

**Scottish MPA Programme  
Assessment against the MPA Selection Guidelines**

**SOUTHERN TRENCH POSSIBLE MPA**

*JUNE 2019*

Further information on the Scottish MPA network and protected areas management is available at -

[www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork](http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork)

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](http://www.nature.scot/mpas) or [www.jncc.defra.gov.uk/scottishmpas](http://www.jncc.defra.gov.uk/scottishmpas)

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Version 16	02/11/2018	Sam Black	Finalisation for SNH Protected Areas Committee.
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## Purpose

This document provides details of the assessment of Southern Trench possible Nature Conservation MPA against the [Scottish MPA Selection Guidelines](#). It presents the assessment for each of the proposed protected features.

We have used the terminology set out in the Selection Guidelines to describe the five main stages in the assessment process from the identification of MPA search locations through to the development of MPA proposals. This area has now become a possible MPA because, following advice from SNH, Scottish Ministers have decided to consult on whether it should be formally designated.

*The main terms used are described below.*

MPA search location - this describes a location identified at stage 1 until it passes the assessment at stage 4.

Potential area for an MPA - if an MPA search location passes the assessment at stage 4 it goes on to become a potential area for an MPA for consideration at stage 5.

MPA proposal - a potential area for an MPA that has passed the assessment at stage 5 and which has been formally recommended for designation by SNH and/or JNCC to Scottish Ministers.

Possible MPA - an MPA proposal approved by Scottish Ministers for public consultation. From this time the location is given policy protection as if it were designated.

MPA search features - specified marine habitats, species and large-scale features that underpin the selection of MPAs.

Geodiversity features - specified geodiversity interests of the Scottish sea bed categorised under themed 'blocks' that are analogous to the MPA search features for biodiversity.

Representative features - habitats and/or species which are not MPA search features or key geodiversity features. They have been assessed to determine whether they would add to the broader representativity of the network.

Proposed protected feature - any feature (habitats, species, large-scale features [MPA search features and/or representative features] and/or geodiversity features) which has been proposed by SNH and/or JNCC for designation.

## History of development

Southern Trench possible MPA was identified for four MPA search features (burrowed mud; fronts; minke whales; shelf deeps) and two geodiversity features (Quaternary of Scotland; Submarine Mass Movement).

Southern Trench possible MPA overlaps with the Southern Moray Firth third-party MPA proposal that was identified for minke whales (see SNH and JNCC, 2012 for further details).

Details of supporting evidence are provided in the Southern Trench possible MPA data confidence assessment.

## SOUTHERN TRENCH POSSIBLE NATURE CONSERVATION MPA - APPLICATION OF THE MPA SELECTION GUIDELINES

### Stage 1 - Identifying search locations that would address any significant gaps in the conservation of MPA search features

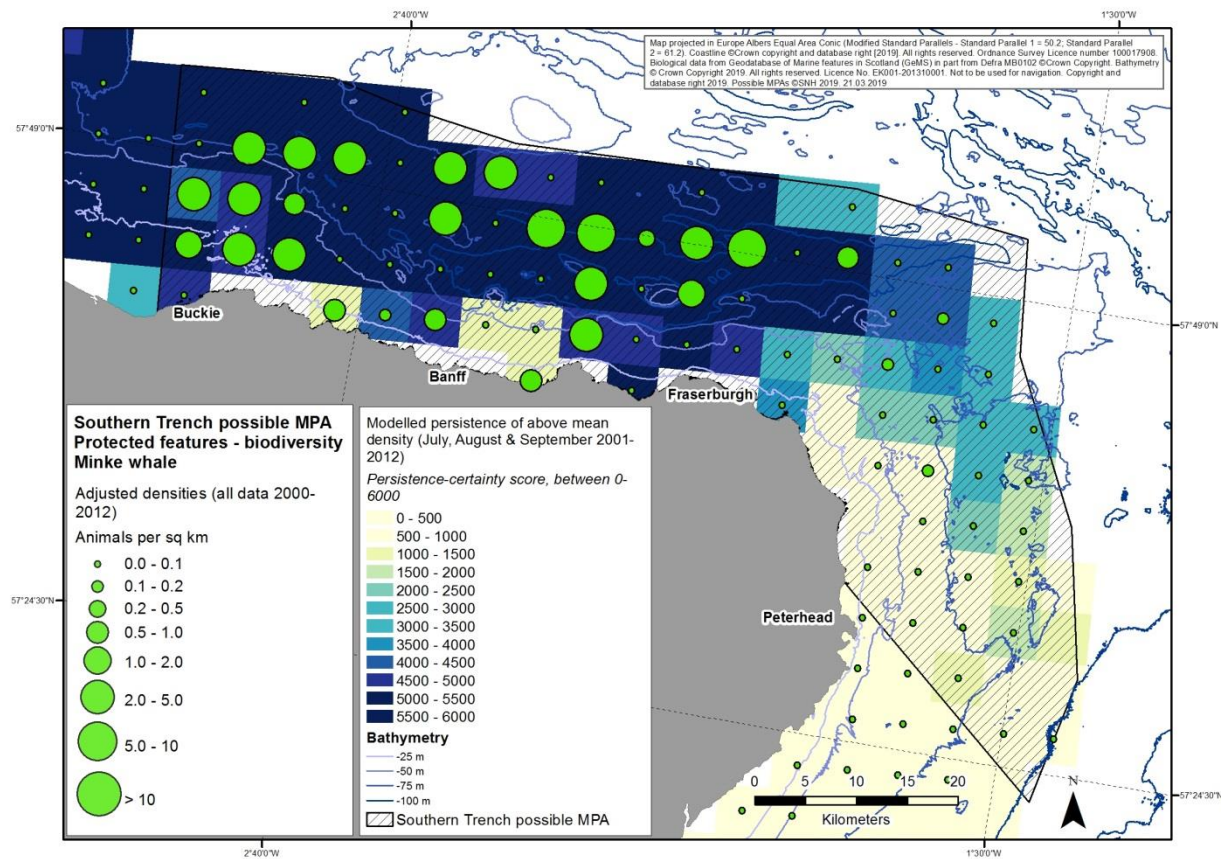
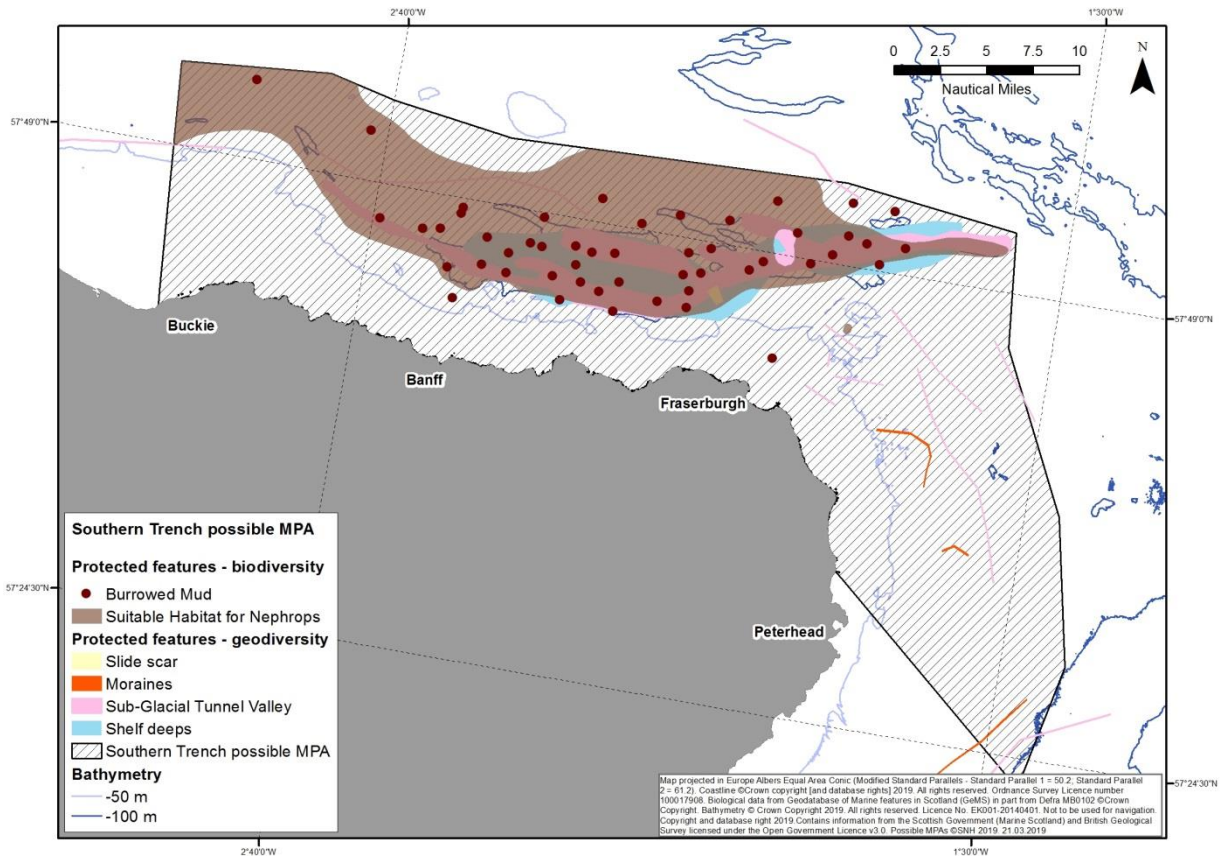
<b>Summary of assessment</b>	Southern Trench possible MPA encompasses four biodiversity features: burrowed mud, minke whales, fronts and shelf deeps. Burrowed mud is included on the OSPAR list of threatened and/or declining habitats and species and minke whales are considered to be under threat and/or in decline in Scottish waters. The shelf deeps and fronts features are of functional significance, with the former comprising the Southern Trench (after which the site is named) which runs across the possible MPA from the western side to the north-east tip. The proposed protected features also include two geodiversity features: Quaternary of Scotland and Submarine Mass Movement.
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<b>Detailed assessment</b>			
<b>Proposed protected features</b>	<b>Guideline 1a</b> <i>Presence of key features [MPA search features and geodiversity equivalents]</i>	<b>Guideline 1b</b> <i>Presence of features under threat and/or subject to rapid decline</i>	<b>Guideline 1c</b> <i>Functional significance for the overall health and diversity of Scottish seas</i>
<i>Biodiversity</i>			
Burrowed mud	✓	✓ OSPAR T&D <sup>1</sup> / T&D <sup>2</sup>	
Fronts	✓		✓
Minke whale	✓	✓ T&D <sup>2</sup>	
Shelf deeps	✓		✓
<i>Geodiversity</i>			
Quaternary of Scotland (subglacial tunnel valleys and moraines)	✓		
Submarine Mass Movement (slide scars)	✓		

