Hornsea Project Four: Derogation Information

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Volume B2, Annex 8.3: Compensation measures for FFC SPA: Predator Eradication: Ecological Evidence

Prepared GoBe Consultants Ltd. September, 2021
Checked Victoria Stoyle, Orsted. September, 2021
Accepted Sarah Randall, Orsted. September, 2021
Approved Julian Carolan, Orsted. September, 2021

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Grey literature	Information that is not produced by commercial publishers. It includes research reports, working papers, conference proceedings, theses, preprints, white papers and reports produced by government departments, academics, business and industry.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound. Where the offshore cables come ashore east of Fraisthorpe.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, or PEIR or ES).
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Order Limits	The limits within which Hornsea Project Four (the 'authorised project) may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).

Acronyms

Term	Definition
AEoI	Adverse Effect on Integrity
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FFC	Flamborough and Filey Coast
GRIMP	Guillemot and Razorbill Implementation and Monitoring Plan
IOSSRP	The Isles of Scilly Seabird Recovery Project
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
NGET	National Grid Electricity Transmission
PEIR	Preliminary Environmental Information Report
PINS	The Planning Inspectorate
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SACO	Supplementary Advice on Conservation Objectives
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WTGs	Wind turbine generators
WMIL	Wildlife Management International Ltd.

1 Summary

1.1 Background

1.1.1.1 This report reviews the evidence base on the potential for predator eradication and/ or control to provide population benefits to common guillemot *Uria aalge* (hereafter guillemot) and razorbill *Alca torda* which will contribute to the southern *albionis* biogeographic population of guillemot and the *Alca torda islandica* biogeographic population of razorbill (further information on the populations of these species can be found in **Appendix A B2.8.1 Compensation measures for FFC SPA: Bycatch Reduction: Ecological Evidence**).

1.1.1.2 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). This document has been prepared to support the identification of compensatory measures for Hornsea Four and its potential impacts on guillemot and razorbill. In light of the conclusions of the Report to Inform Appropriate Assessment (RIAA) which will support the Hornsea Four DCO application, Hornsea Four's position is that no Adverse Effect on the Integrity (AEoI) on the FFC SPA will arise from Hornsea Four alone or in-combination with other plans and projects (**B2.2: Report to Inform Appropriate Assessment**). Nevertheless, in light of the Secretary of State's clear direction in his decision letter for Hornsea Three, Hornsea Four's DCO application will be accompanied by a derogation case (including compensatory measures) which will be provided on a "without prejudice" basis i.e. the derogation case will be provided without prejudice to Hornsea Four's conclusion that no AEoI will arise.

1.1.1.3 This report discusses the following;

- Key guillemot and razorbill predators (**Section 4**);
- Potential benefits of predator eradication/ control to guillemot and razorbill (**Section 6**);
- Implementation and monitoring (**Section 7**);
- Biosecurity measures (**Section 8**);
- Likelihood of success (**Section 9**);
- Potential location/s for predator eradication and/ or control (**Section 12**); and
- Size of compensatory population required and how much of this could be supported by this compensation measure (**Section 13**).

1.2 Key findings

1.2.1.1 The main predators for guillemot and razorbill in the UK are black and brown rats. Both species are known to predominately predate on eggs and chicks (e.g. Stapp, 2002, Jones *et al.*, 2008) and will also occasionally predate small-bodied adult seabirds (Atkinson, 1985).

1.2.1.2 Despite not being the target species for previous predator eradication programmes, it has been documented that eradications have resulted in benefits to guillemot and razorbill, namely: increase in population, improved breeding success, i.e. number of offspring per breeding event (e.g. Booker *et al.*, 2018) and productivity, i.e. the number of fledglings (e.g. Main *et al.*, 2019), increase in occupied breeding sites (e.g. Booker *et al.*, 2018) and recolonisation (e.g. Nordstrom *et al.*, 2003; Swann, 2008).

1.2.1.3 Pre-eradication feasibility assessments, monitoring pre- and long term post-eradication for both ecosystems/seabirds and invasive predators are required in order to ensure complete eradication of invasive species and to monitor the impact their eradication has on seabirds and the wider ecosystem.

1.2.1.4 Biosecurity measures are essential in order to ensure the area does not become reinvaded by predators. Note that control would not maintain 100% eradication of predators (due to re-infestation), but instead aim to maintain a reduced population.

1.2.1.5 The majority of invasive mammal eradications on islands globally, to date, have been successful.

1.2.1.6 The site selection process to date has highlighted a number of potential locations which support populations of guillemot and/ or razorbill colonies, rats and where a predator eradication and/ or control scheme is potentially feasible (**Figure 1**). These are[1]:

- Bailiwick of Guernsey:
  - Alderney: A number of islands/ islets around the main island;
  - Herm: Including Herm, The Humps and Jethou; and
  - Sark: A number of islands/ islets around the main island.
- Isles of Scilly: A number of Islands/ islets;
- Rathlin Island; and
- Several islands/ islets along the south coast of England.

[1] Note that exact island names for some locations are not disclosed due to confidentiality/ on-going discussions which are commercially sensitive.

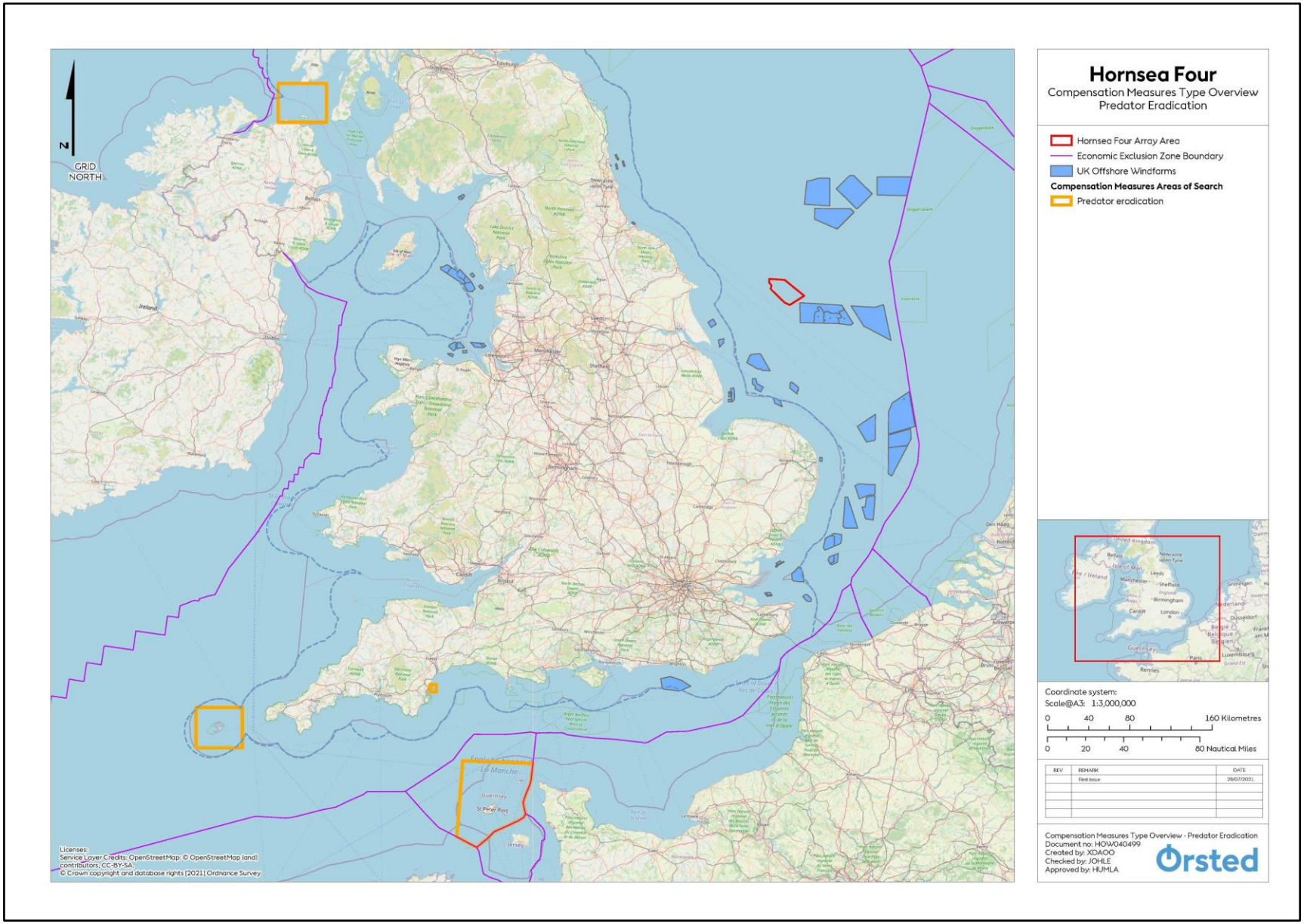

Figure 1: Areas considered for potential predator eradication and/ or control (represented in orange) in the UK and Channel Islands.

1.3 Conclusion

1.3.1.1 Based upon this review of literature, predator eradication and/ or control programmes offer the opportunity to benefit guillemot and razorbill at UK islands / the Channel Islands (excluding Jersey). It is acknowledged that previous eradication and/ or control projects often were not targeted at guillemot and razorbill, however pre- and post-monitoring reports from the case studies presented in this report have shown that predator removal has also benefited both of these species through increases in productivity, nesting populations and recolonisation/ colonisation of new areas previously occupied by invasive species.

