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

Conservation and Management Advice

PAPA WESTRAY MPA

MAY 2025

This document provides advice to Public Authorities and stakeholders about the activities that may affect the protected features of Papa Westray Marine Protected Area (MPA). It provides advice from Scottish Natural Heritage (SNH) (operating under the name of and hereinafter referred to as NatureScot) under Section 80 of the Marine (Scotland) Act 2010 to public authorities as to matters which are capable of damaging or otherwise affecting the protected features of MPAs, how the Conservation Objectives of the site may be furthered or their achievement hindered, and how the effects of activities on MPAs may be mitigated. 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 -

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 www.jncc.defra.gov.uk/scottishmpas

Document version control			
Version	**Date**	**Author**	**Reason / Comments**
1	24/02/2023	Kelly James	1st Draft
2	09/06/2023	Lucy Quinn	Added black guillemot text
3	18/06/2023	Sarah Cunningham	Review
4	21/06/2023	Kelly James	Sarah's comments addressed
5	23/06/2023	Kelly James	Reviewing Laura's comments and editing map
6	01/09/2023	Kelly James	Review area comments
7	19/10/2023	Sarah Cunningham	Review of geodiversity feature text
8	20/10/2023	Kelly James	Review document
9	25/10/2023	Nick Everett	Review of geodiversity feature text
10	14/10/2014	Lucy Quinn	Update to black guillemot text with Seabird Census results

Distribution list			
Format	**Version**	**Issue date**	**Issued to**
Electronic	5	25/07/2023	NatureScot Staff (advisors and area)
Electronic	8	02/11/2023	Operations Manager

CONTENTS

1 Overview of document

This document provides details of the Conservation and Management Advice for Papa Westray Marine Protected Area (MPA) and it is divided into eight main sections. The introduction in section 2 gives an overview of Papa Westray MPA 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 marine protected area. 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 site for which they are designated.

Annex 1 sets out the Papa Westray MPA Conservation Objectives. Annex 2 provides supporting information relating to the protected features.

2 Introduction

2.1 Purpose statement

The Papa Westray MPA has been designated to protect black guillemot (*Cepphus grylle*) and a geodiversity feature, Marine Geomorphology of the Scottish Shelf Seabed (Orkney Carbonate Production Area and the Fair Isle Strait Process Bedforms). 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. The main purpose of the Papa Westray MPA is to conserve the protected features in favourable condition. This makes a contribution to the OSPAR MPA network in the North-East Atlantic.

2.2 Conservation benefits

Papa Westray MPA provides conservation benefits by affording protection to the protected features. In summary the conservation benefits of this designation are:

- The Papa Westray MPA protects important foraging areas for black guillemots. The protected marine waters surround the Holm of Papa Westray Site of Special Scientific Interest (SSSI), which supports around 1.1% of the Great Britain black guillemot population.
- Conservation of part of the Orkney Carbonate Production Area (a key element of the geodiversity feature) which is an internationally important example of a shelf carbonate system, supplying shell-rich sands to beaches and machair.
- Conservation of part of the Fair Isle Strait Marine Process Bedforms between Orkney and Shetland, (a key element of the geodiversity feature). This is an important area for the study of the interactions between currents, seabed sediments and bedforms such as sand banner banks, sand waves and sand ribbons.

2.3 Wider benefits

Papa Westray MPA provides ecosystem services locally and to the wider marine ecosystem. We describe these ecosystem services in terms of their functions (the support or provision of something to the wider ecosystem e.g. habitat, nutrient cycling, sediment stabilisation) and natural resources (e.g. fish and shellfish, aggregates, wildlife), which in turn lead to benefits for people.

Figure 1 illustrates how the protected features of Papa Westray MPA 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 functions associated with the protected features of Papa Westray MPA are described in Annex 1 as part of the site's Conservation Objectives. The features contribute to certain functions more than others, e.g. sediment supply, carbon storage and climate regulation, and nutrient cycling. The functions of the protected features 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.

Papa Westray MPA supplies a variety of natural resources. The fish and shellfish (including juveniles), and seaweeds living within the MPA that can be harvested by humans or utilised by other marine species, are the most obvious resource. The Orkney Carbonate Production Area plays a role in carbon storage with a high amount of inorganic carbon within the sands and gravel. Whilst not a protected feature at this site, kelp beds are present throughout this site that may also contribute to carbon storage, with such systems acting as carbon donors to other stores (e.g. deep sea sediment). The MPA supports wildlife including birds, in particular black guillemots, which are a protected feature of the site. The Papa Westray MPA is valued by the local community and contributes to Orkney's identity. The complexity of the shoreline and waters around the MPA, which include sheltered bays and the extremely wave exposed west coast sea cliffs, create a unique seascape and a sense of place.

The Papa Westray MPA is a socially valued place. It is an area where people can engage in outside pursuits for health and wellbeing e.g. sailing and diving, and is home to wildlife and habitats that can be watched, enjoyed and studied. It is 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.