<sup>1</sup> The burrowed mud MPA search feature encompasses the two component biotopes (**SS.SMu.CFiMu.SpMg** and **SS.SMu.CFiMu.MgMax**) and the seapen species (*Funiculina quadrangularis*) specifically associated with the OSPAR Threatened and/or Declining (T&D) habitat 'sea-pen and burrowing megafauna communities' (see OSPAR, 2008 a & b). The MPA search feature category also recognises the fireworks anemone *Pachycerianthus multiplicatus* as a distinct component species (not listed under the OSPAR T&D habitat) and reflects known variation in physical parameters within Scottish waters (e.g. includes a wider range of sediment types than simply fine muds). Further details about the relationship between the MPA search feature and the OSPAR T&D habitat are provided in SNH (2014b).

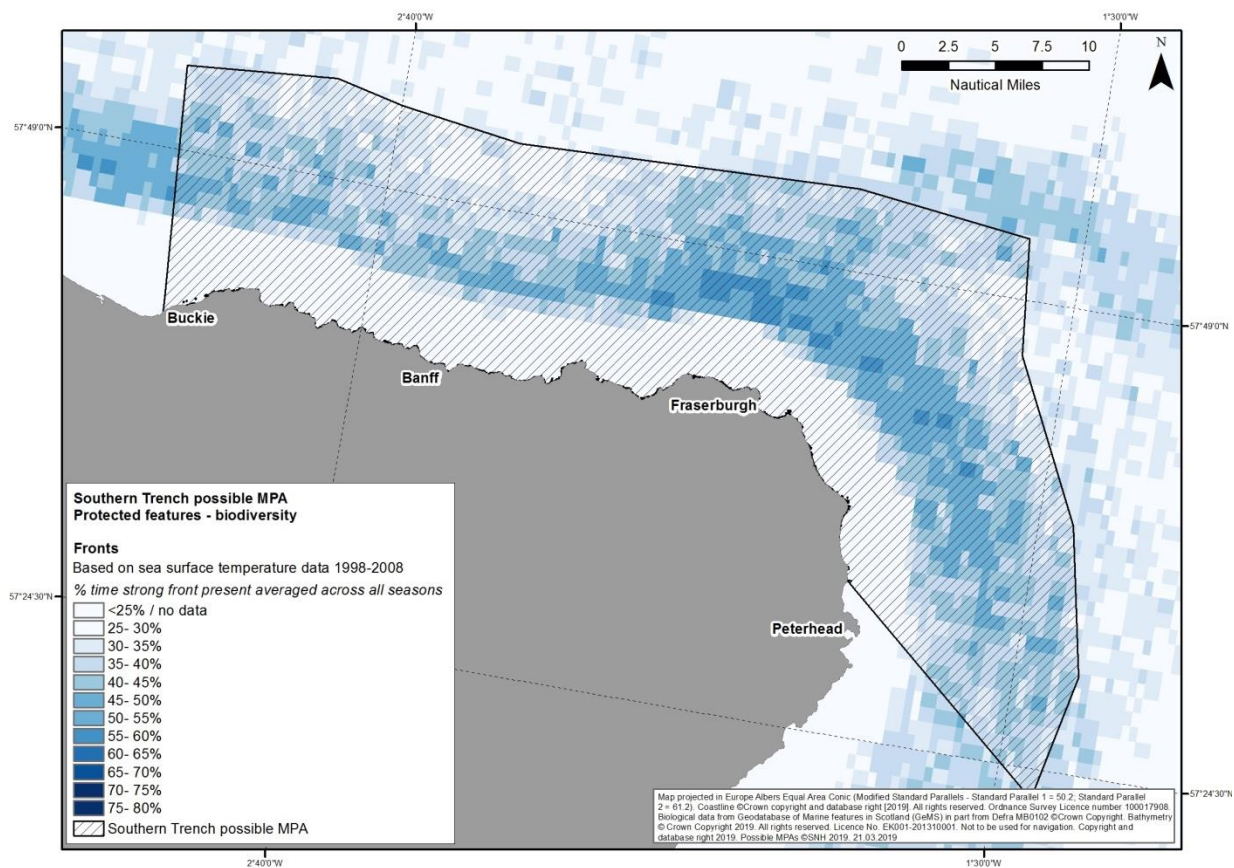
<sup>2</sup> Feature considered to be under threat and/or in decline in Scottish waters (see <https://www.nature.scot/snh-commissioned-report-388-identification-priority-marine-features-scottish-territorial-waters> for further details).