2 Introduction

2.1 Project Background

2.1.1.1 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four will be located approximately 69 km offshore of the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm) including up to 180 wind turbine generators (WTGs), export cables to landfall, and connection to the National Grid Electricity Transmission (NGET) network at Creyke Beck. Detailed information on the project design can be found in **Volume A1, Chapter 1: Project Description**, with detailed information on the site selection process and consideration of alternatives described in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**.

2.1.1.2 This document has been prepared to support the identification of compensatory measures for Hornsea Four and its potential impacts on guillemot and razorbill. In light of the conclusions of the Report to Inform Appropriate Assessment (RIAA) which will support the Hornsea Four DCO application, Hornsea Four's position is that no Adverse Effect on the Integrity (AEoI) on the FFC SPA will arise from Hornsea Four alone or in-combination with other plans and projects (**B2.2: Report to Inform Appropriate Assessment**). Nevertheless, in light of the Secretary of State's clear direction in his decision letter for Hornsea Three, Hornsea Four's DCO application will be accompanied by a derogation case (including compensatory measures) which will be provided on a "without prejudice" basis i.e. the derogation case will be provided without prejudice to Hornsea Four's conclusion that no AEoI will arise.

2.2 Purpose of document

2.2.1.1 Seabirds encounter many factors which influence adult survival and breeding success. These factors include (but are not limited to); predation (e.g., Craik 1997; Buchadas & Hof 2017), climate change related shifts to prey availability and abundance (Gaston & Elliott 2014; Divoky *et al.,* 2015) and fisheries practices (Furness & Tasker 2000; Frederiksen *et al.,* 2004). Other factors may also include seabird bycatch (Northridge *et al.*, 2020, Miles *et al.*, 2020) and plastic pollution (O'Hanlon *et al.,* 2017).

2.2.1.2 Colony population and nest surveys are undertaken to assess the overall adult breeding population and breeding success of a colony which can be consequently linked to external factors influencing a population (Gjerdrum *et al.*, 2003). Predation of seabird eggs, nestlings

and adult birds may be one such influencing factor. For example, guillemot and razorbill have been shown to be vulnerable to numerous species of predator.

2.2.1.3 The removal of invasive predators to benefit guillemot and/or razorbill is one compensation measure being proposed by the Applicant and is the focus of this report. The purpose of this report is to review the ecological evidence base on the potential to use predator eradication and/ or control as a management option to provide benefits to guillemot and razorbill with the aim to increase their productivity. This report provides evidence of the benefits of previous predator eradication schemes to guillemot and razorbill; information on potential implementation, monitoring and biosecurity that may be required; potential locations for predator eradication and/ or control and defines the size of compensatory population that is required to compensate for the annual loss of the predicted mortality of guillemot and razorbill from FFC SPA due to displacement from Hornsea Four as presented in the Hornsea Four RIAA (**B2.2: Report to Inform Appropriate Assessment**), compensation for a total of 35 adult guillemot and 1.5 adult razorbill is required.

2.2.1.4 This report should be read alongside the Guillemot and Razorbill Compensation Plan (**B2.8: FFC SPA: Razorbill and Guillemot Compensation Plan**) which describes a potential plan for execution of the compensation measure for both species (should it be required), including potential locations for a predator eradication and/ or control programme.

2.2.1.5 Should this compensation measure be taken forward, further details on the delivery methodology for the measure would also be provided in a Guillemot and Razorbill Implementation and Monitoring Plan (GRIMP) (**B2.8.7: Outline Guillemot and Razorbill Compensation Implementation and Monitoring Plan)**. The GRIMP would be submitted to the Secretary of State for approval (in consultation with the MMO and Natural England) at least one year prior to the commencement of any wind turbine generator[2]. An outline of the GRIMP (**B2.8.7: Outline Guillemot and Razorbill Compensation Implementation and Monitoring Plan)** has been prepared[3] and will be submitted with the DCO application.

2.2.1.6 An outline of the steps proposed to take forward predator eradication and/ or control as a compensation measure is described in the Guillemot and Razorbill Predator Eradication Roadmap (**B2.8.4 Compensation measures for FFC SPA: Predator Eradication: Roadmap**) which accompanies the DCO application.

2.3 Guillemot and razorbill overview

2.3.1 Guillemot

2.3.1.1 Common guillemot is part of the family Alcidae, which contains auks/alcids such as guillemots (including the razorbill), auklets, puffins and murrelets. Currently the global population of guillemot is increasing (BirdLife International, 2018a), and in the UK, it is estimated that there are currently 950,000 breeding guillemot pairs, (RSPB, 2021a) which equates to approximately 12.9% of the global population (Mitchell *et al.*, 2004). There are several different subspecies (races) of the guillemot, however, the exact number has been widely debated. Knox (2012) states there are currently five distinct races each with their own species range (Appendix A **B2.8.1 Compensation measures for FFC SPA: Bycatch Reduction:**

[2] "Commencement of any wind turbine generator" means the first day on which installation of any wind turbine generator foundation is programmed to be undertaken.
[3] This document is being drafted and will be submitted within the Hornsea Four Application.

Ecological Evidence).

2.3.1.2 Guillemots breed along many of the coasts in the UK and Ireland where there is suitable habitat. Guillemots are mainly recorded nesting on low-lying flat-topped islands and stacks and on broad and narrow cliff ledges, however they are also occasionally recorded nesting under boulders and in caves (Tuck, 1960; Parslow, 1966). In areas where there is a shortage of suitable ledge habitat on cliffs, guillemots have the potential to breed in greater numbers in boulder fields and caves (Furness, 1981). However, their preferred habitat is cliff ledges as guillemots cannot fly off as easily from the flat ground at boulder sites (Birkhead, 1978) and access to the sea is more difficult when birds are disturbed (Furess, 1981). Guillemot do not build nests; the single relatively large egg is incubated on bare rock, guano or soil. Breeding success is highest where birds breed at high density or where sites are well protected from predators (Mitchell *et al.*, 2004) and may assume a density of 20 pairs per square metre on flat rocks and up to 70 pairs per square metre where the surface is uneven (Harris & Birkhead 1985).

2.3.1.3 Guillemots dive from the sea surface, using their wings to propel themselves underwater in pursuit of small fish and can dive to depths and distances of at least 100 m. Guillemot diets in the North Sea comprise of around 70% fish. During the summer, in the North Sea guillemots feed mainly on sandeel, with sprats being the main alternative prey source (e.g. Anderson *et al.*, 2013). During the winter, they have a more varied diet made up mainly of fish. Unlike other seabirds they can take sandeel from the seabed by digging or scaring them out of the sediment. During the breeding season, the mean foraging range for guillemot is 33.1 km (mean maximum foraging range is 73.2 km) and the maximum recorded is 338 km (Woodward *et al.*, 2019).

2.3.1.4 The FFC SPA is located on the east coast of England and supports the largest guillemot and razorbill colonies in England (Natural England, 2020), supporting over 80,000 breeding guillemot adults. At the FFC SPA the population of guillemot has increased by 81% between 2000 and 2018 , compared to 1% increase overall in the total UK guillemot population (JNCC, 2020a; JNCC, 2020b). The breeding guillemot colony within the FFC SPA is of the southern *albionis* race, with the FFC SPA supporting 15.6% of the southern *albionis* biogeographical population (Natural England, 2020). Outside of the breeding season, guillemots of the *aalge* race have been recorded off the Flamborough coast whilst traveling south from their breeding colonies. The *albionis* race also have populations recorded in Scotland, Wales, Northern Ireland, Ireland and other parts of England (minus Northumbria).

2.3.1.5 Guillemots have a relatively high degree of breeding philopatry (Lyngs, 1993; Harris *et al.*, 1996; Halley *et al.*, 1995), however display inter-colony movement with first-time breeders breeding away from their natal colony (Lyngs, 1993; Lavers *et al.,* 2007). Therefore, there is potential for this species within the FFC SPA to exhibit colony movement to other UK colonies (potentially even outside of the UK). Outside of the breeding season guillemots disperse from their breeding grounds and can be seen all around the UK (Sweet, 2008). The majority of individuals travel south over the winter, but some have been recorded moving further north than their breeding colony. Juvenile birds travel further distances and have been recorded from Portugal to north Norway, whereas adults mostly stay within UK waters (Swann and Ramsay, 1983; Furness, 2015). More information on the race distribution and dispersal of guillemots can be found in Appendix A of the Bycatch Ecological Evidence Report (**B2.8.1 Compensation measures for FFC SPA: Bycatch Reduction: Ecological Evidence**).

2.3.2 Razorbill

2.3.2.1 Razorbill are part of the family Alcidae, which contains auks/ alcids such as guillemots (including the razorbill), auklets, puffins and murrelets. Currently, the global population of razorbill is decreasing (BirdLife International, 2018b), however is increasing in the UK (JNCC, 2020) with populations currently estimated at 30,000 breeding razorbill pairs, which equates to approximately 20.2% of the global population (Mitchell *et al.*, 2004). There are two subspecies of razorbill recognised by the American Ornithologists' Union; *Alca torda torda* which is found in the Baltic and White Seas, Norway, Bear Island, Iceland, Greenland and eastern North America and *Alca torda islandica* which occurs throughout Ireland, Great Britain and north-western France.