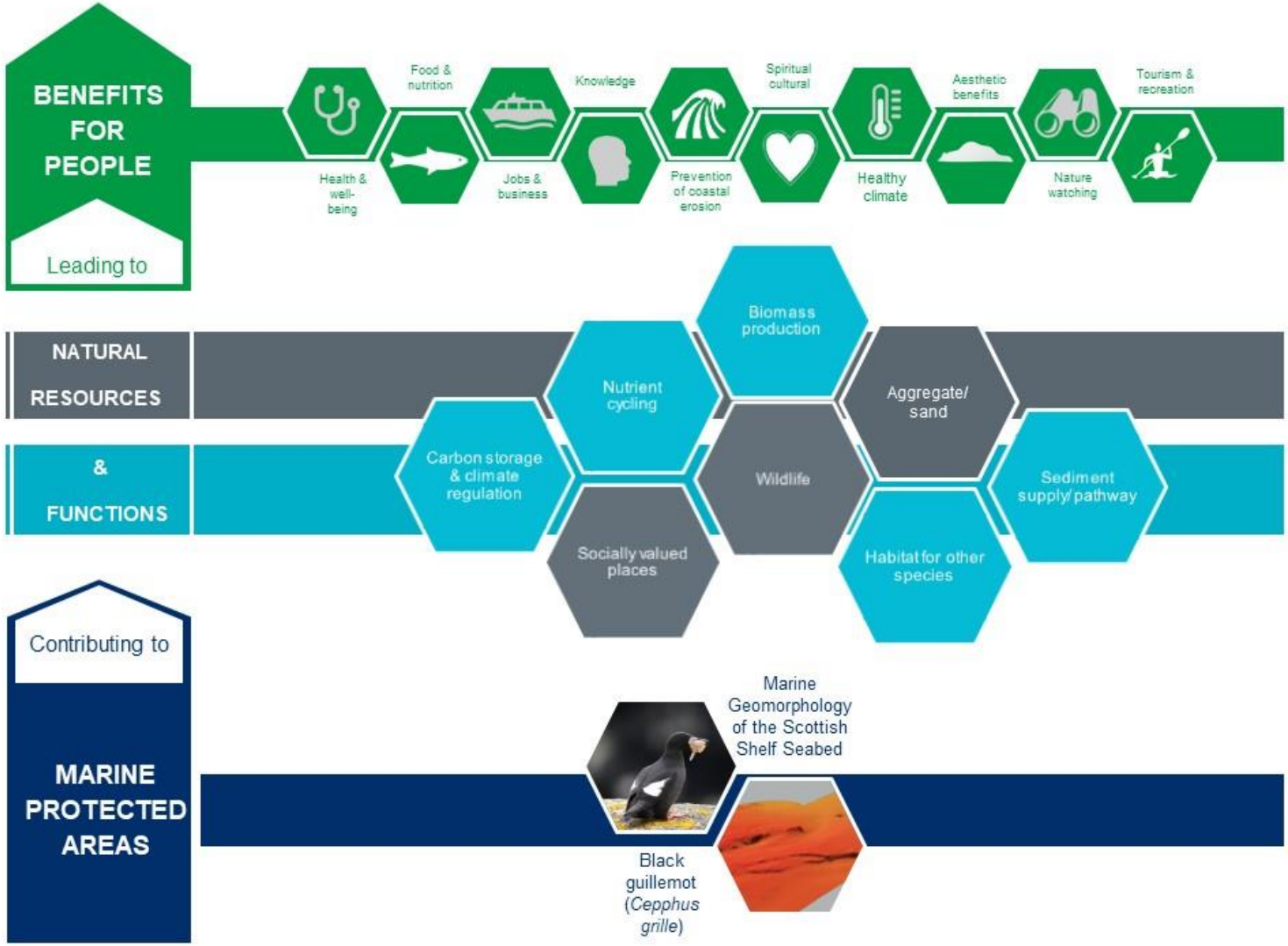

Figure 1 *Benefits to people associated with protected features of the Papa Westray MPA.*

2.4 Contribution to policy commitments

Managing this MPA to conserve the black guillemot and the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature, 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.
- Progress towards achieving Good Environmental Status in relation to biological diversity and seafloor integrity.
- Protection, enhancement and health of the marine area under the Marine (Scotland) Act 2010.
- 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 by increasing the resilience of habitat and species in the area, and by geodiversity study contributing to better understanding of future global climate change.

3 Roles

This document provides advice for Papa Westray MPA in relation to activities that may affect the protected features. More detailed advice can be provided to public 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.

Section 80 of the Marine (Scotland) Act 2010 gives NatureScot the remit to provide advice and guidance to public authorities as to the matters which are capable of damaging or otherwise affecting the protected features of MPAs, how the conservation objectives of the site maybe furthered or their achievement hindered, and how the effects of activities on MPAs may be mitigated.

It is the role of public authorities to ensure that the activities they regulate, permit or licence do not hinder the achievement of the Conservation Objectives of Papa Westray MPA. The management advice in this document is provided to assist public authorities in managing the activities outlined in Table 2 and carrying out their duties under Section 82 and 83 of the Marine (Scotland) Act 2010.

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 Papa Westray MPA has been selected to become part of 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, and the broader conservation status of the protected features.

The locations and extent of the protected features within the Papa Westray MPA are shown in Figure 2. This may have been superseded by more up-to-date information on extent/distribution of features since the publication of this document. The most up-to-date distribution of the features described is available to view at National Marine Plan Interactive[1].

For black guillemot feature condition is based on the latest Seabird Counts census data (Burnell *et al.* 2023).

Table 1. Protected features and condition for the Papa Westray MPA.
Feature condition refers to the condition of the protected feature assessed at a site level. Broader conservation status is the overall condition of the feature throughout its range as outlined by the footnote.

Protected Features	Feature condition	Assessment year	Broader conservation status
Black guillemot	Favourable	2021	UK: Amber[2] European region: Least Concern[3]
Marine Geomorphology of the Scottish Shelf Seabed	Favourable	2014	N/A

[1] https://marinescotland.atkinsgeospatial.com/nmpi/
[2] Based on Birds of Conservation Concern 5 (BoCC5), for further details on definitions see Stanbury *et al.* 2024.
[3] Based on BirdLife International, 2021

