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Scottish MPA Project

Assessment against the MPA Selection Guidelines

CLYDE SEA SILL NATURE CONSERVATION MPA

SEPTEMBER 2014

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Purpose

This document provides details of the assessment of Clyde Sea Sill Nature Conservation MPA against the Scottish MPA Selection Guidelines. It presents the assessment for each of the 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 Nature Conservation MPA following designation by Scottish Ministers.

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 Nature Conservation 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 geodiversity features. They have been assessed to determine whether they would add to the broader representativity of the MPA network.

Protected feature - any feature (habitats, species, large-scale features [MPA search features and/or representative features] and/or geodiversity features) specified within the site Designation Order.

History of development

Clyde Sea Sill Nature Conservation MPA was identified for two MPA search features (black guillemot and fronts) and one geodiversity feature (Marine Geomorphology of the Scottish Shelf Seabed). Circalittoral and offshore sand and coarse sediment communities is not an MPA search feature but was recommended as a protected feature to add to the broader representativity of the Scottish MPA network (i.e. a representative feature).

Details of supporting evidence are provided in the Clyde Sea Sill data confidence assessment.

CLYDE SEA SILL 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[1]

Summary of assessment	The MPA encompasses the core part of a persistent front that extends across the sill at the mouth of the Clyde Sea. Fronts, which are essentially boundaries between water masses of differing temperature or salinity, can concentrate nutrients and plankton and are often associated with pelagic biodiversity hotspots. The protected features also include a breeding black guillemot population on Sanda, Sheep Island and Glunimore Island (encompassed by an existing Site of Special Scientific Interest situated approximately 3 km south from the mainland coast of southern Kintyre). Circalittoral and offshore sand and coarse sediment communities are distributed across the floor of the central part of the sill. These mobile substrates are reworked by tidal currents to create sand ribbon fields, sand wave fields and sand banks (representing the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature).

