

Inshore Proposed Special Area of Conservation: Inner Hebrides and the Minches

SAC Selection Assessment Document



Version 12 (August 2016)

1. Introduction

This document provides the joint advice and detailed information for the Inner Hebrides and the Minches site proposed for designation for the Annex II species harbour porpoise (*Phocoena phocoena*), and evaluates this interest feature according to the Habitats Directive¹ selection criteria and guiding principles. This is a single feature site, proposed for designation solely for the purpose of aiding the conservation of harbour porpoise throughout UK waters, in accordance with EU legislation. The site covers territorial waters (out to 12 nautical miles from the baseline) within Scotland only.

The Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland)² transpose the Habitats Directive into law on land and in territorial waters of Scotland (out to 12 nautical miles from the baseline). Designation of Special Areas of Conservation (SACs) in Scottish Territorial Waters is the responsibility of Scottish Ministers.

The Habitats Directive aims to conserve biodiversity by maintaining or restoring Annex I habitats and Annex II species to a favourable conservation status. Member States are required to contribute to a coherent European ecological network of protected sites through designation of SACs for natural habitats and wild species listed on the Annexes of the Directive. Sites eligible for designation as marine SACs are selected on the basis of the criteria set out in Annex III (Stage 1) of the Habitats Directive and relevant scientific information. Sites are considered only if they host a Habitats Directive Annex I habitat or Annex II species. For Annex II aquatic species that range over wide areas, sites must clearly identify areas that represent the physical and biological factors essential to these species' life and reproduction. Socio-economic factors are not taken into account in the identification and designation of sites to be proposed to the European Commission.

While some wide-ranging highly mobile aquatic species have clearly-defined breeding/nurturing/feeding areas (i.e. areas 'essential to their life and reproduction'), the harbour porpoise is a naturally widely-distributed cetacean in European North Atlantic waters, and relatively little is known about its breeding behaviour. In addition, there are no obvious natural site boundaries for mobile species in the open sea. In practice, therefore, Article 4 of the Habitats Directive which requires member states to propose sites for Annex II species, and Annex III (site selection criteria), have proved difficult to apply to this species.

To address this problem, the European Commission (EC) published guidance on the designation of SACs for harbour porpoise in 2007 (EC, 2007). The guidance states that '*it is possible to identify areas representing crucial factors for the life cycle of this species. These areas would be identifiable on the basis of:*

- *the continuous or regular presence of the species (although subject to seasonal variations);*
- *good population density (in relation to neighbouring areas);*
- *high ratio of young to adults during certain periods of the year; and*

¹ http://www.central2013.eu/fileadmin/user_upload/Downloads/Document_Centre/OP_Resources/HABITAT_DIRECTIVE_92-43-EEC.pdf

² <http://www.legislation.gov.uk/uk/si/1994/2716/contents/made> with amendments in Scotland as outlined in <http://www.snh.gov.uk/protecting-scotlands-nature/protected-species/legal-framework/habitats-directive/regulations/>

- *other biological elements are characteristic of these areas, such as very developed social and sexual life.*

The guidance also states that *'defining boundaries for 'sites' in offshore waters which support a given percentage of the national population of some mobile species may be difficult due to the lack of obvious natural boundaries (such as coast, topographical boundaries, etc.) in the open sea. This criterion is also challenging to use in the offshore marine environment where populations may often be distributed across several national boundaries.'*

In addition to information on the Annex II species hosted within the site, this document contains:

- i) a map of the proposed site;
- ii) its name, location and extent;
- iii) the data resulting from application of the criteria specified in Annex III (Stage 1) of the Habitats Directive.

In preparing this document, consideration has been given to the format established by the European Commission, under which the Member States are required to provide site information to the Commission when proposing candidate SACs. This format is set out in the 'Natura 2000 Standard data form'³ (prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the European Commission to collect standardised information on SACs throughout Europe).

Further information

This document is available as a pdf file on SNH's website for download if required - www.snh.gov.uk/porpoiseSAC

Recommended citation: SNH (2016) SAC Selection Assessment Document: Inner Hebrides and the Minches. Version 12. Scottish Natural Heritage, UK.

³ The Standard Data Form template is available here: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011D0484&from=EN>

Document Version Control

Version and date	Amendments made	Issued to and date
1, 01/02/2016	Development of generic document for use at workshop – Karen Hall, Sarah Cunningham	Harbour porpoise workshop (4 th /5 th February) attendees – 02/02/15
2, 05/02/2016	Site-specific text drafted during harbour porpoise workshop – Karen Hall, Sarah Cunningham, Eunice Pinn, Finlay Bennett	Katie Gillham - 05/02/15
3, 06/02/2016	Review of workshop draft to address comments made by Katie Gillham and complete first full version – Sarah Cunningham and Karen Hall	Katie Gillham, Karen Hall – 06/10/2016
3, 09/02/2016	Update with details of additional models, general editing – Karen Hall	HP working group - 09/02/2016
4, 10/02/2016	General editing and incorporation of comments from JNCC and MS – Karen Hall	MS for dissemination to external reviewers - 10/02/2016
5, 16/02/2016	Edits following comments from external reviewers & John Baxter, update of proportion of population, insertion of site map and change of name from 'West Coast' to 'Inner Hebrides and the Minches' – Sarah Cunningham and Karen Hall	HP working group and SNH Directors Andrew Bachell & Nick Halfhide - 18/02/2016
6, 19/02/2016	Edits to address comments from SNH Directors – Katie Gillham, Karen Hall and Sarah Cunningham	SNH's Scientific Advisory Committee, Management Team and Protected Areas Committee - 22 February 2016
7, 29/02/2016	Edits to address comments from Scientific Advisory Committee – Katie Gillham, Karen Hall and Sarah Cunningham	SNH Management Team, Marine Scotland/Marine Scotland Science, JNCC, 1 March 2016
8, 02/03/2016	Edits to address comments from Management Team - Katie Gillham, Karen Hall and Sarah Cunningham	SNH's Protected Areas Committee, Marine Scotland/Marine Scotland Science/JNCC, 2 March 2016
9, 07/03/2016	Edits to address comments from Protected Areas Committee – Katie Gillham and Andrew Bachell	Marine Scotland, 9 March 2016
10, 21/03/2016	Change references from draft SAC to proposed SAC for consultation – Sarah Cunningham	Owen McGrath, 21 March 2016
11, 04/07/2016	Update to maps, site area and site abundance following consultation for SNH sign off process	Andrew Bachell, 4 July 2016
12, 25/08/2016	Update to site coordinates and site abundance range not undertaken in v11. Final advice.	Marine Scotland, 2 September 2016

2. Background to identification of harbour porpoise Special Area of Conservation in West Scotland

In January 2016 a request was made by Marine Scotland for SNH to work with Marine Scotland Science, JNCC and others to provide joint advice on a site in the harbour porpoise West Scotland Management Unit (MU) (IAMMWG, 2015a). The document presents this joint advice. The UK waters are divided into three MUs for harbour porpoise: the North Sea (NS), the Celtic and Irish Seas (CIS) and West Scotland (WS) and were selected based on a combination of what we understand of the ecology of harbour porpoise with the practicality of managing human activities⁴. Advice for a site within the West Scotland MU was requested by the Scottish Government because this is the only MU that overlaps with UK waters in which a site for harbour porpoise has not been proposed.