### Maps of Southern Trench possible MPA showing the known/modelled distribution<sup>3</sup> of proposed protected features



<sup>3</sup> Note: The Submarine Mass Movement (Slide scars) proposed protected feature is under-represented in the mapping of geodiversity interests within the possible MPA. Grid boxes used in modelling work are 5 x 5 km.





### **Interpretation of the fronts MPA search feature**

This summary overview is provided to aid interpretation of the terminology used within this technical assessment. The fronts MPA search feature is one of five large-scale features included on the list of MPA search features to represent areas of potential wider significance to the overall health and biodiversity of Scotland's seas. Fronts form at the boundary between two different water bodies, for example where tidally mixed coastal waters meet thermally stratified offshore waters, or where fully saline oceanic waters meet lower salinity inshore waters that have freshwater influence. In identifying Nature Conservation MPAs for fronts, the focus has been on those areas in which fronts occur persistently and frequently. Frequently occurring fronts (e.g. spatially and/or seasonally) are widely recognised as supporting enhanced biological activity. Fronts are described in more detail in the SNH and JNCC position paper '*Marine Protected Areas and large-scale features*' (see <https://www.nature.scot/scottish-mpa-project-large-scale-features-position-paper>). For further detail on the identification of locations on the Scottish continental shelf in which fronts are present see Miller *et al.* (2014).

## Stage 2 - Prioritisation of search locations according to the qualities of the MPA search features they contain

### Summary of assessment

The possible MPA contains a combination of features, with functional links between the large-scale shelf deeps feature and the geodiversity features and between these features and the burrowed mud habitat. There are also links between the fronts feature and occurrence of minke whales. The burrowed mud habitat exhibits a moderately high level of natural biological diversity. The possible MPA contains coherent examples of all four biodiversity features including the whole of shelf deeps feature (the Southern Trench), the area where thermal fronts are present year round and the area predicted by habitat modelling work to persistently support above average densities of minke whales during July, August and September. The burrowed mud feature is present both within and outside the Southern Trench itself. The fronts, shelf deeps and geodiversity features are considered to be least damaged/more natural whilst the other features (burrowed mud and minke whales) have either been modified by human activity and/or there is some uncertainty over their status. The seabed habitat and minke whales are considered sensitive to a range of pressures and at a regional level are considered to be at medium risk of significant damage by human activity. Regional risk assessments have not been carried out for the large-scale features or geodiversity interests although these are considered to be less sensitive than the other proposed protected features.

**All of the five Stage 2 guidelines have been met.**

### Detailed assessment

#### Guideline 2a The search location contains combinations of features, rather than single isolated features, especially if those features are functionally linked

The possible MPA supports six proposed protected features. These include two geological features and four biodiversity features. The latter comprise one habitat, one mobile species and two large-scale features. The possible MPA is located around the Southern Trench. This is a large undersea valley consisting of an area of deep water (~250 m) which extends along the south of the outer Moray Firth located approximately 10 km from the coast between the ports of Banff and Fraserburgh. The morphology of the trench is irregular and represents the most topographically complex region in the Moray Firth (Brooks *et al.*, 2013). Several of the proposed protected features in the area are believed to be functionally linked<sup>4</sup>.

- The trench represents two geodiversity features (Quaternary of Scotland and Submarine Mass Movement interests) and one large-scale biodiversity feature (shelf deeps). The geodiversity and biodiversity interests are integrally linked.
- The shelf deeps have remained open (i.e. they have not been infilled with sediment) and are significantly deeper than the surrounding sea bed. In general, it is expected that shelf deeps will exhibit weak tidal and residual currents and therefore may be relatively low-energy areas, with reduced levels of mixing near the sea bed and increased seasonal stratification (SNH and JNCC, 2014). Burrowed mud has been recorded within the trench and on the sea bed around the edges (Greathead *et al.*, 2007; Allan *et al.*, 2012; Hirst *et al.*, 2012; Moore, 2017).
- Based on habitat modelling, the coastal waters of the southern Moray Firth are predicted to support persistently higher than average densities of minke whales (Paxton *et al.*, 2014). This area is considered to be a feeding area for minke whales (Robinson *et al.*, 2007a), but it is unclear whether the trench itself enhances feeding opportunities. Their utilisation of the area is likely to be related to the bathymetry and large-scale features such as fronts. Fronts are likely to influence the distribution and availability of minke whale prey, which in turn, are closely related to temperature and chlorophyll concentration (e.g. Anderwald *et al.*, 2012).

**Guideline met.**

<sup>4</sup> This term refers to linkages between features and also the wider marine ecosystem in Scottish waters and is not the same as functional significance used in relation to Guideline 1c.