2.3.2.2 Razorbills, like guillemot, nest predominately on small ledges or in cracks of rocky cliffs and in associate scree and on boulder-fields resulting in them exhibiting a similar distribution around the UK as guillemot (JNCC, 2020a; 2020b; 2020c). Razorbill 'nest' sites are usually hidden from view, making census for this species difficult.

2.3.2.3 Razorbill are pursuit divers that use their wings to propel themselves underwater in order to catch small fish prey. Razorbills tend to make shallower dives than guillemot and feed on more sandeel and less sprat. Razorbills only make pelagic dives compared to guillemot which make both pelagic and benthic dives (Chimienti *et al.*, 2017). Razorbill diets in the North Sea comprise of around 70% fish, mainly sandeel followed by sprat and herring (ICES, 2011). During the breeding season, the mean foraging range for razorbill is 61.3 km (mean maximum foraging range is 88.7 km) and the maximum recorded is 313km (Woodward *et al.*, 2019).

2.3.2.4 The FFC SPA supports the largest razorbill colony in England (Natural England, 2020), supporting over 20,000 breeding pairs (Aitken *et al.*, 2017). At FFC SPA the population of razorbill has increased by 228% from 2000, compared to 33% increase overall in the total UK population (JNCC, 2020b; JNCC, 2020c). The FFC SPA represents 2.3% of the biogeographic population of the *Alca torda islandica* subspecies (Natural England, 2014).

2.3.2.5 Razorbills have a high degree of breeding philopatry (Lyngs, 1993; Harris *et al.*, 1996; Halley *et al.*, 1995), however display inter-colony movement with first-time breeders breeding away from their natal colony (Lyngs, 1993; Lavers *et al.*, 2007). Therefore, there is potential for this species within the FFC SPA to exhibit colony movement to other UK colonies (potentially even outside of the UK). Winter dispersal of razorbills is similar to that of guillemots, however much less is known about razorbill winter dispersal as there is currently no published winter geolocator tagging data (currently in press Lila Buckingham *pers comm*). The majority of individuals move south, with a few from northern colonies dispersing north towards Norway. Lloyd (1974) identified different dispersive movements for different geographical locations with adults from the North Sea being more inclined to stay within this region, however some individuals have been recorded moving south to the Bay of Biscay. More information on the race distribution and dispersal of razorbill can be found in Appendix A of the Bycatch Ecological Evidence Report (**B2.8.1 Compensation measures for FFC SPA: Bycatch Reduction: Ecological Evidence**).

3 Methods

3.1 Literature review

3.1.1.1 A literature review (including grey literature) was undertaken in order to determine the main predation pressures on guillemot and razorbill in the UK and further afield, to explore potential sites for predator eradication and/ or control schemes and to understand the implementation, monitoring and degree of recovery of previous eradication programmes. Sources included, but were not limited to, scientific journals, site management plans, predator eradication implementation and monitoring plans and the Database of Island Invasive Species Eradications (Database of Island Invasive Species Eradications (islandconservation.org)). Additionally, engagement with site managers and owners has been undertaken in order to ascertain information on sites considered for predator eradication and/ or control and begin to assess the feasibility of eradications in locations across the UK.

3.2 Data search

3.2.1.1 Data on current and historical guillemot and razorbill colony locations, their populations and trends, including pre- and post-eradication trends for colonies located in areas that have previously undergone predator eradications, were extracted from the JNCC's Seabird Monitoring Program (SMP) database (Seabird Monitoring Programme | JNCC - Adviser to Government on Nature Conservation) or from sub colony count data provided by site managers.

4 Key guillemot and razorbill predators

4.1.1.1 Seabirds have a number of natural predators distributed across their range. Natural predators generally pose a low risk to breeding seabirds as they have co-evolved with predation pressure and have mechanisms or behaviours to avoid or withstand it, such as nesting on remote islands which are free from ground dwelling predators.

4.1.1.2 When non-native predators are introduced to these island colonies, they may have profound impacts on the native fauna (Jones *et al.*, 2016; Thomas *et al.*, 2017a). Invasive species influence seabird colonies by predating on eggs, chicks and adults; changing the distribution of breeding colonies, and changing their nesting habitat. There are many species that have been introduced into sensitive island ecosystems within the UK and the Channel Islands, with many offshore islands around the UK and the Channel Islands having established populations of invasive mammals, originating from mainland Britain or from further afield (e.g. through shipwrecks) (Stanbury *et al.*, 2017). The following section provides an overview of the key predators to guillemot and razorbill at UK and Channel Islands colonies.

4.1.2 Invasive Mammalian Predators

Rats (Rattus)

4.1.2.1 Rats are omnivorous species that can impact native fauna through predation, competition for resources and modification of habitat (Jones *et al.,* 2008) and are estimated to occur on over 80% of islands globally (Atkinson, 1985). In the UK the key rat species are brown rat *Rattus norvegicus* and black rat *Rattus rattus*. Both species are known to predominately predate on eggs and chicks, as evidenced through numerous monitoring methods, including

stable isotope analysis extracted from rat tissue (Stapp, 2002) but will also occasionally predate small-bodied adult seabirds (Atkinson, 1985).

4.1.2.2 Rats are known to impact guillemot and razorbill colonies, especially those breeding on islands (Thomas *et al.*, 2017a). In the UK, examples include Shiant Isles and Canna Island. On the Shiant Isles, prior to their eradication, black rats were associated with the population declines of the 13,000 pairs of nesting guillemot and 11,000 pairs of nesting razorbills due to predation of eggs and chicks (Swann, 2002). Whilst brown rats were responsible for the predation of auk eggs (Russell, 2011) and the redistribution of nesting guillemot into areas which were inaccessible to rats (Mavor *et al.*, 2004) at Canna Island. This led to the initiation of an island wide rat eradication scheme in 2006.

Other mammalian predators

4.1.2.3 A number of other invasive species pose a potential threat to breeding auks including American mink *Mustela vision*, feral ferrets, house mice and hedgehogs.

4.1.3 Avian predators

4.1.3.1 Currently, the majority of studies relating to the impacts of predator eradication programmes on guillemot and razorbill are where rats have been eradicated. Therefore, this report predominately focuses on the evidence for invasive mammalian predator eradication programmes. However other, non-mammalian species also have the potential to impact guillemot and razorbill at breeding colonies. For example, guillemot and razorbill are also prone to predation from avian predators such as large gulls, great skua (*Stercorarius skua*), corvids and raptors. In the UK, avian predation has been recorded across multiple guillemot and razorbill colonies, including Skomer and Skokholm, Sumburgh Head (Wales), The Gobbins (Northern Ireland), Rathlin Island (Northern Ireland), Isle of May (Scotland) and FFC SPA (Aitken *et al.*, 2017).

4.1.3.2 All known avian predators of seabirds are native to the UK and have significant distributions (apart from great skua which is largely restricted to northern Scotland during the breeding season) throughout the UK. While not being invasive, they can have a detrimental impact on other breeding seabird populations. For example, observed crow predation of guillemot and razorbill eggs was noted by Aitken *et al.,* (2017) to be likely responsible for low breeding productivity at monitored nesting locations at the FFC SPA.

4.1.3.3 As mentioned above, this report focuses on the invasive mammalian predators, while recognising the potential threat posed by avian predators (particularly corvid species).

5 Introduction to predator eradication

5.1.1.1 The eradication of invasive predators is gaining traction as a key conservation tool in the recovery of native animal populations worldwide (Jones *et al.,* 2016). The Database of Island Invasive Species Eradications (DIISE, 2020) provides a comprehensive overview of the global scale of eradication programmes, with links to relevant published results.

5.1.1.2 Rat eradication has been pioneered in New Zealand (which has a significant number of islands hosting rats (and other invasives) and a large number of endangered seabirds which are vulnerable to the presence of rats) and is now being applied across the globe with the

successful removal from islands ranging in size from less than one ha to 12,875 ha (Main *et al.*, 2019).

5.1.1.3 In the UK, the successful eradication of rats has been shown on over a dozen islands ranging in size from just one ha (e.g., Inchgarvie, Firth of Forth, Scotland) to 1,300 ha (Canna and Sanday, Scotland) (Ratcliffe *et al.*, 2009; Thomas *et al.*, 2017a; Bell, 2019). To date, the most common and effective eradication programmes on UK islands are those of brown rats (Bell *et al.*, 2011; Thomas *et al.*, 2017a; Bell *et al.*, 2019; Pearson *et al.*, 2019), with the exceptions such as Lundy (Main *et al.*, 2019) where there were both populations of brown and black rats removed (Thomas *et al.*, 2017a; Bell, 2019) and the Shiant Isles, where black rats were eradicated (Main *et al.*, 2019).

5.1.1.4 Other species eradication programmes have been successfully conducted in the UK, namely, American mink eradication in the Western Isles of Lewis and Harris, Benbecula, North Uist (which however became reinvaded) and South Uist (all located in Scotland). Other eradication programmes in the UK are currently in progress or being planned for other seabird predators such as stoat and European hedgehog (DIISE, 2020).

