and prey are for the qualifying features.

Information is also provided below on how minor changes to features should be considered and the influence of environmental change on features, particularly in relation to climate change. Temporary impacts on the qualifying features resulting from plans or projects can only be permitted where there is certainty that the features will be able to quickly recover. Further details on the potential for each qualifying feature to recover are described in more detail in Annex 2 '*Factors determining the potential of features to recover*'.

A definition of the terms used is in the Glossary (Annex 3).

Moray Firth SPA
Qualifying features: • Great northern diver (*Gavia immer*) • Red-throated diver (*Gavia stellata*) • Slavonian grebe (*Podiceps auritus*) • Common eider (*Somateria mollissima mollissima*) • Common goldeneye (*Bucephala clangula*) • Common scoter (*Melanitta nigra*) • Greater scaup (*Aythya marila*) • Long-tailed duck (*Clangula hyemalis*) • Red-breasted merganser (*Mergus serrator*) • Velvet scoter (*Melanitta fusca*) • European shag (*Phalacrocorax aristotelis*)
1. To ensure that the qualifying features of Moray Firth SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status. 2. To ensure that the integrity of Moray Firth SPA is restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature: 2a. The populations of qualifying features are viable components of the site. 2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species. 2c. The supporting habitats and processes relevant to qualifying features and their prey resources are maintained, or where appropriate restored, at the Moray Firth SPA.

1. To ensure that the qualifying features of Moray Firth SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
Achieving Favourable Conservation Status (FCS) is defined in terms of the natural range and population of the species and the extent of habitat necessary for long-term maintenance of populations. There is an important role for all protected sites in the UK in defining, achieving and maintaining FCS for any habitat or species. Achieving FCS requires that each parameter is either stable or increasing, exceeds the relevant reference value and has good prospects of continuing to do so in the foreseeable future (JNCC, 2018). FCS is assessed across the Marine Atlantic Biogeographic Region with individual SPAs and SPA networks contributing to FCS. The conservation status will be taken as 'favourable' when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis. When carrying out appraisals of plans and projects against these Conservation Objectives, it is not necessary to understand the status of the qualifying features within each individual SPA in this Biogeographic Region. The focus of the appraisal should be at a site level. If the site Conservation Objectives are met then the site's contribution to FCS across the qualifying features' biogeographic range will be maintained. Similarly, when determining whether management measures may be required to ensure that the Conservation Objectives for this SPA are achieved, the focus should be on maintaining the contribution that it makes to FCS. Further advice on how these appraisals should be focussed in relation to maintaining site integrity is provided by Conservation Objective 2 (including parts a, b and c). If broader information (status, trends) on the qualifying features is available, it should be used to provide context to the site-based appraisal. Note '*Appropriate'* within this part of the Conservation Objectives is included to indicate that the contribution to FCS varies from site to site, and feature to feature.

2. To ensure that the integrity of Moray Firth SPA is restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:
This objective recognises that European shag are in unfavourable condition at the Moray Firth SPA and consequently site integrity is compromised. When carrying out appraisals of plans or projects, or determining whether management measures are required, the focus should be to understand the impact of the plan or project on site integrity by ensuring the favourable condition of all waterfowl species is maintained and that the plan or project does not prevent or reduce the recovery potential of European shag (e.g. result in a further decline, accelerate the rate of decline or prevent a recovery from occurring for European shag at East Caithness Cliffs SPA). The expectation is not for the plan or project to restore site integrity. Similarly, when determining whether management measures are required to meet the Conservation Objectives, the focus is on ensuring the conditions are appropriate to support recovery and subsequently restore site integrity. Further advice on how these appraisals should be focussed in relation to site integrity is provided in 2a, b and c. Temporary impacts on these objectives resulting from plans or projects can only be permitted where there is a high degree of certainty that the features will be able to quickly recover from the impact and that impacts do not prevent the ability of unfavourable features to fully recover in the long-term. ***Environmental changes*** This Conservation Objective recognises that the qualifying features are part of a complex, dynamic and multi-dimensional marine environment. Marine birds depend on environmental conditions (for example water movement, up-wellings and prevailing weather) which vary over time and space. Consequently, marine bird species are exposed to a wide range of drivers of change. 'Environmental changes' for the purpose of these Conservation Objectives means any change to the qualifying features reflecting both natural population dynamics and also broader environmental changes (i.e. those related to climate change and environmental variability, management of which is beyond the scope of the SPA). The impact of human activities on the SPA that can be managed will not be considered as part of the broader context of environmental change (i.e. where required they should be managed). Some site-level changes are natural and are not a direct result of human influences (e.g. population fluctuations arising from factors such as variable breeding success or weather conditions across the wintering range / shifts or changes in prey availability resulting from variability in environmental factors processes such as water temperature and movements). Changes in the qualifying features' distribution and use of the site, which are brought about by entirely natural drivers, directly or indirectly, are normally considered compatible with the SPA's Conservation Objectives. There may also be historical human influences that have now ceased but have modified and continue to drive change within the site. It is also recognised that climate change pressures could affect the qualifying features within the site. These changes cannot be prevented, so the

Conservation Objectives seek at a site level to take account of them and where possible, improve the qualifying species' resilience to environmental change when considering future plans or projects. The magnitude of the future impacts will depend on the nature, scale, duration and intensity of the activity and the qualifying features tolerance and ability to recover from such an impact.

Additionally, management of human activities at a wider scale (i.e. regional, Scotland or the area covered by an international agreement such as the OSPAR convention) may also affect the qualifying features associated with this site (either by making a positive contribution or having a negative impact). Wider scale impacts may affect the ability of the qualifying features to recover from site level changes, and therefore additional precaution over the impacts of any future human activities may be necessary.

An assessment of whether a change is natural or anthropogenic, or a combination of both, will need to be looked at on a case-by-case basis.

In relation to Moray Firth SPA and its qualifying features, the following effects of environmental change (climate change) are relevant. These effects should be taken into account when considering plans and projects as additional pressures may reduce the protected features' resilience to climate change, and conversely climate change impacts may start to hinder the their ability to recover from human activities.

- ***All qualifying features:*** Under climate change, sea temperatures are predicted to increase, sea levels may rise and there could be increases in the frequency of stormy conditions. Any of these factors could cause changes in bird abundance and distribution at the SPA due to changes in prey (species, availability and distribution), both in marine waters and in intertidal areas.
- ***For all waterfowl:*** climate change may result in effects at their breeding grounds or in other parts of the overall wintering range which could have subsequent effects on their wintering populations and distributions.
- ***Great northern diver:*** There is no species-specific evidence on the potential impacts of climate change or environmental variability for this species in the non-breeding season.
- ***Red-throated diver:*** Long-term population variations in breeding populations of red-throated divers have been identified as corresponding with a large scale climatic pattern but the mechanism for any causal link has not been established (Schmutz, 2014). It is unclear what effects climate change might have on non-breeding red-throated divers.
- ***Slavonian grebe:*** In southern breeding areas, climate change may negatively impact availability of invertebrate prey through drying of wetlands (BirdLife International, 2019). There is no species-specific evidence on the potential impacts of climate change or environmental variability for this species in the non-breeding season.
- ***Common eider:*** Rising winter temperatures have been identified as a driver for declines in the mussel stocks that common eider feed on in the Wadden Sea (Nehls *et al*. 2006).
- ***Common goldeneye:*** Significant north-easterly shifts in the wintering range of common goldeneye in NW Europe over the past three decades are attributed to climate change (Lehikoinen *et al.* 2013).

- ***Greater scaup:*** Breeding grounds are identified as being vulnerable to changes in population dynamics and phenology linked to climate change (Ross *et al.* 2015). There is no species-specific evidence on the potential impacts of climate change or environmental variability for this species in the non-breeding season.
- ***Long-tailed duck:*** Rising winter water temperatures and an increase in frequency of mild winters are predicted to significantly and negatively affect the condition and distribution of bivalves in winter and spring at sea duck foraging sites (Waldeck & Larsson, 2013). Another key potential impact of climate change on long-tailed duck abundance is through the disruption of established predator-prey cycles in breeding areas driving a reduction in average productivity of West Siberia/North Europe populations (Hearn *et al*. 2015).
- ***Red-breasted merganser:*** Recent apparent shifts in wintering range may be linked to a longer-term trend of relatively mild winters (Holt *et al*. 2011).
- ***Scoters (common and velvet scoters):*** common scoter populations at their breeding grounds are identified as being vulnerable to climate change (BirdLife International, 2019). No assessment of the potential impacts of climate change has taken place for velvet scoter though they are known to be influenced by severe weather in their wintering areas (Hartman *et al.* 2013).
- ***European shag:*** shags are susceptible to increased storminess and extreme weather which can lead to mass mortality events, particularly in the winter (Bustnes *et al.* 2013).

2a. The populations of qualifying features are viable components of the site.

This objective seeks to specifically protect the qualifying features from ***significant*** mortality, injury or removal that can lead to a long-term decline of the feature(s) within the site. It protects the features from significant risk of incidental killing and injury from activities both within and outwith the site. Impacts and effects are considered 'significant' where they could result in a permanent reduction or continued decline in the population and consequently, reduction in the contribution the Moray Firth SPA makes to the maintenance of the qualifying features in their natural range in the UK. It should be ensured that the qualifying features are protected from anthropogenic pressures that could lead to a significant long-term decline in numbers using the site, such that recovery cannot be expected.

At a site level, all qualifying features are considered to be viable if the species can carry out their life cycle functions relevant to the season(s) they are present, irrespective of dependencies such as immigration. In the Moray Firth SPA, this means that overwinter survival should not decrease for non-breeding birds and birds that have overwintered on this site should have good enough body condition to be able to migrate to their breeding grounds and breed successfully. For breeding shag, the viability of the species within the Moray Firth SPA is intrinsically linked to their ability to access and use breeding habitat in areas of functionally linked land outwith the site.

When assessing the effects of any plan or project consideration should also be given to whether impacts outwith the SPA could affect achievement of this Conservation Objective. This Conservation Objective is considered to be met if the conditions to support all the species' essential behaviours and activities are in place. This includes:

- avoiding effects within and outwith the site that could prevent or reduce the ability of the populations of qualifying features to recover.

- avoiding effects within and outwith the site that could lead to a permanent reduction in the populations of qualifying features through mortality, injury, or impacts caused by disturbance, displacement, barrier effects or reduction in mobile prey resources.
- maintaining the species' ability to use all areas of importance within the site (to be considered under Conservation Objective 2b)
- maintaining access to, and availability of, supporting habitats and prey within the site (to be considered under Conservation Objective 2c).

Where known, the populations of the qualifying features should be maintained at or above site reference populations, as detailed below. The site reference population may be revised from the baseline at designation where a) there is evidence to show that a population's size has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally equivalent to at least one generation length for the given species) and/or b) to reflect any wider strategic objectives for the species (e.g. national or international species action plan). Where there is evidence to show that a qualifying feature has historically been more abundant than the stated minimum target and current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account.

All qualifying features are protected throughout the whole site, throughout the year. This means that irrespective of the season for which they are designated, the qualifying features are protected during both their breeding and non-breeding seasons when using the SPA.

Temporary short-term changes in the populations due to human activity may be considered not to compromise the Conservation Objectives within the site provided it can be demonstrated that the populations of any affected qualifying features can fully recover. Factors limiting the recovery of the qualifying features include: the average generation times, population growth rates, availability of prey and the timing and duration of the activity around vulnerable stages of their life cycles such as during moulting or chick-rearing period.

Direct mortality can arise from: collision (above and underwater); entanglement (incidental bycatch); and pollution. Indirect mortality can arise from reduction of prey or prey-supporting habitats (e.g. through harvesting; physical removal of or damage to seabed; nutrient enrichment; changes to water temperature, salinity, or flows; introduction of invasive non-native species (INNS); pollution). Indirect mortality can arise from reduced ability to capture or access prey arising from e.g. increased water turbidity.

For all waterfowl species, the site-specific information includes a site reference population that is considered the most appropriate for assessments of plans and projects. Where this is based on the citation population at classification or recent surveys, the site reference population is rounded using standard procedures (Stroud *et al.* 2001). For waterfowl, GB population estimates are taken from Musgrove *et al.* 2013 and UK trend information from Frost *et al.* 2018.