### Interpretation of the burrowed mud MPA search feature

This summary overview is provided to aid interpretation of the terminology used within this technical assessment. The burrowed mud MPA search feature is described in more detail in Tyler-Walters *et al.* (2012). The burrowed mud feature encompasses four components considered to be of particular relevance in a Scottish context: two component biotopes (**relevant biotope<sup>5</sup> codes provided in bold text below**) and two specific species -

- Biotope - “Seapens and burrowing megafauna in circalittoral fine mud” (**SS.SMu.CFiMu.Spnmeg**)
- Biotope - “Burrowing megafauna and the mud volcano worm *Maxmuelleria lankesteri*” (**SS.SMu.CFiMu.MegMax**)
- Species - *Funiculina quadrangularis* (the tall seapen)
- Species - *Pachycerianthus multiplicatus* (the fireworks anemone)

### **Guideline 2b The search location contains example(s) of features with a high natural biological diversity** (seabed habitats only)

Burrowed mud	The burrowed mud feature within Southern Trench possible MPA contains one component of the burrowed mud search feature, the biotope <b>SS.SMu.CFiMu.Spnmeg</b> . This biotope has been recorded both inside and outside the shelf deep area (Greathead <i>et al.</i> , 2007; Allan <i>et al.</i> , 2012; Hirst <i>et al.</i> , 2012; Moore, 2017). At a number of locations between 70 - 188 m depth <i>Pennatula phosphorea</i> , was recorded along with <i>Virgularia mirabilis</i> , <i>Munida</i> sp. and crustacean burrows, including <i>Nephrops norvegicus</i> and <i>Goneplax rhomboides</i> . Other species recorded which are characteristic of the <b>.Spnmeg</b> biotope included <i>Pagurus bernhardus</i> , <i>Cerianthus lloydii</i> , <i>Chaetopterus</i> sp., <i>Liocarcinus depurator</i> , <i>Asterias rubens</i> and <i>Amphiura chiajei</i> (Hirst <i>et al.</i> , 2012; Moore, 2017). At one station around 87 m depth the mud-burrowing amphipod <i>Maera loveni</i> was also recorded (Hirst <i>et al.</i> , 2012). Overall there is a high level of biological diversity with an average Shannon’s diversity (H’) of 3.5 (range of 3.0 - 4.2) and average species richness of 58.8 per 0.1 m <sup>2</sup> (range of 35 - 95 per 0.1 m <sup>2</sup> ) (Hirst <i>et al.</i> , 2012). Equitability values ranging between 0.79 - 0.94 indicate a fairly equal distribution of species across the area (Axelsson <i>et al.</i> , 2017).
<b>2b - Result</b>	<b>Guideline met.</b>

### **Guideline 2c The search location contains coherent examples of features, rather than smaller, potentially more fragmented ones**

Burrowed mud	<p>Within the possible MPA the burrowed mud feature is predominantly located along the outer Moray coast, both within and outside the Southern Trench. From a survey carried out in 2011 the <b>SS.SMu.CFiMu.Spnmeg</b> biotope was observed at 28 stations covering an estimated total area of 225.85 km<sup>2</sup> (Hirst <i>et al.</i>, 2012). The megafaunal communities associated with the burrowed mud habitat in Southern Trench possible MPA are typical for the deep shelf location in which they are found. Species diversity and composition records align well with the <b>SS.SMu.CFiMu.Spnmeg</b> biotope (Connor <i>et al.</i>, 2004). The most abundant species recorded were <i>Pennatula phosphorea</i>, <i>Munida</i> sp., <i>Calocaris macandreae</i>, <i>Callianassa subterranea</i> and <i>Goneplax rhomboides</i> burrows (Hirst <i>et al.</i>, 2012; Moore, 2017).</p> <p>There has been very little research on seapen and burrowing megafaunal communities to assess their natural spatial and temporal variability. Hill <i>et al.</i> (2010) assessed the potential viability of these habitats and concluded that whilst only very large areas (1,962 km<sup>2</sup>) would protect all the life-cycle stages of most of the constituent fauna, an area of 500 m<sup>2</sup> would be suitable for the maintenance of most species (no data were available for seapens). In the absence of significant disturbance, the burrowed mud habitat is considered stable and expected to persist.</p>
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<sup>5</sup> Further details on the UK marine habitat classification are available online at <http://jncc.defra.gov.uk/page-5931>

<b>Guideline 2c      The search location contains coherent examples of features, rather than smaller, potentially more fragmented ones</b>	
Fronts	The possible MPA encompasses the area where a thermal front forms persistently from year-to-year. In autumn and winter the thermal front which is maintained by tidal currents is located close to the coast and lies within the area covered by the possible MPA. In spring and summer the additional stratification from summer warming generates additional surface thermal fronts which extend over a much wider area. The possible MPA encompasses the area where thermal fronts are expected to be present year round. The position of the front corresponds to a relatively narrow, shallow, inner shelf associated with enhanced tidal mixing (Miller <i>et al.</i> , 2014).
Minke whale	Minke whales can live for up to 50 years, maturing at around 7-10 years (Evans, 1991), with adults reaching lengths of 6.5-10 m (Reid <i>et al.</i> , 2003; Edwards, 2006). Group sizes are generally small (1-3 individuals), although animals may aggregate in larger groups (10-20 individuals) where feeding conditions are good (Reid <i>et al.</i> , 2003). There is no information to determine what a minimum viable population for minke whales might be, or the size of an area required to support a viable population. In the outer Moray Firth, minke whales tend to move inshore from July onwards to feed (Robinson <i>et al.</i> , 2007b). A large proportion of animals recorded within the possible MPA are juveniles (Robinson <i>et al.</i> , 2009). Habitat modelling (Paxton <i>et al.</i> , 2014) predicts that the area supports persistently above average densities of the species, while effort-corrected sightings data indicate that relatively high numbers of minke whale (compared to Scottish territorial waters as a whole) occur within the possible MPA, with an apparent peak during the summer feeding season. This season is a key stage in the minke whale life cycle, when animals build up sufficient energy reserves (by feeding on prey species such as sandeels, sprat and herring) to enable them to migrate to winter breeding grounds (SNH, 2012).
Shelf deeps	Shelf deeps are enclosed topographic depressions on the sea bed, in most cases created by glacial erosion during periods of lower sea level. The whole of the Southern Trench is encompassed within the possible MPA.
<b>2c - Result</b>	<b>Guideline met.</b>