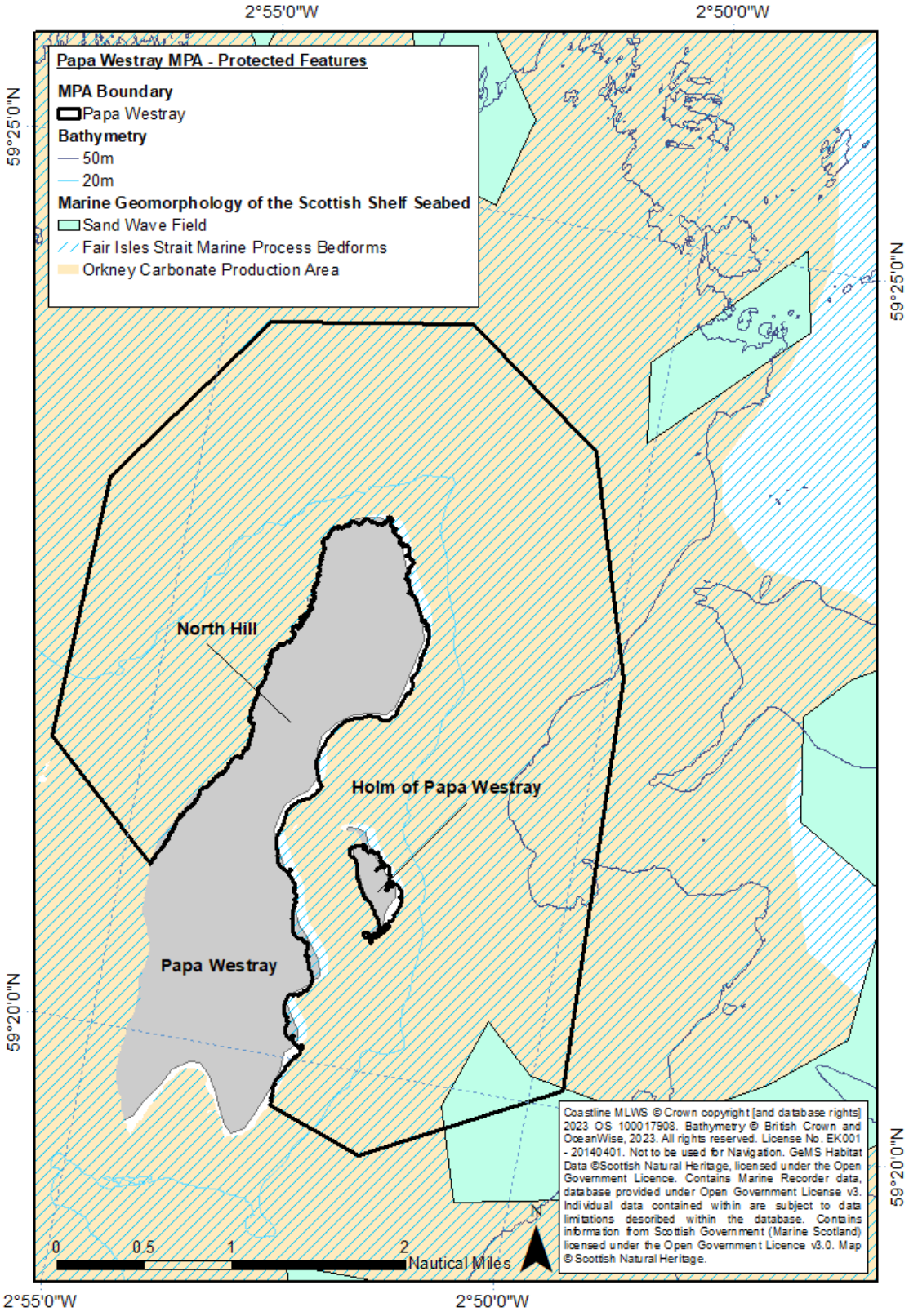

Figure 2 *Location of the Papa Westray MPA and distribution of the protected features.* * Note the black guillemot protected feature is not shown on the map, as they will be distributed throughout the MPA.

5 Conservation objectives

5.1 Background

Conservation objectives set out the desired quality of the protected features within the Papa Westray MPA (Annex 1) and they are in place at the time the site is formally designated. They provide the framework for the setting of site conservation measures (management) and for public authorities in managing the activities outlined in Table 2 and carrying out their duties under Section 82 and 83 of the Marine (Scotland) Act 2010.

5.2 Relationship between feature condition and Conservation Objectives

The Conservation Objectives seek to *conserve* the protected feature(s) of a MPA where evidence exists that it 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 is in unfavourable condition in the site, the Conservation Objectives will seek to *recover* the protected feature.

All of the biodiversity and geodiversity features are in favourable condition at Papa Westray MPA and therefore the COs seek to *conserve* this condition.

5.3 Overlapping Protected Areas

The following protected areas overlap with, or are immediately adjacent to, the Papa Westray MPA:

- Papa Westray (North Hill and Holm) SPA
- Holm of Papa Westray SSSI
- North Hill SSSI

Conservation measures in the overlapping protected areas need to ensure the Conservation Objectives of all the sites are met. Priority would be given to the SPA.

There are no apparent management conflicts between the protected features of the Papa Westray MPA and the protected features of the other overlapping areas.

Site information including the Conservation Objectives for the MPAs overlapping Papa Westray are available on SiteLink.

6 Feature sensitivity

The following sections provide an overview of the pressures most relevant to the protected features. Further information on feature sensitivity, can be found at Marine Scotland's Feature Activity Sensitivity Tool (FEAST)[4] and also for the features not covered by FEAST, Marine Evidence based Sensitivity Assessment (MarESA)[5]. The information in FEAST reflects 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 Black guillemot (Cepphus grylle)

Black guillemots are vulnerable to the introduction or spread of non-native and invasive species (e.g. mink, rats, cats) (Nordstrom et al. 2003; Mitchell et al. 2004). Black guillemots are also assessed as being vulnerable to risk of bycatch and entanglement in fishery nets

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

[5] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

(Zydelis et al. 2013; Okill, 2002), which can have potentially severe impacts in part of their range (Nettleship et al. 2018). Other pressures include barriers to movement and collision as a result of wave and tidal developments (Furness et al. 2012). Black guillemots are sensitive to oil spill pollution as they are exclusively coastal, resident all year round, and spend a lot of time feeding at sea and resting on the sea surface (Heubeck & Richardson 1980; Heubeck et al. 1993; Heubeck, 2000). Visual disturbance as a result of vessel movements may negatively impact foraging behaviour for black guillemots (Ronconi & Clair, 2002). Some auk species are very sensitive to noise e.g. marbled murrelet (inshore species) (US Navy Report, 2011). Black guillemot is probably of a similar sensitivity, therefore inshore seismic proposals are likely to be an issue for this species, especially during the breeding season when birds forage close to breeding sites. Being a predominantly inshore feeding seabird, kelp forests form an important feeding habitat for black guillemots (Forrester, 2007). Any reduction in prey-supporting habitat such as kelp forests, or in prey species they rely on could result in declines in numbers of black guillemots.

6.2 Marine Geomorphology of the Scottish Shelf Seabed – Orkney Carbonate Production Area and the Fair Isle Strait Process Bedforms

The component landforms which make up these two overlapping geodiversity areas are shelves, banks and sand wave fields composed of carbonate rich gravels and sands and actively maintained by hydrodynamic processes. They are known to be sensitive to a range of pressures. Banks and sand wave fields are considered highly sensitive to hydrodynamic changes (tidal flow, wave regime) whereby even small scale changes can significantly disrupt sediment supply. They also have a medium sensitivity to both physical change and removal of sediment within the immediate area which have the potential to affect sediment supply. The recovery potential of the Marine Geomorphology feature depends on the scale and duration of the activity causing such changes.

The geodiversity feature is also considered to have a medium sensitivity to temperature changes and ocean acidification on a national level and an accompanying low resilience due to the sensitivities of organisms (i.e. bivalves) associated with the carbonate production.