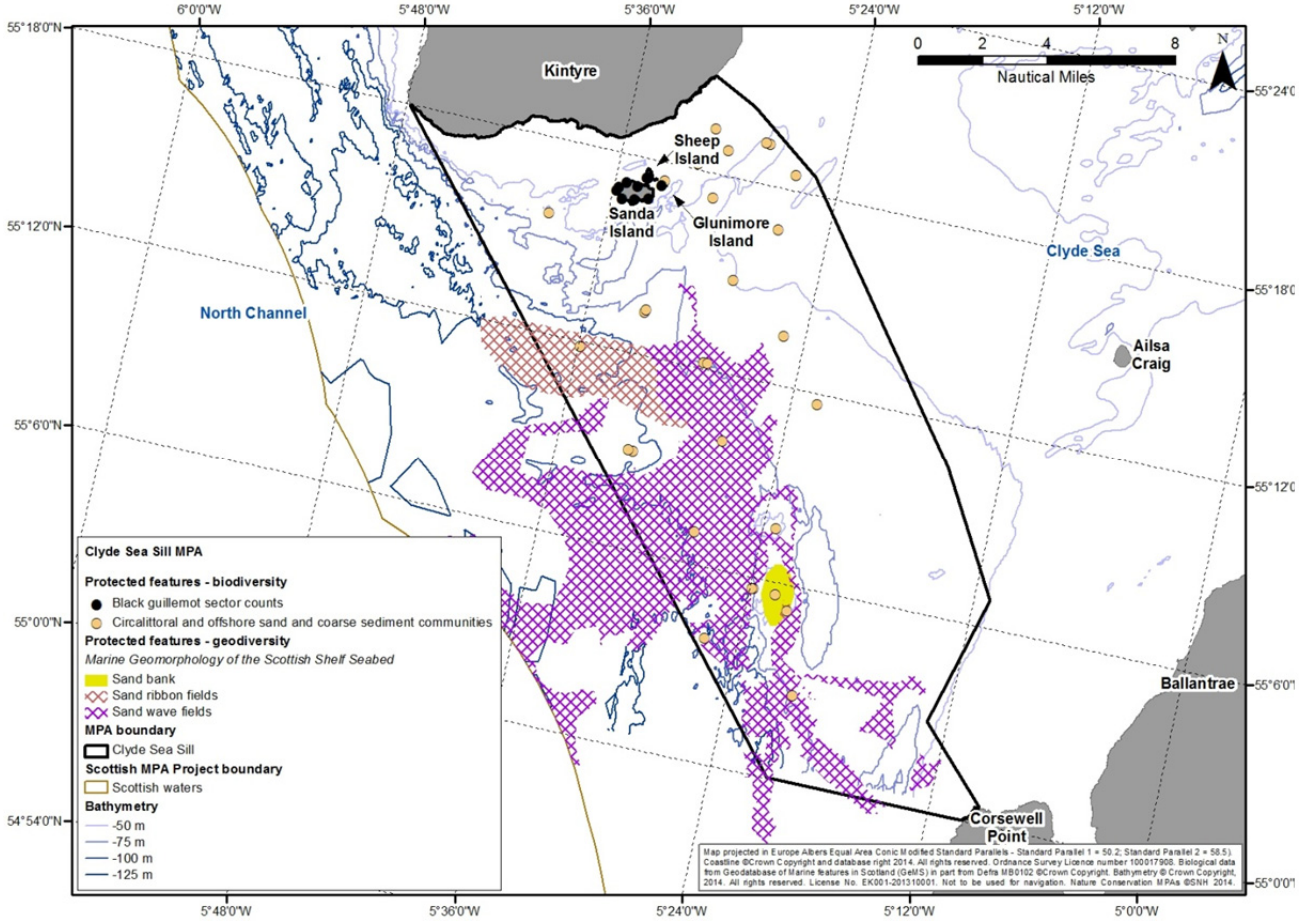
Detailed assessment

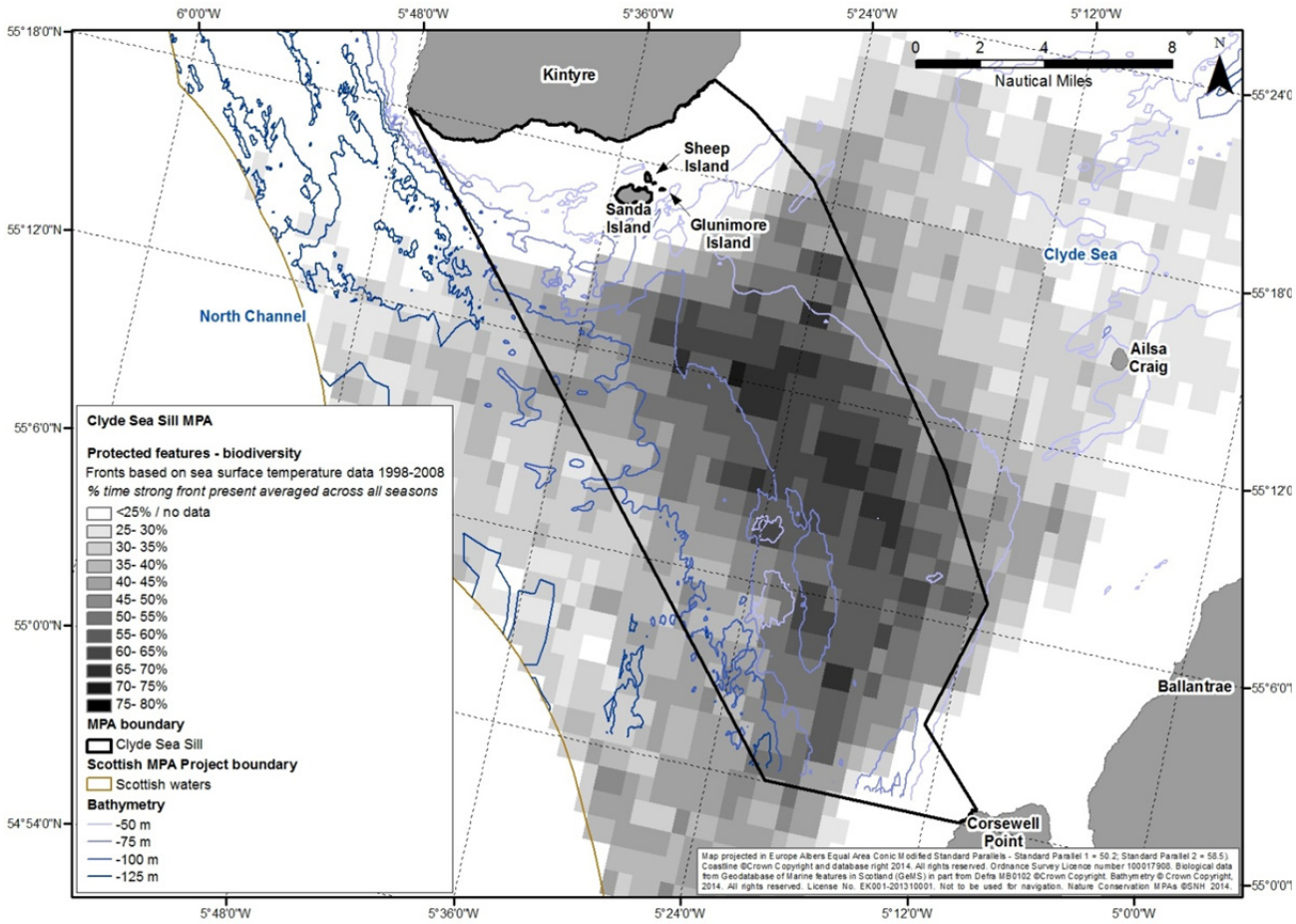
Protected features	**Guideline 1a** *Presence of key features* [MPA search features and geodiversity equivalents]	**Guideline 1b** *Presence of features under threat and/or subject to rapid decline*	**Guideline 1c** *Functional significance for the overall health and diversity of Scottish seas*
Biodiversity			
Black guillemot	✓		
Circalittoral and offshore sand and coarse sediment communities[2]	*Representative feature*		
Fronts	✓		✓
Geodiversity			
Marine Geomorphology of the Scottish Shelf Seabed (sand ribbon fields, sand wave fields and sand banks)	✓		

[1] All protected features of the MPA (rather than just the MPA search features) are listed in the stage 1 detailed assessment table and subsequently assessed against the MPA Selection Guidelines (wherever practicable).

[2] Comprising 'Circalittoral coarse sediment' (**SS.SCS.CCS**) and in particular '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel habitats' (**SS.SCS.CCS.**[**MedLumVen**] - A5.14[2]), 'Offshore circalittoral coarse sediment' (**SS.SCS.OCS** - A5.15), 'Circalittoral fine sand' (**SS.SSa.CFiSa** - A5.25) and 'Offshore circalittoral sand' (**SS.SSa.OSa** - A5.27).

Maps of Clyde Sea Sill MPA showing the known distribution of protected features





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