5.1.1.5 In the UK, previous eradication schemes have been carried out in conjunction with organisations such as RSPB, Wildlife Trust, Natural England and Scottish Natural Heritage (SNH), alongside landowners and communities inhabiting the islands. Additionally, initiatives such as Biosecurity for LIFE aim to safeguard the UK's internationally important seabird islands through raising awareness of the threat of invasive predators and ensuring the prevention of their accidental introduction to islands. Biosecurity for LIFE is an RSPB led project which currently focuses on 42 SPAs with the aim to work with communities, businesses, government agencies and conservation NGOs in order to raise the level of biosecurity across all 42 SPAs with a major focus on how residents and visitors can improve biosecurity at islands (further information on biosecurity in **Section 8**).

5.1.1.6 At the Shiant Isles, the Shiant Isles Recovery Project was a four-year EU LIFE funded project which ran from 2014 to 2018 and included the partnership of RSPB Scotland, SNH and the Nicolson family (the custodians of the Shiant Isles) in order to remove invasive black rats and improve island biosecurity. Whilst at the Isles of Scilly, the Isles of Scilly Seabird Recovery Project aimed to remove rats from St Agnes and Gugh and keep the uninhabited seabird islands 'rat-free'. This was a partnership of Isles of Scilly Wildlife Trust, Isles of Scilly Area of Outstanding Natural Beauty, Natural England and Duchy of Cornwall, in which rats were declared rat-free in 2015.

5.1.1.7 In order for an effective eradication scheme to be conducted it must adhere to the following stages:

- Pre-eradication monitoring and feasibility studies (**Section 7**);
- Implementation of eradication (**Section 7**);
- Post-eradication monitoring of invasive species populations (**Section 7**);
- Post-eradication monitoring of beneficiary species and surrounding ecosystems (**Section 7**); and
- Implementation of biosecurity measures (**Section 8**).

5.1.1.8 Additional requirements for a successful eradication scheme to be conducted include, but are not limited to, comprehensive stakeholder engagement throughout each stage of the

project and community engagement.

5.1.1.9 The purpose of eradication is to ensure the removal of target invasive species in order to have positive consequential impacts on beneficiary species, in this case on breeding guillemot and razorbill recovery (more information on consequent recovery and likelihood of long-term rat free status can be found in **Section 9**). There will be wider ecosystem benefits resulting from this work for other species of seabird and other flora and fauna.

5.1.1.10 In absence of the ability to maintain a full eradication for the lifetime of the project (e.g., islands easily accessible by predators from nearby landmasses), predator control can be implemented to reduce the impact of predators on seabird populations. Although predator control may not eliminate the predator, the reduction in numbers could increase productivity and aid seabird population growth (Igual *et al.,* 2005; Jones *et al.,* 2008).

6 Potential benefits of predator eradication to guillemot and razorbill

6.1.1.1 Very few studies have attempted to quantify the population recovery of guillemot and razorbill following the implementation of eradication programmes. This has typically been a result of the fact that previous eradication projects have focused on islands where other species which are often of higher conservation concern (Eaton *et al.,* 2015) or at risk of local extinction (JNCC, 2020b) breed such as Manx shearwater (*Puffinus puffinus*), European storm petrel (*Hydrobates pelagicus*) and puffin (*Fratercula arctica*). Therefore, it is often found that the scope of post eradication monitoring is limited to those species of higher conservation value, with more common species which form part of the wider seabird assemblage not being monitored to the same extent, if at all. However, some studies have documented the benefits to guillemot and razorbill post-eradication, namely: increase in population, breeding success (e.g. Booker *et al.*, 2018) and productivity (e.g. Main *et al.*, 2019), increase in occupied breeding sites (e.g. Booker *et al.*, 2018) and recolonisation (e.g. Nordstrom *et al.*, 2003; Swann, 2008). Additionally, national seabird census data (usually undertaken independently to eradication projects) can also highlight changes at a species and colony level.

6.1.1.2 The following sections present evidence of benefits to guillemot and razorbill from eradication of invasive mammalian predators. The information is presented on a case-by-case basis, presenting information from previous eradication projects.

6.2 Lundy Island – brown and black rat eradication

6.2.1.1 Lundy Island is situated 19 km off the Devon coast in the UK's Bristol Channel. Lundy is occupied by eleven seabird species, including razorbill and guillemot. The island was also occupied by both brown and black rat, which led to the establishment of the Seabird Recovery Project in 2001. The projects main aim was to improve the conditions for burrow-nesting seabirds (such as puffin and European storm petrels) through the eradication of brown and black rats, however it was anticipated that other species may also benefit. From 2002–2004 a ground-based eradication operation was undertaken, and in 2006 Lundy was officially declared rat-free.

6.2.1.2 The seabird populations of Lundy have been well studied with detailed regular data collection spanning the last 35 years. Over the last decade, as a result of rat removal, seabird numbers on the island have doubled and European storm petrels have colonised. By

2013, the breeding population of Manx shearwaters increased more than ten-fold to an estimated 3,451 pairs (JNCC, 2020b).

6.2.1.3 With regard to guillemot and razorbill, both species had reduced populations prior to the eradication programme, with increases in populations at the sites following eradication. Table 1 shows the pre- and post-eradication population of guillemot and razorbill at Lundy.

Table 1: Seabird populations at Lundy before and after eradication. Count type: IND. Source: BTO/JNCC SMP (JNCC, 2020d) and recording coordinated by the Lundy Field Society.

Count year	Guillemot	Razorbill
1992	2629	785
1996	1921	959
2000	2348	950
Predator eradication 2002-2004		
2004	2321	841
2006 - Lundy declared rat-free		
2008	3302	1045
2013	4114	1324
2017	6198	1735
2019	6415	1955
2020	8252	2177
2021	9880	3533

6.2.1.4 National trends reported by JNCC show that Lundy's seabirds are generally faring better when compared to the wider UK (JNCC, 2020b). The latest trend information for guillemots have increased by 5% nationally between Seabird 2000 and 2015 and razorbills by 32% in the same period (JNCC, 2016). The population increases for Lundy are considerably higher for these species at 164% and 82% respectively between 2000 and 2017 (Booker *et al.*, 2018). The population of guillemot at Lundy as of 2017 is at a level not seen since the late 1940s (Davis and Jones, 2007). Additional years of survey data have been collected since the publication of Booker *et al.* (2018) showing further increases in the populations of guillemot and razorbill nesting at Lundy. These show that there has been a population increase of 321% for guillemot and 272% for razorbill from 2000 (before rat eradication) to 2021 (15 years after the island was declared rat-free).

6.2.1.5 On a regional scale, when comparing the populations of guillemot and razorbill from before and after the Lundy eradication with other neighbouring colonies, results show that there has been a significant increase at Lundy compared to other nearby colonies since 2004, including Skomer and Castlemartin Coast. Table 2 and Table 3 shows the population percentage change at Lundy Island before and after eradication compared to neighbouring guillemot and razorbill colonies which have not undergone predator eradications, but due to proximity, are likely to be exploiting the same local prey resource. Comparing counts of guillemot and razorbill colonies within the same region helps to distinguish whether changes are due to site specific factors or are region wide. As Lundy populations have increased significantly since the eradication compared to other colonies in this region, this implies that the eradication scheme has benefited the populations of guillemot and razorbill at Lundy.

Table 2: Guillemot population percentage change at Lundy and nearby colonies (Skomer and Castlemartin Coast) before and after Lundy predator eradication. Source of counts: BTO/JNCC SMP (JNCC, 2020d).

	Lundy	Skomer	Castlemartin Coast
Change 2000-2017	164%	79%	94%
Change 2004-2017	167%	75%	32%
Change 2008-2017	88%	45%	13%

Table 3: Razorbill population percentage change at Lundy and nearby colonies (Skomer and Castlemartin Coast)before and after Lundy predator eradication. Source of counts: BTO/JNCC SMP (JNCC, 2020d).

	Lundy	Skomer	Castlemartin Coast
Change 2000-2017	83%	93%	32%
Change 2004-2017	106%	66%	39%
Change 2008-2017	66%	51%	52%

6.2.1.6 The substantial increases in guillemot and razorbill numbers have occurred since 2004. Lundy now supports almost three times the number of guillemots recorded in 2004 with the population currently at a level not recorded since the late 1940s (Davis and Jones, 2007). This pattern is also coincident with the increase in Manx shearwaters (Booker and Price, 2014). Booker *et al.* (2018) and Price *et al.* (2014) suggest that the absence of rats is probably the main driver for such positive changes. An increase in productivity of both species since the eradication has also been shown (Wheatley and Saunders, 2011), with Sherman (2020) showing an increase in guillemot productivity in particular between 2008-2019 at certain locations of the colony.

6.2.1.7 Other notable changes reported by Booker *et al.* (2018) were the prevalence of birds, including guillemots, razorbills and puffins now exploiting previously unoccupied areas of broken ground where the cliff top meets the steep grassy coastal slopes and the habitat becomes a complex mix with rock, soil and broken ground providing numerous nesting opportunities. These areas were previously occupied by rats but are now available as safe nest sites. Alongside these areas, seabirds are generally colonising new sites, with sizeable increases in numbers along the south coast as well as from Jenny's Cove northwards with the change being particularly apparent at Jenny's Cove where breeding numbers of most species have seen the biggest increase.