7 Management advice

7.1 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 or biological. 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' or 'recommended'. The term 'considered' is included to highlight that a fishery-feature interaction 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 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 than 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 would need to be considered on a case-by-case basis. Whilst it is recognised that there is potential for a variety of impacts, e.g. species disturbance, abrasion of seabed habitats and changes to trophic links, there are uncertainties about how significant these impacts could be and the evidence base is still being developed.

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.

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[6] (where available).

7.2 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.

7.3 Conservation Measures

The following conservation measures are currently in place for the Papa Westray MPA:

- Activities and developments subject to licensing that could affect the protected features of the MPA need to be assessed. Authorities need to determine whether if by carrying out their duties e.g. permitting an activity to take place, it would hinder the achievement of the Conservation Objectives of the MPA. This is referred to as an assessment under Section 82 or Section 83 of the Marine (Scotland) Act 2010.
- The MPA overlaps with two notified Sites of Special Scientific Interest and management changes described on their lists of Operations Requiring Consent, available on SiteLink, must have prior consent from NatureScot.

[6] https://marinescotland.atkinsgeospatial.com/nmpi/

- The ‘Biosecurity for Scotland’s seabird islands’ project (2023 – 2026) funded by NRF and led by RSPB Scotland, builds on the Biosecurity for LIFE project (2018 – 2023), and aims to permanently remove the threat of introduction and establishment of invasive predators on seabird islands. The project will work with stakeholders to implement and maintain sustainable biosecurity measures including awareness raising, prevention, surveillance, and incursion response. Papa Westray is one of the islands this project is focusing work on.

Table 2. NatureScot's advice to support management for Papa Westray MPA 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 7.2). 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. An * has been used to highlight those activities to which the advice under '*Boat use associated with both commercial and recreational activities'* also applies. Cells are also coloured grey where it is considered there is no additional management required to achieve the Conservation Objectives. For some activities, the pressures associated with new proposals are considered unlikely to affect some 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).

Activities considered capable of affecting the protected features	**Advice to support management**
	Black guillemot (*Cepphus grylle*)
Aquaculture*	**Remove or avoid pressures** (entanglement due to set nets) in existing and new finfish farms by prohibiting the use of set (gill) nets for recapture of escaped farmed stock within the MPA. **Reduce or limit pressures** (entanglement, disturbance, reduction of prey supporting habitat) associated with new, consented inactive or existing fish farms that are proposing to expand or relocate. Appropriate mitigation may include: • Application of best practice, monitoring and reporting of incidences of bird entanglement, ensuring cage mesh sizes and tensioning are appropriate. • Seasonal limitation and/or defining routes for maintenance vessels; • Spatial limitation to avoid damaging or restricting access to prey-supporting habitats; and/or • Careful siting of new finfish farms.
Anchorage areas*	*Pressures unlikely to affect this feature,* beyond pressures associated with the vessel movement (covered below).

Activities considered capable of affecting the protected features	Advice to support management
	Black guillemot (*Cepphus grylle*)
Boat use	**Reduce or limit pressures** (disturbance) associated with new boat 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 black guillemot and/or; • 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** (disturbance, loss or damage to prey-supporting habitat) associated with new cable laying activities on land or in marine waters, within or adjacent to the MPA.
Coastal development – other*	**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.

Activities considered capable of affecting the protected features	Advice to support management
	Black guillemot (*Cepphus grylle*)
Dredging/extraction of material*	**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 black guillemots and/or; • Seasonal restrictions.
Fishing - demersal mobile/active gear*	Whilst we have limited understanding about the extent of interactions between benthic fisheries and prey-supporting habitat within the site, 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 for black guillemots **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, herring spawning grounds) **should be considered**.
Fishing – hydraulic (diver or vessel)*	Hydraulic dredging has the potential to cause significant disturbance to the sedimentary habitats that support the prey species of the protected features, particularly for sandeel and herring. 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, herring spawning grounds) **is recommended**.

Activities considered capable of affecting the protected features	Advice to support management
	Black guillemot (*Cepphus grylle*)
Fishing – static gear (including bottom set nets, drift nets, fyke nets)*	**Remove or avoid pressures** (entanglement) associated with the use of all static nets. Spatial exclusion of all static nets in areas identified as being important for black guillemot (as identified from habitat and dive depth preferences) **is recommended**.
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 principle 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 the qualifying features, i.e. it should be considered as part of a broader ecosystem-based approach to management of this fishery.
Renewable energy*	**Remove or avoid pressures** (disturbance, displacement, collision, loss of foraging habitat) for any new marine renewable proposals in areas identified as being important for black guillemot within the MPA.
Seaweed harvesting*	**No additional management** for existing seaweed harvesting activities for hand-harvesting. **Reduce or limit pressures** (disturbance, removal of prey supporting habitat) associated with new hand-harvesting seaweed harvesting developments. **Remove or avoid pressures** (disturbance, removal of prey supporting habitat) associated with mechanical harvesting of seaweed (in particular, of kelp).

Activities considered capable of affecting the protected features	Advice to support management
	Black guillemot (*Cepphus grylle*)
Tourism & recreation*	**No additional management** for existing recreational activities (includes diving, angling, boating, and 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) where an increase by water-borne or land-based 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 MPA. There would be potential for some zonation of measures across the site.
Wildlife tour operators*	**No additional management** for existing wildlife tours providing the Scottish Marine Wildlife Watching Code (SMWWC) is followed by wildlife tour operators. **Reduce or limit pressures** (disturbance) where an increase by wildlife tours demonstrates there is evidence of impacts at particular locations and/or if there is a major increase in intensity of these pursuits within the MPA. There would be potential for some zonation of measures across the site.

Table 3. Activities that are considered not likely to affect the protected features (other than insignificantly)[7]

Activity	Comments
Discharges - sewage	Discharges are considered unlikely to reach a level where they will affect the protected features of this site.
Harbours	There are no harbours within the MPA. New developments would be subject to assessment on a case by case basis (see coastal development in table 2).
RYA sailing areas	The North East Scotland sailing area overlaps with the southern half of the MPA however it is not considered to affect the protected features.
Commercial shipping	As the levels of shipping within this MPA are low, commercial shipping is not considered to pose a high risk to the protected features.
Fishing – diver collection of bivalves	Diver collection of bivalves may take place but it is not considered to be at a level where it affects the protected features of this site.
Fishing - recreational	Existing but due to the low level of recreational fishing (both angling from shore and off private and chartered boats) it is not considered to be at a level where it affects the protected features.
Fishing – static gear – Creels (including lobster, crabs and *Nephrops*)	Fishing using creels takes place within the MPA. Whilst there is the potential for entanglement for the black guillemot protected feature, the occurrence is thought to be rare and therefore we consider this method poses a low risk to black guillemots. Pressures associated with the vessel traffic from this pressure is covered under Table 2.
Fishing – line-fishing - jigging	Beyond pressures associated with the vessel movement (covered in Table 2), this activity is not expected to have the potential to cause an adverse effect on the protected features.