Summary of assessment	Clyde Sea Sill MPA has been designated for four intrinsically linked protected features. These include the core part of the Clyde front, a relatively persistent year-round feature formed where the tidally mixed waters in the North Channel of the Irish Sea meet the calmer, less saline Clyde Sea. In 2001 an estimated 1.1% of the GB population of breeding black guillemots were present on Sanda and Sheep Island (Mitchell *et al*., 2004). Recent counts from 2013 (Swann, 2013) and 2014 (Swann, *in prep*.) indicate a decrease in the numbers of breeding black guillemots, an issue that requires more detailed investigation. The same currents that generate the frontal system over the sill have formed sand wave fields and other sedimentary bedforms that support various infaunal communities. The protected features are sensitive to a range of pressures and at a regional level are considered to be at low-medium risk of damage by human activity. **Two of the five Stage 2 guidelines have been met** (2a and 2e). *Guidelines 2c and 2d are also considered to have been partially met* - The MPA encompasses coherent examples of two of the three biodiversity features, and three of the four protected features (biodiversity and geodiversity) are considered to be in a natural state. However, the MPA may no longer support greater than 1% of the GB population of black guillemots, and whilst further work is required to explore the reasons for the observed declines in bird numbers, it may not be appropriate to consider the population 'unmodified'.