Table 4: Summary of benefits as a result of Lundy Island eradication.

Species	Species eradicated	Benefits	Limitations
Razorbill Guillemot	Brown and black rat (declared rat free from 2006)	• Significant increase in breeding populations • Newly colonised and recolonised areas of breeding colony • Increase in breeding success	N/A

6.3 Canna and Sanday – brown rat eradication

6.3.1.1 The islands of Canna and Sanday are located at the southern end of the Minch in north west Scotland. They were designated as an SPA by regularly supporting more than 20,000 individuals of 13 species of seabirds, with guillemot and razorbill being two key species. Since the initial designation of the SPA, breeding success had fallen along with the seabird breeding population which had declined severely from approximately 21,000 breeding seabirds in 1995 to approximately 14,000 in 2004 (Mitchell *et al.*, 2004). This was largely due to the increasing levels of predation of eggs and chicks by introduced brown rats (LIFE, 2008; Luxmoore *et al.*, 2019; Swann, 2002). Predation was inferred from three types of evidence:

- Direct observation of increasing numbers of rats foraging in the seabird colonies and of stashes of predated eggshells and carcasses;
- Declining numbers and decreasing breeding success of vulnerable species; and
- Changing nesting behaviour of breeding seabirds moving to less accessible sites (to predators).

6.3.1.2 Only one seabird, the black-legged kittiwake (*Rissa tridactyla*), was found to be increasing in numbers on the islands and this is only in areas where it nests on vertical cliffs inaccessible to rats. Rat eradication began in late 2005 and by February 2006 signs of rats were gone. An intensive post-monitoring programme then enabled the island to be declared rat free in 2008 (Bell *et al.*, 2011).

6.3.1.3 Luxmoore *et al.*, (2019) reviewed the changes in seabird population size and breeding success reported in Swann *et al.*, (2018) following the eradication of rats with the 2019 breeding seabird census for the islands also made available (Swann *et al.*, 2019). Guillemot numbers peaked prior to the eradication programme in 2001 when 1,249 nests were counted during the census. There was then a long-term decline down to 291 nests in 2010 (Swann *et al.*, 2019). In 2019, 602 nests were counted in the study areas continuing the recent trend of a slow increase in numbers following the eradication of rats from the island (Swann *et al.*, 2019).

6.3.1.4 Razorbill numbers on Canna underwent a long-term decline which started in the early 1990s. In 2006 and 2007 numbers increased following the successful rat eradication campaign over winter 2005/06, with numbers back up to 2001 levels. After this initial increase the number of occupied breeding sites stayed roughly stable, with some fluctuations, until 2016, however, breeding success remained low, probably as a result of food shortage (Swann *et al.*, in press). More recently there have been some notable increases in numbers most evident in 2019 when 425 nests were counted, the highest figure since 1995 (Swann *et al.*, 2019).

6.3.1.5 Where razorbills showed a sharp jump in breeding numbers in 2006 and 2007, this was almost certainly due to a reduction in rat predation with recolonisation of areas that had been clear of nesting for several years (Swann, 2008; Swann, 2016).

6.3.1.6 As occupied breeding sites counts record breeding adults with the presence of an egg or chick, excluding those adults that fail to breed, the increase in numbers of razorbills observed in 2006 may be attributed to either the increase of breeding adults at the site or an increase in early survival of eggs (Luxmoore *et al.*, 2019).

6.3.1.7 In 2009 and 2010 there were signs of improvement to the recruitment of auks, suggesting

improved survival of young. In the 2014 count, auks appeared to have had good breeding success, with chicks in good condition as indicated by above average mean weights of a sample of guillemot chicks (Swann *et al.*, 2016). Furthermore, both species started to recolonise areas of the colony which were clear of nests for several years (Swann, 2008).

Table 5: Summary of benefits as a result of Canna and Sanday eradication.

Species	Species eradicated	Benefits	Limitations
Razorbill Guillemot	Brown rat (declared rat free from 2008)	• Slow increase in breeding populations • Improved breeding success in particular years • Recolonised areas of breeding colony	Populations have fluctuated which will be as a result of other influencing factors (likely due to prey availability). Low breeding success due to food shortages.

6.4 Shiant Isles – black rat eradication

6.4.1.1 The Shiants is a group of small, uninhabited islands located in the Minch on the west coast of Scotland. The group of islands form the Shiant Isles SPA and support significant numbers of breeding seabirds including 10% of UK puffins and 7% of UK razorbills each year (Mitchell *et al.*, 2004). The SPA also supports other seabird species, namely guillemot and kittiwake. The Shiants colony structure is formed of extensive seabird breeding ledges on cliffs topped with nesting burrows with significant areas of boulder scree, particularly on Garbh Eilean island. Guillemot and razorbill nest in both boulder fields and on cliff edges at the SPA (Taylor *et al.*, 2018).

6.4.1.2 Black rats are thought to have arrived at the Shiants from an 18th century shipwreck and have subsequently colonised the three main islands in the archipelago (Haswell Smith, 2004). A survey in April 2012 estimated a rat population of 3,600, with the population expected to increase significantly during the summer months when seabird prey is more readily available (LIFE, 2018). Records of black rats predating seabird eggs and chicks were provided for multiple species (namely razorbill and puffin), with the presence of rats also thought to be a reason behind the absence of Manx shearwater and European storm petrel as breeding species. Stable isotope analysis was undertaken on rats at the Shiants and found the ratios of carbon and nitrogen extracted from rat tissues of individuals caught at seabird colonies were closer to those from tissues of seabird origin than those of rats caught from areas away from seabird colonies (Stapp, 2002). This indicated that in the seabird breeding season, coastal colonies of rats were likely to have fed upon seabird eggs and chicks.

6.4.1.3 The Shiant Isles Recovery Project (the "Recovery Project") was established following a 2008 species population assessment which classified razorbill and guillemot as unfavourable declining (LIFE, 2018). The Recovery Project had a number of aims with a key one being to improve the breeding habitat for razorbill, guillemot, puffin and shags by removing black rats, while the primary aim was to restore Manx shearwater and European storm petrel as a breeding species (LIFE, 2018).

6.4.1.4 The Recovery Project initiated work at the Shiants in 2015/ 2016. A full colony census was undertaken in June 2015 (prior to the baiting for eradication) which found that numbers of

guillemot, kittiwake and fulmar had dropped significantly since previous census work in 2000. For example, at the largest colony for each species, populations of guillemot declined from 10,960 individuals in 1999 to 5,624 individuals in 2015, fulmar numbers declined from 1,698 to 413 pairs and kittiwake reduced from 1,798 nesting pairs to 525 over the same period. The census also gathered productivity data for a number of species nesting in the Garbh Eilean boulder scree, including guillemot and razorbill. This nesting habitat makes nesting seabirds particular vulnerable to predation and black rats were able to easily access nest areas without having to scale cliffs to reach nesting ledges.

6.4.1.5 Over the winter of 2015-16, a successful ground-based eradication of black rats was undertaken and complete eradication was declared in March 2018 (Main *et al.*, 2019).

6.4.1.6 Although razorbills were distributed around the Shiant Isles, the most accessible colonies were located within the boulder fields, and for this species only this habitat was studied. Razorbill breeding success was higher on average in each of the post eradication years compared to the pre-eradication year (0.72 prior in 2015 and 0.79 in 2018). This increase in productivity was also consistent with other species where productivity was monitored. Results for guillemot were not presented despite being one of the species initially monitored. This was due to the difficulty of accessing nests without causing significant disturbance (*Personal communication:* Main, 2020)

6.4.1.7 The measurement of only one year of pre-eradication breeding success (i.e. baseline) was possible within the time frame of the project, which may mask some of the inter-annual fluctuation in breeding success that is driven by stochastic events (e.g. weather) and long-term change (e.g. sea surface temperature) in the marine ecosystem. Furthermore, a comprehensive colony census has not been undertaken since 2015 and therefore understanding potential changes to seabird populations at the SPA since the eradication are currently unknown.

6.4.1.8 It is important to note that despite the evidence of significant population declines recorded during pre-eradication monitoring, Taylor *et al.*, (2018) who analysed the Shiant seabird population trends between 2000 and 2015, found no conclusive evidence that the seabird population of the SPA was decreasing between years due to the presence of rats. However, a post-eradication colony census may help to determine if rat eradication has caused an increase in populations at Shiant Isles.

Table 6: Summary of benefits as a result of Shiant Isles eradication.

Species	Species eradicated	Benefits	Limitations
Razorbill	Black rat (declared rat free in March 2018)	Productivity increased from 0.72 in 2015 to 0.79 in 2018 (one year since declared rat free)	No productivity data provided for guillemot No colony population census has been undertaken since 2015 and therefore difficult to understand seabird recovery
Guillemot		N/A	

6.5 South West Finland – American mink eradication

6.5.1.1 Local declines of seabirds due to American mink predation have been observed in islands across Europe. In particular, colonies of black guillemots and razorbills have suffered considerable local declines as they often breed in cavities and adults are at high risk of

predation by mink (Olsson, 1974; Hario *et al.*, 1986; Jonsson and Rosenlund, 1990; Hagemeijer and Blair, 1997). At a colony in south west Finland, monitoring found a decline of razorbill numbers following mink introduction in the 1970s (Stjernberg *et al.*, 1974; Miettinen *et al.*, 1997). An eradication programme was initiated on a 72 km^2 island during autumn 1992-2001, whilst mink were not removed from a 35 km^2 control area, and a secondary eradication between 1998-2001 on a 125 km^2 island with a 130 km^2 control area (Nordstrom *et al.*, 2003).

