METHODS DOCUMENT
IDENTIFYING THE SHORT LIST OF PROPOSED PROTECTED FEATURES FOR A DEEP-SEA MARINE RESERVE IN SCOTLAND
AUGUST 2019

1. Purpose

This document has been produced to outline the process followed by the Joint Nature Conservation Committee (JNCC) and Marine Scotland Science (MSS) to identify which 'features' (a collective term to describe marine habitats, species, geological/geomorphological features and ecological processes) to consider for protection within a possible marine protected area (herein referred to as pMPA) within the deep-waters to the west of Scotland.

Application of this process resulted in the production of the following set of documentation for a pMPA in the deep-waters to the west of Scotland: The West of Scotland pMPA:

- **Ecological overview** – An overview of our ecological understanding of the West of Scotland pMPA; both in terms of the proposed protected features and the geographic area more broadly with regards to its functional significance.

- **Data confidence assessments** – An overview of JNCC's confidence in the data underpinning presence and extent for the proposed protected features of the West of Scotland pMPA.

- **Conservation & management advice** - An overview of the conservation objectives for the proposed protected features of the West of Scotland pMPA and the management measures considered necessary to best achieve those objectives.

This piece of work has been undertaken to support Marine Scotland's commitment to '*evaluate options to create a deep-sea national marine reserve*[1]' and '*consult on the creation of a national deep sea marine reserve, with the aim of this being in place by the end of 2019*' to protect some of the most vulnerable habitats and species[2].

This document outlines the two-step process taken to identify the short list of proposed protected features for the West of Scotland pMPA:

The first step, outlined in Section 2, was the creation of an initial 'long list' of possible features drawn from lists of features of conservation importance of relevance to Scotland; such as the Priority Marine Features list, where they may occur in the deeper waters (Table 1).

The second step, outlined in Section 3, describes the refinement of the initial 'long list' via the application of a modified version of Stage 1 of the Scottish MPA selection guidelines for Nature Conservation MPAs[3] and drawing from a range of data sources (Table 2) to generate a 'short list' (Table 3) of proposed protected features.

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[1] Government's Programme for Scotland 2017-18 available at: http://www.gov.scot/Publications/2017/09/8468/8
[2] Government's Programme for Scotland 2018-19 available at:
https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2018/09/delivering-today-investing-tomorrow-governments-programme-scotland-2018-19/documents/00539972-pdf/00539972-pdf/govscot:document/
[3] Available at: https://www2.gov.scot/Topics/marine/marine-environment/mpanetwork/mpaguidelines

2. Developing the initial long-list of possible features

To identify which features of conservation interest may be present within the deep-sea area to the west of Scotland (defined in the context of this work as waters deeper than 800m as set out by Marine Scotland), JNCC reviewed existing lists of features of conservation importance and appraised available evidence for their occurrence in the deep-sea areas around Scotland:

- Scottish Priority Marine Features (PMFs)[4];
- OSPAR Threatened and/or Declining (T&D) species and habitats[5]
- Vulnerable Marine Ecosystems (VMEs)[6]

In total, a 'long list' of 47 possible features/feature categories (in the case of geological/geomorphological features) for initial consideration was created (Table 1). This included habitats, mobile species, low & limited mobility species and large-scale features. In the case of seabirds, UK population density maps from Kober *et al.* (2010)[7] were used to identify species which had relatively higher density areas within the deep-waters around Scotland below 800m compared to the rest of UK waters. For the purposes of this exercise, all geological/geomorphological features where they represent a key component of Key Geodiversity Areas within Scotland's seas (after Brooks *et al.,* 2011)[8] were scoped in; as were all large-scale features (e.g. seamounts, areas of the continental slope) due to their potential functional importance.