Feature	Site-specific advice	Site-specific information

Great northern diver	Maintain the population of non-breeding great northern divers at a stable or increasing trend relative to the site reference population.	The site reference population for great northern divers at Moray Firth SPA is 140 individuals (5 year mean 2001/02-2006/07[7]), representing around 6% of the GB non-breeding population (for the period 2004/05-2008/09). Great northern diver numbers in both Scotland and the UK have been generally increasing since at least 1993/94. However, in Europe, their populations are expected to decline by 30-49% between 2000-2029 (BirdLife International, 2019).
Red-throated diver	Maintain the population of non-breeding red-throated divers at a stable or increasing trend relative to the site reference population.	The site reference population for red-throated diver at Moray Firth SPA is 320 individuals (5 year mean 2001/02-2006/07), representing 2% of the GB non-breeding population. Red-throated divers in the non-breeding period have decreased by 27% in the UK (2005/06-2016/17).
Slavonian grebe	Maintain the population of non-breeding Slavonian grebe at a stable or increasing trend relative to the site reference population.	The site reference population for Slavonian grebe at Moray Firth SPA is 43 individuals (4 year mean 2001/02-2005/06), representing around 4% of the GB non-breeding population (for the period 2004/05-2008/09). Slavonian grebe (non-breeding) numbers in both Scotland and the UK have increased substantially since 1993/94, but the trend more recently (from 2005/06 to 2016/17) is declining.
Common eider	Maintain the population of non-breeding common eider at a stable or increasing trend relative to the site reference population.	The site reference population for eiders at Moray Firth SPA is 1700 individuals (5 year mean 2001/02-2006/07), representing around 3% of the GB non-breeding population (for the period 2004/05-2008/09). Common eider numbers in both Scotland and the UK have declined by 22.5% since at least 1980/81.
Common goldeneye	Maintain the population of non-breeding common goldeneye at a stable or increasing trend relative to the site reference population.	The site reference population for goldeneye at Moray Firth SPA is 900 individuals (5 year mean 2001/02-2005/06), representing around 5% of the GB non-breeding population (for the period 2004/05-2008/09). Goldeneye numbers in the UK have decreased by over 8% between 1980-2017 with the short-term trend showing a decrease of around 36% (2005/06-2016/17).
Common scoter	Maintain the population of non-breeding common scoter at a stable or increasing trend relative to the site reference population.	The site reference population for common scoter at Moray Firth SPA is 5500 individuals (5 year mean 2001/02-2005/06), representing around 6% of the GB non-breeding population (for the period 2004/05-2008/09). Common scoter numbers have increased in the UK since 1980, with their population estimated to have increased by over 155%

[7] For further details on original survey data see Lawson *et al.* 2015.

		(2005/06-2016/17). However, this trend is likely to reflect better contemporary survey coverage, in particular through aerial surveys covering waters further from the shore.
Greater scaup	Maintain the population of non-breeding greater scaup at a stable or increasing trend relative to the site reference population.	The site reference population for scaup at Moray Firth SPA is 930 individuals (4 year mean 2001/02-2005/06), representing around 18% of the GB non-breeding population (for the period 2004/05-2008/09). Scaup numbers across the UK have increased by 15% between 1980/81-2016/17, however their short-term trend (2005/06-2016/17) shows a large decline of around 52%.
Long-tailed duck	Maintain the population of non-breeding long-tailed duck at a stable or increasing trend relative to the site reference population.	The site reference population for long-tailed ducks at Moray Firth SPA is 5000 individuals (5 year mean 2001/02-2005/06), representing around 46% of the GB non-breeding population (for the period 2004/05-2008/09). Long-tailed duck numbers in both Scotland and the UK have declined by 83.5% since 2005/06 but remain 51.5% higher than in 1980/81. Both the European and global population conservation statuses are Vulnerable because of an apparent severe decline detected in the wintering population in the Baltic Sea between the early 1990s and late 2000s (BirdLife International, 2019). Similar declines have been observed in Norway and north-east Scotland (Hearn *et al*. 2015).
Red-breasted merganser	Maintain the population of non-breeding red-breasted merganser at a stable or increasing trend relative to the site reference population.	The site reference population for red-breasted merganser at Moray Firth SPA is 150 individuals (5 year mean 2001/02-2005/06), representing around 2% of the GB non-breeding population (for the period 2004/05-2008/09. Red-breasted merganser numbers in the UK have declined by 21.3% since 2005/06.
Velvet scoter	Maintain the population of non-breeding velvet scoter at a stable or increasing trend relative to the site reference population.	The site reference population for velvet scoter at Moray Firth SPA is 1500 individuals (5 year mean 2001/02-2005/06), representing around 60% of the GB non-breeding population (for the period 2004/05-2008/09). Velvet scoter (non-breeding) numbers in both Scotland and the UK have increased substantially since 1980, but the trend more recently (from 2005/06 to 2016/17) has declined by over 50%.
European shag	Ensure breeding European shag have the ability to recover to the site reference population for East Caithness Cliffs SPA. ***and***	Shags using the Moray Firth SPA during the breeding season will include those from East Caithness Cliffs SPA as well as other smaller local seabird colonies. Shags have experienced a 45% decline in their breeding populations within the UK (1986-2015) (JNCC, 2016) and an overall 53% decline in of breeding shag within the East Caithness Cliffs SPA since classification (1993-2015). The reasons for the decline are uncertain but are potentially associated with poor weather conditions (shags are prone to large population crashes ‘wrecks’ as a result of extreme weather events) and factors such as

	Ensure breeding shag can move safely between the site and important areas of functionally linked land outwith the site. ***and*** Ensure European shags are not at significant risk from injury or mortality during the breeding and non-breeding seasons within the Moray Firth SPA.	reduction in prey in foraging areas. Breeding European shag are considered to be in unfavourable condition at the Moray Firth SPA. Similarly, non-breeding populations within the UK have experienced a 24% decrease (1993-2017) (Frost *et al.* 2018). Research is required to fully understand the reasons behind the decline and whether there is anything that can be done to reverse it. No site-reference population is set for shag at the Moray Firth SPA due to the citation populations representing only a snapshot of usage during both the breeding and non-breeding seasons. Essentially, the total relevant local breeding and non-breeding populations are not at sea at any one time and are not solely confined to the SPA. The total number of individuals using the site over the breeding and non-breeding seasons will be in excess of the estimate used for site selection purposes and will reflect the populations from many different colonies and the turnover within the site. For breeding shag, when assessing plans or projects, the population impact should be considered in relation to the site reference population for East Caithness Cliffs SPA. The site reference population for East Caithness Cliffs SPA is 2,300 pairs (1996 citation). For non-breeding shag, when assessing plans or projects, the site trend should be considered in relation to the wider Moray Firth trend, as determined by relevant WeBS sectors. European shag are highly mobile species and the recovery and long-term maintenance of the species in the SPA is intrinsically linked to their ability to access and use breeding habitat in areas of functionally linked land outwith the SPA.

2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species.
This objective seeks to ensure that the qualifying features can continue to use and access all areas within Moray Firth SPA used for feeding, breeding, moulting, roosting, loafing, shelter and other maintenance activities. Changes in the distribution of the qualifying features are most likely to be brought about through disturbance, therefore this objective relates to avoiding significant disturbance. Disturbance associated with

human activity may take a variety of forms including: noise, light, sound, vibration, trampling, presence of people, animals and structures, as well as displacement and barrier effects on the species. The type of disturbance, its duration and the area over which the qualifying features are likely to be affected are important considerations in any assessment of disturbance.

Disturbance can, for example, result in changes to feeding or roosting behaviour, increased energy expenditure due to increased time spent moving to avoid stressors, abandonment of nest sites and desertion of supporting habitat (both within or outside the protected area where appropriate). This may affect successful chick rearing in the subsequent breeding season (related to poor winter condition of adult birds), feeding and/or roosting, and/or may reduce the availability of suitable habitat as birds are displaced and their distribution within the site contracts.

'Significant disturbance' should be interpreted to mean disturbance that affects the integrity of the site through alteration of the distribution of the qualifying features such that recovery cannot be expected or effects can be considered long term. It is expected that significant disturbance will lead to more than a transient effect on the distribution of the qualifying features. It may result in the following types of effect:

- Contributes to the long-term decline in the use of the site by the qualifying features.
- Changes to the distribution of the qualifying features on a continuing or sustained basis.
- Changes to the qualifying features behaviour such that it reduces the ability of the species to survive, breed or rear their young.

There are two main ways in which the qualifying features' continued access to suitable resources could be restricted and distribution affected and this is where assessments should be focussed:
1. Large scale physical barriers that prevent access and use of the site, or;
2. Disturbance which alters their distribution (displacement) within the site or disrupts important behaviours.

Direct displacement of the qualifying features can arise from: barriers off-site that reduce or prevent movement to and between foraging and roosting locations; and visual disturbance (e.g. associated with vessel movements). Indirect displacement can arise from loss of or damage to prey or prey-supporting habitats (e.g. through harvesting; physical removal of or damage to seabed; nutrient enrichment; changes to water temperature, salinity, or flows; introduction of INNS; pollution (e.g. light, noise, chemical)).

For all waterfowl and non-breeding European shag: Disturbance to foraging birds may reduce the time spent feeding or cause them to move to different areas that are less energetically profitable. Disturbance that creates an avoidance response or disrupts/reduces roosting behaviour can also put increased energetic demands on birds. Ensuring safe movement within and between areas used for foraging, roosting and other maintenance behaviours (see also 2c) is important to meet the energetic demands required for winter survival and to achieve or maintain body condition needed to support subsequent migration and successful breeding. Barriers to movement may reduce access to preferred foraging habitat and cause sub-optimal foraging.

For breeding European shag: Disturbance to foraging birds may reduce the time spent feeding or cause them to move to different areas that are less energetically profitable. Disturbance that creates an avoidance response or disrupts/reduces incubation, chick-rearing, foraging or resting behaviour can also put increased energetic demands on birds during an already energetically expensive season. Ensuring safe movement within and between the breeding colony and those areas used for foraging, roosting and other maintenance behaviours (see also 2c) is important to meet the energetic demands required to achieve or maintain body condition needed to support migration and successful breeding and for subsequent winter survival. Barriers to movement may reduce access to preferred foraging habitat and cause sub-optimal foraging.

All qualifying features are protected throughout the whole site, throughout the year. This means that irrespective of the season for which they are designated, the qualifying features are protected during both their breeding and non-breeding seasons when using the SPA.

We anticipate that some locations within the Moray Firth SPA will be more, or less, important than others for individual species. Distributions within the site may also change over time in response to a range of abiotic and biotic factors (e.g. changes in abundance or quality of prey resources at particular locations, numbers of each qualifying feature within the site as a whole, seasonal fluctuations or trends in prevailing weather conditions etc.). In some cases detailed bespoke surveys of bird numbers and distributions, to determine qualifying features' current usage of particular locations within a proposals area of influence, may be required to complete the necessary assessments.

Temporary short-term disturbances due to human activity may be considered not to compromise the Conservation Objectives within the site provided it can be demonstrated that the population can fully recover. Factors limiting the recovery of the qualifying features include the timing, frequency and duration of the activity around vulnerable stages of their life cycle such as during moulting or chick-feeding period.

Feature	**Site-specific advice**	**Site-specific information**
Great northern diver	Ensure great northern divers continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to great northern divers and	Great northern divers are long distant migrants, moving annually between northern breeding grounds in Iceland, Greenland or Baffin island, and more southerly wintering grounds such as Moray Firth SPA. They are present at Moray Firth SPA from October until mid-May, with a flightless moult period from February until mid-April. Great northern divers are widely distributed throughout the Moray Firth SPA. The open coastal waters and more sheltered marine waters are used for foraging, roosting, and maintenance activities. Generally, foraging is largely restricted to dive depths of up to 55m (Robbins, 2017), although typically they forage in shallower waters (Woodward & Humphreys, 2018). Within the Moray Firth SPA areas recorded being used across this SPA are associated with the 20m sea depth contour (Sotheran *et al.* 2019). Non-breeding birds have been observed forming communal rafts in deeper waters at sunset, where it is assumed they remain to roost at night (e.g. Shackleton, 2012). It is not yet known if great northern divers at this SPA use communal rafts in the same way.

	ensure individuals can move safely between these areas within the site.	
Red-throated diver	Ensure red-throated diver continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to red-throated diver and ensure individuals can move safely between these areas within the site.	Red-throated divers are present in Scottish waters throughout the year and for Moray Firth SPA their non-breeding season is between mid-September and late March. They undergo a post-breeding flightless moult commencing sometime between late September and December. Red-throated divers are widely distributed throughout the Moray Firth SPA, and have been recorded in higher densities in the Outer Dornoch Firth, the Inverness Firth, around Spey Bay and between Cromarty Firth and Tarbet Ness along the coast of Easter Ross. They use habitats within the Moray Firth SPA for foraging, resting, and other maintenance activities. Dive depths are typically less than 10 m, with a maximum of 21m (Sotheran *et al.* 2019). Numbers off Dornoch have recently shown a peak in late winter/spring time (Patterson, 2019).
Slavonian grebe	Ensure Slavonian grebe continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to Slavonian grebe and ensure	Slavonian grebes from the north-west Europe (large-billed) biogeographic population are migrants which move from their breeding ground in Iceland, Faeroes, Scotland and northern Norway to more southerly wintering grounds such as Moray Firth SPA. They are present at Moray Firth SPA from mid-September until late April. A post-breeding moult of primaries occurs before arrival in the wintering grounds, meaning some locally breeding Slavonian grebes which might arrive early within the SPA, may even moult here. Slavonian grebes are widely distributed along the coast of the Moray Firth SPA. The sheltered, inshore marine areas are used for foraging, roosting and maintenance activities. Foraging is largely restricted to water depths from 4-14m, with an optimum of 6-9m (Sonntag *et al.* 2009). Some Slavonian grebes socialise and forage in small grebe groups, occasionally in close proximity to other diving ducks, where there may be some indirect benefits of this behaviour (Patterson, 2019).