In the request, Marine Scotland provided additional guidance that a single site should host between 25% and 50% of the management unit population of harbour porpoise, and aim for between 5% and 10% of the available porpoise habitat. A significant majority of the site must be supported by at least three years of evidence and it must not be wholly reliant on any single model output. Qualitative evidence of calf presence would where possible inform the approach. This site has been identified jointly by the organisations involved to fulfil these requirements as well as those of the site selection criteria of the Habitats Directive. On reviewing the available evidence it became clear that it was not possible to identify a site that fulfilled Marine Scotland's population criterion without exceeding the habitat criterion. This is because of the way in which the population calculation has been done i.e. it assumes uniform density of harbour porpoises across the SCANS-II survey block N (Hammond *et al.* 2013) and thus the relationship between area and population abundance is fixed. Therefore to achieve the population criteria the proposed SAC has to include more than 10% of harbour porpoise habitat.

Two modelled outputs have been used to identify a proposed Special Area of Conservation (SAC) for harbour porpoise in the West Scotland MU.

DHI Water Environments (UK) Ltd (DHI) were contracted by JNCC to undertake an analysis of the Joint Cetacean Protocol (JCP) dataset in order to determine if persistent areas of high harbour porpoise density were present in UK waters (Heinänen and Skov, 2015), I. The JCP was created in 2004 and is amongst the largest collation of standardised survey data on harbour porpoise in the world, comprising 39 data sources with data from at least 545 distinct survey platforms (ships and aircraft) representing over 1.05 million km of survey effort (coverage across the entire study area) over an 18 year period from 1994-2011.

The other set of modelling outputs used was by Booth (2010) and Booth *et al.* (2013). Booth (2010) used sightings and acoustic detections of harbour porpoise from Hebridean Whale and Dolphin Trust (HWDT) data, collected during the summers of 2003-2008 (using the same data as Embling *et al.* (2010) for 2003 to 2005). The publication by Booth *et al.* (2013) used an additional two years of data from 2009 and 2010. Predicted density surfaces presented as percentiles were derived using data presented in Booth *et al.* (2013). The HWDT sightings data used by Booth are also contained within the JCP dataset and are therefore mostly a subset of those used by Heinänen and Skov (2015).

⁴ The harbour porpoise management units were identified by the UK's Interagency Marine Mammal Working Group (IAMMWG 2015a). They align with the UK parts of the Assessment Units proposed for harbour porpoise by the International Council for the Exploration of the Sea (ICES) in their advice to OSPAR. These are available from http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2014/WGMME/wgmme_2014.pdf

The outputs of the modelling undertaken by Embling *et al.* (2010) and Marubini *et al.* (2009) were given qualitative consideration as additional supporting evidence. The empirical sightings and acoustic data used as inputs to the various different models provide further confidence, particularly through the large number of records subject to a robust quality assurance process. Together, these other sources of evidence support the modelling outputs of Heinänen and Skov (2015), Booth (2010) and Booth *et al.* (2013) for SAC identification in the West Scotland MU.

Heinänen and Skov (2015) incorporated the modelled relationship between the observed harbour porpoise distribution and environmental variables to develop distribution models in each MU within the UK. The models produced by Heinänen and Skov (2015) for these MUs described discrete areas of predicted high porpoise density and captured the year-to-year variation within the different locations.

A detailed explanation of the development of the boundary for the Inner Hebrides and the Minches site is provided in SNH (2016). Marine Scotland hosted a workshop in February 2016 which brought together staff from Marine Scotland Science, SNH, JNCC and two independent scientists to develop a site jointly. The areas identified as persistently including the areas containing the top 10% of harbour porpoise density in the West Scotland Management Unit (from the Heinänen and Skov (2015) analysis) were overlain with the areas showing the top 20% of harbour porpoise density derived from data presented in Booth *et al.* (2013). An Area of Search (AoS)⁵ was identified through visual inspection of both these model outputs to identify areas predicted to be of high harbour porpoise density. It incorporated virtually all of the top 20% of harbour porpoise density derived from data from Booth *et al.* (2013) and some areas that were in the top 50% of harbour porpoise densities, as well as being in the top 10% persistent high density areas from the Heinänen and Skov (2015) analysis. The area was then refined based on the consensus view of the expert working group whose decisions were informed by a range of modelled outputs from Heinänen and Skov (2015), Booth (2010) and Booth *et al.* (2013) including predicted density surfaces and associated coefficients of variation, distribution of survey effort, overlap with other marine protected areas and simplification of the boundary along the eastern edge of the Outer Hebrides to make a boundary that could be readily identifiable by sea users. Areas were removed that had lower levels of model confidence. The boundary was also checked to ensure that there were visual sightings and/or acoustic detections and three or more years of survey coverage in the majority of the site. Following this, data on harbour porpoise calves and juveniles (HWDT unpublished data) were overlain and the site provided good coverage of these locations, so the site boundary remained unchanged. Boundary setting principles as outlined in SNH (2016) were then applied.

Together the existing Skerries & Causeway SAC (grade C for harbour porpoise), the pSACs consulted on by the other countries and this site cover 12.8% of the UK habitat and 18.5% of the UK population⁶ of harbour porpoises, and are distributed in territorial and offshore waters throughout the three relevant MUs. In terms of sufficiency, the Chief Scientists Group advised targets of 10-14% of the UK habitat for the species and 20% of the nominal UK harbour porpoise abundance. In addition there are 34 UK SACs which already list harbour porpoise as a non-qualifying feature (grade D) in UK waters.

Along with all other Member States, the UK has legal obligations to protect harbour porpoises wherever they are found in our seas. The designation of a Special Area of Conservation will

⁵ Identification of an Area of Search (AoS) is an initial step in identifying a Special Area of Conservation. An AoS can be defined as an area from within which SACs may be identified.

⁶ UK habitat for harbour porpoise is considered the UK continental shelf which is approximated by waters of 200m depth or less. This area and the abundance of porpoises in it, is considered as the 'UK area' and 'UK population', estimated as 537,000km² and 133,000 individuals, respectively.

contribute towards maintaining the favourable conservation status of harbour porpoise in the marine Atlantic biogeographic region by providing protection for habitats that support on average higher densities of the species. Alongside the identification of harbour porpoise sites, an overarching conservation strategy⁷ has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG, 2015c) the UK Conservation Strategy for Harbour Porpoise is currently being updated.