Detailed assessment

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

The MPA supports four protected features. Simple modelling of black guillemot foraging range data, based on limited survey findings, suggests that approximately 95% of foraging occurs within 2 km of the coastline where they nest (SNH, 2012). Incorporation of the core part of the persistent thermal front that extends across the sill has resulted in a boundary that accommodates the foraging requirements of the black guillemot (albeit recognising that they are only likely to utilise a small area of the front adjacent to Sanda, Sheep Island and Glunimore Island). The distribution of mobile coarse sandy substrates representative of the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature broadly aligns with that of the circalittoral and offshore sand and coarse sediment communities feature across the floor of the central and upper part of the sill. **Guideline met**.

The approach and rationale behind the selection of MPAs for black guillemots is outlined in a position paper (SNH, 2012) presented to the 4th MPA stakeholder workshop in March 2012. The development of the MPA network for black guillemots has focused on enhancing the contribution of existing protected areas (i.e. by overlaying / designating a Nature Conservation MPA adjacent to existing SSSIs / SPAs). Initial assessment work indicated this could achieve sufficient representation and replication of sites. In general, MPAs should hold in excess of 1% of the GB population based on the most recent census (rounded to 380 individuals - *see also Guideline 2c in relation to the current population estimate for the Clyde Sea Sill MPA*).

Existing protected areas were considered in the following order:

- Sites of Special Scientific Interest (SSSIs) notified for black guillemot; and
- Special Protection Areas (SPAs) with marine extensions (existing tern SPAs without marine extensions were also included in the analyses as these may be extended into the marine environment in future).

These existing protected areas lack elements vital to the protection of black guillemots and therefore require enhancement through the designation of new MPAs. SSSIs cannot extend below mean low water spring tides and essential areas for foraging cannot therefore be protected through the existing SSSI mechanism (similarly, foraging areas are not encompassed within SPAs lacking marine extensions). For SPAs with marine extensions, black guillemot cannot be a qualifying species. There are also differences in habitat use and the behaviour of black guillemots which mean that for it to be protected within an SPA classified for other seabirds, the SPA needs to be overlain with an MPA.