	individuals can move safely between these areas within the site.	
Common eider	Ensure eider continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to eider and ensure individuals can move safely between these areas within the site.	Eiders are present throughout the year at Moray Firth SPA. Their non-breeding season is from September to mid-April, with their flightless moult period being from July to mid-September. In the non-breeding season, eiders within the Moray Firth SPA are widely distributed, with high densities recorded between Golspie and Portmahomack, as well as along the south coast of the Moray Firth. They were recorded in largest numbers close inshore, in shallow waters, often in the presence of other species, contributing to large mixed-species sea duck rafts. The Moray Firth SPA waters are used for foraging, moulting and roosting. Eiders prefer to moult in sheltered waters free from disturbance (Waltho & Coulson, 2015). Foraging is largely restricted to waters less than 10m deep (Woodward & Humphreys, 2018), although dive depths of 60m have been identified when in pursuit of prey (Waltho & Coulson, 2015). Birds may roost offshore, as well as onshore when sheltering from prevailing weather (Cramp & Simmons, 2004). Eiders will occasionally move to roost offshore at dusk in the company of both velvet and common scoters (D. Patterson *pers. comm.)*. In addition, this species will occasionally 'loaf/rest' on exposed sand banks in large numbers during very low tides (e.g. Gizzen Briggs and Loch Fleet channel) (Patterson, 2019).
Common goldeneye	Ensure common goldeneye continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to common goldeneye and ensure	The goldeneye GB wintering population is thought to come from the Scandinavian breeding population (Wright *et al.* 2012). Goldeneye will be present at Moray Firth SPA from September to mid-April. Post-breeding flightless wing moult lasts 3-4 weeks from mid-July to mid-September in males and around 3 weeks later in females. Within the Moray Firth SPA, goldeneye were previously recorded predominately within the shallow waters in the southerly parts of Inverness Firth, in the Dornoch Firth and in the Culbin/Findhorn area. Goldeneye use a range of shallow freshwater, brackish and marine waters in the non-breeding season and are commonly associated with estuaries (Woodward & Humphreys, 2018). They feed predominantly during the day and have a maximum known dive depth of 6m (Woodward & Humphreys 2018).

	individuals can move safely between these areas within the site.	
Common scoter	Ensure common scoter continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to common scoter and ensure individuals can move safely between these areas within the site.	The common scoter GB wintering population is derived mainly from Scandanavian and Icelandic breeding populations (Wernham *et al.* 2002). Common scoter non-breeding period is from July-April. In Moray Firth SPA peak numbers of non-breeding birds typically occur between October to April. However, common scoter may be present in the Moray Firth SPA within any month of the year. Their flightless moult period lasts for around 3-4 weeks and will typically be between mid-July and mid-September for males and September-October in females. Within the Moray Firth SPA, common scoters were recorded most frequently close inshore between Burghead and Nairn, around the mouth of the inner Dornoch Firth, at Spey Bay and on the Riff Bank. Observations in 2019 and 2020 indicates that the inshore shallow sandy coast of Golspie to Embo also has importance as a foraging zone (D. Patterson *pers. comm.).* Mixed scoter rafts have been recorded regularly occurring off Dornoch and the surrounding coast. Their favoured foraging sites may change depending on the year, as some previously identified foraging sites can remain 'fallow' for notable periods of time (Patterson, 2019). Common scoters use open coast habitats, usually with a depth of 20m or less (Woodward & Humphreys, 2018). Common scoters typically dive to around 10m (Robbins, 2017). Some dedicated observations on roosting birds at Dornoch (2019/2020) have shown that birds will normally surface swim out into deeper water after dusk. The timing of this roost movement is likely to be subject to darkness levels, which can often be affected by different phases of the moon. Rarely, birds will fly out to roost. Occasionally, a specific roost zone can be identified when available light allows (D. Patterson *pers. comm.).*
Greater scaup	Ensure greater scaup continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and***	Scaup wintering in Britain and Ireland are thought to be derived mainly from the Icelandic breeding population (Wright *et al.* 2012). They are present in the Moray Firth SPA between mid-September and March. Scaup are widely distributed along the coast within the Moray Firth SPA, with higher densities being recorded in the Beauly Firth and off Culbin Bar. In late January and into February, a small flock (*c.* 150) may congregate with other sea ducks off Dornoch, as part of a multi-species raft (Patterson, 2019). Although this species can be traditional in its use of favoured foraging locations, observations suggest that small flocks may move to different parts of the SPA, depending on the time of the year (D. Patterson & I. Macdonald *pers. comm*.).

	Avoid significant disturbance to greater scaup and ensure individuals can move safely between these areas within the site.	Scaup will use the Moray Firth SPA waters for foraging, roosting and other maintenance behaviours. They prefer shallow waters and have a maximum foraging depth of 10m (McCluskie et al. 2012). They are considered to be mainly nocturnal feeders (Woodward & Humphreys 2018). However, some individuals have been seen to dive during daylight hours in the company of other seaducks (D. Patterson *pers. comm.).*
Long-tailed duck	Ensure long-tailed duck continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to long-tailed duck and ensure individuals can move safely between these areas within the site.	The origins and migration routes of long-tailed duck wintering around Britain and Ireland are poorly understood but the majority are thought to breed in northern Fennoscandia and northwest Russia (Wright *et al.* 2012). Long-tailed duck within the Moray Firth SPA can be present from mid-September until late April. However, late flocks occasionally persist within the SPA in proximity to Portmahomack and offshore there until mid-late May in some years. This can often involve over 1,000 individuals (Highland Bird Reports, 2018). This species rarely summers in Scotland, so birds are not thought to become flightless (during their late summer moult) in Scottish waters. Long-tailed duck are widely distributed throughout the Moray Firth SPA with high concentrations often being recorded off Golspie, Embo, Dornoch, Portmahomack, Spey Bay and along the south coast of the Moray Firth. Inshore waters are normally used for foraging, socialising, roosting and maintenance activities. Long-tailed duck appear to prefer open coast habitats and can also be found to frequent far offshore (Heinänen *et al.* 2017). Freshwater outlets may also be used at low tide. Many studies indicate that long-tailed duck use shallow water habitats; with a preferred depth of less than 20m and a maximum depth of around 37m (Woodward & Humphreys, 2018).
Red-breasted merganser	Ensure red-breasted merganser continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to red-	Red-breasted mergansers are present throughout the year at Moray Firth SPA. The wintering population of this species within Moray Firth SPA may include birds from breeding grounds within Britain and Ireland, from Iceland, and some European birds (Wernham *et al.* 2002; Wright *et al.* 2012). Their non-breeding season is from mid-August to late March. A flightless moult period for around 1 month mid-July to late August in males and around 1 month later in females occurs in (generally) small coastal or near-coastal groups and precedes migration to wintering grounds (Cramp & Simmons, 2004). Moulting flocks have been recorded off the Golspie coastline in September, often involving tight rafts up to 300 birds. This particular section of coastline appears to be favoured by this species, where regular movement (involving both swim and flight) occurs between the open coast and the small Loch Fleet estuary (D. Patterson *pers. comm.)*.

	breasted merganser and ensure individuals can move safely between these areas within the site.	Red-breasted mergansers are spread along the Moray Firth SPA coast, with concentrations recorded in the Beauly Firth, between Dornoch and Golspie and along the southern coastline of the Moray Firth. They use coastal habitats, normally less than 2km from land, more usually within 850m from shore (Craik *et al.* 2011) and have a preference for clear, shallow water, between 0-10m though usually less than 4m deep (BirdLife International, 2019). They may roost further offshore in waters up to 12m deep (Craik *et al.* 2011). It is not currently known whether red-breasted mergansers in Moray Firth SPA have a similar pattern of roosting in slightly deeper waters.
Velvet scoter	Ensure velvet scoter continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and*** Avoid significant disturbance to velvet scoter and ensure individuals can move safely between these areas within the site.	Velvet scoter are long-distance migrants, coming from breeding population in Scandinavia and western Siberia. Velvet scoter are present in the Moray Firth SPA between September and mid-April. Their flightless post-breeding moult lasts for around 3-4 weeks (for males between late July and late August, and for females between late August and early October). Similar to common scoter, within the Moray Firth SPA, velvet scoters were recorded most frequently close inshore between Burghead and Nairn, at Spey Bay and on the Riff Bank. Smaller numbers also occur around the mouth of the Inner Dornoch Firth, normally in association with common scoter (Patterson, 2019). They have a mean depth of 4.2±3.1m, with dives up to 35m possible (Robbins, 2017). Velvet scoters feed diurnally and move out to sea at dusk (Mudge & Allen, 1980).
European shag	Ensure European shags continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated within the site. ***and***	European shags are a resident UK species and are present within the Moray Firth SPA throughout the year. Their non-breeding period is from late September to early February, and their main breeding period is from March to September. The foraging distribution of breeding shags within the Moray Firth SPA are largely concentrated between Brora and Helmsdale. Tracking studies show that in the breeding season shags feed within a mean maximum distance of 13.3±10.5km of their breeding colony, though a maximum foraging distance of 46km has been noted (Woodward *et al.* 2019). In winter, they will be widely distributed throughout the Moray Firth SPA, with concentrations being previously recorded around Portsoy and between Brora and Berriedale. Their non-breeding

	Avoid significant disturbance to European shags and ensure individuals can move safely between these areas within the site.	foraging range is larger, with shags from the Isle of May recorded roosting up to 486 km north and 136 km south of their breeding colony (Grist *et al.* 2014). Shags feed diurnally within the marine environment, and tend not to feed far from land. Shags predominant foraging strategy is as a benthic feeding piscivore. As such, foraging areas tend to coincide with areas of sandy benthic sediment, and occur where depth is less than 80 m (Daunt *et al.* 2015). Shags mostly dive to 10-40m, though dives of more than 50m have been recorded (Daunt *et al*. 2006; Watanuki *et al.* 2008).

2c. The supporting habitats and processes relevant to qualifying features and their prey resources are maintained, or where appropriate, restored at the Moray Firth SPA.
This objective seeks to maintain the current extent, quality and distribution of supporting habitats within the site as well as ensure a sufficient food supply within the site. It also recognises however, that the populations of breeding shag using the Moray Firth SPA are in unfavourable condition and that this may, in part, be due to a reduction in prey causing declines at the breeding colonies. The qualifying features require suitable habitat for shelter, roosting, foraging, loafing, moulting and other maintenance activities. The variety, quality, abundance and availability of food resources on which the qualifying features depend is important for ensuring adult fitness, survival and breeding success (including for over-wintering species). The supply of food resources is supported by environmental processes. Supporting habitats refer to the characteristics of the seabed and water column relevant to their use by the qualifying features. Supporting processes relates to wider oceanographic processes such as up-wellings, tidal flows, hydrological movements which may be necessary for the habitat, and thus affects nutrient cycling and prey distribution. Maintenance of populations of mobile prey species and their supporting habitats is important to maintain the conditions required to support the qualifying features populations, particularly for those species feeding on fish within the water column. Temporary short-term changes in supporting habitat and/or food resources due to human activity may be considered not to compromise the Conservation Objectives within the site provided it can be demonstrated with a high degree of certainty that the populations of any affected qualifying features can fully recover. The species-specific information includes a summary of available information on food resources and where known, the distribution of the key supporting habitats and associated processes within the Moray Firth SPA.

The overall water body condition status relevant to Moray Firth SPA was assessed as being "Good"[8]. This assessment includes consideration of water chemistry, pollutants, the physical condition of the water body, plant and animal communities, including plankton, and the risk from invasive non-native species. There are some areas further from the coast of the SPA which are outwith the water body condition assessment, and hence no information is available for these sections. There is currently insufficient information to support quantitative advice on the environmental processes associated with the supporting habitats and prey of the qualifying features at Moray Firth SPA.		
Feature	**Site-specific advice**	**Site-specific information**
Great northern diver	Maintain the extent and distribution of supporting habitats for great northern diver within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce	Great northern divers require suitable habitat within the SPA for foraging, loafing, moulting and roosting. In Scotland, great northern divers occur along rocky shores, in sheltered bays and channels as well as open coastal waters. These habitats are used for foraging in the water column and on the seabed (up to 55m depth). Open waters are also used potentially for loafing, moulting and roosting. The limited data available on non-breeding season diet show the principal food resource of great northern divers is fish, including both pelagic and benthic species. Fish species taken will be influenced by what is locally and most readily available, but can include haddock, cod, herring, sprats and gurnard, eels, along with smaller species such as sandeels, pipefish, gobies, flatfish and butterfish. They also feed opportunistically on crustaceans, including crabs (Woodward & Humphreys, 2018). Information on prey habitat associations is lacking. In Scotland, four biotopes are associated with flatfish (one of the named prey species of great northern diver (Sotheran *et al*. 2019). Within Moray Firth SPA records for this prey's associated habitats/biotopes are limited (Sotheran *et al*. 2019). The key supporting processes for great northern divers at Moray Firth SPA are not well known but may include water quality (nutrients and turbidity), tidal cycles, and water flow.