3. Inner Hebrides and the Minches pSAC: Selection Assessment Document

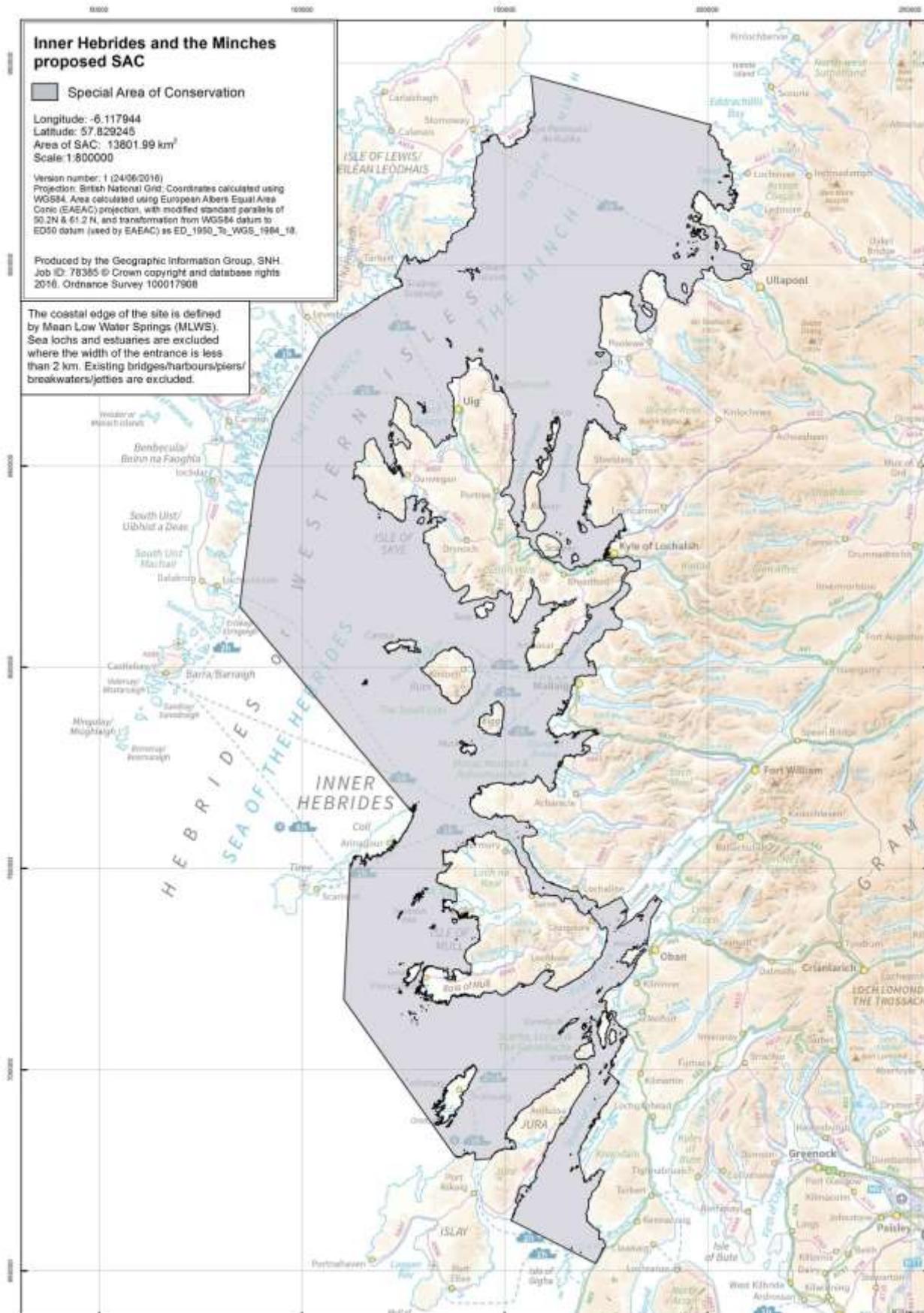
<p>Site name Inner Hebrides and the Minches</p>	<p>Site centre location Longitude: - 6.117944 Latitude: 57.829245 (Datum: WGS 1984)</p>
<p>Site surface area 13,801.99 km² (Datum: Europe Albers Equal Area modified to UK, calculated in ArcGIS)</p>	<p>Biogeographic region Atlantic</p>
<p>Administrative Region Scottish inshore waters (Marine Scotland/SNH)</p>	<p>Percentage cover within region Scottish inshore waters: 100%</p>