Guideline 2b	The search location contains example(s) of features with a high natural biological diversity (applies to seabed habitats only)
Circalittoral and offshore sand and coarse sediment communities	The protected feature comprises four biotope[3] complexes: circalittoral fine sands (**SS.SSa.CFiSa**); offshore circalittoral sands (**SS.SSa.OSa**); offshore circalittoral coarse sediment (**SS.SCS.OCS**) and circalittoral coarse sediment (**SS.SCS.CCS** - with a particular focus on the finer resolution **SS.SCS.CCS.MedLumVen** biotope). The majority of records are of circalittoral fine sands (**SS.SSa.CFiSa**), assigned on the basis of drop-down video sampling undertaken in 2012. The biotope complex was recorded at depths of 42 - 109 m and often little visible fauna was evident on the video footage, with shell and stones on fine or fine-medium rippled sands supporting sparse hydroid clumps, the bryozoan *Flustra foliacea*, dahlia anemones *Urticina felina* and dead man's fingers *Alcyonium digitatum* (Moore and Atkinson, 2012). The 2012 video survey also recorded medium-coarse sands and gravel (**SS.SCS.CCS**) off the Kintyre coast at depths of between 24 - 94 m. Grab samples were collected from a number of the video stations. The grab samples were assigned to biotope classes on the basis of infaunal species composition and the results of detailed sediment sample analyses. Deep sand samples with dominant species not particularly characteristic of any given biotope (e.g. the bivalves *Tellimya ferruginosa* and *Nucula nitidosa*; polychaetes *Scoloplos armiger* and *Pholoe baltica*, and the brittlestar *Amphiura filiformis*) were classified as offshore circalittoral sand (**SS.SSa.OSa**). Where the infauna also included high numbers of the tubeworm *Owenia fusiformis*, the samples were assigned to the more specific **SS.SSa.OSa.OfusAfil** biotope (*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand). Samples from gravelly sand or gravel in deep waters had a somewhat variable taxa which were generally indicative of the coarser sediments present. These were classified as **SS.SCS.CCS**, **SS.SCS.OCS** (a deeper water / offshore circalittoral coarse sediment biotope complex) or **SS.SSa.CFiSa**. One of the stations was of note in having relatively high numbers of the polychaete *Sabellaria spinulosa* (although these were within the sediment as opposed to forming reef structures). Stations characterised by the polychaete *Mediomastus fragilis* were assigned to the **SS.SCS.CCS.MedLumVen** biotope (*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel) although there were no records of venerid bivalves (see Moore and Atkinson, 2012; Allen, 2013). **Guideline <u>not</u> met**. Species richness and diversity were variable across the different habitats but were only <u>moderately</u> diverse overall (Shannon Wiener H' = 3.9, mean taxa = 38). Only two of the stations (both assigned to **SS.SCS.CCS**) were considered to support particularly diverse communities, supporting 53 and 77 taxa (Allen, 2013). The more diverse areas tended to correspond to coarser mixed sediments (Allen, 2013).

Guideline 2c	The search location contains coherent examples of features, rather than smaller, potentially more fragmented ones
Black guillemot	Black guillemots breed primarily on two of the three small islands (Sanda and Sheep Island) with small numbers also recorded on Glunimore Island where suitable nesting habitat exists. Black guillemots are almost exclusively cliff nesters utilising crevices, holes under rocks and other concealed locations (SNH, 2012). The Seabird 2000 population count (sampling undertaken in 2001) estimated that 410[4] breeding black guillemots were present within the Sanda Islands SSSI, approximately 1.1% of the GB population (Mitchell *et al*., 2004). The 2001 count was ca. 40% higher than the estimated 250 individuals recorded during the 1982-85 Seabird Colony Register survey (Lloyd *et al*., 1991).

[3] Further details on the UK marine habitat classification are available online at http://jncc.defra.gov.uk/page-5931

[4] Black guillemot count numbers quoted in this document have been rounded up / down to the nearest ten.