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[4] For more information see: https://www.snh.scot/professional-advice/safeguarding-protected-areas-and-species/priority-marine-features-scotlands-seas
[5] For more information see: https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats
[6] For more information see: http://www.ices.dk/marine-data/data-portals/Pages/vulnerable-marine-ecosystems.aspx
[7] Available at: http://jncc.defra.gov.uk/page-5622
[8] Available at: https://www.researchgate.net/publication/279440166

Table 1. Long list of possible features for consideration

Possible feature name	Possible feature type	Scottish PMF	OSPAR T&D	ICES Vulnerable Marine Ecosystem
Burrowed mud/Sea-pen and burrowing megafauna communities	Habitat	Y	Y	Y (Sea-pens)
Carbonate mound communities/Carbonate mounds	Habitat	Y	Y	N
Cold-seeps	Habitat	N	N	Y
Cold-water coral reefs/*Lophelia pertusa* reefs	Habitat	Y	Y	Y
Coral gardens	Habitat	Y	Y	Y
Deep-sea sponge aggregations	Habitat	Y	Y	Y
Oceanic ridges with hydrothermal vents	Habitat	N	Y	Y
Offshore deep-sea muds	Habitat	Y	N	N
Offshore subtidal sands and gravels	Habitat	Y	N	N
Seamount communities/Seamounts	Habitat	Y	Y	N
Northern feather star (*Leptometra celtica*)	Low or limited mobility species	Y	N	N
Continental slope	Large scale feature	N	N	N
Seamounts	Large scale feature	N	N	N
Geological/geomorphological features representative of Key Geodiversity Areas in Scotland's seas	Geological / geomorphological feature	N	N	N
Atlantic halibut (*Hippoglossus hippoglossus*)	Fish/elasmobranch	Y	N	N
Blue ling (*Molva dypterygia*)	Fish/elasmobranch	Y	N	N
Greenland halibut (*Reinhardtius hippoglossoides*)	Fish/elasmobranch	Y	N	N
Gulper shark (*Centrophorus granulosus*)	Fish/elasmobranch	N	Y	N
Leafscale gulper shark (*Centrophorus squamosus*)	Fish/elasmobranch	Y	Y	N
Anglerfish (*Lophius piscatorius*)	Fish/elasmobranch	Y	N	N
Spiny dogfish/North-east Atlantic spurdog (*Squalus acanthias*)	Fish/elasmobranch	Y	Y	N
Orange roughy (*Hoplostethus atlanticus*)	Fish/elasmobranch	Y	Y	N
Porbeagle shark (*Lamna nasus*)	Fish/elasmobranch	Y	Y	N
Portuguese dogfish (*Centroscymnus coelolepis*)	Fish/elasmobranch	Y	Y	N

Species	Type			
Round-nose grenadier (*Coryphaenoides rupestris*)	Fish/elasmobranch	Y	N	N
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Marine mammal	Y	N	N
Blue whale (*Balaenoptera musculus*)	Marine mammal	N	Y	N
Bottlenose dolphin (*Tursiops truncatus*)	Marine mammal	Y	N	N
Fin whale (*Balaenoptera physalus*)	Marine mammal	Y	N	N
Harbour porpoise (*Phocoena phocoena*)	Marine mammal	Y	Y	N
Killer whale (*Orcinus orca*)	Marine mammal	Y	N	N
Long-finned pilot whale (*Globicephala melas*)	Marine mammal	Y	N	N
Minke whale (*Balaenoptera acutorostrata*)	Marine mammal	Y	N	N
Northern bottlenose whale (*Hyperoodon ampullatus*)	Marine mammal	Y	N	N
Northern right whale (*Eubalena glacialis*)	Marine mammal	N	Y	N
Risso's dolphin (*Grampus griseus*)	Marine mammal	Y	N	N
Short-beaked common dolphin (*Delphinus delphis*)	Marine mammal	Y	N	N
Sowerby's beaked whale (*Mesoplodon bidens*)	Marine mammal	Y	N	N
Sperm whale (*Physeter macrocephalus*)	Marine mammal	Y	N	N
European storm-petrel (*Hydrobates pelagicus*) breeding season	Bird	N	N	N
Great black-backed gull (*Larus marinus*) breeding & wintering seasons	Bird	N	N	N
Black-legged kittiwake (*Rissa tridactyla*) breeding & wintering seasons	Bird	N	Y	N
Leach's storm-petrel (*Oceanodroma leucorhoa*) breeding season	Bird	N	N	N
Long-tailed Skua (*Stercorarius longicaudus*) March-June and September-November	Bird	N	N	N
Northern fulmar (*Fulmar glacialis*) breeding & wintering seasons	Bird	N	N	N
Northern gannet (*Morus bassanus*) breeding & wintering seasons	Bird	N	N	N
Pomarine skua (*Stercorarius pomarinus*) March-June and August-November	Bird	N	N	N