4. Interest features under the EU Habitats Directive

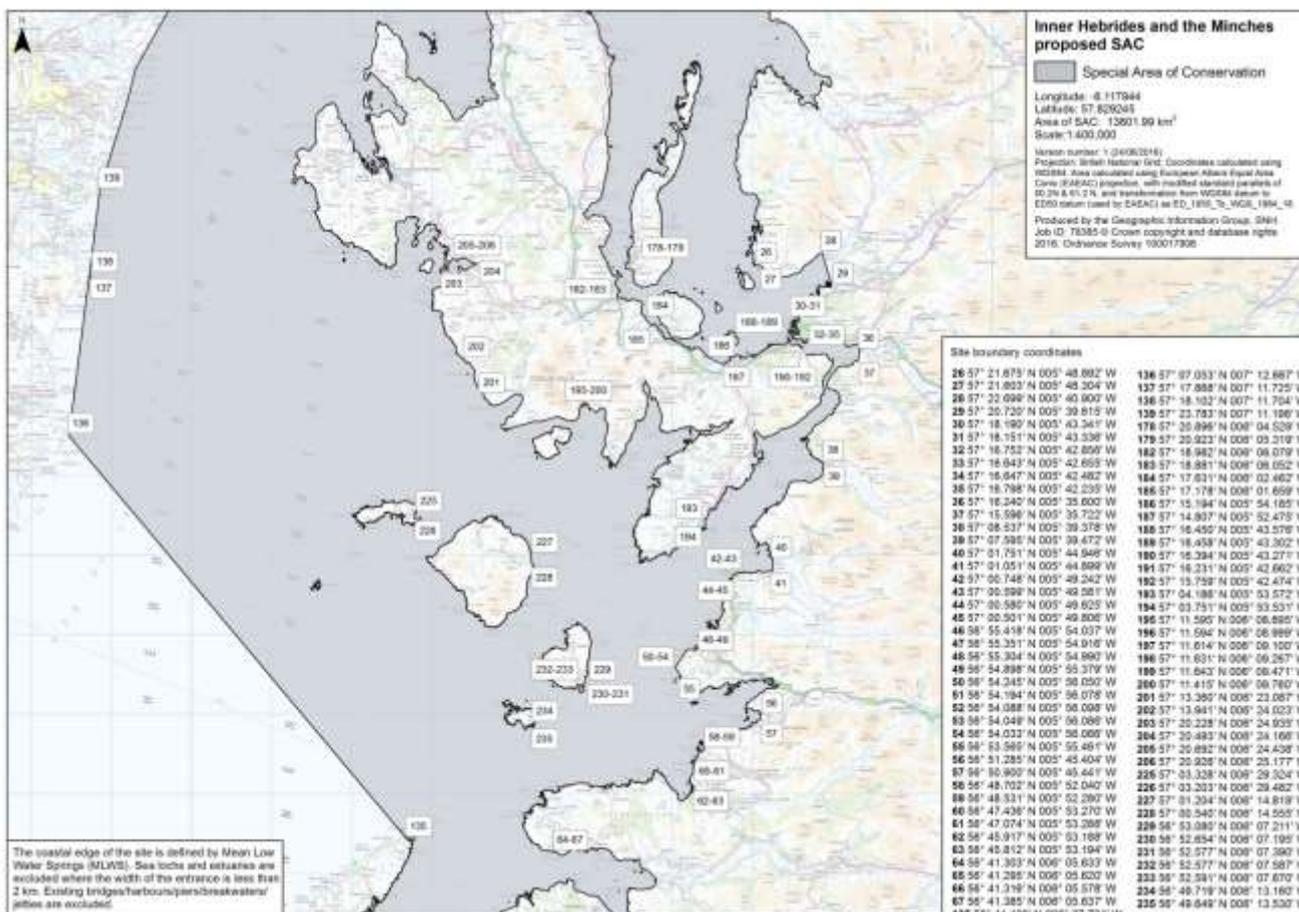
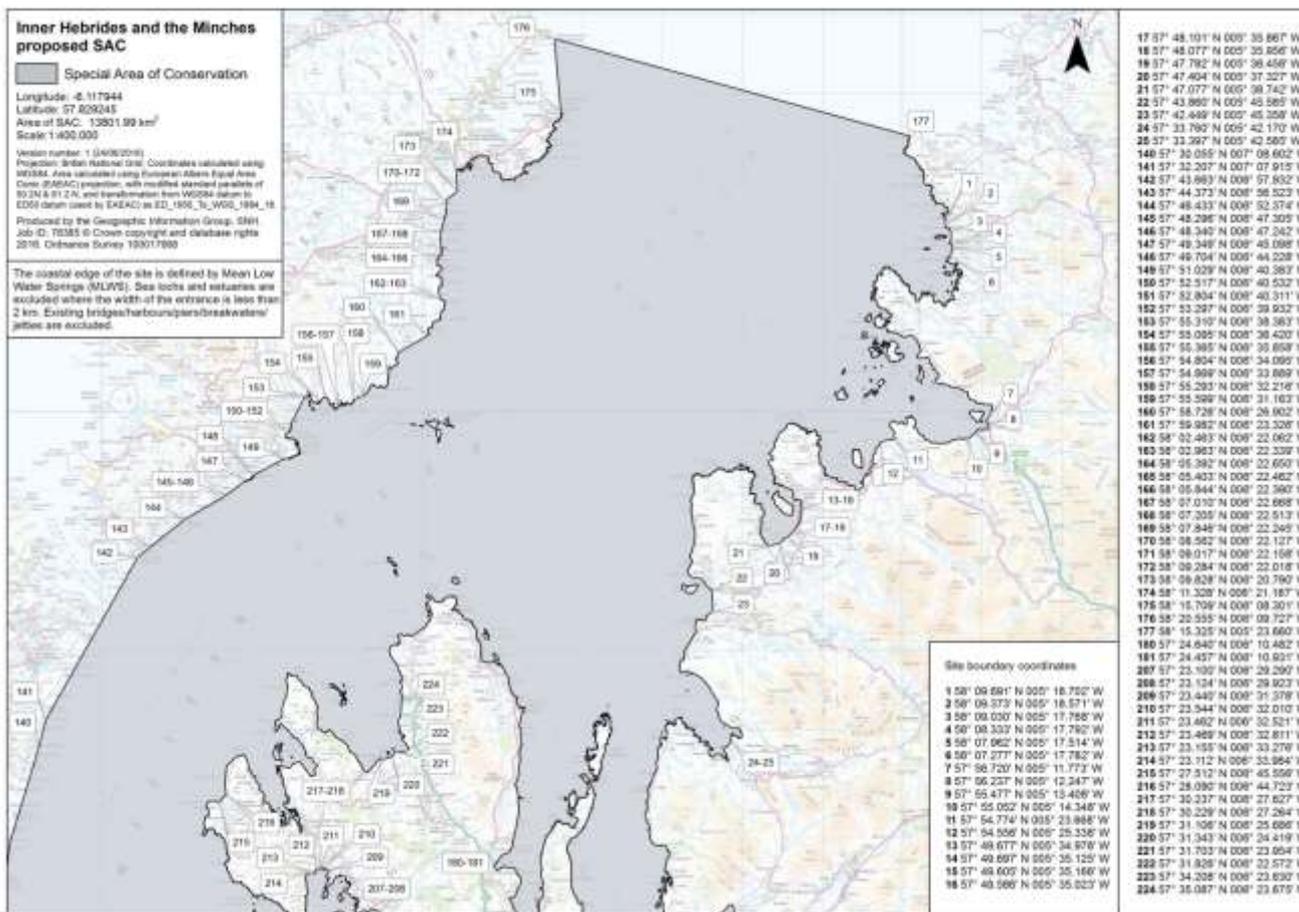
1351: [Harbour porpoise \(*Phocoena phocoena*\)](#)