8 Research and survey requirements

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 requirements 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 aid monitoring priorities.

1. Finer resolution surveying to help improve the mapping of the extent of the components of the geodiversity feature and distribution of black guillemots throughout the MPA.

[7] 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).

2. Analysis of survey findings to investigate inter-relationships between the Marine Geomorphology bedforms within the MPA and those in the surrounding area, and their relative scales.
3. Updated count data required for black guillemots using the site and at their associated breeding colonies (e.g. on Holm of Papa Westray and on Papa Westray), including distribution data.
4. Further research required on the decline of black guillemots at one of the associated breeding colonies (Holm of Papa Westray) is required. This may require a survey for mammalian predators at the site.
5. 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 MPA for black guillemot.
6. 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 protected features.

Annex 1. Papa Westray MPA Conservation Objectives

The box below provides the high-level Conservation Objective statements. The full Conservation Objectives, which includes site-specific advice and information on the features that form part of this MPA, are provided in the tables that follow.

These tables are grouped split by feature type, i.e. species and geomorphology. The site-specific advice and information provides more detail in relation to each of the high-level Conservation Objective statements for each feature type, e.g. detail on the extent of a habitat within a site and what the supporting features are for a species.

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 for context.

A definition of the terms used is in the Glossary.

A map of the MPA, the location of the features and the place names mentioned in the site-specific information is provided in Figure 2.

Papa Westray MPA

Protected features:
Mobile species – Black guillemot (*Cepphus grylle*)

Geomorphological features – Marine Geomorphology of the Scottish Shelf Seabed

The Conservation Objectives of the Papa Westray MPA, are that the protected features

- so far as already in favourable condition, remain in such condition
- so far as not already in favourable condition, be brought into such condition, and remain in such condition

"Favourable condition", with respect to a mobile species of marine fauna, means that

a) the species is conserved or, where relevant, recovered to include the continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds;
b) the extent and distribution of any supporting features upon which the species is dependent is conserved or, where relevant, recovered; and
c) the structure and function of any supporting feature, including any associated processes supporting the species within the MPA, is such as to ensure that the protected feature is in a condition which is healthy and not deteriorating.

"Favourable condition", with respect to a feature of geomorphological interest, means that

a) its extent, component elements and integrity are maintained;
b) its structure and functioning are unimpaired; and
c) its surface remains sufficiently unobscured for the purposes of determining whether the criteria in paragraphs (a) and (b) are satisfied.

For the purpose of determining whether a feature of geomorphological interest is sufficiently unobscured under paragraph (3)(c), any obscuring of that feature entirely by natural processes is to be disregarded.

For the purpose of determining whether a protected feature is in favourable condition any alteration to that feature brought about entirely by natural processes is to be disregarded.

Consideration of minor changes to features

Temporary short-term and/or minor changes in the protected features due to human activity may be considered not to compromise the Conservation Objectives and will be considered on a case by case basis. Assessments should consider the timing, duration and scale of the impact on the features and their ability to recover. Factors determining the potential for features to recover following temporary deterioration vary between features. These are described in more detail in Annex 2 ''*Factors determining the potential for features to recover'*.

Environmental Change

The Conservation Objectives recognise and acknowledge that the protected features of the MPA are part of a complex, dynamic and multi-dimensional marine environment. Habitats and mobile species are exposed to a wide range of drivers of change. This may include changes to their population and habitats that reflect their natural cycles, and also broader environmental changes, i.e. those related to climate change and environmental variability that are beyond the scope of the MPA.

For marine birds, 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.

Any alterations to the proposed protected features that are brought about by entirely by natural processes is to be disregarded when assessing against the Conservation Objectives.

In relation to the Papa Westray MPA and its protected features, the following effects of climate change are relevant as outlined below. These effects should be taken into account when considering plans and projects within Papa Westray MPA as additional pressures may reduce the feature's resilience to climate change, and additionally climate change impacts may start to hinder the feature's ability to recover from human activities.

Black guillemot	Under climate change, sea temperatures are predicted to increase, sea levels will rise and there could be increases in the frequency of stormy conditions. Increased levels of atmospheric CO_2 will also result in ocean acidification. Any of these factors could cause changes in bird abundance and distribution at the MPA due to changes in prey (species, availability and distribution). Climate change may result in effects at wintering grounds or in other parts of the overall breeding range which could have subsequent effects on their breeding population and distributions. In coastal breeding sites, increased flooding associated with storm tides may also cause nest site failures in breeding seabirds (Mendel *et al.* 2008). As a result of climate change, the geographic range of black guillemot in the UK is predicted to shrink, so that Shetland, Orkney and the northern tips of mainland Scotland may be the only places holding breeding colonies (Daunt & Mitchell, 2013). In other parts of their range, out with

	the UK, black guillemots have been shown to be affected by climate-induced changes in habitat and prey (Divoky, 2011; Buchadas & Hof, 2017).
Marine Geomorphology of the Scottish Shelf Seabed	As an interest comprised of dynamic landforms, it is likely that the Marine Geomorphology of the Scottish Shelf Seabed feature will change to some degree in response to variations in current speed and sediment supply driven by both natural and climate change. Projected increases in seawater temperatures, availability of CO_2 for photosynthesis, ocean acidification, the frequency and strength of storm events, and sea level associated with climate change all have implications for the continued extent, distribution, and structure of the biogenic component elements contributing to this feature.