3. Refining the long list of possible features

Annex 1 of the 'Guidelines on the selection of MPAs and development of the MPA network[3]' outlines the selection criteria for the identification of MPAs for nature conservation purposes. The components of Question 1 of these selection criteria were used as the basis to determine which possible features would be suitable for further consideration as proposed protected features of the pMPAs:

1a. Sufficiency of evidence for the presence and extent of key features

Information collected from national and international databases and the available literature were used to determine if there was sufficient information available which supported feature presence and extent within the pMPA. The information sources that were accessed as part of this step in the process are summarised in Table 2.

To pass through this first criterion, JNCC needed to be satisfied that there were sufficient data to support an assessment of the presence and extent of each of the features. If a feature failed against criterion 1a at this stage, it was not considered further.

1b. Sufficiency of evidence for the functional significance of the area

This criterion was only applied to mobile species under consideration (deep-water fish/elasmobranchs, marine mammals and seabirds). To pass through this first criterion, JNCC needed to be satisfied that there were sufficient data to support the presence of important areas within the pMPA for the life history of the mobile species under consideration. Again, the range of data sources accessed to apply this criterion are provided in Table 2.

Of the 47 possible features from the initial long-list, 14 passed through the assessment to be considered as proposed protected features of the pMPA (Table 3). The rationale behind decisions made when applying these criteria are outlined by feature type in Sections 3.1 to 3.7 below.

Table 2. Data sources

Data sources
Brooks, A.J. Kenyon, N.H. Leslie, A., Long, D. & Gordon, J.E. (2011). 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 (interim report July 2011). Scottish Natural Heritage Commissioned Report No.430.
British Geological Survey particle size analysis (PSA) data (downloaded 2018).
Cleasby I.R., Owen E., Wilson L.J, Bolton M. (2018) Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK: Technical Report. RSPB Research Report no. 63. RSPB Centre for Conservation Science, RSPB, The Lodge, Sandy, Bedfordshire, SG19 2DL Available at: https://www.rspb.org.uk/globalassets/downloads/documents/conservation-science/cleasby_owen_wilson_bolton_2018.pdf
CODA, (2009). Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA). Final Report. 43pp http://biology.st-andrews.ac.uk/coda/documents/coda_final_report_11-2-09.pdf

Charif, R.A., and Clark, C.W. 2000. Acoustic monitoring of large whales off north and west Britain and Ireland: a two year study, October 1996 - September 1998. JNCC Report No.313.

Doggett, M., Baldock, B. & Goudge, H. (2018). A review of the distribution and ecological importance of seabed communities in the deep waters surrounding Scotland. JNCC Report No. 625.

Geodatabase of Marine features in Scotland (GeMS) Version 5.

Hammond et al. 2017. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf

Hammond, P. S., Macleod, K., Burt, L., Cañadas, A., Lens, S., Mikkelsen, B., Rogan, E., et al. (2010). Abundance of baleen whales in the European Atlantic. Paper Presented to the IWCSC/63/ RMP24.

Hammond et al. 2017. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf

ICES Vulnerable Marine Ecosystem (VME) database (2018).

Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S., Wilson, L.J., Reid, J.B. (2010). An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs. JNCC report No. 431.