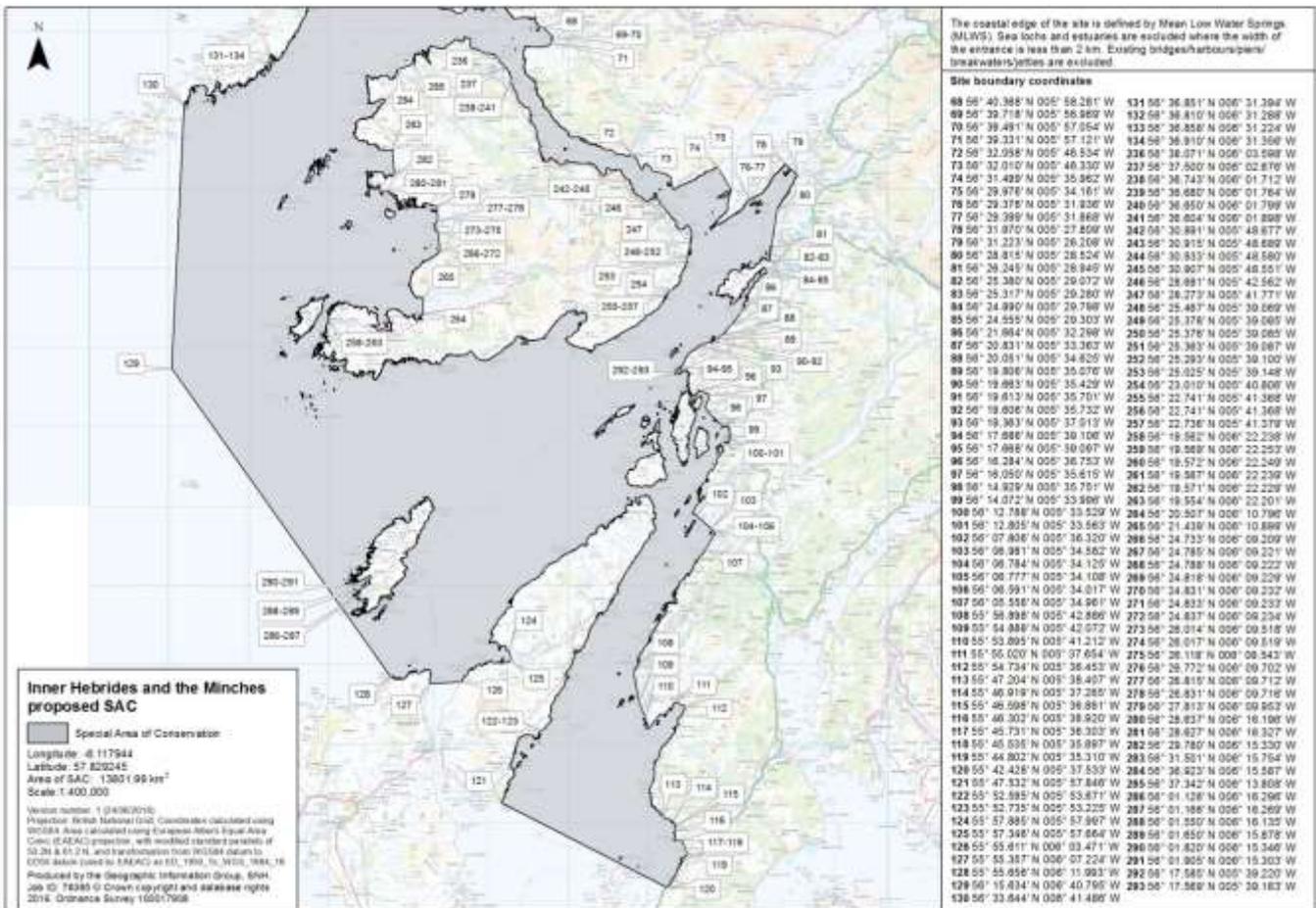
⁷ DETR. 2000. A UK conservation strategy for the harbour porpoise (*Phocoena phocoena*). Department for the Environment Transport and the Regions; Ministry of Agriculture, Fisheries and Food; Scottish Executive Rural Affairs Department; Department of Agriculture and Rural Development (Northern Ireland); National Assembly for Wales Environment Division; Department of the Environment in Northern Ireland

4. Map of site



The following maps provide the coordinates of the vertices for the site boundary:





6. Site summary

The Inner Hebrides and the Minches site is located within the West Scotland harbour porpoise MU and is an area with high predicted and observed densities of harbour porpoise. The area included within the site covers important summer habitat, where the density of animals has been shown to be consistently above average by both Heinänen and Skov (2015) and the work from Booth *et al.* (2013). Additionally, work by Embling *et al.* (2010) and Marubini *et al.* (2009) also indicate that locations within this proposed site support high densities of harbour porpoise in summer and thus could be suitable as a protected area for the species. No modelling work was undertaken for the winter season for the West Scotland management unit because there were insufficient data available. Although there are more data from summer months, harbour porpoise are present throughout the year (Paxton *et al.* 2016), and thus the designation applies year round.

The Inner Hebrides and the Minches site comprises an area of 13801.99km². The site's northern boundary crosses the North Minch between the Point of Stoer and Tolsta Head. A simple boundary follows the coastline of the Outer Hebrides to Rubha na h-Ordaig on South Uist. From there it crosses the Sea of the Hebrides to the northern tip of Coll, and then runs from Port a' Mhùrain on the south west of Coll, down to Rubha Bholsa on the north coast of Islay. It has a southern boundary between the Rubha na Tràille at the southern end of Jura and the mainland coast near Ballochroy. From Ballochroy it follows the mainland coastline back to the Point of Stoer including the Sound of Mull and Kyle Rhea. It encompasses the islands of Skye, Mull, Lismore, the island group within the Firth of Lorn and Colonsay.

The site is heterogenous in terms of its physical characteristics. The water depth within the site ranges from mean low water springs at the coast to depths of around 250 m in the Firth of Lorn. The shallower areas (down to 30 to 40 m depth) generally occur near the coast of the mainland and the islands and the deepest areas (100-200 m) are located within the central part of the Minch channel, outer parts of the main bays along the north-west mainland coast, channels in the Sound of Mull, Loch Linnhe, Firth of Lorn and the Sound of Jura. Booth (2010) and Booth *et al.* (2013) noted that higher densities of harbour porpoise were consistently associated with depths of between 50m and 150m across the various models constructed. There is a mosaic of substrate types within the site (EUNIS level 3, EUSeaMap⁸). The most dominant substrate types in the southern area of the site (south of Mull and north-west of Islay) are shallow sand, rock and coarse or mixed sediment. The central part of the site incorporating Mull, the Small Isles and Skye is composed of mainly mud, interspersed with rock and coarse or mixed sediments. The northern part of the site from Skye through the Minch is a similar mosaic of substrates, with mud dominating the seabed between Skye and the mainland, and the North Minch; and sandy areas dominated between the East coast of Lewis and the Eye Peninsular with a band running around the northern most edge of the site down in to Enard Bay. Harbour porpoise feed on a wide variety of fish that are associated with a range of sea bed substrates, and they generally focus on the most abundant local species. Their predominant prey includes sandeels (*Ammodytes* spp.), although pelagic species such as mackerel (*Scomber scombrus*) and herring (*Clupea harengus*) are also taken (Santos & Pierce, 2003; Pierce *et al.*, 2007). Sandeels (*Ammodytidae*) exhibit a strong association with surface sediments (Benke & Siebert, 1996; Santos, 1998), and their distribution is confined to sandy sediments with low amounts of silt and clay (Wright *et al.* 2000). The Inner Hebrides and the Minches pSAC includes not only sandy substrates suitable for sandeels, but also mixed and muddy sediments which may be important for other prey species. Therefore it is likely that the variety of sediments within the site and the prey species they support contribute to this site being a productive foraging area for harbour porpoise, supporting them in high densities.