[8] https://www.sepa.org.uk/data-visualisation/water-classification-hub/

	supporting habitats and/or prey, should be avoided.	
Red-throated diver	Maintain the extent and distribution of supporting habitats for red-throated diver within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	Red-throated divers require suitable habitat within the SPA for foraging, resting, and other maintenance activities. They are more likely to be found over shallow, flat, sandy substrates close to shore (Gray *et al.* 2015). Relatively little is known about the diet of red-throated diver in the non-breeding season. The available evidence indicates a diet of fish, both benthic and pelagic, of up to 25-30cm in length, but typically smaller with species and size composition reflecting seasonal and local availability. Fish species include herring, whiting, gobies, sticklebacks and smelt (Woodward & Humphreys, 2018). The key supporting processes for red-throated divers at Moray Firth SPA are water quality (nutrients and turbidity), tidal cycles, and water flow. Recent research has found an association between diver abundance and the edges of estuarine frontal zones, particularly during times at high and low tide when they are dominated by slack water (Skov *et al*. 2016). Birds follow the trailing edge of the coastal current and abundance may also be linked to shallow areas, high $chlorophyll_a$ and low sea surface temperature and salinity (Skov & Prins, 2001). In the German Bight, no divers were recorded in waters with a surface salinity above 34 psu[9], suggesting salinity could also affect their distribution (Skov & Prins, 2001).
Slavonian grebe	Maintain the extent and distribution of	Slavonian grebe require suitable habitat within the SPA for foraging, loafing, and roosting. In Scotland, Slavonian grebes occur in sheltered inshore marine areas with sandy substrates

[9] Practical Salinity Unit (a measure of the salt concentration in sea water)

	supporting habitats for Slavonian grebe within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	associated with their main prey items (Woodward & Humphreys, 2018). These habitats are used for foraging in the water column (up to 14m). The limited information available on non-breeding season diet show the principal food resource of Slavonian grebes is a range of fish species, though they may occasionally take crustaceans, insects and molluscs opportunistically (Woodward & Humphreys, 2018). Fish species taken will be influenced by what is locally and most readily available, but can include: gobies, sandeels, stickleback, and sculpins. Information on prey habitat associations is limited. The key supporting processes for Slavonian grebes at Moray Firth SPA are not well known but may include water quality (nutrients and turbidity), tidal cycles, and water flow. Slavonian grebes prefer high water quality, which has been related to the efficiency of catching fish (Summers & Mavor, 1995). As Slavonian grebes are visual feeders it is possible that an increase in water turbidity could affect their foraging ability or have an effect on their prey species (Cook & Burton, 2010).
Common eider	Maintain the extent and distribution of supporting habitats for common eider within the site. ***and*** Maintain the variety and abundance of	Eider require suitable habitat within the SPA for foraging, loafing, moulting and roosting. In Scotland, eiders occur in sheltered bays with rocky, stony or hard substrates associated with their main prey items. Foraging in these habitats occurs on the seabed. Open waters are also used potentially for loafing, moulting and roosting. Eiders have a wide variety of prey items. Their principal food resource is benthic bivalves, in particular blue mussels, and other species such as the common cockles, razor clams and clams. They also take shore crabs other marine invertebrates, including gastropods, and fish (Woodward & Humphreys, 2018; Waltho & Coulson, 2015).

	food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	Eider dive from the surface to pluck their prey from the seabed and typically feed in water depths of under 10m. They prefer areas where there are high abundances of benthic molluscs and actively select particular sizes of their preferred prey (Nehls & Ketzenberg, 2002). Eiders may be attracted to artificial structures that support mussel populations (Heubeck & Mellor, 2013; Cervencl *et al.* 2015). The prey supporting habitats of eider are relatively fixed and the principal prey species are not particularly mobile. In Scotland, six biotopes are associated with blue mussel and ten with other named bivalve prey of eider (Sotheran *et al*. 2019). A number of biotopes were found in association with eider prey items (blue mussel, other bivalves, and crustacea) within Moray Firth SPA (Woodward & Humphreys, 2018). However, the distributions of the principal prey species and associated supporting habitats of eider in the Moray Firth SPA are largely unknown. The key supporting processes for eiders at Moray Firth SPA are water quality (nutrients and turbidity), tidal cycles, and water flow. Eiders exhibit increased feeding activity at low tide when mussel beds are more accessible and in the morning and towards dusk. In Scotland, greater numbers were observed during ebb tides on an exposed west-facing coast and during slack tides and in mornings and evenings in a strongly tidal area (Robbins, 2011 & 2012). Eider appear to be unable to feed in currents faster than ~1.2 m s-1 (Heath *et al.* 2010). High turbidity may also affect eiders, potentially by limiting their visibility (Dickson & Smith, 2013), or reducing growth of mussel prey (Nehls, 2000). The causal links between eider numbers and water turbidity however are unclear.
Common goldeneye	Maintain the extent and distribution of supporting habitats for common goldeneye within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats	Goldeneye require suitable habitat for foraging, loafing, roosting and other maintenance activities within this SPA. Goldeneye use a range of freshwater, brackish and marine waters in the non-breeding season and are commonly associated with estuaries (Woodward & Humphreys, 2018). They feed predominantly during the day and have a preference for shallow waters, with their maximum dive depth being 6m (Sotheran *et al.* 2019). Goldeneye does not appear to exhibit a particular preference for a single type of substrate. Goldeneye take a wide variety of prey items, including: bivalues such as blue mussels, zebra mussels, gastropods (inc. *Bittium reticulatum* and *Rissoa membranacea*), crustaceans (including the shore crab), polychaetes, other invertebrates (e.g. chironomid larvae) and plant materials (Woodward & Humphreys, 2018).

	and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	The prey supporting habitats of goldeneye are relatively fixed and the principal prey species are not particularly mobile. Information is lacking on prey supporting habitats for common goldeneye within the Moray Firth SPA. The key supporting processes for goldeneye at Moray Firth SPA are not well known, but may include water quality (nutrients), tidal cycles and water flow. Goldeneye in the Moray Firth have previously been recorded feeding directly on sewage and industrial waste outfalls (Barrett & Barrett, 1985), suggesting that water with high levels of nutrients is still suitable. Goldeneye foraging activity has been recorded as being higher during low tides, compared to other tidal states (Mudge & Allen, 1980). Roost flights have been recorded in darker twilight periods in mid-winter and colder temperatures (Sayler & Afton, 1981).
Common scoter	Maintain the extent and distribution of supporting habitats for common scoter within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained	Common scoter require suitable habitat for foraging, loafing and roosting within this SPA. They are normally found in open coast habitats, in shallow waters of 20m of less (Woodward & Humphreys, 2018). However, they will regularly swim (and occasionally fly) to deeper water further offshore to roost at night (Mudge & Allen 1980; D. Patterson *pers. comm.).* Common scoter diet in winter is almost exclusively bivalves, and they will preferentially feed on the most locally abundant species (Woodward & Humphreys, 2018). In the UK, key prey items include: common cockle, Baltic clam, and the bivalve *Nucula sulcata* with blue mussel, surf clams (specifically *Spisula subtruncata*), soft-shell clam*, Cardium lamarckii,* and Atlantic jackknife clam recorded from studies elsewhere in Europe (Woodward & Humphreys, 2018). Some studies also indicate that other food groups including gastropods, crustaceans and echinoderms are occasionally consumed in low quantities. The prey supporting habitats of common scoter are relatively fixed and the principal prey species are not particularly mobile. Common scoter are usually associated with sandy substrates, which support many of its bivalve prey with the notable exception being blue mussel, which is found on rocky or stony substrates. In Scotland, 16 biotopes are associated with 11 bivalve prey species for common scoter, which have been identified in a review by Woodward and Humphreys (2018). However, there is limited information on prey and their supporting habitat distributions within the Moray Firth SPA.

	any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	The key supporting processes for common scoter at Moray Firth SPA are not well known, but may include water quality (nutrients), tidal cycles and water flow. There is limited evidence that foraging is also influenced by tides, with one study recording more feeding activity at high tide (Goudie & Ankney, 1986), and counts in Carmarthen Bay suggest movement closer to shore at high tide (Banks *et al*. 2007). However these movements are likely to relate to access to different feeding areas at different tidal stages. Observations at Dornoch during 2019-2020, suggest that birds tend to loaf/rest at peak high tide, often outwith forage zones. However, birds often fly back to foraging sites again and begin diving as soon as the tide starts to turn. This may be associated with a preference to be foraging in association with tidal currents, such as the outflow of the Dornoch Firth (Patterson, 2019). Scoters foraging along the open coast with no apparent outflow current, may utilise different foraging strategies. For example, open coast flocks appear to engage more in synchronised diving bouts compared to birds foraging within the outer Dornoch Firth (D. Patterson *pers. comm*.).
Greater scaup	Maintain the extent and distribution of supporting habitats for greater scaup within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or	Scaup require suitable habitat within the SPA for foraging, loafing and roosting. They prefer shallow waters, having a maximum dive depth of 10m (Sotheran *et al.* 2019). They have been previously recorded as being associated with sandy substrates and over the Zostera zone or over blue mussel beds, although it is not known if they have the same preferences within the Moray Firth SPA. Scaup diet consists predominantly of bivalves including: blue mussel, non-native zebra mussel, soft shell clam, and Baltic clam; gastropods and crustaceans also feature (Woodward & Humphreys, 2018). In Scotland, 15 biotopes are associated with principal bivalve prey species identified for scaup (Sotheran *et al*. 2019). There are relatively few records of scaup prey species and/or associated biotopes within the Moray Firth SPA. The key supporting processes for scaup at Moray Firth SPA are not well known, but may include water quality (nutrients), tidal cycles and water flow. Scaup may benefit from improved transparency of waters where it can lead to recovery of eutrophication-sensitive prey (Pringle & Burton, 2017). As scaup have previously been recorded feeding directly on sewage and industrial waste outfalls (Pringle & Burton, 2017), water with high levels of nutrients may be suitable for them and thus a reduction in nutrients may also affect this species. Tidal races are strongly avoided and previous studies have shown they favour areas of low water current due to the presence of sediment-type for foraging (Jones & Drobney, 1986; Furness *et al.* 2012). Observations of scaup within nearby Dornoch Firth SPA showed that scaup tended to forage during high tides and tended to roost/loaf at

	contaminants where this could reduce supporting habitats and/or prey, should be avoided.	low tide. It is not known whether this same strategy is true for Moray Firth SPA, which is more open sea habitat compared to estuarine habitat.
Long-tailed duck	Maintain the extent and distribution of supporting habitats for long-tailed duck within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	Long-tailed duck require suitable habitat within the SPA for foraging, loafing and roosting. Long-tailed duck appear to prefer open coast habitats and can be found far offshore (Heinänen *et al.* 2017). Foraging occurs within the water column (up to 37m) and on the seabed (Woodward & Humphreys, 2018). Long-tailed ducks do not appear to demonstrate a general preference for a single type of substrate and have been recorded across both hard and soft substrates, stony/gravel substrates, and sandy/muddy substrates (Nilsson, 1972; Sanger & Jones, 1982). Long-tailed duck distribution has been correlated with bivalve, including blue mussel, abundance (e.g. Vaitkus & Bubinas, 2001). Long-tailed duck is a generalist and opportunistic feeder exploiting a wide range of prey resources (Woodward & Humphreys, 2018). Information on non-breeding season diet suggests that it is based largely on bivalves (including blue mussel, cockles, and clams), gastropods and crustaceans (e.g. amphipods and isopods) with occasional fish (e.g. Gobiidae) and echinoderms (Woodward & Humphreys, 2018). In late winter and spring, they will also exploit fish eggs where available (Bustnes & Systad, 2001). The majority of prey items taken are small (typically less than 10mm). During spring, in particular, large number of birds have been seen to feed closer to the shore at Moray Firth SPA, often within the wave zone. This will often involve synchronized diving. It is possible that this 'close-to-shore' foraging may be linked to a seasonal change/preference in diet, where small fish may help to equip birds with extra resources in advance of the spring migration north. Observations of long-tailed ducks in Orkney also suggests that mobile prey (i.e. small fish shoals) may become an important part of their spring diet (D. Patterson, *pers comm.).* The prey supporting habitats of long-tailed duck are relatively fixed and the principal prey species are not particularly mobile. In Scotland, 27 biotopes can be associated with benthic prey of long-tailed duck, including six with blue mussel, nine with other bivalves, two with gastropods, and, twelve with Mysidae crustraceans (Sotheran *et al.* 2019). There are limited records of long-tailed duck benthic prey species and/or associated biotopes within the Moray Firth SPA, with only a few records at the mouth of the Dornoch Firth.