Kober, K., Wilson, L.J., Black, J., O'Brien, S., Allen, S., Win, I., Bingham, C. and J.B. Reid, (2012). The identification of possible marine SPAs for seabirds in the UK: The application of Stage 1.1 – 1.4 of the SPA selection guidelines. JNCC Report No 461. Available at: http://jncc.defra.gov.uk/pdf/461_final_web.pdf

Large, P. A., Diez, G., Drewery, J., Laurans, M., Pilling, G. M., Reid, D. G., Reinert, J., South, A. B., and Vinnichenko, V. I. (2010). Spatial and temporal distribution of spawning aggregations of blue ling (Molva dypterygia) west and northwest of the British Isles. – *ICES Journal of Marine Science*, **67**: 494–501.

Macleod, K, Simmonds, M.P., Murray, E (2006). Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. borealis*) amid oil exploration and development off northwest Scotland. J. Cetacean Res. Manage 8(3): 247-254.

Macleod K. (2004). Abundance of Atlantic white-sided dolphin (*Lagenorhynchus acutus*) during summer off northwest Scotland. *J Cetacean Res Manag*. 6:33-40.

Marine Recorder database (Version 11)

Marine Scotland Science deep-water trawls (1997-2018)

OSPAR database of Threatened and/or Declining Habitats (2017).

Pollock, C.M., Mayor, R., Weir, C.R., Reid, A., White, R.W., Tasker, M.L., Webb, A, Reid, J.B. (2000). The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west of Scotland. Joint Nature Conservation Committee.

Priede, I.G. (2018) Deep-sea Fishes Literature Review. JNCC Report No. 619.

Reid, J. B, Evans, P G H, and Northridge, S P (2003). Atlas of Cetacean distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough.

Stone, C.J. (2015). Marine mammal observations during seismic surveys from 1994-2010. JNCC report, No. 463a.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S., Roos, S., Bolton, M., Langston, R.H. & Burton, N.H., 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation*, *156*, 53-61

UKSeaMap (2018). Modelled habitat map of UK seabed.

Wakefield, E.W., Bodey, T.W., Bearhop, S. *et al.* (2013) Space partitioning without territoriality in gannets. *Science*, 341, 68– 70.

Wakefield, E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., Guilford, T., Mavor, R.A., Miller, P.I. & Newell, M.A. 2017. Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species. *Ecological Applications*, *27*, 2074-2091.

Table 3. Short list of proposed protected features for consideration in the pMPAs

Proposed protected feature	Proposed protected feature type
Burrowed mud	Habitat
Cold-water coral reefs	Habitat
Coral gardens	Habitat
Deep-sea sponge aggregations	Habitat
Offshore deep-sea muds	Habitat
Offshore subtidal sands and gravels	Habitat
Seamount communities	Habitat
Blue ling *(Molva dypterygia)*	Fish/elasmobranch
Leaf-scale gulper shark *(Centrophorus squamosus)* / Gulper shark (*Centrophorus granulosus*)	Fish/elasmobranch
Orange roughy *(Hoplostethus atlanticus)*	Fish/elasmobranch
Portuguese dogfish *(Centroscymnus coelolepis)*	Fish/elasmobranch
Round-nose grenadier *(Coryphaenoides rupestris)*	Fish/elasmobranch
Seamounts	Large-scale feature
Geological/geomorphological features representative of Key Geodiversity Areas in Scotland's seas	Geological/geomorphological feature

3.1 Habitats

The Priority Marine Features (PMFs) offshore deep-sea muds and offshore subtidal sands and gravels were identified as covering large areas of the pMPA (based on Particle Size Analysis of sediment samples collected by the British Geological Survey and information from the predictive habitat mapping product UKSeaMap2018). The PMF burrowed mud was also identified as occurring within the pMPA (based on the ICES Vulnerable Marine Ecosystems (VME) database and Marine Scotland Science deep-water trawl data that reports occurrence of sea-pens (an indicator species for the presence of burrowed mud habitat), as well as the Geodatabase of Marine Features, Scotland (v5) and the OSPAR database of T&D habitats that lists verified occurrences of burrowed mud habitat. Doggett *et al.* (2018)[9] provides collated information on the ecological importance of sedimentary habitats in the deep waters surrounding Scotland and supported the assessment.