Guideline 2c	The search location contains coherent examples of features, rather than smaller, potentially more fragmented ones
Black guillemot *cont*.	Results from counts undertaken in 2013 (Swann, 2013) and 2014 (Swann, in prep.) have seen a decrease in numbers from the 2001 census to approximately 340 / 230 birds respectively. The reduction in numbers observed over two successive spring breeding periods suggests a real decline in the numbers of birds (i.e. outwith normal count variability). Mink predation in auk colonies was reported on Sanda in 2012 (Swann, in prep.) and this may be responsible for the observed decline in black guillemots. Further details are provided in the management options paper produced for this MPA.
Circalittoral and offshore sand and coarse sediment communities	A fairly distinct gradient in habitat type exists along the MPA, with coarse and mixed substrates in tide-swept conditions off Kintyre, rippled fine-medium sands in the centre of the sill, and sandy mud habitats on the Galloway side (Moore and Atkinson, 2012). The protected feature is widely distributed across the upper and central portion of the sill, running from the north-east to the south-west. The feature undoubtedly extends beyond the outer boundary of the MPA into the North Channel of the Irish Sea. The estimated area of the circalittoral and offshore sand and coarse sediment communities feature within the MPA is 390 km^2 (Envision, 2014). The 2012 sample records align well with the descriptions provided for the relevant circalittoral biotopes within the national classification (Connor *et al*., 2004). The 'offshore' sediment sections of the classification are comparatively poorly defined (little quantitative data were available in 2004 when the classification was written) and are currently the subject of an ongoing review by JNCC. As such, the offshore / transitional coarser sediment and sand biotope assignments (**SS.SCS.OCS** or **SS.SSa.OSa**) within the Clyde Sea Sill MPA will need to be revisited as the offshore classification evolves.
Fronts	The Clyde front forms in the area of the Clyde Sea sill, where the tidally mixed North Channel of the Irish Sea meets the calmer less saline Clyde Sea. Beyond the sill, the North Channel is well mixed year round, while weak tidal currents in the Clyde Sea allow thermal stratification, particularly in summer when the weather is warmer and typically more stable. In winter, increased freshwater input from the Clyde and other rivers helps to preserve a density driven stratification. Thermal and density stratification result in a relatively persistent year round front, although the balance of factors influencing front formation varies seasonally. The location of the front is evident from satellite derived frequent fronts data, based on sea surface temperature, which indicate that thermal fronts are present throughout the year (Miller *et al.,* 2010). A less frequent front based on satellite derived colour (chl-A) is also evident. A data snapshot from autumn 2010 indicates slightly elevated concentrations of phytoplankton in the area of the Clyde Sea sill (Miller *et al.,* 2014.). The Clyde front is a well-studied feature which has persisted over time. The satellite derived frequent front maps, for example, are based on 10 years of data from 2000 to 2009. As its formation is driven by relatively constant factors (e.g. including tides, topography and freshwater inputs) the front is considered likely to continue to persist in the long-term.
2c - Result	**Guideline <u>partially</u> met**. The MPA encompasses coherent examples of two of the three biodiversity features. Recent observed declines in the number of breeding black guillemots on Sanda and Sheep Island (potentially caused by mink predation) mean that the MPA <u>may</u>[5] no longer support greater that 1% of the GB population (380 individuals at the time of the last nationwide census in 2001).

[5] It is not possible to state with certainty that the number of black guillemots present on Sanda, Sheep Island and Glunimore Island has fallen below 1% of the GB population because the 2013 and 2014 counts were localised in their extent and not undertaken as part of a wider GB-scale census in either year.

Guideline 2d	**The search location contains features considered least damaged / more natural, rather than those heavily modified by human activity**
Black guillemot	Black guillemot numbers increased between the 1982-85 Seabird Colony Register (250 birds) and Seabird 2000 (410 birds) censuses. However, recent results from counts undertaken in 2013 and 2014 show a decrease in numbers to 340 / 230 birds respectively. Mink predation in auk colonies was reported on Sanda in 2012 and may be responsible for the observed decline in black guillemots. Areas of nesting habitat within the MPA are essentially unmodified.
Circalittoral and offshore sand and coarse sediment communities	No indicators of change / damage to this feature were reported in the most recent surveys (Moore and Atkinson, 2012; Allen, 2013) and it is therefore considered to be in a natural state.
Fronts	The Clyde front is a well-studied feature which has persisted over time and is not considered to have been heavily modified by human activity.
Geodiversity	The components of the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature (sand ribbon fields, sand wave fields and sand banks) have been formed by the action of water currents on mobile sediments. They are considered to be in a natural state within the MPA.
2d - Result	**Guideline <u>partially</u> met**. Three of the four features are considered to be in a natural state within the MPA. Mink predation may be adversely affecting the black guillemot population on Sanda and Sheep Island (this is yet to be confirmed but will be the subject of more detailed investigations).