<b>Guideline 2d</b>	<b>The search location contains features considered least damaged / more natural, rather than those heavily modified by human activity</b>
Burrowed mud	Although there are no obvious signs of damage, the 2011 survey (Hirst <i>et al.</i> , 2012) observed <i>P. phosphorea</i> at lower abundances than those recorded in 2003 (Greathead <i>et al.</i> , 2007). This may be indicative of damage and/or a decline in the quality of the habitat.
Fronts	Fronts form at the boundary between two different water bodies. In Southern Trench possible MPA the marine input is provided by the Dooley current which circulates cold waters from the north in a clockwise direction (Tetley, 2004). The cooler waters meet a warm water plume extending from the inner firth into the wider area to produce a thermal front. The surface thermal fronts within the possible MPA have persistently occurred in the same locations over time, based on a 10-year time series of satellite derived sea surface temperature data (Miller <i>et al.</i> , 2014). They are not considered to be modified by human activity.
Minke whale	The 2016 SCANS III survey provided an estimate of 5000 minke whales within the blocks that overlap with the possible MPA (stretching from the Northern Isles south and including the whole of the east coast of Scotland) (Hammond <i>et al.</i> , 2017). Within UK waters, effort-corrected sightings data indicate that minke whales are most abundant around Scotland with high numbers off the west coast and in a broad swathe from the Moray Firth (including the Southern Trench) and along the east coast. Habitat modelling predictions suggest that Southern Trench possible MPA supports persistently higher than average densities of minke whale compared to wider Scottish territorial waters, while annual cetacean surveys also indicate consistent presence of the species (Robinson <i>et al.</i> , 2009). The main threats to minke whale in Scottish waters are considered to be entanglement, vessel collisions and disturbance (Koschinski, 2003; Dolman <i>et al.</i> , 2006; Northridge <i>et al.</i> , 2010).
Shelf deeps	Shelf deeps are enclosed topographic depressions on the seabed, in most cases created by glacial erosion during periods of lower sea level, over hundreds of thousands of years. The feature is robust, entirely natural in origin and not considered to have been modified by human activity.
Geodiversity features	Although the exact origin of the trench and the other large-scale incisions found in this region (the Quaternary of Scotland interests) remains contentious, they are thought to have formed from at least two erosional events driven by different processes of fluvial and/or ice-marginal erosion. The trench is also thought to contain rock features greater than 250 million years old (Brooks <i>et al.</i> , 2013). Slide scars (Submarine Mass Movement interests) form when large volumes of sediment move rapidly downslope. Their formation is likely to be driven by the same processes that led to the formation of the trench. Both geodiversity features are robust, entirely natural in origin and are not considered modified by human activity.
<b>2d - Result</b>	<b>Guideline met.</b>

<b>Guideline 2e The search location contains features considered to be at risk<sup>6</sup> of significant damage by human activity</b>	
Burrowed mud	Based on a regional risk assessment the burrowed mud search feature is at <b>medium</b> risk from significant damage by human activity. This is largely as a result of potential exposure to pressures associated with towed, bottom-contacting fishing activity.
Fronts	<b>Regional risk assessments have not been completed for large-scale features.</b> The thermal front within the possible MPA could be sensitive to pressures such as changes in tidal flow or physical changes to the sea bed. Activities (such as marine energy production or other large-scale development), that have potential to cause substantial changes to either water flow or seabed topography could have implications for the structure or distribution of the feature and its functional role within the possible MPA. Currently most pressures associated with marine anthropogenic activities are considered unlikely to present a significant risk to the fronts feature.
Minke whale	Based on a regional risk assessment the proposed protected feature is considered to be at a <b>medium</b> risk. There is some overlap between offshore wind energy lease areas and areas predicted to be persistently of above average minke whale density in the Moray Firth, however, the lease areas are some distance from the Southern Trench possible MPA. Minke whales are also at risk from entanglement/bycatch from fishing gear and ropes/nets. Incidental catches and entanglements have been recorded, however, these are rare and at present levels it is unlikely that this pressure impacts minke whales at a regional scale (Northridge <i>et al.</i> , 2010).
Shelf deeps	<b>Regional risk assessments have not been completed for large-scale features.</b> Shelf deeps are robust and not considered to be at risk of significant damage from human activity.
Geodiversity features	<b>Regional risk assessments have not been completed for geodiversity features.</b> However, information is available on the likely sensitivity of these features to pressures arising from human activity (Brooks, 2013). The sub glacial tunnel valleys are highly resistant to human activities (having been formed originally by glacial scouring). These and slide scars (Submarine Mass Movement feature) are either considered not sensitive, or to have a low sensitivity to pressures arising from human activities. Moraines are relict features that comprise glacial till. Their resistance to erosion is highly variable and depends upon the composition and level of consolidation of the till. Overall, moraines are considered to have a medium sensitivity to sub-surface abrasion and changes in tidal flow, and a high sensitivity to physical removal.
<b>2e - Result</b>	<b>Guideline met.</b> This is not an assessment of activities that require management within the possible MPA. That assessment is provided in the <i>conservation objectives and advice to support management</i> paper.

<sup>6</sup> Information on the sensitivity of the MPA search features to pressures and their associated activities was taken from FEAST (FEature, Activity, Sensitivity Tool - <http://www.marine.scotland.gov.uk/FEAST/>). The degree to which an MPA search feature is exposed to activities / pressures to which it is sensitive at a regional scale was assessed to provide a qualitative measure of risk. Risk assessments for the various activities were examined to produce an overall qualitative risk assessment by region (Chaniotis *et al.*, 2014). The conclusions may therefore not reflect the level of risk at the scale of the MPA. Site-specific activities and pressures are considered in further detail within the *conservation objectives and advice to support management* paper produced for this MPA.

### Stage 3 - Assessing the appropriate scale of the search location in relation to search features<sup>7</sup> it contains

#### Assessment

**The size of the search location should be adapted where necessary to ensure it is suitable for maintaining the integrity of the features for which the MPA is being considered. Account should also be taken where relevant of the need for effective management of relevant activities**

The size and shape of the possible MPA reflects the distribution and extent of the range of proposed biodiversity and geodiversity protected features. Modelling work indicates that the possible MPA encompasses areas predicted to support persistently higher than average densities of minke whales. The northern and western boundaries of the site were drawn on the basis of outputs from minke whale habitat modelling and effort-corrected minke whale sightings data (2000-2012). Whilst the habitat modelling indicated an area of persistently above average densities stretching from the Southern Trench into the inner Moray Firth, the western boundary was drawn close to Buckie to reflect the coverage of effort-corrected sightings data along this stretch of coastline. The north-eastern tip of the boundary extends beyond Scottish territorial waters and reflects the known extent of the shelf deep/Quaternary of Scotland geodiversity feature (and the closely aligned burrowed mud). The southern and eastern boundaries have been drawn to reflect the location of the persistent seasonal front that forms along this part of the outer Moray Firth coastline, extending down past Peterhead. **Guideline met.**

### Stage 4 - Assessing the potential effectiveness of managing features within a search location as part of a Nature Conservation MPA

#### Summary of assessment

**The possible MPA passed the assessment against the Stage 4 guideline.** This resulted in the original MPA search location progressing as a potential area for an MPA to Stage 5.

#### Detailed assessment

**There is a high probability that management measures, and the ability to implement them, will deliver the objectives of the MPA**

The conservation objective for all of the protected features within this possible MPA is to 'conserve'. The features are generally considered to be in good condition.

A number of activities are considered capable of affecting the proposed protected features (see 2e above) and there is therefore a need to consider whether additional management is required.

Statutory mechanisms exist (e.g. Fisheries Orders or Marine Conservation Orders) to support the introduction of spatial / temporal measures to conserve the features within the possible MPA. For example, Fisheries Orders have already been used to underpin management of marine Special Areas of Conservation and Marine Conservation Orders for Nature Conservation MPAs. There are also a range of voluntary measures in place that could contribute to achieving the conservation objectives (e.g. the Scottish Marine Wildlife Watching Code). There is therefore potential for management measures to be implemented successfully and the conservation objective of the MPA to be achieved. Further discussion is required with those involved in using the possible MPA to provide clarification on interactions between the protected features and known / potential activities / developments.