		The key supporting processes for long-tailed duck at Moray Firth SPA are not well known but may include water quality (nutrients and turbidity), tidal cycles, and water flow. Long-tailed duck have been associated with slack waters, main flow in channels and in eddies, as opposed to more turbulent water (Holm & Burger, 2002). It is not known whether long-tailed ducks in this SPA demonstrate the same preferences.
Red-breasted merganser	Maintain the extent and distribution of supporting habitats for red-breasted merganser within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	Red-breasted merganser require suitable habitat within the SPA for foraging, loafing, moulting and roosting. In Scotland, red-breasted mergansers occur in open coast habitats with clear, shallow waters and have been associated with both rocky and sandy substrates. Foraging in these habitats occurs within the water column (up to 12m depth). Open, deeper waters are also used potentially for loafing, moulting and roosting. The limited information on non-breeding season diet suggests that red-breasted merganser feeds principally on small (generally less than 8–10 cm but up to 15cm long) fish. Fish species taken will be influenced by what is locally most readily available, but can include: gobies, sandeels, flounder, butterfish, herring, sprat, sticklebacks and coalfish, as well as amphipods and other crustacea (e.g. brown shrimp and shore crab) (Woodward & Humphreys, 2018; Cramp & Simmons, 2004). Given largely mobile fish prey of red-breasted merganser, linkages to supporting benthic habitats are poorly defined. The key supporting processes for red-breasted merganser at Moray Firth SPA are water quality (nutrients and turbidity), tidal cycles, and water flow. Red-breasted merganser show a preference for clear, shallow waters not affected by heavy wave action, strong tidal flows or eddies. It is likely this is related to efficiency of foraging, both in visually spotting prey and in the prey capture itself.

Velvet scoter	Maintain the extent and distribution of supporting habitats for velvet scoter within the site. ***and*** Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	Velvet scoters require suitable habitat within the SPA for foraging, loafing, and roosting. They are normally found in open coast habitats in shallow waters (less than 20m usually) (McCluskie *et al*. 2012). Preferred substrate is either sandy or coarse (stony, cobbles, or fine gravel) (Woodward & Humphreys, 2018). In sandier substrates they may dig into the seabed with their bills to locate prey (Byrkjedal *et al.* 2008). The non-breeding season diet of velvet scoters is almost exclusively bivalves (Woodward & Humphreys, 2018). Fox (2013) gives an upper bivalve prey size limit of around 40 mm for a similar scoter species. In Scotland, 11 biotopes are associated with 4 (*Cerastoderma edule*, *Limecola balthica*, *Mya arenaria* and *Spisula subtruncata*) of the 5 bivalve prey species identified by Sotheran *et al.* (2019) as principal prey resources for velvet scoters. Within the Moray Firth SPA records of velvet scoter prey items are relatively sparse. Velvet scoter may also take smaller numbers of crustacean, isopods, amphipod, echinoderms, polychaetes and occasional fish. The key supporting processes for velvet scoter at Moray Firth SPA are poorly understand but may be linked to water quality (nutrients and turbidity), tidal cycles, and water flow. Holm & Burger (2002) found that a similar species, white-winged scoters, avoided turbulent waters and eddies. It is not known if the same is true for velvet scoters.
European shag	Maintain the extent and distribution of supporting habitats for European shag within the site. ***and***	Shags require suitable habitat for foraging, loafing, bathing, and other maintenance activities within this SPA. Shags predominant foraging strategy is as a benthic feeding piscivore. As such, foraging areas tend to coincide with areas of sandy benthic sediment, and occur where depth is less than 80m (Daunt *et al.* 2015). Shags from the Isle of May typically dive to between 10-40m, though dives of more than 50m have been recorded (Daunt *et al.* 2006). Shags prefer rocky coasts with deep, clear water and forage over sandy and rocky seabeds (del Hoyo *et al.* 1992). Shags will also forage in sheltered bays and channels, and will generally avoid estuaries, shallow or muddy inlets and fresh or

	Ensure there is sufficient prey availability and, if appropriate, ensure prey resources and/or prey supporting habitat have the ability to recover. ***and*** Maintain the condition of supporting habitats and associated processes. ***and*** Existing water quality should be maintained any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	brackish waters (Wanless & Harris 1997; BirdLife International, 2019). They will also forage within kelp forests (Kelly, 2005). Shags are predominantly piscivores, feeding on a wide range of demersal, benthic and pelagic fish, however numbers of polychaetes, cephalopods, other molluscs and small benthic crustaceans have also been recorded in their diet (Barrett & Furness, 1990; del Hoyo *et al.* 1992). Sandeels are their dominant prey species (Wanless & Harris, 1997), with some populations being shown to be reliant on sandeel particularly during the breeding season (Lilliendahl & Solmundsson, 2006). Other prey include fish of the families Gadidae, Clupeidae, Cottidae, and Labridae are also consumed. Studies have demonstrated factors relating to prey availability (including sandeel and saithe) correlate with breeding success (e.g. Bustnes *et al.* 2013). Continued declines in breeding European shag at the East Caithness Cliffs SPA are potentially associated with pressures within the Moray Firth SPA, such as reduction in prey. Research is required to fully understand the reasons behind the decline and whether there is anything that can be done to reserve it. The key supporting processes for shags at Moray Firth SPA are water quality (nutrients and turbidity), tidal cycles, and water flow. Shags have been recorded commonly feeding in areas with strong tidal flow (Wanless *et al.* 1991). The fact that shags tend to avoid muddy areas for foraging suggests turbid waters may be harder to forage in due to a decrease in visibility to see and catch prey. Therefore any increase in turbidity in waters within this SPA could affect the shags. Strong winds have also been noted to negatively affect the foraging efficiency of this species (Lewis *et al.* 2015), and thus having sheltered areas closer to the shore will be important for shags.

Annex 2. Supporting information

Factors determining the potential for feature recovery.

Feature	*Factors determining the potential for feature recovery*
Great northern divers	Great northern diver have a relatively long generation length estimated at 11.3 years and a maximum longevity of around 30 years (Bird *et al.* 2020). Adults first breed at 3 years with a clutch size of 2 (1-3) eggs (Cramp & Simmons, 2004). Adult survival rates have been estimated at 0.915 (Bird *et al.* 2020) and average productivity as 0.543 (Horswill & Robinson, 2015). With a low fecundity and population stability relying on high levels of adult survival, any pressure on adult survival would quickly have an adverse effect on great northern diver population numbers. Great northern divers use marine waters off Scotland's coasts in their non-breeding season between October and mid-May. They exhibit high site fidelity, which may limit individual ability to adapt to changes within wintering areas and hence potential for population recovery from perturbations. Great northern divers may be particularly sensitive to disturbance on their wintering grounds during their pre-breeding flightless moult period on their wintering grounds between February and mid-April. The birds wintering in GB waters are thought to derive mainly from the European breeding population in Iceland, Greenland and Baffin Island (total population estimated at 700-1,300 pairs, which equates to 1,400-2,600 mature individuals, BirdLife International, 2019) with a very small proportion coming from eastern Canada (Furness, 2015). Pressures in these breeding grounds (e.g. human disturbance and pollution of inland breeding lakes) could limit potential for populations to recover from impacts arising in wintering areas.
Red-throated diver	Red-throated diver estimated generation length is 8.2 years, with the maximum longevity estimated as around 24 years (Bird *et al.* 2020). Age of first breeding is uncertain, but has been estimated as being 2.5 years (Bird *et al.* 2020). Clutch size is 2 (1-3) eggs (Cramp & Simmons, 2004) and Horswill & Robinson (2015) give national average productivity of 0.571 (±0.222 SD). However, productivity is known to vary depending on region and on the year, from 0.13 (Orkney in 2017) to 0.91 (southern Finland). Horswill & Robinson (2015) give an estimated adult (3+years) survival rate of 0.840 (±0.074 SE). Most mortality is thought to occur in the non-breeding season (Schmutz, 2014). Juvenile (0-1year) and immature (1-2 year) survival rates have been estimated as 0.600 and 0.620 (Horswill & Robinson, 2015). As for other species with apparently high adult survival rates, relatively large impacts on population trends may arise from changes to adult survival. Red-throated divers breeding in Scotland winter over a substantial area including both east and west coasts of Britain and Ireland (Okill, 1994). Birds from breeding grounds in Scandinavia and the Baltic states are thought to migrate mainly to the southern North Sea in winter (Wright *et al*, 2012; O'Brien *et al*, 2008); while birds from Greenland have been recovered in Scotland (Wernham *et al.* 2002). Recent tracking studies of wintering birds captured in the German North Sea indicate that individual birds exhibit high levels of consistency in migration routes, breeding, wintering & moulting areas (Kleinschmidt *et al.* 2017) which may limit individual ability to adapt to changes within wintering areas and hence potential for population recovery from

	perturbations.. Red-throated divers may be particularly sensitive to disturbance during their post-breeding flightless moult period, commencing sometime between late September and December (Cramp & Simmons, 2004). Pressures at terrestrial nesting grounds (e.g. pollution of inland breeding lakes, depredation by invasive mammalian predators (Furness, 2016)) or in wintering areas at sea (e.g. displacement from offshore wind farms) could limit the potential of populations to recover from impacts arising in marine foraging areas.
Slavonian grebe	Slavonian grebes have an estimated generation length of 4.4 years and a maximum longevity of 13 years (Bird *et al.* 2020), which is relatively short for waterfowl and lower than in true seabirds. Adults first breed at 2 years (Bird *et al.* 2020) with a clutch size of 4-5 eggs (Cramp & Simmons, 2004). Productivity estimates are lacking for this species, though an average of 1.9 fledged chicks per clutch was recorded from one colony (Cramp & Simmons, 2004) and a similar species, great crested grebe, has average productivity of 1.275 (±0.0.35SD) (Horswill & Robinson, 2015). Adult survival rate has been estimated as being 0.728 (Bird *et al.* 2020). Slavonian grebe population stability is therefore likely to rely on high levels of adult survival, and any pressure on adult survival would quickly have an adverse effect on Slavonian grebe population numbers. Slavonian grebes depend on sheltered, shallow inshore marine waters in their non-breeding season between mid-September and late April. This may restrict their potential to occupy alternative wintering areas in event of habitat loss or displacement. The birds wintering in GB waters are thought to derive mainly from the large-billed NW European population breeding in Iceland, Faeroes (occasional) and North Norway (Cramp & Simmons, 2004) estimated at 4,600 – 6,800 birds (Wetlands International, 2015 & 2018). Pressures in these breeding grounds (e.g. human disturbance and pollution or acidifications of inland breeding lakes (Mendel *et al*. 2008)) could limit potential for populations to recover from impacts arising in wintering areas.
Common eider	Eiders have a relatively long generation length estimated at 11.2 years and a maximum longevity of around 38 years (Bird *et al.* 2020). Females first breed at 3 years with a clutch size typically of 4-6 eggs (Cramp & Simmons, 2004). Adult survival rates from older studies are highly variable, but have been estimated as 0.872 (Bird *et al.* 2020), with annual productivity being 0.379 (Horswill & Robinson, 2015). The critical factor for the long-term survival of the species appears to be the survival rate of young ducklings (Waltho & Coulson, 2015) and both disease outbreaks and poor breeding female condition have been associated with mass mortality in this species (BirdLife International, 2019). Eider are dispersive partial migrants, resident year round in Scotland. The non-breeding season extends from September to mid-April during which period large flocks may form. Males start to assemble from June or early July and are joined by post-breeding females 3-4 weeks later forming aggregations during the flightless post-breeding moult period between July to mid-September (Cramp & Simmons, 2004). Eider are especially vulnerable to disturbance at sea during this period. Flightless young ducklings also form crèches at sea, guarded by females.

	Eider nest on the ground in loose colonies usually in areas free of mammalian predators (Waltho & Coulson, 2015), 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 or on tundra pools (BirdLife International, 2019). Pressures in these breeding grounds (e.g. human disturbance and depredation by introduced mammals) could limit potential for populations to recover from impacts arising at sea.
Common goldeneye	Estimated generation length is 7.1 years and they have a maximum known longevity of around 20 years (Bird *et al.* 2020). Age of first breeding is 3 years (Bird *et al.* 2020) with a clutch size of 8-11 (5-13) eggs (Cramp & Simmons, 2004). Breeding success is difficult to assess as young leave nest holes shortly after hatching. Horswill & Robinson (2015), gives an estimate of 0.365 chicks fledged per pair per annum. Baldassarre (2014) characterises brood survival as low, but variable with geographic location and year. Adult survival rates range from 0.65 (Bird *et al.* 2020) to 0.83 (Balmer & Peach, 1997). Goldeneye utilise a range of shallow (up to c.6m) freshwater, brackish and marine habitats in the non-breeding season and also appear able to utilise a wide range of small prey items, including both animal and plant materials (Cramp & Simmons, 2004; Woodward & Humphreys, 2018). This may enable them to utilise alternative wintering areas in event of localised habitat loss or displacement. Goldeneye wintering in GB are thought to come mainly from the Scandinavian breeding population (Wright *et al.* 2012). Pressures in their breeding grounds (e.g. wetland degradation, acid rain, loss of natural nesting habitat in old and decaying trees with potential nest holes) could limit potential for populations to recover from impacts arising in wintering areas (BirdLife International, 2019).
Common scoter	Estimated generation length is 5.3 years, which appears fairly short for a seaduck, and they have a maximum known longevity of 18 years (Bird *et al.* 2020). Age of first breeding is 2 years (Bird *et al.* 2020). They have a clutch size is 6-8 (5-11) eggs and birds may relay following egg loss (Cramp & Simmons, 2004). Horswill & Robinson (2015) cite an estimated productivity of 1.838 (±1.184 SD), which appears quite a low productivity. Adult survival rate has been estimated as being 0.78 (Bird *et al.* 2020). The annual mortality among adult birds ringed in Iceland was estimated at 23% (Cramp & Simmons, 2004). Common scoter population stability is likely to be related to a high levels of adult survival, and any pressure on adult survival may adversely effect on population numbers. However, common scoter populations have previously demonstrated the ability to recover from once-off pollution events (e.g. an oil spill event at Carmarthen Bay, where after three winters no observable long-term effects were noted (Banks *et al.* 2007)). Common scoter exhibit complex migratory behaviour between breeding, moulting and wintering grounds, but the GB wintering population appears to be derived mainly from Scandanavian and Icelandic breeding populations (Wernham *et al.* 2002). Pressures in these breeding grounds could limit potential for populations to recover from impacts arising in wintering areas. Common scoter is highly gregarious outside of the breeding season and is commonly observed in large dense flocks of thousands or even tens of thousands of individuals. This may mean that if a disturbance was to occur within their flock that a large number of individuals could potentially be affected. Adults become flightless for several weeks during their wing moult and may be particularly susceptible to disturbance or pollution at this time.