Four additional PMFs (which are also classed as Vulnerable Marine Ecosystems and under threat/subject to decline by OSPAR) also passed through the assessment based on a review of information from national and international databases (Geodatabase of Marine Features, Scotland (v5), the OSPAR database of T&D habitats, and the ICES Vulnerable Marine Ecosystems (VME) database) as well as numerous sources of peer-reviewed and grey literature (see Table 2). There was insufficient evidence available to support the presence of carbonate mounds/carbonate mound communities, cold-water seeps or oceanic ridges with hydrothermal vents and so these did not progress onto the refined list of proposed protected features.

3.2 Low/limited mobility species

The PMF Northern feather star (*Leptometra celtica*) is a comatulid crinoid occurring on coarse sediments as well as rocky reefs in water depths thought to range from <20m to over 1,000m. It has been recorded in the typical taxon list for the epibenthic assemblages from the upper bathyal regions of the Rosemary Bank Seamount. However, no ecological studies reporting its occurrence at depths greater than 570m were found by Doggett *et al,* (2018). Evidence from studies in other areas of the North Atlantic suggest that *L. celtica* is most likely to occur on the continental slope on coarse sediments at depths shallower than 800m where there are elevated currents in water temperatures greater than 8°C (Doggett *et al.*, 2018). As such, there is insufficient information for further consideration based on a lack of sufficient evidence to support presence within the pMPA.

3.3 Large-scale features

Of the two large-scale features under consideration from the initial long-list, 'Seamounts' have been identified as occurring within the pMPA: Anton Dohrn and Rosemary Bank. The feature was included in the short-list due to our understanding of the functional significance of seamounts to the health and biodiversity of Scotland's seas. There is insufficient spatial coverage of the pMPA with areas of the continental slope to the west of Scotland to justify its inclusion on the short-list of proposed protected features.

3.4 Geological/geomorphological features

All geological/geomorphological features representative of Key Geodiversity Areas in Scotland's seas (after Brooks *et al.,* 2011) were included in the short-list where they occur in the deep waters to the west of Scotland.

3.5 Fish/elasmobranchs

Six of the eleven deep-water fish/elasmobranch species passed through the assessment from the initial long-list of possible features to the short-list of proposed protected features on the grounds of suitable evidence being available to support the presence and extent of the species and scientific

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[9] Available at: http://jncc.defra.gov.uk/page-2132

understanding of areas of functional importance. This was largely based on Marine Scotland Science deep-water trawl surveys and evidence reviewed within Priede (2018).

The deep-waters to the west of Scotland contain characteristic habitat for round-nose grenadier, leafscale gulper shark, gulper shark, and Portuguese dogfish. Round-nose grenadier can be considered resident within the pMPA, and it is one of only 17 locations globally where gulper shark has been reported. Studies have documented that the Rockall Trough is important to the life cycle of Portuguese dogfish, but current scientific understanding remains unclear as to whether this is for the full life cycle of the species (Moura *et al.*, 2014 in Priede, 2018) or if this species migrates south along the continental slope of Europe to give birth, before returning to the more northern feeding areas (Verissimo *et al.,* 2011 in Priede, 2018). The pMPA contains (spawning) areas important to the life history of blue ling (Large *et al.*, 2010). Adult orange roughy form large spawning congregations around seabed features such as summits and steep slopes; the pMPA includes two seamounts features and areas of the continental slope at suitable depths for orange roughy. Spawning aggregations had not been identified at these locations prior to the cessation of the orange roughy fishery, but the habitat protected is similar to that in locations where large spawning aggregations have been recorded e.g. at the Hebrides Terrace Seamount (Priede, 2018).

There was insufficient evidence to pass the other deep-water fish/elasmobranch species through the stage 1b criterion at this stage and so were dropped from further consideration.