The Inner Hebrides and the Minches site overlaps or adjoins with the following existing or proposed marine SACs and Nature Conservation MPAs (NCMPA):

Designation	Site name	Protected feature
NCMPA	Wester Ross	Burrowed mud, flame shell beds, maerl beds, circalittoral muddy sand communities, kelp and seaweed communities on sublittoral sediment, maerl or coarse shell gravel with burrowing sea cucumbers, northern feather star aggregations on mixed substrata, geodiversity (Marine Geomorphology of the Scottish Shelf Seabed - banks of unknown substrate, Seabed Fluid and Gas Seep –

⁸ <http://www.emodnet-seabedhabitats.eu/>

		pockmarks, Submarine Mass Movement - slide scars, Quaternary of Scotland)
	Loch Sunart	Flame shell beds, serpulid aggregations, northern feather star aggregations on mixed substrata
	Loch Sunart to the Sound of Jura	Common skate
	Lochs Duich Long and Alsh	Flame shell beds, burrowed mud
Proposed NCMPA	North-east Lewis	Risso's dolphin, sandeels, geodiversity (Quaternary of Scotland - glaciated channel/troughs, landscape of areal glacial scour, megascale glacial lineations; Marine Geomorphology of the Scottish Shelf Seabed - longitudinal bedform field)
	Shiant East Bank	Circalittoral sands and mixed sediment communities, northern sea fan and sponge communities, shelf banks and mounds, geodiversity (Quaternary of Scotland)
	Sea of Hebrides	Minke whale, basking shark, fronts and geodiversity (Marine Geomorphology of the Scottish Shelf Seabed)
SAC	Ascrib, Isay and Dunvegan	Harbour seal
	Eileanan agus Sgeiran Lios mor	Harbour seal
	Firth of Lorn	Reefs
	Lochs Duich, Long and Alsh	Reefs
	Sound of Arisaig	Subtidal sandbanks
	Treshnish Isles	Reefs, grey seal

7. Assessment of interest feature against selection criteria

Annex III selection criteria for Annex II Species: Stage 1B

Stage 1 of Annex III of the Habitats Directive refers to the assessment at national level of the relative importance of sites based on:

- (a) Size and density of the population of the species present on the site in relation to the populations present within national territory.

- (b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities.
- (c) Degree of isolation of the population present on the site in relation to the natural range of the species.
- (d) Global assessment of the value of the site for conservation of the species concerned.

As UK waters are divided into three MUs to ensure geographic coverage and to facilitate management for harbour porpoise, this site has been assessed in relation to the MU rather than at the national level.

a) Proportion of UK part of the West Scotland Management Unit population⁹

Abundance estimates calculated for this site (and those in the rest of the UK) were used directly to grade criterion III a) *Size and density of the population of the species present on the site in relation to the populations present within national territory.*

The explanatory notes to the Natura 2000 standard data form suggest the following ranking to grade the sites based on the size of the population in the site relative to the population in the national territory (criterion III (a)) and for the purpose of harbour porpoise proposed SACs, relative to the relevant UK management unit:

Grade A: >15% to 100% of the relevant UK management unit population

Grade B: >2% to 15% of the relevant UK management unit population

Grade C: >0% to 2% of the relevant UK management unit population

The site is '*clearly identifiable*' based on the modelling undertaken by Booth *et al.* (2013) and Heinänen & Skov (2015), and confirmed by comparison with other elements of the available evidence. The analytical approach taken by both of these studies incorporated some of the sub-criteria of the European Commission guidance for identifying sites for marine mobile species (EC, 2007), particularly the sub-criteria '*Continuous or regular presence of the species (although subject to seasonal variations)*', '*Good population density (in relation to neighbouring areas)*'. The site has a regular presence of harbour porpoise, as supported by effort-related survey data and model outputs. It is not possible to assess the ratio of young to adults because data have not been collected consistently at an appropriate scale. However, data from the Hebridean Whale and Dolphin Trust (HWDT) from 2004 to 2015 indicate that calves have been sighted throughout the Inner Hebrides and the Minches site (HWDT *unpublished*).

The Inner Hebrides and the Minches site was identified as being within the top 10% of persistent high density areas for harbour porpoise in UK waters during the summer season (Heinänen & Skov, 2015) and it incorporates virtually all of the top 20% of harbour porpoise density derived using data presented in Booth *et al.* (2013) and some areas that were in the top 50% (SNH, 2016).

It is estimated (based on the SCANS-II survey which took place in July 2005 only) that the site supports approximately 5438 individuals (95% Confidence Interval: 2426-12191) for at least part of the year, as seasonal differences are likely to occur, and represents approximately 32% of the population within the UK part of the West Scotland MU (in water depths of 200m or less). It should be noted that because this estimate is from a one-month survey in a single year it cannot

⁹ UK MU population is defined throughout this document as 'the UK portion of the MU, where water depths are 200m or less'.

be considered as a specific population number for the site. It is therefore not appropriate to use site population estimates in any assessments of effects of plans or projects (i.e. Habitat Regulations Appraisal), as these need to take into consideration population estimates at MU level, to account for daily and seasonal movements of the animals.

Therefore the Inner Hebrides and the Minches site has been identified as an important area for harbour porpoise during the summer season, and based on 32% of the MU population surveyed by SCANS in July 2005 of the West Scotland MU population it would be graded A on the basis of the EC standard data form (A =15% to 100% of the UK part of the MU population).

b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities

The UK network of sites for harbour porpoise¹⁰ covers approximately 12.8% of available porpoise habitat (continental shelf) and porpoise densities within this site are amongst the highest modelled for the population as indicated by Heinänen and Skov (2015) and Booth *et al.* (2013) analysis. This supports the opinion that these areas, relative to the rest of the continental shelf include the best habitat for harbour porpoises and have been used consistently over the last two decades. It is assumed that the preference for these habitats is associated with good feeding opportunities and prey aggregations. Additionally, there have been sightings of calves and juveniles in the area (Hebridean Whale and Dolphin Trust, unpublished data) which infers that breeding and calving may be occurring within the proposed site. The available evidence indicates that the conservation status of the UK harbour porpoise population is currently *Favourable*¹¹. Therefore, it is considered that the conservation of the feature in this site is graded as II (elements are well conserved), and restoration possibilities do not have to be considered. Therefore, the overall grade for this criterion is at least grade B. We do not know which features of the habitat are the most important drivers of the association with prey; nor do we know what are the main prey species of porpoise within the site. Until this is known, the quality of the habitat (good or excellent) cannot be determined and so a grade of A/B has been awarded.