Greater scaup	Estimated generation length is 4.1 years, which appears fairly short for a seaduck, and they have a maximum known longevity of 22 years (Bird *et al.* 2020). Age of first breeding is uncertain but thought to be 1-2 years (Bird *et al.* 2020). Clutch size is 8-11 (6-15) eggs and birds may relay following egg loss (Cramp & Simmons, 2004). Horswill & Robinson (2015) give a mean productivity of 0.570 (± 0.120). Adult survival is estimated as 0.74 (Bird *et al.* 2020) with juvenile (0-1 years) survival estimated as 0.40 (Horswill & Robinson, 2015). Annual mortality among adult birds ringed in Iceland was 52% (Boyd 1962), which appears to be quite high. Scaup wintering in Britain and Ireland are derived mainly from the (small) Icelandic breeding population (Wright *et al*. 2012; Balmer *et al*. 2014). During severe winters large numbers of birds arrive in the UK from the Baltic (Salmon, 1988). Pressures in their breeding grounds (e.g. particularly susceptible to nests being flooded) could limit potential for populations to recover from impacts arising in wintering areas. Scaup are highly gregarious outside of the breeding season and are commonly observed in small or large flocks sometimes of several thousand individuals. This may mean that if a disturbance was to occur within their flock that a large number of individuals could potentially be affected. Their nocturnal feeding habits and potential use of daytime onshore roosts may make it vulnerable to some types of disturbance of less relevant to diurnal foragers. Scaup appears to be relatively adaptable and able to consume a range of different prey groups when they are available, which may lessen potential impacts of localised prey or habitat loss.
Long-tailed duck	Long-tailed ducks have an estimated generation length of 6 years with a maximum longevity estimated as around 23 years (Bird *et al.* 2020). Adults first breed at 2 years (Bird *et al.* 2020). Clutch size is 6-9 (5-11) eggs and birds may relay, up to twice, following egg loss (Cramp & Simmons, 2004). Estimated productivity is 1.900 (±0.660 SD) (Bengtson, 1972), although this is from an old study on an Icelandic population. Adult survival rate is estimated as 0.75 (Bird *et al.* 2020). It is a relatively long-lived species that can, like many Arctic-breeding waterbirds, withstand high variation in annual breeding success (Hearn *et al.* 2015). However, for populations to remain stable, long-term breeding success needs to exceed a certain level to ensure sufficient debut breeders enter the breeding stock to compensate for adult mortality. The most likely demographic explanation of the observed declining population trend is likely to be low productivity in combination with the additional adult mortality from anthropogenic causes in non-breeding areas (Hearn *et al.* 2015; Hario *et al.* 2009). Long-tailed duck have a circumpolar breeding distribution across Arctic coasts of North America, Greenland, Europe and Asian Russia migrating south to winter at sea (BirdLife International, 2019). The GB wintering population is on the south-western edge of the NW Europe biogeographic range. The origins and migration routes of birds wintering around Britain and Ireland are poorly understood; the majority are thought to breed in northern Fennoscandia and northwest Russia, but there is very little supporting evidence (Wright *et al.* 2012). Pressures in these breeding grounds (e.g. increased predation associated with climate-change induced disruptions to established predator-prey cycles) could limit potential for populations to recover from impacts arising in wintering areas (Hario *et al.* 2009; Hearn *et al.* 2015).

	Long-tailed duck have a very varied diet and multiple studies in both Europe and North America have identified different diets among different groups of birds or at different sub-sites (e.g. Bustnes & Systad, 2001; Žydelis & Ruskyte, 2005, Schummer *et al.* 2008). This dietary plasticity, together with ability to exploit both exposed and sheltered waters to depths in excess of 20m and absence of a flightless moult period in their wintering grounds may provide some resilience against localised displacement and to loss of or damage to prey or prey-supporting habitats in wintering grounds. However, Hearn *et al.* (2015) suggest that cumulative impact of factors such as increased water temperature, reduced nutrient loads or predation by non-native fish on the availability and accessibility of optimal prey resources are of considerable concern in wintering and staging areas in the Baltic.
Red-breasted merganser	Red-breasted merganser have an estimated generation length of 5.7 years and a maximum longevity of around 21 years (Bird *et al.* 2020). Adult survival rates have been estimated as 0.62 (Bird *et al.* 2020). Adults first breed at 2 years old and clutch size is 8-10 eggs (Cramp & Simmons, 2004). Studies in Finland recorded average young reared per pair over three years of between 0.7-2.0 (Cramp & Simmons, 2004). Red-breasted merganser are dispersive partial migrants, resident year round in Scotland. The non-breeding season extends from mid-August to late March. Their behavioural sensitivity to visual disturbance and noise may be of particular importance during their post-breeding flightless moult period (August-September) when birds gather in coastal or near-coastal waters, prior to migration to wintering grounds. The birds wintering in GB waters include British breeding birds, the majority of the Icelandic breeding population, and some European birds (Wernham *et al*. 2002; Wright *et al.* 2012). Pressures in breeding grounds (e.g. non-native mammalian predators, human persecution; BirdLife International, 2019) could limit potential for populations to recover from impacts arising in wintering areas.
Velvet scoter	Estimated generation length is 5.8 years, which appears fairly short for a seaduck, and they have an estimated known longevity of around 21 years (Bird *et al.* 2020). Age of first breeding is 2-3 years (Bird *et al.* 2020). Clutch size is 7-9 (5-12) eggs and birds may relay following egg loss (Cramp & Simmons, 2004). Average productivity has been estimated at 0.350 (Horswill & Robinson, 2015), which is quite low. Adult survival has been estimated as 0.79 (Bird *et al.* 2020). Velvet scoter population stability is likely to be related to a high levels of adult survival, and any pressure on adult survival would quickly have an adverse effect on population numbers. Velvet scoter in the biogeographic (Western Siberia and Northern Europe) population breed in Scandinavia and western Siberia. The vast majority (c.82%) winter in the Baltic with smaller numbers along coasts of western Europe (BirdLife International, 2019). Pressures in breeding grounds (e.g. non-native mammalian predators, pollution, persecution) could limit potential for populations to recover from impacts arising in wintering areas. Velvet scoter are much less gregarious than common scoter, forming generally small scattered groups, rarely of more than 100 birds, at sea (Cramp & Simmons, 2004). They have a tendency to dive rather than to fly when disturbed (Cramp & Simmons, 2004); this could affect the potential energetic consequences of disturbance. Winter flocks in UK are of reportedly unbalanced composition, with males tending to predominate to north (e.g. up

	to 30:1 in Orkney) and females and young to south (Cramp & Simmons, 2004); this could affect population consequences of any excess anthropogenic mortality in wintering grounds. They appear able to adapt diet to different bivalve species depending on what is locally available but may have limited flexibility to switch away from molluscs as their main diet (Woodward & Humphreys, 2018).
European shag	Estimated generation length is 9.2 years and maximum known longevity is around 30 years (Bird *et al.* 2020). Age at first breeding is normally at 2 or 3 years old (Wanless & Harris, 2004). Clutch size is usually 3 (1-6) eggs and they will only have one brood per breeding season (Cramp & Simmons, 2004). Their pre-laying period is in March, their egg incubation period from April-June and takes 30-31 days; and their chick rearing period is between June-August and can take 48-58 days (Cramp & Simmons, 2004). Shags often defer breeding for a year if local conditions are unfavourable (Wanless & Harris, 2004). Adult survival rates have been estimated as being between 0.85 (Bird *et al.* 2020) to 0.88 per annum for well-studied Isle of May birds (Wanless & Harris, 2004). Average productivity is estimated as 1.303 (Horswill & Robinson, 2015). Recruitment rates are relatively low which means any effect which causes a decline in numbers could limit the ability for the population to recover. Survival and productivity are thought to be affected by the amount of available prey (Wanless & Harris, 2004). European shags are a resident UK species and present around the UK coastline throughout the year. In winter, numbers of shags move short distance migrations within and 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 (Goodship & Furness, 2019). Immatures may disperse over short distances post-breeding (del Hoyo *et al.* 1992). Adults return to breeding sites from February, with their main breeding period being from March-end of September and thus their non-breeding period is from late September-early February. They are highly site faithful, both in the breeding period (Aebischer, Potts & Coulson, 2008) and in their non-breeding period with preferred roost sites (Grist *et al.* 2014), which may limit individual ability to adapt to changes within these areas and hence potential for population recovery from perturbations. Shags predominant foraging strategy is as a benthic feeding piscivore (Wanless *et al.* 1991) and whilst their diet is predominantly associated with sandeels, they have a wide prey base of demersal and pelagic fish. At some colonies (Isle of May), shags have demonstrated an ability to switch prey items in times of poor sandeel availability, but it is not known if this has population consequences for the shags, or indeed whether the ability to prey switch is possible in all locations (e.g. more northern locations) (Daunt *et al.* 2015). The available data shag feeding habitat suggest that, within the inshore zone as a whole, the species is fairly plastic in its habitat requirements (BirdLife International, 2019). Shag plumage is different to other seabird species in that it requires a 'wing-drying' process after foraging/diving, as their feathers are not fully water-repellent. They require longer period of 'wing drying' depending on the weather conditions and how long they had been under water for (Debout & Sellers, 1995). Their lack of complete waterproofing may explain why they are so susceptible to increased storminess and extreme weather which can lead to mass mortality 'wreck' events for shags, particularly in the winter, (Bustnes

	et al. 2013; Frederiksen *et al.* 2008). Shags also tend to nest further down the cliff, making them vulnerable to summer storms when large waves hit the coastlines, potentially resulting in nests lower down becoming washed out or swept away. Extreme weather events in the summer periods with increased high winds and rainfall have previously resulted in widespread breeding failures (Aebischer, 1993).

Annex 3. Glossary for Conservation Objectives and References

Glossary

Conservation Objective term	Definition
Distribution	The "distribution" is how the qualifying feature is spread out within the site.
Favourable condition	This refers to the assessed condition of a feature through Site Condition Monitoring. Features considered to be in favourable condition for the purposes of these Conservation Objectives are those that have an assessed condition of either: • Favourable Maintained - the attribute targets set for the natural features have been met, and the natural feature is likely to be secure on the site under present conditions. • Favourable Recovered - the condition of the natural feature has recovered from a previous unfavourable condition, and attribute targets are now being met.
Generation length	Generation length is the average age of parents of the current cohort. Generation length therefore reflects the turnover rate of breeding individuals in a population (IUCN, 2019).
Maintain	Where a qualifying feature of the SPA is assessed as being in favourable condition the conservation objective is 'maintain'. This means that the various attributes of the feature should be kept at that favourable level. This can include increasing/improving condition as well, but not a permanent decline.
Marine birds	This term encompasses true seabirds and waterfowl (seaducks, divers, and grebes).
Restore	Where a qualifying feature of the SPA is assessed as being in unfavourable condition the conservation objective is 'restore'. This means that the various attributes of the feature should be returned to the favourable level by increasing/improving condition.
Site integrity	The integrity of a site is defined in general terms as the coherence of its ecological structures and function, across its whole area, which enables it to sustain the habitat, complex of habitats and and/or the levels of populations of the species for which it was designated.
Site reference population	This refers to the estimated population figure for the site and should be used to form the basis of carrying out HRAs. In most cases, the site reference population will be the baseline population (figure at designation). However, where recent surveys show a population to have increased or stayed stable, the current population is considered the most appropriate population figure to use for HRA's.
Supporting habitats and processes	This includes (but is not limited to) the following environmental conditions which are important for maintaining/restoring the protected features, e.g. hydrography and supporting water currents, chemical water quality parameters, suspended sediment levels, radionuclide levels.
Unfavourable condition	This refers to the assessed condition of a feature through Site Condition Monitoring. Features considered to be in unfavourable condition for the purposes of these Conservation Objectives are those that have an assessed condition of either: • Favourable declining - The attribute targets set for the natural feature have been met, but evidence suggests that its condition will worsen unless remedial action is taken.

Conservation Objective term	Definition
	• Unfavourable recovering - One or more of the attribute targets have not been met on the site, but management measures are in place to improve the condition. • Unfavourable no change - One or more of the attribute targets have not been met, and recovery is unlikely under the present management and activity on the site. • Unfavourable declining - One or more of the attribute targets have not been met, evidence suggests that condition will worsen unless remedial action is taken.
Waterfowl	Encompasses seaducks, grebes and divers.