MOBILE SPECIES

(a)Species is conserved		
The boxes below provide the site specific advice on the '*species is conserved'* element of Conservation Objective (a). Information on '*Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds'* is provided separately below.		
Feature	**Site specific advice**	**Site specific information**
Black guillemot	Ensure the population of breeding black guillemot is at a stable or increasing trend relative to the site reference population. *and* Ensure black guillemots within the MPA are not at significant risk from injury or mortality.	The site reference population for breeding black guillemots at the Papa Westray MPA is 570 birds (2013 count). The last count for Papa Westray also recorded 570 individuals (2015-2021, Burnell *et al.* 2023). The Holm of Papa Westray SSSI, designated for black guillemot, is surrounded by the Papa Westray MPA. The SSSI had 183 breeding black guillemots at the last count (2013), a decline of 32% from baseline. Other black guillemot breeding sites, such as on Papa Westray itself, will also use the Papa Westray MPA marine waters. Black guillemot populations in both the UK and in Scotland have shown a decrease of around 11% (2015-2021) since Seabird 2000 (1998-2002) (Burnell *et al.* 2023). Reasons for the decline at one of the associated breeding colonies (Holm of Papa Westray SSSI) is not fully understood. The extent of the supporting habitat is not thought to have changed. Mammalian predation has been suggested as a cause for the breeding colony decline but a survey of mammals on the Holm of Papa Westray would need to take place. Another possible cause is relocation to another breeding site (e.g. at North Hill on Papa Westray) but further work is required to assess this. Plans or projects should ensure that black guillemots are not at significant risk from injury or mortality. For the purposes of the MPA assessments black guillemot are only protected when they are within the site (which extends 2km out to sea). Any activities that take place within or outside the MPA that could kill or injure black guillemots in the MPA should be considered in assessments.

(a) Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds.

The boxes below provide the site-specific advice on the '*continued access…'* element of Conservation Objective (a). Information on '*The species is conserved'* is provided separately above.		
Feature	**Site specific advice**	**Site specific information**
Black guillemot	Ensure black guillemots have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated with the site. ***and*** Avoid significant disturbance to black guillemots and ensure individuals can move safely between these areas within the site.	Black guillemots are resident species and will remain near their breeding colonies throughout the year. Their breeding season is from March until end of August. The MPA boundary is based on the black guillemots foraging within 2km of their nesting sites, so we expect them to be widely distributed along the coastline throughout the MPA, however particular concentrations may be expected. The latest assessment of distribution of nesting black guillemots adjacent to and within the Papa Westray MPA showed black guillemots concentrated around Holm of Papa Westray coastline as well as in the northern end of Papa Westray by North Hill and at the southern end of Papa Westray. Black guillemots use nearshore waters for foraging and resting. In the breeding period, the foraging range of black guillemot has a mean maximum of 4.8 km ± 4.3 km (Woodward *et al.* 2019). Black guillemots predominantly forage in waters up to a dive depth of 50 m (Johnston *et al.* 2018). Black guillemots will also use the MPA as a moult and winter foraging area.

(b) Extent and distribution of any supporting feature **(c) Structure and function of any supporting feature**, **including any associated processes supporting the species**		
Feature	**Site specific advice**	**Site specific information**
Black guillemot	Conserve the extent and distribution of the supporting habitats for black guillemots within the site. ***and*** Conserve the variety and abundance of food resources and the condition of supporting habitats and associated processes. ***and***	Black guillemots at the Papa Westray MPA require suitable habitat for breeding, foraging, resting, and other maintenance activities. On Holm of Papa Westray they nest in burrows and in crevices amongst the boulder strewn rocky shore. Black guillemots use areas close to the coast in which to forage and rest. Guillemots have a small foraging radius, and will forage down to 50 m (Johnston *et al.* 2018), feeding primarily in the benthic environment. Black guillemots are also strongly associated with feeding amongst seaweed. Black guillemots are pursuit divers that propel themselves in the water using their wings. Breeding black guillemot in Scotland feed diurnally, predominantly on butterfish, but will also take sandeel, gadiods, blenny, sculpins and flatfish species, depending on what is locally available (Johnston *et al*. 2018). Some invertebrate prey items may also be taken depending on the region, although some studies have shown adults have a higher proportion of invertebrates compared to chicks (Birdlife International, 2022). Both generalist and specialist foraging behaviours have been recorded in black guillemots, and their foraging preferences change

	Existing water quality should be conserved and any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.	seasonally (Johnston *et al.* 2018). Black guillemots have also been recorded using man-made objects in the sea to rest on. The key supporting habitats for black guillemots in the terrestrial environment adjacent to the Papa Westray MPA will relate to the availability of suitable nesting habitat. Supporting habitats in the marine waters of Papa Westray MPA will relate to availability of seaweed. Supporting processes in the marine environment may relate to water speed, tides, turbidity and water quality. Black guillemots are associated with moderate current speeds, tidal eddies, and tidal streams, with foraging being most common at speeds of 0.5–1 m/s^{-1}, reducing in frequency at higher current speeds of >2 m/s^{-1} (see references within Johnston *et al.* 2018). Densities of black guillemots are greater during the low tide, which may relate to the accessibility of the prey (Johnston *et al.* 2018). Their diving depths and their diving behaviour has been associated with the seafloor (Johnston *et al.* 2018). As with other guillemot species that feed in the water column and as a visual feeder, black guillemots could be affected by any increase in turbidity that would affect their ability to successfully forage for their prey (Cook & Burton, 2010).

GEOMORPHOLOGICAL FEATURES

(a) Extent, component elements and integrity		
Feature	**Site specific advice**	**Site specific information**
Marine geomorphology of the Scottish shelf seabed	Conserve the features extent, component elements and integrity of the Marine Geomorphology of the Scottish Shelf Seabed feature.	Component elements of this feature refers to the varied landforms consisting of carbonate rich sands and gravels that make up the Orkney Carbonate Production Area and the overlapping Fair Isle Strait Marine Process Bedforms (Brooks et al., 2013). Integrity relates to the collective assemblage of these landforms and their inter-relationships. Within the MPA the Orkney Carbonate Production Area encompasses the shelf areas around Orkney. The Marine Geomorphology of the Scottish Shelf Seabed feature is present throughout the whole of the Papa Westray MPA, with the MPA area being 33 km^2. Part of a notable sand wave field is present in the south-eastern corner of the MPA (Brooks et al., 2009). Bivalve shells dominate the sediment in the carbonate production area (Gordon et al., 2013). Studies show that the carbonate sand and gravels are transported shoreward by near bed currents produced by wind and waves in storm events (Light and Wilson, 1998). The

		extent of these sediments is sensitive to large scale changes in water flow, wave exposure and activities involving the physical change/ removal of sediments. Assessments should focus on activities which may significantly alter water flow characteristics as well as those involving significant disruption of the carbonate rich seabed sediments. A consideration of the scale of the impact or activity in relation to individual component elements and to the full feature should be undertaken in assessments to conserve the integrity of the feature.