Therefore, with respect to the degree of conservation of the features of the habitat important for the harbour porpoise, the Inner Hebrides and the Minches site would be graded A/B-grade ('Excellent'/'Good conservation') overall, without the necessity for consideration of restoration possibilities.

c) Degree of isolation of the population present on the site in relation to the natural range of the species

Only populations that are isolated from other populations of the same species (i.e. highly restricted in their distribution) would score highly against this criterion. Harbour porpoise within the site are part of the wider MU population and UK population. Therefore, as a wide ranging species, the animals within the site cannot be considered isolated in relation to the rest of the population.

¹⁰ Includes the Skerries & Causeway SAC, the pSACs consulted on by the other UK countries and the Inner Hebrides and the Minches pSAC.

¹¹ http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf

Therefore, with respect to isolation, the Inner Hebrides and the Minches site would be graded C: population not isolated within extended distribution range.

d) Global assessment

The global assessment is weighted towards the grade awarded to the site for its size and density, given that the conservation of features are not clearly understood and this site and the other pSACs are all equal in quality with regard their ‘degree of isolation’.

The Inner Hebrides and the Minches site is considered to have a global grade A, i.e. within the context of the UK West Scotland Management Unit. It contains a significant proportion of the West Scotland MU population of harbour porpoises and it covers an important and persistent high density area for the summer season.

Summary of grades for Stage 1b criteria

	Proportion of UK Population (a)	Conservation of features (b)	Isolation of population (c)	Global assessment (d)
Inner Hebrides and the Minches	A	A/B	C	A

8. Supporting scientific documentation

The process leading to the selection of the Inner Hebrides and the Minches site was based on a combination of observed data and predicative modelling (Heinänen and Skov, 2015, Booth 2010 and Booth *et al.* 2013). Note that the sightings data used by Booth (2010) and Booth *et al.* (2013) are not independent to the data set used by Heinänen and Skov (2015) but were subject to different analytical approaches.

Heinänen & Skov (2015) analysis

This study investigated whether persistent high density areas of harbour porpoise could be identified in UK waters using 18 years (1994 to 2011) of sea-based JCP data covering the entire UK EEZ. The JCP assembled disparate effort-related cetacean sightings datasets from European / north-east Atlantic waters and including the data used in Booth (2010) and Booth *et al.* (2013) along with those from all major UK sources e.g. ‘Small Cetacean Abundance in the North Sea and adjacent waters’ SCANS, and ‘Small Cetacean Abundance in the European Atlantic and North Sea SCANS-II from 1994 and 2005, respectively (Hammond *et al.*, 2002; 2013); ‘Cetacean Offshore Distribution and Abundance in European Atlantic’ CODA surveys from 2007 (CODA, 2009); European Seabirds At Sea (ESAS), which collected and collated seabird and cetacean data from the majority of countries with a north-west European coastline between 1979 and 1999, with ad hoc surveys beyond 1999; Sea Watch Foundation (SWF; i.e. NGO lead surveys); Atlantic Research Coalition (ARC); and from other non-governmental and marine renewable industry sources where such data were made available.

Heinänen and Skov (2015) addressed challenges, such as variable survey coverage in different parts of the UK EEZ within the study period, by developing statistical distribution models capable of predicting seasonal and yearly means. Where there were sufficient data, models were run for two seasons: summer and winter for each MU.

Data on concentrations of prey of harbour porpoises were not available for the entire EEZ at a fine spatial scale (5km). Therefore, physical oceanographic properties of currents, water masses and the sea floor were used as variables in the models. It is assumed that these variables affect the probability of harbour porpoises encountering prey. Heinänen and Skov (2015) also included mean shipping intensity in the model to account for some anthropogenic disturbance.

Heinänen and Skov (2015) model results indicate that densities of harbour porpoises are influenced by both oceanographic and pressure variables. The degree of influence of these factors varies in different parts of UK waters and between seasons. Analyses of the persistency of high density areas integrated evaluations of the number of years that high densities were predicted for an area with evaluations of the degree of recent high densities as predicted by the distribution models. Due to the uneven survey effort over the period, the uncertainty in modelled distributions varied greatly. Robust model predictions (based on relative standard errors) were found in most parts of the waters off the north-west Scottish coast for the summer period.

Booth (2010) and Booth *et al.* (2013) analyses

Booth (2010) used Hebridean Whale and Dolphin Trust (HWDT) data, collected during the summers of 2003-2008 (using the same data as Embling *et al.* (2010) for years 2003-2005) with a further two years (2009 and 2010) used in an extended analysis (Booth *et al.* 2013). Covariates included in the models (GEE-GAMs) were year, month, sea state, boat speed, sediment type (% mud), maximum spring tidal range, seabed depth and slope, and distance to coast. The models predicted that most of the coastal waters of the west of Scotland hold a high density of harbour porpoises, especially the waters around Mull and the Firth of Lorn, and the Sea of the Hebrides. This study also investigated inter-annual differences by comparing the model using the full dataset (including year as a covariate), with models for each year's data in turn. Whilst there appeared to be some variations in distribution among summers in different years, a generally consistent pattern of coastal waters usage was observed and consistent oceanographic variables were selected in the best models (e.g. depth and seabed slope). Density percentiles were derived using data presented in Booth *et al.* (2013).

Booth (2010) and Booth *et al.* (2013) also constructed models using acoustic data collected by a towed PAM array. These data were collected from the same vessel, often concurrent with visual surveys so are not statistically independent. Outputs from the full (all years) model from both visual and acoustic data show a very similar predicted distribution of harbour porpoises, although predicted densities from the acoustic model are generally slightly lower than from the visual model.

Booth (2010) and Booth *et al.* (2013) did not formally investigate persistency, although some of the relationships with covariates were consistent over multiple years.

Additional supporting evidence

In addition, work by Marubini *et al.* (2009) and Embling *et al.* (2010) were reviewed and their findings also demonstrated the importance of this site for harbour porpoise. Both studies only

covered a restricted part of the site and were for a limited time period. The data used in both these studies were included in the Heinänen and Skov (2015) model.

Marubini *et al.* (2009) used Sea Watch Foundation data. Sightings data were collected on surveys from a sailing vessel during July/August 1993, 1994, 1996 and 1997 and covered a limited area of the pSAC, from the north of Mull up into the Minch. Models (GAMs) investigated the influence of depth, distance to coast, tide height, current speed, year and sea state on the number of sightings per transect. The regions north west of Ardnamurchan and around the Small Isles, and the Inner Sound and north of Skye showed the highest modelled density of harbour porpoises.