3.6 Marine mammals

None of the 14 marine mammal species passed through the assessment from the initial long-list of possible features to the short-list of proposed protected features. Information from national and international databases (such as Geodatabase of Marine Features, Scotland (v5), Marine Recorder[10], and The Cetacean Offshore Distribution and Abundance in the European Atlantic[11] (CODA)), in addition to literature included in Table 2 were used to evaluate the 14 species of marine mammals identified in the initial long-list against the selection criteria 1a (presence and extent) and 1b (functional importance.

For blue whale, long-finned pilot whale, northern right whale and Risso's dolphin, there was insufficient information or limited sightings data in Scottish waters to support passing of the species against criterion 1a. Additionally, difficulty with identification to species level for Sowerby's beaked whale results in scarce information on species presence being available within Scottish waters.

For harbour porpoise, killer whale, minke whale and short-beaked common dolphin), available data supports their distribution as primarily being in shallower waters (of <100m) or continental shelf breaks (depths of 100-500m) and so were not considered to pass the assessment against criterion 1a either.

Northern bottlenose whale and Atlantic white-sided dolphin are known to be found predominantly in deeper waters around Scotland, while fin whale and sperm whale are frequently reported within the deeper-waters of the Faroe-Shetland Channel. As such, these species did pass through the criterion 1a assessment. However, there is little or no information on patterns of these species' usage of the area and no known important life history stages occurring in the pMPA. As such, there was no evidence to justify further consideration of these species as proposed protected features of the pMPAs on the grounds of not passing through criterion 1b.

3.7 Birds

A total of eight seabird species were identified as having relatively higher density areas within the pMPA compared to other areas of the UK, using UK population density maps from Kober *et al.* (2010). These eight seabird species (Table 1) were considered further as possible features within the deep-sea marine reserve. In addition to Kober *et al.,* 2010, we reviewed the evidence provided

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[10] Available at: http://jncc.defra.gov.uk/page-1599
[11] Available at: http://biology.st-andrews.ac.uk/coda/

by tracking data (Wakefield *et al.,* 2013 and 2017; and Cleasby *et al.,* 2018), and foraging ranges (Thaxter *et al.,* 2012) (Table 2). These studies looked at seabird foraging range and at sea distribution during the breeding season and for those species studied (northern gannet, black-legged kittiwake, common guillemot (*Uria aalge),* razorbill (*Alca torda),* and European shag (*Phalacrocorax aristotelis*)) indicated usage of areas over the continental shelf, inshore of the pMPA was greater during the breeding season. With the exception of Leach's storm petrel, northern fulmar and northern gannet, the pMPA may be at the edge of the breeding season foraging ranges (Thaxter *et al.,* 2012) of these species (Table 2).

The density surfaces produced by Kober *et al.*, (2010) were considered to provide the best available data at the spatial scale required for this assessment and provided at sea distributions in breeding and non-breeding seasons.

The first stage of the assessment was to determine if significant numbers of each of these species were present within the pMPA compared to other areas of Scottish waters. Following the precedence from the application of the Birds Directive (2009/147/EC) within the UK[12] and the identification of Nature Conservation MPAs for black guillemot (*Cepphus grylle*) (SNH, 2012)[13], a threshold of 1% of the relevant UK or biogeographic population was used to define significance in terms of the numbers of birds present. For those species where significant numbers were present within the pMPA the methodology used by Kober *et al.* (2010) was followed.

Seabird density hotspot areas (1% Getis-Ord) were identified and tested to determine whether they were regularly present (as defined by Kober *et al.*, 2010). None of the seabird species from the long-list of possible features (Table 1) met these criteria of significant numbers being regularly present. Therefore, there was insufficient evidence to identify areas of importance to these seabird species within the pMPAs compared to other areas within Scottish waters and none were shortlisted. No bird species passed through the assessment from the initial long-list of possible features to the short-list of proposed protected features.

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[12] Available at: http://jncc.defra.gov.uk/page-1405
[13] Available at: https://www.gov.scot/resource/0038/00389462.doc