(b) Its structure and functioning are unimpaired		
Feature	**Site specific advice**	**Site specific information**
Marine geomorphology of the Scottish shelf seabed	Conserve the structure and functioning of the feature so that they are unimpaired.	The structure of the Orkney Carbonate Production Area and overlapping Fair Isle Strait Process Bedforms is considered here to relate to the composition of the shelf carbonate system. This is characterised by banks and other bedforms of carbonate rich sediments composed of broken mollusc and echinoid shells and fragments of maerl (Porter *et al.,* 2020). Silt, organic waste and other shell material accumulated within the bed also contributes to the structure, through which seawater is able to percolate. The structure is sensitive to physical change or removal of sediment, and changes in water flow (Perry and Tyler-Walters, 2018). The feature has several functions including sediment supply, carbon storage and the provision of habitat for other species. The feature's sediment supply function, operates through storm-driven waves and currents driving carbonate-rich sands onshore. This function is important for maintaining the supply of carbonate to coastal dune and machair systems (Brooks et al., 2013). It may be impaired by activities which are detrimental to its extent, component elements and integrity, as set out above under (a). Assessments should focus on activities which may significantly alter water flow characteristics as well as those involving significant disruption of the carbonate rich seabed sediments. Maintaining the ability of the feature to generate and supply sediments should also be an important consideration.

(c) Its surface remains sufficiently unobscured for the purposes of determining whether the criteria in paragraphs (a) and (b) are satisfied.		
Feature	**Site specific advice**	**Site specific information**
Marine geomorphology of the Scottish shelf seabed	Conserve the surface of the feature so that it remains sufficiently unobscured for the purposes of determining whether the criteria in conservation objectives (a) and (b) are satisfied.	Assessments should focus on whether the activity or development has the potential to significantly obscure the seabed and its landforms to the extent that conservation objectives (a) and (b) could not be fully assessed. Whilst the feature as a whole is not likely to be obscured, the degree to which any of the component landforms might be obscured will vary greatly according to their size and nature. Therefore the type of data and/or assessment required will vary likewise.

Annex 2. Supporting information

Factors limiting the recovery of features

Black guillemot (Cepphus grylle)
Black guillemots have an estimated generation length of 9.2 years and age of first breeding is 3-4 years (Bird *et al.* 2020). Their maximum longevity is close to 26 years (Bird *et al.* 2020). Black guillemots are unlike other auk species in that they lay two eggs. Productivity of black guillemots in Scotland, which is derived from regularly monitored colonies mostly located in Orkney and Shetland, was approximately 1.01 chicks fledged per pair per year between 1986 and 2012 (JNCC, 2021). Adult survival is estimated as being 0.87 (Bird *et al.* 2020). Any effect on adult mortality can potentially have serious effects on breeding numbers. As with other long-lived seabird species, the adult will balance parental investment into their current breeding attempt with their own need to survive, and future reproductive attempts.

As black guillemots have such a restricted foraging range within inshore waters this can make them particularly vulnerable to any pressures that would affect their prey within this environment, as well as being more vulnerable to oil-spill events that more often occur in nearshore waters.

As a resident species black guillemots tend to remain near their breeding colonies throughout the year. They have a flightless moult period between mid-August and the end of November, during which they will be particularly vulnerable to pressures (for example pollution or disturbance), which could have a subsequent effect on reproduction or survival.

As with other auk species, black guillemots have a high wing loading, and consequently flight has a high energetic cost (Thaxter *et al.* 2010). This may mean that if they have to travel further to find food, they may suffer energetically (Masden *et al.* 2010).

Marine Geomorphology of the Scottish Shelf Seabed:
The recoverability of the feature is influenced by a range of factors. Recoverability of the feature's overall functions for carbon sequestration and sediment supply is likely to be robust or high given the dynamic bedforms. However, these functions are dependent on the biogenic habitats affected, including those surrounding the MPA, as the recoverability of species varies considerably.

The recovery of the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature may be limited by changes to hydrodynamics (water flow, waves), or changes in sediment transport and availability. The degree of limitation will be influenced by the scale and duration of the activity in question. The dynamic processes which underpin the feature can be 'tipped' into new states of equilibrium by activities of greater scale and longer duration, limiting the recovery of the feature.

Glossary for Conservation Objectives

Conservation Objective term	Definition
Composition of characteristic biological communities	This should include a reference to the diversity and abundance of species forming part of, or inhabiting, that habitat. In particular, this includes those species that are especially relevant to the habitat's definition, e.g. species that form the structure of a bivalve bed, or sea pens on burrowed mud. In ecological terms, "community composition" means the number and abundance of flora and fauna included in the habitat. This is also referred to as biodiversity - the variety of life in a particular habitat.
Extent (and distribution)	The "extent" of a feature is the total area that it covers. This should also include consideration of the "distribution" i.e. how it is spread out within the MPA. A feature could be continuous and contained within one area, dispersed in smaller patches over a wider area, or as a mosaic with other habitats/features. Indeed, it could also be a combination of these.
Favourable condition	Favourable condition for each protected feature type for NC MPAs is defined in the box at the start of Annex I which summarises the conservation objectives for the site.
Function	The habitat must be able to be maintained in terms of the growth and reproduction of the habitat-forming species (e.g. through self-recruitment of larvae) and help to maintain the provision of essential ecosystem services that the habitat provides. The text within the supplementary advice explains function in relation to both of these factors for the feature concerned where information is available.
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).
Integrity (geodiversity)	For geodiversity features, integrity is the way the component elements make up the full extent of the feature. Integrity relates to the relationship between the component elements, where the whole is greater than the sum of the parts. In other words, integrity refers to the full assemblage of component elements.
Quality / Processes	Quality outlines the processes relevant to the habitat/feature and include but are not limited to hydrography and supporting water currents, chemical water quality parameters, suspended sediment levels, radionuclide levels.
Supporting environment	This includes the following environmental conditions (but is not limited to) 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.
Structure	The structure of a habitat/feature includes what it is created from and what it requires to exist, e.g. habitat forming species, geological features or sediment; the depth of the substrate or thickness or height of the biogenic structures from the seabed; biogenic material forming the structure should still retain a live component where this exists at baseline.

References

Bird, J., Martin, R., 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*, 34(5): 1252-1261.

BirdLife International. 2021. European Red list of birds. Accessed at: https://www.birdlife.org/wp-content/uploads/2021/10/BirdLife-European-Red-List-of-Birds-2021.pdf

BirdLife International. 2022. Species factsheets. Downloaded from http://www.birdlife.org on 07/05/2022.