Guideline 2e	The search location contains features considered to be at risk[6] of significant damage by human activity
Black guillemot	Clyde Sea Sill MPA is in the South-west MPA region[7]. On the basis of a risk assessment undertaken at the level of the MPA region, there is considered to be a **low-medium** risk of significant damage to this feature arising from human activity (a cumulative assessment considering the range of activities known to be taking place in the MPA region). Within the MPA region, non-native species colonisation and predation e.g. by American mink, presents a high risk to black guillemot populations. Pressures associated with shipping activities present a medium risk and the risks associated with coastal infrastructure, fishing and recreation-related activities are considered to be low.
Circalittoral and offshore sand and coarse sediment communities	**Regional risk assessments have not been completed for representative features**. However, preliminary results are available on the likely sensitivity of this feature to pressures arising from human activity. The feature is considered to have a medium sensitivity to physical abrasion, substratum loss and modification, local changes in temperature and chemical contamination and decreases in salinity. It is considered to have a low sensitivity to abrasion and high rates of change in siltation. It is considered to have a low sensitivity to organic enrichment, changes in water flow rate and wave exposure.
Fronts	**Regional risk assessments have not been completed for fronts**. The formation of the Clyde front is driven by differences in water density and sea temperature. The frontal system is not considered to be at risk of significant damage by human activity.
Geodiversity	**Regional risk assessments have not been completed for geodiversity features**. However, information is available on the likely sensitivity of these features to pressures arising from human activity (Brooks, 2013). The sand ribbon fields, sand wave fields and sand banks are considered highly sensitive to localised changes in hydrodynamics because they are formed and actively maintained within a specific range of tidal current conditions. They are considered to have a medium sensitivity to pressures arising from activities such as aggregate dredging which have the potential to cause widespread disruption to the feature's surface or stratigraphy. However, they are active features and so have the potential to recover. In the vast majority of instances, most pressures associated with marine anthropogenic activities will not be sufficient to impact geological and geomorphological seabed features (Brooks, 2013).
2e - Result	**Guideline met**. This is not an assessment of activities that require management within the MPA. That assessment is provided in the management options paper.

[6] Information on the sensitivity of the MPA search features to pressures and their associated activities was taken from Tillin *et al*. (2010). The degree to which an MPA search feature is exposed to activities / pressures to which it is sensitive in each MPA region 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 MPA 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 management options paper produced for this MPA.

[7] The seas around Scotland were split into five MPA regions (East, North, West, South-west and Far West) at the outset of the MPA Project to aid the identification of MPA search locations and the preliminary appraisal of these against the MPA Selection Guidelines (e.g. the completion of regional risk assessments). This approach provided a useful framework for the initial stages of assessment. Within SNH and JNCC's formal MPA network advice (SNH and JNCC, 2012) the MPA proposals and remaining MPA search locations were then cast within the context of broader OSPAR regions.

Stage 3 - Assessing the appropriate scale of the search location in relation to search features[8] 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 boundary of the MPA has been drawn to encompass the area where strong thermal fronts occur at highest frequency across the centre of the sill. The boundary allows for a 2 km marine extension around the Sanda Islands Site of Special Scientific Interest (SSSI) suitable for black guillemot foraging activity, with the landward boundary at the level of mean low water spring (MLWS) tides. The Sanda Islands SSSI already confers a protective mechanism for the nesting habitat of these birds. Field studies and modelling work indicate that approximately 95% of all black guillemot foraging is likely to occur within 2 km of the coastline where they nest (SNH, 2012). The boundary includes the known distribution of the circalittoral and offshore sand and coarse sediment communities and provides good representation of the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature which also extends outwith the MPA. The western, outer extent of the MPA mirrors that of an existing fisheries restriction area for spring spawning cod. **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 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 objectives for all protected features within this MPA were set to 'conserve' at the time of designation in July 2014. On the basis of the latest black guillemot count (Swann, in prep.) a more detailed investigation will be undertaken to determine whether mink are adversely affecting the status of this feature and this may in due course inform amendments to its conservation objective. A number of activities are considered capable of affecting the 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 MPA. For example, Fisheries Orders have already been used to underpin management of marine Special Areas of Conservation. If mink are confirmed as present within the Sanda Islands SSSI (outwith the MPA) and adversely affecting black guillemot breeding habitat / success, then the focus of management would be on removal from the SSSI as part of a broader approach to tackling predation of seabirds by invasive non-native species (INNS). There is therefore potential for management measures to be implemented successfully and the conservation objectives of the MPA to be achieved. Further discussion is required with those involved in using the MPA to provide clarification on interactions between the protected features and known / potential activities / developments. Additional details are provided in the management options paper produced for this MPA.