References

Aebischer, N.J. 1993. Immediate and delayed effects of a gale in late spring on the breeding of the Shag *Phalacrocorax aristotelis*. Ibis, 135: 225-232.

Aebischer, N., & Potts, G. R. & Coulson, J. 2008. Site and mate fidelity of Shags *Phalacrocorax aristotelis* at 2 British colonies. Ibis. 137. 19 - 28. 10.1111/j.1474-919X.1995.tb03215.x.

Allen, D., Mellon, C. & Enlander, I. 2004 Factors relating to the wintering population of diving ducks on the Lough Neagh System. Report for EHS CON 2/1 (162), Allen & Mellon Environmental Ltd. Belfast.

Baldassarre, G.A. 2014. Ducks, Geese, and Swans of North America. JHU Press. ISBN 9781421407517.

Balmer, D.E. and Peach, W.J. 1997 Review of Natural Avian Mortality Rates BTO Research Report No.l75

Banks, A.N., Bolt, D., Bullock, I.D., Collier, M.P., Fairney, N.P., Hasler C., Haycock, B., Maclean, I.M.D., Roberts, N.P., Sanderson, W.G., Schofiled, R.A., Smith, L., Swan, J.M. & Whitehead, S. 2007. Ground and aerial monitoring for Carmarthen Bay SPA 2004-07. *Marine Monitoring Report No. 48, CCW [BTO Research Report No. 477*]

Baptist, M.J. & Leopold, M.F. 2009. The effects of shoreface nourishments on Spisula and scoters in the Netherlands. Marine Environmental Research 68: 1-11.

Barrett, R.T. & Furness, R.W. 1990. The prey and diving depths of seabirds on Hornøy, north Norway, after a decrease in the Barents Sea capelin stocks. Ornis Scandinavica, 21, 179-186

Barrett, J. & Barrett, C.F. 1985. Wintering Goldeneye in the Moray Firth. Scottish Birds 13: 241-249

Bengtson, S.-A. 1972. Reproduction and fluctuations in the size of duck populations at Lake Mývatn, Iceland. Oikos, 23, 35–58.

Beukema, J. 1993. Increased mortality in alternative bivalve prey during a period when the tidal flats of the Dutch Wadden Sea were devoid of mussels. Netherlands J. Sea Res. 31: 395–406.

Bird, J., Martin, Robert., Akcakaya, H.R., Gilroy, J., Burfield, I., Garnett, S., Symes, A., Taylor, J., Sekercioglu, C., & Butchart, S. 2020. Generation lengths of the world's birds and their implications for extinction risk. Conservation Biology. 10.1111/cobi.13486.

BirdLife International. 2017. European birds of conservation concern: populations, trends and national responsibilities. (Compiled by Anna Staneva and Ian Burfield)http://www.birdlife.org/europe-and-central-asia/European-birds-of-conservation-concern

BirdLife International. 2019. Species factsheets. Downloaded from http://www.birdlife.org on 03/05/2019.

Bradbury, G., Shackshaft, M., Scott-Hayward, L., Rexstad, E., Miller, D. & Edwards, D. 2017. Risk assessment of seabird bycatch in UK waters. Report to Defra. Defra Project: MB0126. Available from:http://sciencesearch.defra.gov.uk/Document.aspx?Document=14236_MB0126RiskassessmentofseabirdbycatchinUKwaters.pdf

Bustnes, J.O. & Systad, G.H. Comparative Feeding Ecology of Steller's Eider and Long-Tailed Ducks in Winter. 2001. Waterbirds Int. J. Waterbird Biol. 24: 407–412.

Bustnes, J., Anker-Nilssen, T., Erikstad, K., Lorentsen, S. & Systad, G. 2013. Changes in Norwegian breeding population of European shag correlate with forage fish and climate. Marine Ecology Progress Series. 489. 235-244. 10.3354/meps10440.

Byrkjedal, I., Eldy, S., Grundetjern, S. & Lyning, M.K. 2008. Feeding associations between Red-necked Grebes *Podiceps griseigena* and Velvet Scoters *Melanitta fusca* in winter. Ibis. 139: 45–50.

Camphuysen, C., Berrevoetsc, C.M., Cremersd, H.J.W.M., Dekingab, A. Dekkerb, R., Ense , B.J., van der Havef, T.M., Katse, R.K.H., Kuikenh, T., Leopold, M.F., van der Meerb, J. & Piersma, T. 2002. Mass mortality of common eiders (*Somateria mollissima*) in the Dutch Wadden Sea, winter 1999/2000: starvation in a commercially exploited wetland of international importance. Biol. Conserv. 106: 303–317.

Camphuysen, C.J., Schouten, S. & Gronert, A. 2010. Mystery spill of Polyisobutylene (C4H8) off the Dutch coast affecting seabirds in March 2010. *Seabird,* **23,** 143-145.

Carboneras, C., Christie, D.A., Kirwan, G.M. & Sharpe, C.J. 2017. Common Eider (*Somateria mollissima*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (ed.), *Handbook of the Birds of the World Alive*, Lynx Edicions, Barcelona.

Cervencl, A., Troost, K., Dijkman, E., de Jong, M., Smit, C.J., Leopold, M.F. & Ens, B.J. 2015. Distribution of wintering common eider *Somateria mollissima* in the Dutch Wadden Sea in relation to available food stocks. Marine Biology 162: 153-168.

Cook, A.S.C.P. & Burton, N.H.K. 2010. A review of the potential impacts of marine aggregate extraction on seabirds. Marine Environment Protection Fund Project 09/P130. British Trust for Ornithology. Thetford, Norfolk, UK.

Craik, S.R., Savard, J.-P.L., Richardson, M.J. & Titman, R.D. 2011. Foraging Ecology of Flightless Male Red-breasted Mergansers in the Gulf of St. Lawrence, Canada. Waterbirds 34: 280–288.

Cramp, S. & Simmons, K. E. L. (eds.). 2004. BWPi: Birds of the Western Palearctic interactive (DVD-ROM). BirdGuides Ltd, Sheffield

Daunt, F., Bogdanova, M., McDonald C. & Wanless S. 2015. Determining important marine areas used by European shag breeding on the Isle of May that might merit consideration as additional SPAs. JNCC Report No: 556 http://jncc.defra.gov.uk/pdf/Report_556_web.pdf

Daunt, F., Wanless, S., Peters, G., Benvenuti, S., Sharples, J., Gremillet, D. & Scott, B. 2006. Impacts of oceanography on the foraging dynamics of seabirds in the North Sea. In: Top predators

in marine ecosystems: their role in monitoring and management. (eds Boyd, I.L., Wanless, S. & Camphuysen, K.) Cambridge University Press, Cambridge, pp177-190

Debout G, Røv N, Sellers R.M. 1995. Status and population development of cormorants Phalacrocorax carbo carbo breeding on the Atlantic coast of Europe. Ardea 83:47–59

del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. *Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks*. Lynx Edicions, Barcelona, Spain.

Dickson, L. & Smith, P. 2013. Habitat used by common and king eiders in spring in the southeast Beaufort Sea and overlap with resource exploration. The Journal of Wildlife Management. 77. 777-790. 10.1002/jwmg.529.

Dierschke, V. & Garthe, S. 2006. Literature review of offshore wind farms with regard to seabirds. *BfN-Skripten* 186: 131-198.

Dierschke, V., K.-M. Exo, B. Mendel & Garthe, S. 2012: Threats for Red-throated Divers Gavia stellata and Black-throated Divers *G. arctica* in breeding, migration and wintering areas: a review with special reference to the German marine areas. Vogelwelt 133: 163 – 194

Eaton, M., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud, D. & Gregory, R. 2015. Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. *British Birds*, 108: 708–746.

Frederiksen, M., Daunt, F., Harris, M.P. & Wanless, S. 2008. The demographic impact of extreme events: stochastic weather drives survival and population dynamics in a long-lived seabird. Journal of Animal Ecology, 77, (5): 1020-1029.

Friend, M. 2006. Evolving changes in diseases of waterbirds. In: G. Boere, C. Galbraith and D. Stroud (eds), *Waterbirds around the world*, pp. 412-417. The Stationary Office, Edinburgh, U.K.

Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Balmer, D.E. 2018. Waterbirds in the UK 2016/17: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT. British Trust for Ornithology, Thetford. 40 pp.

Fox, A.D. 2013. Diet and habitat use of scoters Melanitta in the Western Palearctic – a brief overview. Wildfowl 54: 163-182.

Furness, R.W. 2016. Key pressures and threats faced by marine birds in the UK, conservation action for these birds, and identification of pressures and threats not effectively addressed by existing conservation action. Unpublished report to JNCC.

Furness, R.W., Wade, H.M., Robbins, A.M.C. & Masden, E.A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. *ICES Journal of Marine Science*, 69 (8), 1466-1479.

Furness, R.W., Wade, H.M. & Masden, E.A. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management*,119: 56-66

Furness, R.W. 2015. Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164. (http://publications.naturalengland.org.uk/publication/6427568802627584)

Garthe, S., & Hüppop, O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: Developing and applying a vulnerability index. *Journal of Applied Ecology*, 41(4), 724-734.

Grist H, Daunt F, Wanless S, Nelson EJ, Harris MP, et al. 2014. Site Fidelity and Individual Variation in Winter Location in Partially Migratory European Shags. PLOS ONE 9(6): e98562. https://doi.org/10.1371/journal.pone.0098562

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.*

Goudie, R.I. & Ankey, C.D. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. Ecology 67(6): 1475-1484.

Guse, N., Garthe, S., Schirmeister, B. 2009. Diet of red-throated divers Gavia stellata reflects the seasonal availability of Atlantic herring *Clupea harengus* in the southwestern Baltic Sea. Journal of Sea Research 62: 268-275

Gray, C.E., Gilbert, A.T., Tash, J. & Anderson, C. 2015. Wintering movements and habitat use of Red-throated Loons (Gavia stellata) in the mid-Atlantic U.S. Final Report to the Department of Energy Wind and Water Power Technologies Office. Biodiversity Research Institute, Portland.

Hario, M., Rintala, J. & Nordenswan, G. 2009. Dynamics of wintering long-tailed ducks in the Baltic Sea – the connection with lemming cycles, oil disasters, and hunting. Suomen Riista 55: 83-96. (in Finnish, with English summary).

Hartman, G., Kolzsch, A., Larsson, K., Nordberg, M. & Hoglund, J. 2013. Trends and population dynamics of a velvet scoter (Melanitta fusca) population: influence of density dependence and winter climate. Journal of Ornithology 154: 837-847

Hearn, R., Harrison, A. & Cranswick, P. 2015. Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) - Draft International Single Species Action Plan for the Conservation of the Long-tailed Duck Clangula hyemalis 2016–2025. Adopted at 6th Session of the Meeting of the Parties in November 2015, Bonn, Germany. http://www.unep-aewa.org/en/document/draft-international-single-species-action-plan-conservation-long-tailed-duck-1

Heath, J.P., Gilchrist, H.G. & Ydenberg, R.C. 2010. Interactions between rate processes with different timescales explain counterintuitive foraging patterns of arctic wintering eiders. Proc. R. Soc. B Biol. Sci. 277: 3179–3186.

Heinänen, S., Žydelis, R., Dorsch, M., Nehls, G. & Skov, H. 2017. High-resolution sea duck distribution modeling: Relating aerial and ship survey data to food resources, anthropogenic pressures, and topographic variables. Condor 119: 175–190.

Heubeck, M. 1997. The long-term impact of the Esso Bernicia oil spill on numbers of Common Loons *Gavia immer* wintering in Shetland, Scotland. In: Effects of Oil on Wildlife. Fifth International Conference, November 3–6, Monterey, California: 110–122.

Heubeck, M. & Mellor, M. 2013. Recent changes in the status and distribution of moulting Common Eiders Somateria mollissima in Shetland. Seabird 26: 71–86.

Highland Bird Reports. 2018. Accessed at: http://www.highlandbirds.scot/highland-bird-report.html

Holm, K.J. & Burger, A.E. 2002. Foraging Behavior and Resource Partitioning by Diving Birds During Winter in Areas of Strong Tidal Currents. Waterbirds 25: 312–325.

Holt, C., Austin, G., Calbrade, N., Mellan, M., Mitchell, C., Stroud, D.A., Wotton, S. & Musgrove, A. 2011. Waterbirds in the UK 2009/10. The Wetland Bird Survey. BTO, WWT, RSPB & JNCC, Thetford. 185 pp.

Horswill, C. & Robinson R. A. 2015. Review of seabird demographic rates and density dependence. JNCC Report No. 552. Joint Nature Conservation Committee, Peterborough.

ICES 2013. Report of the Workshop to review and advise on Seabird Bycatch (WKBYCS) 14-18 October 2013, Copenhagen, Denmark

IUCN (International Union for Conservation of Nature). 2019. Guidelines for the IUCN Red List categories and criteria. Version 13. IUCN, Gland, Switzerland.