Embling *et al.* (2010) used HWDT data. Sightings data were collected on surveys from a motor-sailing vessel during the summers of 2003-2005 and were focussed in the southern part of the pSAC, from Rum to Jura. Models (GAMs) investigated the influence of a suite of oceanographic (e.g. maximum tidal current, position in spring-neap cycle), physical (e.g. sediment type, distance to coast) and survey-related (e.g. vessel speed, sea state) covariates on the number of groups of porpoises detected per 2 km segment. The Inner Sound, West of Mull, the Small Isles/Sea of the Hebrides and the Sound of Sleat were the areas with highest predicted density of harbour porpoises. Areas with 10% highest predicted harbour porpoise density were delineated as areas most suitable to protect and these fell within the boundary of the proposed site.

References

- BENKE, H., and SIEBERT, U. 1996. *The current status of harbour porpoises (Phocoena phocoena) in German waters*. Reports of the International Whaling Commission, SC/47/SM49.
- BOOTH, C.G. 2010. *Variation in habitat preference and distribution of harbour porpoises west of Scotland*. Unpublished Ph.D thesis, University of St Andrews, Scotland.
- BOOTH, C.G., EMBLING, C., GORDON, J., CALDERAN, S.V. and HAMMOND, P.S. (2013). Habitat preferences and distribution of the harbour porpoise *Phocena phocena* west of Scotland. *Marine Ecology Progress Series* **478**: 273-285
- CODA. 2009. Cetacean Offshore Distribution and Abundance in the European Atlantic. Final Report. 43pp. [Available from http://biology.st-andrews.ac.uk/coda/documents/CODA_Final_Report_11-2-09.pdf]
- EC. 2007. Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the habitats and Birds Directives. [Available from http://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf]
- EMBLING, C. B., GILLIBRAND, P. A., GORDON, J., SHRIMPTON, J., STEVICK, P. T., and HAMMOND, P. S. 2010. Using habitat models to identify suitable sites for marine protected areas for harbour porpoises *Phocoena phocoena*. *Biological Conservation*, **143**(2): 267-279.
- HAMMOND, P. S., BERGGREN, P., BENKE, H., BORCHERS, D. L., COLLET, A., HEIDE-JORGENSEN, M. P., HEIMLICH, S., HIBY, A. R., LEOPOLD, M. F. and ØIEN, N. 2002. Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. *Journal of Applied Ecology*, **39**: 361-376.
- HAMMOND, P.S., MACLEOD, K., BERGGREN, P., BORCHERS, D.L., BURT, L., CAÑADAS, A., DESPORTES, G., DONOVAN, G.P., GILLES, A., GILLESPIE, D., GORDON, J., HIBY, L., KUKLIK, I., LEAPER, R., LEHNERT, K., LEOPOLD, M., LOVELL, P., ØIEN, N., PAXTON, C.G.M., RIDOUX, V., ROGAN, E., SAMARRA, F., SCHEIDAT, M., SEQUEIRA, M., SIEBERT, U., SKOV, H., SWIFT, R., TASKER, M.L., TEILMANN, J., van CANNEYT, O. and VÁZQUEZ, J.A. 2013. Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation*, **164**: 107-122.
- HEINÄNEN, S. and SKOV, H. 2015. The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, *JNCC Report No. 544*, JNCC, Peterborough. http://jncc.defra.gov.uk/pdf/JNCC_Report%20544_web.pdf
- IAMMWG. 2015a. Management Units for cetaceans in UK waters (January 2015). *JNCC Report No. 547*, JNCC Peterborough http://jncc.defra.gov.uk/pdf/Report_547_webv2.pdf
- IAMMWG, 2015b. The use of harbour porpoise sightings data to inform the development of Special Areas of Conservation in UK waters. *JNCC Report No. 565*, JNCC, Peterborough. http://jncc.defra.gov.uk/pdf/JNCCReport565_TheUseOfSightingsDataToInformTheDevelopmentOfSACs.pdf

IAMMWG, 2015c. A Conservation Literature Review for the Harbour Porpoise (*Phocoena phocoena*). JNCC Report No. 566, Peterborough.
http://jncc.defra.gov.uk/pdf/JNCCReport566_AConservationLiteratureReviewForTheHarbourPorpoise.pdf

MARUBINI, F., GIMONA, A., EVANS, P. G., WRIGHT, P. J. and PIERCE, G. J. 2009. Habitat preferences and interannual variability in occurrence of the harbour porpoise *Phocoena phocoena* off northwest Scotland. *Marine Ecology Progress Series*, **381**(1): 297-310.

PAXTON, C.G.M., SCOTT-HAYWARD, L., MACKENZIE, M., REXSTAD, E. & THOMAS, L. (2016), Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resources with Advisory Note, JNCC Report 517, ISSN 0963-8091. Available at: <http://jncc.defra.gov.uk/page-7201> .

PIERCE, G. J., SANTOS, M. B. and CERVINO, S. 2007. Assessing sources of variation underlying estimates of cetacean diet composition: a simulation study on analysis of harbour porpoise diet in Scottish (UK) waters. *Journal of the Marine Biological Association UK*, **87**: 213–221.

SANTOS, M. B. 1998. *Feeding ecology of harbour porpoises, common and bottlenosed dolphins and sperm whales in the northeast and Atlantic*. PhD thesis, School of Biology, University of Aberdeen, Scotland.

SANTOS, M. B. and PIERCE, G. J. 2003. The diet of harbour porpoise (*Phocoena phocoena*) in the northeast Atlantic. *Oceanography and Marine Biology: an Annual Review* 2003, **41**: 355–390.

SKOV, H. and THOMSEN, F. 2008. Resolving fine-scale spatio-temporal dynamics in the harbour porpoise *Phocoena phocoena*. *Marine Ecology Progress Series*, **373**: 173-186.

SKOV, H., HEINÄNEN, S., HANSEN, D.A., LADAGE, F., SCHLENZ, B., ZYDELIS, R. and THOMSEN, F. 2014 Habitat Modelling. Pp 102-112 in: BSH & BMU (2014). Ecological Research at the Offshore Windfarm alpha ventus - Challenges, Results and Perspectives. *Federal Maritime and Hydrographic Agency (BSH), Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Springer Spektrum*. 180 pp.

SNH. 2016. The use of harbour porpoise sightings data to inform the development of the Inner Hebrides and the Minches proposed Special Area of Conservation on the west coast of Scotland.

WRIGHT, P.J., JENSEN, H. and TUCK, I. 2000. The influence of sediment type on the distribution of the lesser sandeel, *Ammodytes marinus*. *Journal of Sea Research*, **44**: 243-256.