6.5.1.2 Birds were censused three times per breeding season throughout the eradication programme. Razorbill were already extinct in one of the removal areas pre-eradication, however it was recorded that they had returned to breed in the area post-eradication (Nordstrom *et al.*, 2003). The conclusion of the eradication programme was that it is possible to remove feral mink from large archipelagos with many small islands with the result of increasing the density of breeding seabirds which were being impacted by mink predation (Nordstrom *et al.*, 2003).

Table 7: Summary of benefits as a result of mink eradication in south west Finland.

Species	Species eradicated	Benefits	Limitations
Razorbill	American mink	Intensive experimentation showed the positive impacts of mink removal Razorbill recolonised historic breeding areas	Lack of population data provided by study Limited evidence of mink issue in UK context for auks

7 Implementation and Monitoring

7.1.1.1 The first stages of an eradication and/ or control programme are pre-eradication monitoring of beneficiary species and target invasive species, as well as a feasibility assessment of the target area. This is followed by the implementation of the programme, post-eradication/ long term monitoring of both the beneficiary species and the target invasive species. Additionally, the programme must consider the implementation of biosecurity measures from the start of the project to reduce the risk of (re)-introducing further mammalian predators to the islands during eradication programmes. Each of these steps are considered in the following sections. It is important to also include stakeholder engagement throughout this process, including engagement with the local community to ensure targets are met and maintained long-term.

7.2 Monitoring

7.2.1.1 Monitoring is important at all stages of the eradication programme (pre-, during and post-eradication) in order to assess the recovery of a scheme including native species population and productivity changes, invasive species survival and any unexpected impacts of the eradication.

7.2.2 Pre-eradication feasibility assessment

7.2.2.1 Determining the presence and species of invasive predators is the first step in planning an island eradication project. While it is usually known by site managers whether or not the location in question is occupied by predators or not, their presence at surrounding satellite islands/ colonies may be less well known. Furthermore, the invasive species might not be

known. Brown and black rat behave in different ways, with black rat being more arboreal and therefore potentially having access to a further realm of seabird nesting locations than the larger brown rat. It is therefore vital that invasive predators are identified to species level.

7.2.2.2 The presence and species of invasive predator can be established in a multitude of ways. This is largely dependent on location and habitat, but a number of core methods exist. These are briefly considered in the case study examples below, with a further overview provided in the Guillemot and Razorbill Compensation Plan (**B2.8: FFC SPA: Razorbill and Guillemot Compensation Plan).**

7.2.2.3 Other important data can also be obtained at this time. Up to date seabird census and productivity data can be obtained to inform future population assessments, while habitat surveys can also determine the amount of habitat potentially available to recovering seabird populations. This can include the number of suitable nesting crevices for species such as razorbill, or nesting ledges for guillemot and a lesser extent razorbill. Furthermore, additional food resources which may sustain rats when seabirds are absent, such as vegetation and seabird carcasses.

7.2.3 Monitoring of target invasive predator

7.2.3.1 For the target invasive species, monitoring must be conducted both during eradication and for two years after final individuals are removed in order to ensure that the eradication scheme was successful and to gain predator-free status, which can only follow two years of intensive post-eradication monitoring (Nathan *et al.*, 2015; Russell *et al.*, 2017; Bell *et al.*, 2019). Note that control would not maintain 100% eradication of predators (due to re-infestation), but instead aim to maintain a reduced population.

7.2.3.2 Monitoring for dead rodent carcasses is necessary during baiting operations as well as systematic monitoring for surviving individuals in tandem with baiting in the weeks following initial implementation. For land-based eradication methods, monitoring is conducted through the use of stations positioned at bait stations as well as additional stations. Monitoring tools can include non-toxic flavoured paraffin wax blocks; soap; tracking tunnels; snap traps and motion-activated cameras. After initial implementation, intensive monitoring can be reduced and permanent monitoring stations should be established at key locations where early detection is most likely (Main *et al.*, 2019). These should be checked regularly during winter and summer months and treated with further rodenticide if required.

7.2.4 Ecosystem monitoring

7.2.4.1 Ecosystem monitoring is essential through pre- and post-eradication monitoring of existing seabirds, land birds, vegetation and invertebrates in order to detect changes to the ecosystem and therefore assess the benefits of the eradication and/ or control (Main *et al.*, 2019). In this case, the predominant interest is benefits of eradication and/ or control schemes to seabirds. An essential component to adaptive island management is understanding the consequential impacts of predator eradication and/ or control on seabird colonies, where the mechanisms of recovery are key for informing conservation management of seabirds. This is particularly true for species that are experiencing population declines exacerbated by threats such as fisheries bycatch, marine plastic pollution and climate change (Rolland *et al.*, 2009; Croxall *et al.*, 2012; Buxton *et al.*, 2016).

7.2.4.2 To date, there is a lack of or limited/ sporadic monitoring conducted both pre- and post-eradication (Jones *et al.*, 2016; Brooke *et al.*, 2018) which may be a key factor leading to a limited amount of evidence reported for guillemot and razorbill. Currently, very few projects have long-term monitoring information currently available to assess long-term impacts, however there are a number of projects that have conducted monitoring during their eradication programme in the UK including the Shiant Isles and Isles of Scilly (Bell *et al.*, 2019) which show positive impacts on guillemot and razorbill numbers and productivity. One factor which may account for rapid population increases after species eradication and/ or control may be the increased breeding in locations which were previously accessible by rats. This was especially noted by Booker *et al.*, (2018) following the eradication of black rats from Lundy where guillemot expanded to previous unoccupied breeding locations. It is therefore likely a combination of longer-term population recovery as a result of increased breeding success, and relatively rapid colonisation of breeding locations which result in the population recovery at colony post-eradication. Therefore, although long-term data would be advantageous, current data from previous eradications clearly show benefits to guillemot and razorbill.

7.3 Implementation of eradication

7.3.1.1 A feasibility study will be required in order to carry out predator eradication and/ or control prior to programme initiation. Consideration must also be taken of the equipment that will be used during eradication and/ or control such as rodent anticoagulant resistance tests, equipment preparation, access to challenging terrain, non-target mitigation, bait quantity and bait application (Main *et al.*, 2019). These are undertaken to ensure that the programme has the best possible chance of targe species complete removal.

7.3.1.2 Bait application should be undertaken in a systematic way e.g. through a gridded bait station system. The Shiant Isles bait stations were spaced at 50 m intervals across the islands and 25 m along coasts and through areas of boulder scree (Main *et al.*, 2019). This grid spacing has become the current UK best practice protocol for rat eradications (Thomas *et al.*, 2017b).

7.3.1.3 Eradication programmes are usually undertaken by specialist island restoration organisations, such as Wildlife Management International Ltd, who specialise in complete island eradication schemes.

7.3.1.4 The following sections give examples of UK eradication programmes including their monitoring and implementation methods.

7.4 Shiant Isles – black rat eradication

7.4.1.1 The Shiant Isles eradication had three main monitoring components; pre-eradication assessment, pre- and post-ecosystem monitoring and systematic eradication monitoring (Main *et al.*, 2019).

7.4.1.2 During the pre-eradication assessment, a feasibility study was commissioned by the RSPB and undertaken by Wildlife Management International Ltd to ensure the suitability of eradication on the Isles. Once this was established, pre-ecosystem monitoring was undertaken in June 2015, including a standardised population census of all seabirds, by RSPB

and SNH (now NatureScot) (monitoring processed outlined by Walsh *et al.*, 1995) (Taylor *et al.*, 2018). Additional boulder nesting colony counts were undertaken (outlined in Taylor *et al.*, 2018) and seabird productivity for guillemot and razorbill at a small number of locations was recorded.

7.4.1.3 Final pre-eradication assessment was undertaken in July 2015 to finalise plans, logistics and health and safety requirements.

7.4.1.4 Bait application was undertaken in a systematic way through a gridded bait station system of 1,183 poison bait stations deployed across the islands and sea stacks during October 2015. Shiant Isles used cereal-based wax blocks (28g Contrac® All-weather Blox™ (Cas No. 28772-56-7, EU 528/2012) containing the anticoagultant rodenticide bromadiolone at 0.005% w/w) which were placed initially loose within bait stations. Regular checks were then made and if damaged by weather, slugs or rat incisor marks, were replaced. Alongside the Contrac® blocks, an alternative soft block bait (100 g Romax® Rat CP™ (Cas No. 5836-29-3, UK UK-2016-1003), containing the anticoagulant coumatetralyl at 0.0375% w/w), was wired into bait stations (one block alongside the Contrac® blocks). This provided an alternative bait for rats not consuming the Contrac® blocks (Main *et al.*, 2019).

7.4.1.5 Systematic eradication monitoring commenced in November 2015. This continued for 14 weeks alongside baiting to monitor for surviving rats. Monitoring stations were set up at every bait station and at intervals half way between bait stations. Tools included paraffin wax blocks, soap, tracking tunnels, snap traps and motion-activated cameras. After the 14 weeks, monitoring reduced and stations were set up in key areas where early detection of reinvasion or surviving rats would be likely. These were checked every few months during 2016 and 2017 winter and April to August 2016 to 2018 during the summer months. In March 2018 the islands were declared rat-free (Main *et al.*, 2019).