Brooks, A.J., Roberts, H., Kenyon, N.H. and Houghton, A.J. (2009). Accessing and developing the required biophysical datasets and datalayers for Marine Protected Areas network planning and wider marine spatial planning purposes. Report No 8: Task 2A. Mapping of Geological and Geomorphological Features. ABP Marine Environmental Research Ltd.

Brooks, A.J., Kenyon, N.H., Leslie, A., Long, D. and Gordon, J.E. 2013. Characterising Scotland's marine environment to define search locations for new Marine Protected Areas. Part 2: The identification of key geodiversity areas in Scottish waters. *Scottish Natural Heritage Commissioned Report No. 432.* http://www.snh.org.uk/pdfs/publications/commissioned_reports/432.pdf

Buchadas, A.R.C. & Hof, A.R. 2017. Future breeding and foraging sites of a southern edge population of the locally endangered Black Guillemot *Cepphus grylle*. *Bird Study*, 64(3): 306-316.

Burnell, D., Perkins, A.J., Newton, S.F., Bolton, M, Tierney, T.D. & Dunn, T.D. 2023. Seabirds Count, A census of breeding seabirds in Britain and Ireland (2015–2021). Lynx Nature Books, Barcelona.

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.

Daunt, F., & Mitchell, I., 2013. Impacts of climate change on seabirds. *MCCIP Science Review*, *2013*, pp.125-133.

Divoky, G. 2011. Black Guillemots in a melting Arctic: responding to shifts in prey, competitors, and predators.
In Watson, R., Cade, T., Fuller, M., Hunt, G. & Potapov, E. (eds) *Gyrfalcons and Ptarmigan in a Changing World*: 125–130. The Peregrine Fund, Boise, ID

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. & Grundy, D.S. 2007. The Birds of Scotland. Scottish Ornithologists' Club, Aberlady.

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.

Gordon, J.E., Brooks, A.J., Rennie, A.G., James, B.D., Chaniotis, P.D., Kenyon, N.H., Leslie, A.B., Long, D. 2013. The selection of Nature Conservation Marine Protected Areas (MPAs) in Scotland - assessment of geodiversity interests. *Scottish Natural Heritage Commissioned Report No. 633*

Heubeck, M. 2000. Population trends of kittiwake *Rissa tridactyla*, black guillemot *Cepphus grylle* and common guillemot *Uria aalge* in Shetland, 1978-98. *Atlantic Seabirds* 2: 227-44.

Heubeck, M., Bird, D.R., Harrop, H.R., Harvey, P.V., Mellor, R.M., Suddaby, D., Tasker, M.L. & Uttley, J.D. 1993. An assessment of the impact of the *Braer* oil spill on the Shetland breeding population of tysties *Cepphus grylle*. Rep. to Ecological Steering Group on the Shetland oil spill by Shetland Oil Terminal Environmental Advisory Group/Joint Nature Conservation Committee/Royal Society for the Protection of Birds/Scottish Natural Heritage.

Heubeck, M. & Richardson, M.G. 1980. Bird mortality following the Esso *Bernica* oil spill, December 1978. *Scottish Birds* 11: 97-108.

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

JNCC. 2021. Seabird Population Trends and Causes of Change: 1986–2019 Report (https://jncc.gov.uk/our-work/smp-report-1986-2019). Joint Nature Conservation Committee, Peterborough. Updated 20 May 2021.

Johnston, D.T., Furness, R.W., Robbins, A.M., Tyler, G., Taggart, M.A. & Masden, E.A., 2018. Black guillemot ecology in relation to tidal stream energy generation: An evaluation of current knowledge and information gaps. *Marine Environmental Research*, *134*: 121-129.

Light, J.M. and Wilson, J.B. 1998. Cool-water carbonate deposition on the West Shetland shelf: a modern distally steepened ramp. In Carbonate Ramps (eds V.P. Wright and T.P. Burchette). *Geological Society Special Publications,* 149: 73-105.

Masden, E.A., Haydon, D.T., Fox, A.D. & Furness, R.W. 2010. Barriers to movement: modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. *Marine Pollution Bulletin,* 60(7): 1085-1091.

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.

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. (eds). 2004. Seabird Populations of Britain and Ireland: results of the Seabird 2000 census (1998-2002). T and A.D. Poyser, London, pp 511. ISBN 0 7136 6901 2. http://jncc.defra.gov.uk/page-1548

Nettleship, D.N.; Boesman, P.; Garcia, E.F.J. 2018. Black Guillemot (*Cepphus grylle*). Barcelona

Nordström, M., Högmander, J., Laine, J., Nummelin, J., Laanetu, N. & Korpimäki, E. 2003. Effects of feral mink removal on seabirds, waders and passerines on small islands in the Baltic Sea. *Biological Conservation*, *109*(3): 359-368.

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

Perry, F. and Tyler-Walters, H. 2018. Maerl beds. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: *Marine Biological Association of the United Kingdom*. Available from http://www.marlin.ac.uk/habitats/detail/255/maerl_beds

Porter, J.S., *et al.,* 2020. Blue Carbon Audit of Orkney Waters. *Scottish Marine and Freshwater Series*, 11(3).

Ronconi, R.A. & Clair, C.C.S. 2002. Management options to reduce boat disturbance on foraging black guillemots (*Cepphus grylle*) in the Bay of Fundy. *Biological Conservation*, 108: 265-271.

Stanbury, A., Burns, F., Aebischer, N., Baker, H., Balmer, D., Brown, A., Dunn, T., Lindley, P., Murphy, M., Noble, D., Owens, R., Quinn, L. 2024. The status of the UK's breeding seabirds: an addendum to the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds*, *117*, pp.471-487.

Thaxter, C. B., Wanless, S., Daunt, F., Harris, M. P., Benvenuti, S., Watanuki, Y., & Hamer, K. C. 2010. Influence of wing loading on the trade-off between pursuit-diving and flight in common guillemots and razorbills. *Journal of Experimental Biology*, *213*(7): 1018-1025.

US Navy 2011. Environmental science panel for marbled murrelet underwater noise injury threshold – final summary report (https://truthout.org/wp-content/uploads/legacy/documents/6_MARBLED-MURRELET-UNDERWATER-NOISE-INJURY-THRESHOLD-SCIENCE-PANELConferenceSummaryReport_090711.pdf)

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*.

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