Additional details are provided in the *conservation objectives and advice to support management* paper produced for this possible MPA.

<sup>7</sup> Setting the size and shape of a possible MPA considers the distribution of both MPA search features and relevant geodiversity features. The latter, which are analogous to the biodiversity search features, were defined after the publication of the MPA Selection Guidelines (refer to Brooks *et al.*, 2013).

## Stage 5 - Assessment of the contribution of the potential area to the MPA network

<b>Summary of assessment</b>	Guideline met - if designated the possible MPA would make a significant contribution to the MPA network.
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### Detailed assessment

The potential area contributes significantly to the coherence of the MPA network in the seas around Scotland

#### Assessment of biodiversity features

Feature	Representation	Replication	Linkages	Geographic range & variation	Resilience
Burrowed mud	Seapens and burrowing megafauna in circalittoral fine mud. <b>[SS.SMu.CFiMu.SpMg biotope]</b> This possible MPA would ensure protection of burrowed mud within OSPAR Region II outwith the hydrographically-isolated Fladen Grounds (Gallego <i>et al.</i> , 2013) where the Central Fladen MPA is located.	Seapens and burrowing megafauna are included within Nature Conservation MPAs within OSPAR Regions II, III and V (see SNH and JNCC, 2012; SNH, 2014).	Not applicable <sup>8</sup> , although see comments under <i>Representation</i> . Part of the justification for including burrowed mud within this possible MPA is because of the lack of connectivity between the existing Central Fladen MPA and waters beyond the Fladen Grounds.	Middle of geographic range in Scotland. Provides an example of burrowed mud on the open coast.	Additional examples are proposed for inclusion within the network because Scottish waters are of proportional importance for this OSPAR Threatened and/or Declining habitat.  The Southern Trench possible MPA complements the protection already provided within OSPAR Region II by the Central Fladen MPA.
Fronts	Persistent feature between years and seasons. Likely to contribute to favourable feeding conditions for mobile species in the area.	There is replication of fronts within the MPA network in OSPAR Regions II and III (see SNH and JNCC, 2012; SNH, 2014).	Unknown. Links may be supported via the pathway of the Scottish Coastal Current (which runs clockwise around Scotland).	Provides an east coast, continental shelf example of this feature.	Fronts are not considered to be threatened and/or declining.

<sup>8</sup> The linkages part of the guideline has only been assessed in situations where there is a good understanding of the relationship between features in different areas to help build connectivity into the network. There is currently insufficient evidence on which to base detailed assessments of linkages for seabed habitats and low or limited mobility species in Scotland's seas but initial conclusions are presented in Gallego *et al.* (2013).



<b>Assessment of biodiversity features</b>					
<b>Feature</b>	<b>Representation</b>	<b>Replication</b>	<b>Linkages</b>	<b>Geographic range &amp; variation</b>	<b>Resilience</b>
Minke whale	Area predicted to support persistently higher than average densities, relatively high effort-corrected sightings. feeding behaviour.	There is replication of minke whales within the MPA network through the Sea of Hebrides possible MPA in OSPAR Region III (see SNH and JNCC, 2012; SNH, 2014).	Minke whales occur in Scottish waters and are present in greater abundance during their summer feeding season. They then migrate to breeding grounds in autumn (although the locations are unknown).	Minke whales are present in Scottish waters within two broad areas, one down the east coast and one down the west coast of Scotland. This provides an example of an area where significant aggregations of minke whale are observed particularly in the summer on the east coast of Scotland.	Two possible MPAs have been identified, one in each of the OSPAR Regions in Scottish waters where minke whales occur in greater abundance. Because they are highly mobile species, the focus should be on managing these MPAs within the context of the wider seas (rather than seeking to identify additional MPAs for minke whales).
Shelf deeps	A high quality example of a glacially scoured shelf deep. The deepest feature on the Scottish east coast continental shelf.	Replication of this feature in the network is proposed within OSPAR Region III and between Regions II and III (see SNH and JNCC, 2012; SNH, 2014).	Not applicable. <sup>8</sup>	Extends the geographic range of the feature within the MPA network to the east.	Shelf deeps are not considered to be threatened and/or declining. The shelf deeps within the Small Isles MPA represent a glacially scoured, open coast example of the feature. The shelf deep within the existing Firth of Lorn SAC (the additional example providing replication within OSPAR Region III) is the only known example of a tidally-scoured deep in Scottish waters. Therefore the possible MPA complements existing protection.

### Assessment of geodiversity features

Geodiversity features<sup>9</sup>

Southern Trench possible MPA encompasses one of the largest and best examples of large-scale seabed incision in Scotland (Bradwell *et al.*, 2008). The trench system is regarded as scientifically important for furthering our understanding of ice sheet drainage patterns in this region. The Southern Trench is 58 km long, (up to) 9 km wide and in places, is up to 250 m deep (Bradwell *et al.*, 2008). The eastern section of the Trench directly overlies the Banff Fault which separates Palaeozoic rocks on a platform to the south from the Mesozoic sedimentary basin of the Moray Firth, to the north. The Southern Trench is unusual in that it is cut through both Quaternary deposits and the underlying bedrock.

The exact origin of the trench (along with the other large-scale incisions found in this region) remains contentious, although detailed morphological analyses reveal that it formed from at least two erosional events operating in different directions. These events may have been driven by different processes of fluvial and/or ice-marginal erosion, for example, by movement of a fast stream of glacier ice, sub-ice water or possibly from the catastrophic release of meltwater. These multiple drivers have led to a wide range of geological features including moraines and slide scars. Information on the coverage of geodiversity features within the MPA network is provided in Gordon *et al.* (2013).

**Source:** Brooks *et al.* (2013) and references therein.

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<sup>9</sup> For geodiversity the stage 5 assessment primarily considers the potential contribution to the principal 'networks' of marine geodiversity interests present in Scottish waters (representation).