7.4.1.6 Monitoring of seabirds, land birds, vegetation and invertebrates was carried out on the two main island's for one year before eradication and for three years post-eradication. The aims of this was to detect any changes in the ecosystem in order to assess the benefits of the eradication on the environment (Main *et al.*, 2019).

7.4.1.7 Other eradication projects in the UK have followed similar eradication monitoring to the Shiant Isles, including the Isles of Scilly (Bell *et al.*, 2019) and others that have similar short-term monitoring to assess seabird colony changes.

7.5 Isles of Scilly – brown rat eradication

7.5.1.1 Brown rats were introduced to the Isles of Scilly in the 1700s and were widespread and abundant across St Agnes and Gugh as well as many other islands in the archipelago (Matheson, 1962; McCann, 2005). In 2010 the Isles of Scilly Seabird Recovery Project (IOSSRP) was established and was managed by a coalition of groups including RSPB, Isles of Scilly Wildlife Trust, Natural England, Duchy of Cornwall, the Isles of Scilly Area of Outstanding Natural Beauty and a representative from St Agnes and Gugh with support from the Isles of Scilly Bird Group.

7.5.1.2 The IOSSRP identified the need to assess the possibility of eradicating brown rats from St Agnes and Gugh to protect and enhance the islands' seabirds and protect Annet from re-invasion (the most important uninhabited island for seabirds in the Isles of Scilly). A feasibility

assessment was carried out in 2010 (Bell, 2011) and a steering group was formed in 2012. Implementation of the eradication ran from October 2013 to April 2014 with long-term monitoring continuing until February 2016 and included the use of a grided bait station system, poisoning, monitoring and biosecurity establishment. Wildlife Management International Ltd. (WMIL) directed the eradication with the assistance of volunteers and RSPB, Isles of Scilly Wildlife Trust and Natural England staff.

7.5.1.3 As the islands of St Agnes and Gugh are inhabited, pre-eradication tasks included consultations with the community about operational techniques; timing of each aspect of the project and confirming access to land and buildings; testing rats for resistance to rodenticides; getting the community to cease using rodenticides on the island six months prior to the eradication; removal of waste, alternative food and harbourage; establishing waste management systems for households and businesses; application for an extension-of-use for rodenticide use from the UK Health and Safety Executive; construction of bait stations; and delivery of all equipment to the islands (Bell *et al.*, 2019).

7.5.1.4 The implementation included using a gridded bait station system and used a similar design to that used on Lundy. Stations were placed on a 40m x 50m grid and consisted of a total of 962 tube stations. The main toxicant used was bromadiolone, Contrac™ and was used between November 2013 and March 2014. Two other baits were available if rats seemed to be avoiding or were resistant to the main bait. Baits were present at each station and replaced when required e.g. when eaten by rats or damaged. Stations were checked at intervals between one to seven days and any carcasses were removed during each check. All carcasses were necropsied to determine cause of death and incinerated to reduce risk to non-target scavengers (Bell *et al.*, 2019).

7.5.1.5 There were three distinct monitoring periods;

- Intensive monitoring using 2,500 stations occurred between November 2013 and March 2014 to detect rats surviving through the poisoning phase;
- This was followed by a 21-month long-term monitoring period using 87 biosecurity stations and six rodent motels from March 2014 to January 2016. These were positioned in high risk areas such as at ports; around the coast and at seabird breeding sites (Bell *et al.*, 2014); and
- Final monitoring checks occurred between January and February 2016 using 448 stations.

7.5.1.6 WMIL and RSPB staff and volunteers carried out the intensive and final check and IOSSRP staff, St Agnes and Gugh residents and volunteers maintained the long-term monitoring. Monitoring stations used attractive materials (such as chocolate, flavoured wax, soap), tracking tunnels and trail cameras. During monitoring sites were checked 3-5 times a week. No rats or signs were detected during any phase of the long-term or final check monitoring, therefore St Agnes and Gugh were declared rat-free in February 2016 (Bell *et al.*, 2019).

7.5.1.7 Isles of Scilly seabird breeding records comprise one of the best long term environmental data sets on the islands. Regular as-island counts have been occurring since 1970 and annual records for breeding numbers has been recorded for Annet since 2006 and for St Agnes and Gugh since 2012 including full surveys of all seabird species breeding at these islands (Heaney, 2017).

7.6 Canna and Sanday – brown rat eradication

7.6.1.1 The Canna and Sanday brown rat eradication conducted pre- and post- eradication monitoring for both target invasive species and target beneficiary species.

7.6.1.2 Pre-eradication monitoring occurred in 2004, during which predated razorbill eggs were found under boulders with almost half of the sites found to have predated eggshells (Swann, 2006).

7.6.1.3 Rat eradication began in late 2005. The eradication was undertaken using a gridded bait station system of 4,388 stations. Bait was placed in the centre of the station through a small access hole at the top. The stations were placed on a 50-metre grid on the coastal slopes and cliffs and were placed 100m apart on the higher plateau areas. First generation rodenticides were chosen for the eradication campaign to minimise the risk of secondary poisoning, particularly to birds. The majority of stations were checked and serviced every three to six days during the first two months and then every 15 to 20 days during the third and fourth month. Towards the end of the poisoning phase (February-March 2006), if isolated incidents of rat activity were found then an additional bait block was deployed. By February 2006 signs of rats were gone. An intensive post-monitoring programme then enabled the island to be declared rat-free in 2008 (Bell *et al.*, 2011).

7.6.1.4 The intensive post-monitoring programme consisted of five periods of (Bell *et al.*, 2011):

- (1) intensive monitoring at stations 50m apart from December to March 2006 in order to detect rats surviving the poisoning phase;
- (2) six month period of long-term monitoring until September 2006;
- (3) second intensive monitoring period until December 2006;
- (4) followed by long-term monitoring until March 2008; and
- (5) final checks were conducted in March 2008. Monitoring items such as soap, chocolate, chocolate wax, and candles were placed inside and outside each station.

7.6.1.5 Following the eradication programme, post-eradication monitoring has consisted of a long-term seabird monitoring programme (SMP) in order to detect population changes following eradication.

7.6.1.6 Biosecurity measures have been put in place following the programme, consisting of continuous monitoring (wax blocks and kill traps) as well as quarantine and contingency plans, with no further incursions of rats having been detected since the project (Luxmoore *et al.*, 2019). More information on biosecurity measures can be found in **Section 8**.

8 Biosecurity measures

8.1.1.1 An integral component of the long-term security of the predator eradication programme would be biosecurity measures to prevent reinvasion (note that control would not maintain 100% eradication of predators (due to re-infestation), but instead aim to maintain a reduced population) Biosecurity, in this context, is the practice of protecting places from the threats posed by introducing animals that do not usually occur there. The installation of biosecurity measures either to accompany successful eradications or at islands without a current invasive species population is suggested by Thomas *et al.*, (2017a) as potentially being the highest conservation priority for a UK island restoration programme.

8.1.1.2 In a global context, numerous islands have experienced a re-establishment of predators which were previously eradicated. The vast majority have related to the reinstatement of rat populations, particularly on small islands in close proximity to larger islands from which rats could not be eradicated (Bassett *et al.*, 2016).

8.1.1.3 Within the UK, a small number of previous eradication projects have been reinvaded. For example, following the eradication at Handa, Sutherland in 1997 (initiation year) the SPA was reinvaded approximately 15 years later. Furthermore, Inchgarvie, Firth of Forth has had reports of rats on the island since the initial eradication scheme in 1990. However, the majority of eradications have resulted in the complete and permanent removal of the target species. For example, at Canna and Sanday, measures consisting of continuous monitoring (wax blocks and kill traps), quarantine and contingency plans have prevented the reinvasion of rats (Luxmoore *et al.*, 2019). Further information of the likelihood of success can be found in **Section 9**.

8.1.1.4 This poses the question of why some biosecurity measures succeeded, and others failed. With regard to Handa, information relating to methods and process underpinning biosecurity measures is scarce. Stoneman and Zonfrillo (2005) noted that bait boxes were set up around the coast in 2001 to provide a permanent source of bait all around the island during summer. The warden regularly replaces bait during the summer months. Further evidence may be as a result of the initial eradication plan being carried out in 1997 and therefore before biosecurity measures had been fully developed and implemented at other seabird colonies.

8.2 Examples of biosecurity measures

8.2.1.1 Biosecurity for LIFE is an RSPB led project set up to safeguard the UK's internationally important seabird islands. In 2016 the project undertook an audit of the biosecurity measures in place on each of the UKs 42 seabird island SPAs which highlighted that many of the UK's most important seabird islands have no protection against the threat of invasion by non-native mammalian predators.

8.2.1.2 The Biosecurity for LIFE project aims to work with communities, businesses, government agencies and conservation NGOs to raise the level of biosecurity protection across all 42 seabird island SPAs in a bid to minimise the likelihood of non-native mammalian predators establishing on these special islands and avoid having to carry out eradication operations. The project focuses mainly on how residents and visitors can improve biosecurity at islands.