Jarrett, D., Cook, A. S. C. P., Woodward, I., Ross, K., Horswill, C., Dadam, D. & Humphreys, E.M. 2018. Short-Term Behavioural Responses of Wintering Waterbirds to Marine Activity: Quantifying the Sensitivity of Waterbird Species during the Non-Breeding Season to Marine Activities in Orkney and the Western Isles. *Scottish Marine and Freshwater Science,* 7, 9, 88pp. DOI: 10.7489/12096-1.

Jones, J. J., and R. D. Drobney. 1986. Winter feeding ecology of scaup and Common Goldeneye in Michigan. Journal of Wildlife Management 50:446–452.

JNCC 2016. Seabird Monitoring Programme data (http://www.jncc.defra.gov.uk/page-3201). Joint Nature Conservation Committee.

JNCC 2018 Favourable Conservation Status: UK Statutory Nature Conservation Bodies common statement 2018. Accessed at: https://hub.jncc.gov.uk/assets/b9c7f55f-ed9d-4d3c-b484-c21758cec4fe

Kaiser, M.J., Galanidi, M., Showler, D.A., Elliott, A.J., Caldow, R.W.G., Rees, E.I.S., Stillman, R.A., Sutherland, W.J. 2006. Distribution and behaviour of Common Scoter Melanitta nigra relative to prey resources and environmental parameters. Ibis. Special Issue: 110–128.

Kelly, E. ed. 2005. The role of kelp in the marine environment. Irish Wildlife Manuals, No. 17. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Kleinschmidt B., Dorsch, M., Žydelis, R., Heinänen, S., Morkūnas, J., Burger, C., Nehls, G. & Quillfeldt, P. 2017. Site fidelity and temporal consistency of red- throated divers (*Gavia stellata*) during migration, moult & wintering. Poster presented at BOU 2017 Annual Conference: From avian tracking to population processes, University of Warwick, UK https://www.researchgate.net/publication/315800704_Site_fidelity_and_temporal_consistency_of_red-_throated_divers_Gavia_stellata_during_migration_moult_wintering

Larsen, J. K. & Guillemette, M. 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. *Journal of Applied Ecology*, 44: 516–522.

Larsen, J. K. & B. Laubek. 2005. Disturbance effects of high-speed ferries on wintering sea ducks. *Wildfowl*, 55: 99-116.

Laursen, K., Asferg, K.S., Frikke, J. & Sunde, P. 2009. Mussel fishery affects diet and reduces body condition of Eiders Somateria mollissima in the Wadden Sea. J. Sea Res. 62: 22–30.

Lawson, J., Kober, K., Win, I., Bingham, C., Buxton, N.E., Mudge, G., Webb, A., Reid, J.B., Black, J., Way, L. & O'Brien, S. 2015. An assessment of numbers of wintering divers, seaduck and grebes in inshore marine areas of Scotland. JNCC Report No 567. JNCC, Peterborough.

Lehikoinen, A., Jaatinen, K., Vähätalo, A.V., Clausen, P., Crowe, O., Deceuninck, B., Hearn, R., Holt, C.A., Hornman, M., Keller, V. and Nilsson, L., 2013. Rapid climate driven shifts in wintering distributions of three common waterbird species. *Global Change Biology*, *19*(7), pp.2071-2081

Lewis, S., Phillips, R.A., Burthe, S.J., Wanless, S. Daunt, F. 2015. *"Contrasting responses of male and female foraging effort to year-round wind conditions"*. Journal of Animal Ecology. 84 (6): 1490–1496. *doi*:*10.1111/1365-2656.12419*.

Lilliendahl, K. & Solmundsson, J. 2006. Feeding ecology of sympatric European shags *Phalacrocorax aristoteles* and great cormorants *P. carbo* in Iceland. Mar. Biol. 149: 979–990.

McCluskie, A.E., Langston, R.H.W & Wilkinson, N. 2012. Birds and wave and tidal stream energy: an ecological review. RSPB Research Report No. 42.

Mendel, B, Sonntag, N., Wahl, J., Schwemmer, P., Dries, H., Guse, N., Müller, S. & Garthe, S. 2008. Profiles of seabirds and waterbirds of the German North and Baltic Seas: Distribution, ecology and sensitivities to human activities within the marine environment. Bonn, Bundesamt für Naturschutz.

Mudge, G.P. & Allen, D.S. 1980. Winter seaducks in the Moray and Dornoch Firths, Scotland. Wildfowl 31: 123–130.

Musgrove, A., Aebischer, N., Eaton, M., Hearn, R., Newton, S., Noble, S., Parsons, M., Risely, K. & Stroud, D. 2013. Population estimates of birds in Great Britain and the United Kingdom. *British Birds,* 106; 64-100.

Nehls, G. 2000. Food selection by eiders – why quality matters. Wadden Sea Newsletter. https://www.bioconsult-sh.de/site/assets/files/1331/1331.pdf

Nehls, G., Diederich, S., Thieltges, D.W. & Strasser, M. 2006. Wadden Sea mussel beds invaded by oysters and slipper limpets: competition or climate control. Helgol Mar Res 60: 135-143

Nehls, G. & Ketzenberg, C. 2002. Do Common Eiders *Somateria Mollissima* exhaust their food resources? A study on natural Mussel *Mytilus Edulis* beds in the Wadden Sea. *Danish Rev. Game Biol*, 16 (1): 47–61.

Nilsson, L. 1972. Habitat Selection, Food Choice, and Feeding Habits of Diving Ducks in Coastal Waters of South Sweden during the Non-Breeding Season. Ornis Scandinavica. 3: 55–78.

O'Brien, S.H., Wilson, L.J., Webb, A. and Cranswick, P.A. 2008. Revised estimate of numbers of wintering Red-throated Divers Gavia stellata in Great Britain, Bird Study, 55:2, 152-160

Okill, J.D. 1994. Ringing recoveries of red-throated divers *Gavia stellata* in Britain and Ireland, Ringing & Migration, 15:2, 107-118

Patterson, D. 2019. *Monitoring trial of marine waterbirds – Dornoch Sector 2018/19 (Moray Firth).* Voluntary report to Scottish Natural Heritage.

Pringle, H.E.K. & Burton, N.H.K. 2017. Improving understanding of the possible relationship between improving freshwater and coastal water quality and bird interest on designated sites – phase 1 review. BTO Research Report No. 696

Robbins, A. 2011. Analysis of bird and marine mammal data for the Billia Croo Wave Test Site, Orkney. SNH Commissioned Report No. 592. University of Glasgow.

Robbins, A. 2012. Analysis of bird and marine mammal data for the Fall of Warness Tidal Test Site, Orkney. SNH Commissioned Report No. 614.

Robbins, A. 2017. Seabird ecology in high-energy environments: approaches to assessing the impacts of marine renewables. PhD Thesis. University of Glasgow.

Ross, B.E., Hooten, M.B., Devink, J.M. & Koons, D.N. 2015. Combined effect of climate, predation, and density dependence on greater and lesser scaup population dynamics. Ecological Applications 25: 1606-1617.

Sanger, R.D. & Jones Jr. 1982. Winter feeding ecology and trophic relationships of Oldsquaws and White-winged Scoters on Kachemak Bay, Alaska. In Nettleship, D.A., Sanger, G.A. & Springer, P.F. (eds) Marine Birds: their feeding ecology and commercial fisheries relationships. Pp 20-28. Proc. Pacific Seabird Group Symp. Seattle, 6-8 Jan 1982. Can. Wildl. Serv. Spec. Publ.

Sayler, R.D. & Afton, A.D. 1981. Ecological Aspects of Common Goldeneyes *Bucephala clangula* Wintering on the Upper Mississippi River. Ornis Scandinavica. 12: 99–108

Schummer, M.L., Petrie, S.A. & Bailey, R.C. 2008. Dietary overlap of sympatric diving ducks during winter on northeastern Lake Ontario. Auk 125: 425–433.

Schwemmer, P., Nendel, B., Sonntag, N., Dierschke, V., & Garthe, S. 2011. Effects of ship traffic on seabirds in offshore waters: Implications for marine conservation and spatial planning. *Ecological Applications*, 21(5): 1851-1860.

Schmutz, J.A. 2014. Survival of Adult Red-throated Loons (*Gavia stellata*) May be Linked to Marine Conditions Waterbirds, 37(sp1): 118-124

Scottish Natural Heritage (SNH). 2019. Consultation Report and recommendations on a network of proposed marine Special Protection Areas. Available from: https://www.nature.scot/consultation-report-network-proposed-special-protection-areas.

Shackleton, D. 2012. Night rafting behaviour in Great Northern Divers and its potential use in monitoring wintering numbers. *Seabird,* 25: 39–46.

Skov, Henrik & Prins, Erik. 2001. Impact of estuarine fronts on the dispersal of piscivorous birds in the German Bight. Marine Ecology-progress Series - MAR ECOL-PROGR SER. 214. 279-287. 10.3354/meps214279.

Skov, H., Heinanan, S., Thaxter, C.B., Williams, A.E., Lohier, S. & Banks, A.N. 2016. Real-time species distribution models for conservation and management of natural resources in marine environments. Mar. Ec. Prog Series 542: 221–234.

Sonntag, N., Garthe, S. & Adler, S. 2009. A freshwater species wintering in a brackish environment: Habitat selection and diet of Slavonian grebes in the southern Baltic Sea. Estuar. Coast. Shelf Sci. 84: 186–194.

Sotheran, I., Thompson, K., Benson, A., Boblin, E. and Nelson, E. 2019. Predictive mapping of supporting seabed habitats for inshore wintering waterfowl within marine proposed Special Protection Areas in Scotland. *Scottish Natural Heritage Research Report (unpublished)*

Stroud,D.A., Chambers,D., Cook,S., Buxton,N., Fraser,B., Clement,P., Lewis,I., Mclean,E., Baker,H., & Whitehead,S. 2001. The UK SPA network: its scope and content, 1-3 ed Peterborough, UK.

Summers, R. W. & Mavor, R. A. 1995. Occupation patterns of lochs by Slavonian Grebes in Scotland. Scott. Birds, 18: 65–70.

Thom, V.M. 1986. Birds in Scotland. T & AD Poyser, Calton.

Tománková, I., Harrod, C., Fox, A.D. & Reid, N. 2014. Chlorophyll-a concentrations and macroinvertebrate declines coincident with collapse of overwintering diving duck populations in a large eutrophic lake. Freshwater Biology 59: 249-256.

Vaitkus, G. & Bubinas, A. 2001. Modelling of Sea Duck Spatial Distribution in Relation to Food Resources in Lithuanian Offshore Waters Under the Gradient of Winter Climatic Conditions. Acta Zool. Litu. 11: 288–302.

Waldeck, P. & Larsson, K. 2013. Effects of winter water temperature on mass loss in Baltic blue mussels: Implications for foraging sea ducks. Journal of Experimental Marine Biology and Ecology 444: 24–30.

Wanless, S. & Harris, M.P. 2004. European Shag *Phalacrocorax aristotelis*. In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. (Eds.) Seabird Populations of Britain and Ireland. London, UK: T. & A.D. Poyser.

Wanless, S.; Harris, M. P. 1997. *Phalacrocorax aristotelis* Shag. *Birds of the Western Palearctic Update* 1(1): 3-13.

Wanless, S., Harris M.P., & Morris J.A. 1991. Foraging range and feeding locations of shags *Phalacrocorax aristotelis* during chick rearing. Ibis, 133, 30-36

Waltho, C. & Coulson, J. 2015. The common eider. – T & AD Poyser

Watanuki, Y., Daunt, F., Takahashi, A., Wanless, S. & Sato, K. 2008. Microhabitat use and prey capture of a bottom feeding top predator, the European Shag, shown by camera loggers. Marine Ecology Progress Series, 356, 283-293

Wetlands International. 2015. Waterbird population estimates, fifth edition. Summary report. Wetlands International, Wageningen, The Netherlands

Wetlands International 2018. "Waterbird Population Estimates". Retrieved from wpe.wetlands.org on Monday 15 Jan 2018

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R. (eds) 2002. Migration Atlas: movements of birds of Britain and Ireland. T. & A.D. Poyser, London

Woodward, I.D. & Humphreys, E.M. 2018. Inshore wintering waterfowl in marine proposed Special Protection Areas (pSPAs): - literature review of dietary and habitat preferences and foraging constraints. Unpublished British Trust for Ornithology report to Scottish Natural Heritage (*SNH Project Reference 017164*)

Woodward, I., Thaxter, C.B., Owen, E. & Cook, A.S.C.P. 2019. Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report No. 724.

Wright, L.J., Ross-Smith, V.H., Austin, G.E., Massimino, D., Dadam, D., Cook, A.S.C.P., Calbrade, N.A. &. Burton, N.H.K. 2012. Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species). BTO Research Report No. 592. Strategic Ornithological Support Services (Project SOSS-05) https://www.bto.org/sites/default/files/u28/downloads/Projects/final-report-soss05.pdf

Žydelis, R. & Ruskyte, D. 2005. Winter foraging of Long-tailed Ducks (*Clangula hyemalis*) exploiting different benthic communities in the Baltic Sea. Wilson Bull. 117: 133–141.

Žydelis, R., Small, C., & French, G. 2013. The incidental catch of seabirds in gillnet fisheries: A global review. *Biological Conservation*, 162, 76-88.