## Bibliography

- Allan, L., Demain, D., Weetman, A., Dobby, H. and McLay, A. (2012). Data mining of the *Nephrops* survey database to support the Scottish MPA Project. *Scottish Marine and Freshwater Science* **3**(9). ISSN: 2043-7722. Available from <<http://www.scotland.gov.uk/Resource/0041/00410486.pdf>>
- Anderwald, P. and Evans, P.G.H. (2010). *Cetaceans of the East Grampian Region*. Sea Watch Foundation Report. pp68.
- Anderwald, P., Evans, P.G.H., Dyer, R., Dale, A., Wright, P.J.W. and Hoelzel, A.R. (2012). Spatial scale and environmental determinants in minke whale foraging behaviour. *Marine Ecological Progress Series* **450**: 259-274.
- Axelsson, M., O'Dell, J. and Dewey, S. (2017). Infaunal and PSA analyses of benthic samples collected from South Arran MPA, Lochs Duich, Long and Alsh MPA and Southern Trench MPA proposal. *Scottish Natural Heritage Commissioned Report No. 946*. Available from <<https://www.nature.scot/snh-commissioned-report-946-infaunal-and-psa-analyses-benthic-samples-collected-south-arran-mpa>>
- Bradwell, T., Stoker, M.S., Golledge, N.R., Wilson, C.K., Merritt, J.W., Long, D., Everest, J.D., Hestvik, O.B., Stevenson, A.G., Hubbard, A.L., Finlayson, A.G. and Mathers, H.E. (2008). The northern sector of the last British Ice Sheet: Maximum extent and demise. *Earth-Science Reviews* **88**: 207-226.
- Brooks, A.J. (2013). Assessing the sensitivity of geodiversity features in Scotland's seas to pressures associated with human activities. *Scottish Natural Heritage Commissioned Report No. 590*. Available from <<http://www.nls.uk/e-monographs/2013/590.pdf>>
- 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 (final report). *Scottish Natural Heritage Commissioned Report No. 432*. Available from <<http://www.nls.uk/e-monographs/2013/432.pdf>>
- Brooks, A.J., Roberts, H., Kenyon, N.H. and Houghton, A.J. (2009). *Assessing 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. Available from <[http://randd.defra.gov.uk/Document.aspx?Document=mb0102\\_8589\\_TRP.pdf](http://randd.defra.gov.uk/Document.aspx?Document=mb0102_8589_TRP.pdf)>
- Chaniotis, P.D., Cunningham, S., Gillham, K. and Epstein, G. (2014). *Assessing risk to Scottish MPA search features at the MPA regional scale*. Final report produced by the Joint Nature Conservation Committee, Scottish Natural Heritage and Marine Scotland for the Scottish Marine Protected Areas Project. Available from <<https://www.nature.scot/assessing-risk-scottish-mpa-search-features-mpa-regional-scale>>
- Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004). *The marine habitat classification for Britain and Ireland, Version 04.05*. JNCC, Peterborough. ISBN 1 86107561 8. Available from <<http://www.jncc.gov.uk/MarineHabitatClassification>>
- Dolman S., Williams-Grey V., Asmutis-Silva R. and Isaac S. (2006). *Vessel collisions and cetaceans: What happens when they don't miss the boat*. A WDCS Science Report.
- Edwards, R. (2006). *Balaenoptera acutorostrata*. Minke whale. *Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]*. Plymouth: Marine Biological Association of the United Kingdom. [cited 16/10/2014]. Available from <<http://www.marlin.ac.uk/speciesinformation.php?speciesID=2703>>
- Eisfeld, S., Keith, S., Pope, A., Still, D., Dolman, S. and Simmonds, M. (2009). *Outer Moray Firth Cetacean Research 2008*. Project Report for the BBC Wildlife Fund, WDCS. pp. 1-23.

## Bibliography

- Evans, P.G.H. (1991). Whales, Dolphins and Porpoises. Order Cetacea. In *The Handbook of British Mammals* (eds G. B. Corbet and S. Harris), pp.299-350. Blackwell, Oxford. Available from <<http://www.seawatchfoundation.org.uk/wp-content/uploads/2012/08/Evans-2008-Order-Cetacea.pdf>>
- Gallego, A., Gibb, F.M., Tulett, D. and Wright, P.J. (2013). Connectivity of benthic priority marine species within the Scottish MPA network. *Scottish Marine and Freshwater Science* 4(2). Available from <<http://www.scotland.gov.uk/Resource/0042/00427638.pdf>>
- Gordon, J.E., Brooks, A.J., Rennie, A.G., James, B.D., Chaniotis, P.D., Kenyon, N.H., Leslie, A.B. and 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. Available from <<https://www.nature.scot/snh-commissioned-report-633-selection-nature-conservation-mpas-scotland-assessment-geodiversity>>
- Greathead, C.F., Donnan, D.W., Mair, J.M. and Saunders, G.R. (2007). The sea pens *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*: distribution and conservation issues in Scottish waters. *Journal of Marine Biological Association of the UK* 87: 1095-1103.
- Hammond, P., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Joergensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Øien, N. (2002). Abundance of the 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.
- Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J., 2017. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. *Wageningen Marine Research*. Available from <<https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf>>
- Hill, J., Pearce, B., Georgiou, L., Pinnion, J. and Gallyot, J. (2010). Meeting the MPA network principle of viability: feature specific recommendations for species and habitats of conservation importance. *Natural England Report 043*. Available from <<http://publications.naturalengland.org.uk/file/76012>>
- Hirst, N.E., Clark, L. and Sanderson, W.G. (2012). The distribution of selected MPA search features and Priority Marine Features off the NE coast of Scotland. *Scottish Natural Heritage Commissioned Report No. 500*. Available from <<https://www.nature.scot/snh-commissioned-report-500-distribution-selected-mpa-search-features-and-priority-marine-features>>
- Hiscock, K. (1996). *Marine Nature Conservation Review: rationale and methods*. Peterborough: Joint Nature Conservation Committee. [Coasts and seas of the United Kingdom. MNCR series.
- Hughes, D.J. (1998). *Sea pens and burrowing megafauna: An overview of dynamics and sensitivity characteristics for conservation and management of marine SACs*. Report prepared for SAMS UK Marine SACs Project, 105pp.
- Koschinski, S. (2003). *Ship collisions with whales*. ASCOBANS 10th Advisory Committee Meeting Document AC10/Doc. 7(P) Bonn, Germany, 9 - 11 April 2003.