[8] Setting the size and shape of a 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

Summary of assessment	**The MPA passed the assessment against the Stage 5 guideline. The MPA has now been designated and will make a significant contribution to the MPA network.**

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
Black guillemot	A breeding population on Sanda, Sheep Island and Glunimore Island.	There is replication of this feature in the network within and between OSPAR Regions II and III (see SNH and JNCC, 2012; SNH, 2014a).	Provides a link with colonies in Northern Ireland (SNH, 2012).	Provides coverage of the southern part of the range for this feature within the MPA network on the south-west coast of Scotland.	There is additional replication within the network because the population in Scotland, particularly along the west coast (and islands), is considered to be threatened as a result of predation by introduced mammalian predators (e.g. mink).
Circalittoral and offshore sand and coarse sediment communities	Examples of deep sand and coarse sediment communities. [**SS.SCS.CCS**; **SS.SCS.OCS**; **SS.SSa.CFiSa**; **SS.SSa.OSa** biotope complexes]	There is replication of the feature in the network within and between OSPAR Regions II and III.	Not applicable[9]	Enhances the southerly geographic range of the feature within the MPA network. Good correlation / spatial overlap with component geodiversity interests.	A representative feature. Not considered to be threatened and/or declining. Recommended to ensure representation of the range of broad-scale habitats within the Scottish MPA network.
Fronts	Tidal and density driven front, with surface to bottom profile, present year round.	Replication of feature in the network is proposed within OSPAR Region III and between OSPAR Regions II and III (SNH and JNCC, 2012; SNH, 2014a & b).	Not applicable[9]	Example of a west coast, shelf front.	Fronts are not considered to be threatened and/or declining.

[9] 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 little evidence on which to base assessments of linkages for seabed habitats and low or limited mobility species in Scotland's seas. Whilst there is information available for some species on dispersion distances, this cannot be readily applied to areas with complicated hydrography. Modelling work undertaken by Marine Scotland Science looking at the connectivity of some benthic species within the Scottish MPAs is presented in Gallego *et al*. (2013).

Assessment of geodiversity features	
Geodiversity features[10]	Marine currents are reworking the complex seafloor morphology constructed by previous glacial and other geomorphological processes. These currents erode relict features and bury others across much of the continental shelf where currents are strongest. The most significant types of current sweeping the shelf sea floor are tidal currents, storm surge currents and currents induced by storm waves. These processes have created sand ribbon fields (thin, elongate bands of sand overlying coarser sediment which is exposed between them - oriented along the direction of the dominant current); sand wave fields (ridges of sand that form at right angles to the direction of the tidal current); and sand banks (a mound or a shoal of sand) across the sill at the entrance to the Clyde Sea (Brooks *et al*., 2009). These bedforms aid our interpretation of the interactions between currents and seabed sediments and provide additional representation of the Marine Geomorphology of the Scottish Shelf Seabed geodiversity feature within the network (Gordon *et al*., 2013). The MPA does not lie within / overlap any of the key geodiversity areas identified in Scottish waters within Brooks *et al*. (2013). The data available on these component geodiversity interests are at a coarse resolution only.

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[10] For geodiversity the stage 5 assessment primarily considers the potential contribution to the principal 'networks' of marine geodiversity interests present in Scottish waters (representation).

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