## Bibliography

- Miller, P.I., Christodoulou, S. and Saux-Picart, S. (2010). *Oceanic thermal fronts from Earth observation data - a potential surrogate for pelagic diversity*. Report to the Department of Environment, Food and Rural Affairs. Defra Contract No. MB102. Plymouth Marine Laboratory, subcontracted by ABPmer, Task 2F, pp. 24. Available from <[http://randd.defra.gov.uk/Document.aspx?Document=MB0102\\_9104\\_TRP.pdf](http://randd.defra.gov.uk/Document.aspx?Document=MB0102_9104_TRP.pdf)>
- Miller, P.I., Xu, W. and Lonsdale, P. (2014). Seasonal shelf-sea front mapping using satellite ocean colour to support development of the Scottish MPA network. *Scottish Natural Heritage Commissioned Report No. 538*. Available from <<https://www.nature.scot/snh-commissioned-report-538-seasonal-shelf-sea-front-mapping-using-satellite-ocean-colour-support>>
- Miller, F., McCallum, S., White, A., Azzarello, J. & Caryl, F. 2017. Predictive mapping of seabed features within selected Special Areas of Conservation and Nature Conservation MPAs in Scottish territorial waters using available datasets. *Scottish Natural Heritage Commissioned Report No. 980*. Available from <<https://www.nature.scot/snh-commissioned-report-980-predictive-mapping-seabed-features-within-selected-special-areas>>
- Moore, C.G. 2017. Biological analyses of underwater video from ongoing monitoring and research cruises in Lochs Sunart, Etive and Alsh, sea lochs off South Skye, the Sounds of Barra and Arisaig and around the Southern Trench. *Scottish Natural Heritage Commissioned Report No. 959*. Available from <<https://www.nature.scot/snh-commissioned-report-959-biological-analyses-underwater-video-ongoing-monitoring-and-research>>
- Moore, C. G. 2019. Biological analyses of underwater video from monitoring and research cruises in Lochs Ailort and Fyne, the Sounds of Barra and Mull, inner Moray Firth, off Wester Ross, Noss Head and Rattray Head, and around the Southern Trench in outer Moray Firth. *Scottish Natural Heritage Research Report No. 1085*. Available from <<https://www.nature.scot/snh-research-report-1085-biological-analyses-underwater-video-monitoring-and-research-cruises>>
- Northridge, S., Cargill, A., Coram, A., Mandelberg, L. and Calderan, S. (2010). *Entanglement of minke whales in Scottish waters; an investigation into occurrence, causes and mitigation*. Report to Scottish Government CR/2007/49.
- Northridge, S.P., Taster, M.L., Webb, A. and Williams, J.M. (1995). Distribution and relative abundance of harbour porpoises (*Phocoena phocoena*), white-beaked dolphins (*Lagenorhynchus albirostris*) and minke whales (*Balaenoptera acutorostrata*) around the British Isles. *ICES Journal of Marine Science* **52**: 55-66.
- OSPAR Commission. (2008a). *List of Threatened and/or Declining Species and Habitats*. Reference Number: 2008-6. Available from <<https://www.ospar.org/documents?d=32794>>
- OSPAR Commission. (2008b). *Case Reports for the OSPAR List of Threatened and/or Declining Species and Habitats*. OSPAR Commission. Biodiversity Series. Available from <[http://qsr2010.ospar.org/media/assessments/p00358\\_case\\_reports\\_species\\_and\\_habitats\\_2008.pdf](http://qsr2010.ospar.org/media/assessments/p00358_case_reports_species_and_habitats_2008.pdf)>
- Paxton, C.G.M., Scott-Hayward, L.A.S. and Rexstad, E. (2014). Statistical approaches to aid the identification of Marine Protected Areas for minke whale, Risso's dolphin, white-beaked dolphin and basking shark. *Scottish Natural Heritage Commissioned Report No. 594*. Available from <<https://www.nature.scot/snh-commissioned-report-594-statistical-approaches-aid-identification-marine-protected-areas-minke>>
- Pierce, G.J., Santos, M.B., Reid, R.J., Patterson, I.A.P. and Ross, H.M. (2004). Diet of minke whales *Balaenoptera acutorostrata* in Scottish (UK) waters with notes on strandings of this species in Scotland 1992-2002. *Journal of the Marine Biological Association of the UK* **84**: 1241-1244.
- 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, UK.
- Robinson, K.P. and Tetley, M.J. (2007). Behavioural observations of foraging minke whales (*Balaenoptera acutorostrata*) in the outer Moray Firth, north-

## Bibliography

- east Scotland. *Journal of the Marine Biological Association of the UK* **87**: 85-86.
- Robinson, K.P., Baumgartner, N., Eisfeld, S.J., Clark, N.M., Culloch, R.M., Haskins, G.M., Zapponi, L., Whaley, A.R., Weare, J.S. and Tetley, M.J. (2007a). The summer distribution and occurrence of cetaceans in coastal waters in the outer southern Moray Firth in northeast Scotland (UK). *Lutra* **50**: 19-30.
- Robinson, K.P., Baumgartner, N. and Tetley, M.J. (2007b). Fine scale studies of coastal minke whales in north-east Scotland. In: Robinson, K.P., Stevick, P.T. & MacLeod, C.D. (Eds) An Integrated Approach to Non-lethal Research on Minke Whales in European Waters. *European Cetacean Society Special Publication* **47**: 23-31.
- Robinson, K.P., Tetley, M.J. and Mitchelson-Jacob, E.G. (2009). The distribution and habitat preference of coastally occurring minke whales (*Balaenoptera acutorostrata*) in the outer southern Moray Firth, northeast Scotland. *Journal of Coastal Conservation* **13**: 39-48.
- SNH. (2012). *Marine Protected Areas and cetaceans. Position paper for the 4th MPA Workshop, Heriot-Watt University, 14-15 March 2012*. Available from <<http://www.scotland.gov.uk/Resource/0038/00389523.doc>>
- SNH. (2014). SNH's advice on selected responses to the 2013 Marine Scotland consultation on Nature Conservation Marine Protected Areas (MPAs). *Scottish Natural Heritage Commissioned Report No. 747*. Available from <<https://www.nature.scot/snh-commissioned-report-747-snhs-advice-selected-responses-2013-marine-scotland-consultation-nature>>
- SNH and JNCC (2012). Advice to the Scottish Government on the selection of Nature Conservation Marine Protected Areas (MPAs) for the development of the Scottish MPA network. *Scottish Natural Heritage Commissioned Report No. 547*. Available from <<https://www.nature.scot/snh-commissioned-report-547-snh-and-jncc-mpa-network-advice>>
- SNH and JNCC. (2014). *Marine Protected Areas and Large-Scale Features. A position paper*. Produced by SNH and JNCC for the Scottish MPA Project. Available from <<https://www.nature.scot/scottish-mpa-project-large-scale-features-position-paper>>
- Tetley, M.J. (2004). *The distribution and habitat preference of the North Atlantic minke whale (Balaenoptera acutorostrata) in the southern outer Moray Firth, NE Scotland*. MSc Thesis, University of Wales, Bangor, UK.
- Tetley, M.J., Mitchelson-Jacob, E.G. and Robinson, K.P. (2008). The summer distribution of coastal minke whales (*Balaenoptera acutorostrata*) in the southern outer Moray Firth, NE Scotland, in relation to co-occurring mesoscale oceanographic features. *Remote Sensing of Environment* **112**: 3449-3454.
- Tillin, H.M., Hull, S.C. and Tyler-Walters, H. (2010). *Development of a sensitivity matrix (pressures-MCZ/MPA features)*. Report to the Department of Environment, Food and Rural Affairs from ABPmer, Southampton and the Marine Life Information Network (MarLIN) Plymouth: Marine Biological Association of the UK. Defra Contract No. MB0102 Task 3A, Report No. 22.
- Tyler-Walters, H., James, B., Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. and Crawford-Avis, O.T. (2012). *Descriptions of Marine Protected Area (MPA) search features*. Report produced by MarLIN, Scottish Natural Heritage and the Joint Nature Conservation Committee, for the Scottish Marine Protected Areas Project. Available from <<http://www.scotland.gov.uk/Resource/0038/00389527.doc>>
- Weir, C.R., Stockin, K.A. and Pierce, G.J. (2007). Spatial and temporal trends in the distribution of harbour porpoises, white-beaked dolphins and minke whales off Aberdeenshire (UK), north-western North Sea. *Journal of the Marine Biological Association U.K.* **87**: 327-338.