8.2.1.3 Biosecurity requires a complex set of measures, including (Russell *et al.*, 2008b; Thomas *et al.*, 2017b):

- Quarantine or prevention measures (vector control) – devised, installed and continuously applied to prevent reinvasion events;
- Surveillance procedures – used to identify any sign of reinvasion of species; and
- Incursion response – aims to respond quickly to incursion events.

8.2.1.4 Note that biosecurity measures should begin to be implemented from the start of the eradication programme (i.e. vector control to reduce the likelihood that boats will introduce further stowaway mammalian predators to the islands during the eradication stage). Surveillance procedures and incursion response will form part of the eradication programme

and should be continued after the island is declared rat free in order to monitor for any signs of re-introduction and provide a quick response if signs of target mammalian predators have returned or not been fully eradicated.

8.2.1.5 Together these measures intend to minimise movement of invasive species and maximise early detection and response to invasive species incursions before establishment of populations (Russell *et al.*, 2008b). It is necessary to have preventative measures and surveillance at origin and arrival points, throughout all potential vectors (e.g., vessels) and across the region/ island where eradication has occurred. Measures can include lethal and non-lethal tools and using a mixed tool approach can maximise detection (Bassett *et al.*, 2016).

8.2.1.6 Prevention tools may include bait stations at origin and arrival points (e.g., ports), poison and kill-traps on vessels, boat and visitor checks to ensure no invasive species is carried onto the island through movement of people or goods to islands (Thomas *et al.*, 2017b). However, there is still a possibility of incursion, therefore surveillance is needed to detect this.

8.2.1.7 Methods of surveillance include lethal tools such as kill-traps and toxins, each of which has 85% success at intercepting incursions (Russell *et al.*, 2008a) and non-lethal tools used for monitoring. Non-lethal methods include a grid system of baited stations with waxtags or chew cards, checked throughout the year, tracking tunnels, camera traps, citizen science reporting and detection dogs used to complement traditional detection tools (Gsell *et al.*, 2010; Sweetapple and Nugent, 2011; Thomas *et al.*, 2017b).

8.2.1.8 Trained dogs are shown to have over 80% success rate for detecting rat presence, similar to that of traps and toxins (Gsell *et al.*, 2010). There has been recent development of traps suitable for both rats and stoats simultaneously and development in the research of using caged laboratory rats as a social attractant for wild rats alongside other monitoring and control devices (Gsell *et al.*, 2014; Shapira, 2014). All devices can be combined or exchanged (Russell *et al.*, 2008b) with different projects opting to use differing combinations of the above techniques (e.g. Bassett *et al.*, 2016; Thomas *et al.*, 2017b).

8.2.1.9 Where a gridded baiting system is in place, this may be used for an incursion response by placing traps at these locations (Thomas *et al.*, 2017b). On small islands, traps may be set out across the islands in suitable habitats, whereas on larger islands, there may be a need to target areas where rats have been sighted (Russell *et al.*, 2008b) or are most likely to re-invade.

8.2.1.10 Following the eradication programme undertaken at Canna and Sanday, biosecurity measures were put in place to keep the islands rat-free through effective surveillance, early detection and rapid response to any future rat re-introduction. The measures consist of continuous monitoring (wax blocks and kill traps), quarantine and contingency plans. No incursions of rats have been detected (Luxmoore *et al.*, 2019).

8.3 Testing of biosecurity measures

8.3.1.1 A study was conducted in New Zealand over the summers of 2001-2004 in order to test the success of island biosecurity systems for reinvasion by brown rats on islands with previous eradication schemes.

8.3.1.2 It is known that employing high density techniques used for eradicating established invasive species, such as bait stations at likely entry points, may not be successful in efficiently removing the low-density reinvasions (Thorsen *et al.*, 2000; Chappell, 2004).

8.3.1.3 The study tested two forms of biosecurity measures; permanent surveillance methods, used for island 'border control' and a contingency response method, used when suspected rat invasion has occurred, such as a shipwreck. The surveillance methods used were kill-traps and bait stations, while the contingency method used for island 1; detection devices followed by kill-traps, poison and trained dogs and island 2; hand-spread poison, live-traps with rodent-scented sawdust and trained dogs on the other.

8.3.1.4 Results showed that only half the rats released were caught within a two-week timeframe with the mean time to interception being just under 14 days. Where rats took a long time to catch, a change of method, an array of devices and more intensive effort was required. Often confirming rat presence was difficult, with similar difficulties for detecting and killing brown rats found at Frégate Island, Seychelles (Thorsen *et al.*, 2000).

8.3.1.5 Trained dogs are able to locate indirect and direct signs of rats (Smith *et al.*, 2001), and may be particularly useful where detection of small numbers of invading rats is difficult (Thorsen *et al.*, 2000). In the New Zealand study, trained dogs were used twice where all other detection methods had failed. The use of dogs may be particularly useful where an island is too large to launch an island-wide response and must be concentrated instead in areas where there are known rats located. The use of dogs, where properly trained can be used in both surveillance and contingency methods for rat biosecurity, however the use of dogs may be dependent on the laws of the country employing the biosecurity measures. In the UK the use of trained conservation indicator dogs is being implemented as part of the stoat eradication on Orkney Mainland and linked isles in Scotland in order to assist with final stages of eradication and biosecurity (Bambini *et al.*, 2018) and may therefore be implemented elsewhere.

8.3.1.6 Overall, it was found that an integrated surveillance approach provided the highest chance of effective implementation for a biosecurity system. On small islands this should be able to eliminate invading rats within 14 days of arrival, whereas on larger islands, there is a need for a more widespread surveillance grid. Persistence is required in order to guarantee the interception of reinvasion and the need to strategically place surveillance devices (e.g., at the point of known invasion) may be necessary. Only where it is believed that a surveillance system has failed to detect an incursion would there be need to use an additional contingency response.

8.3.1.7 Susceptibility of invasion and the appropriate biosecurity response will vary between islands. Where there is high conservation value or where there is high potential for reinvasion, managers should consider testing their biosecurity systems by introducing one male radio-collared rat. This is best done just after eradication so tailored surveillance can be adapted before other conservation features are restored at the island.

9 Review of predator eradication programmes

9.1 Predation eradication – likelihood of complete removal

9.1.1.1 Globally, many eradication projects have resulted in the complete removal of the target

species, installation of bio-security measures and recovery of seabird populations. Note that control would not maintain 100% eradication of predators (due to re-infestation), but instead aim to maintain a reduced population. As of December 2019, the Database of Island Invasive Species Eradications contained records for over 2,000 eradication events on islands (DIISE, 2020). This includes 1,233 completed mammalian eradications (classified as whole island events, where data quality is good or satisfactory, and excluding domestic populations and reinvasion events) with a success of 88% i.e. 806 islands (DIISE, 2020). However, a small minority of eradication programmes fail. The potential reasons for failures are beginning to emerge and has been explored by Holmes *et al.* (2015), further information on this can be found in Section 9.2. Understanding previous eradication failures can help to ensure future eradications are implemented successfully.

9.1.1.2 **Table 8** provides a global perspective on the invasive mammalian island eradication programmes which have been successful, successful but with reinvasion, failed, in progress or planned with total eradication programmes for known mammalian predators of guillemot and razorbill (DIISE, 2020).

Table 8: A global perspective of invasive mammalian island eradication programmes from DIISE, 2020.

Type	Species	Successful	Reinvasion	Failed	In Progress	Planned	Total
Rodent	Brown rat	203 (on 176 islands)	67 (on 56 islands)	11	5	4	298 (on 257 islands)
	Black rat	315 (on 277 islands)	97 (on 86 islands)	47 (on 42 islands)	11	14	513 (on 423 islands)
Mongoose and weasel	American mink	9	1	0	0	0	12

9.1.1.3 From a UK perspective, Thomas *et al.* (2017a) reviewed the success of UK island eradications and noted the following reinvasions:

- Inchgarvie, Firth of Forth (successful but recent unconfirmed reports of rats on the island);
- Ailsa Craig, Firth of Clyde (Failed in 1920s, successful in 1994); and
- Handa Island; Sutherland (Successful in 1997 (start year) but reinvaded more than a decade later).

9.1.1.4 Despite these reinvasions, numerous UK projects have been successful and where re-invasions occurred, successful eradications were completed on most of these islands in subsequent years.

9.2 Reasons why eradications fail

9.2.1.1 There are two main ways in which an eradication programme may fail; (1) operational failure whereby the scheme failed to fully eradicate the target species enabling some to survive and repopulate or (2) where operations were initially successful however there was subsequent reinvasion and repopulation of the target species. The latter is associated with the success of biosecurity measures (Harris *et al.*, 2012; Russell *et al.*, 2008a).

9.2.1.2 Failure due to the incomplete removal of the invasive species may be due to the inadequate

availability of bait, either owing to insufficient access to bait due to low application rates, operational deficiencies that resulted in poor bait distribution (e.g., equipment failure) or biological factors such as rodents only foraging in areas that are un-baited (Holmes *et al.*, 2015). Inadequate trapping of mink is demonstrated in the Western Isles eradication programme. Due to the lack of traps (approximately 100 in total) mink were not removed and breeding populations became re-established on the southern island group (North Uist and Benbecula) (Harrington *et al.*, 1999).

9.2.1.3 On a global scale, eradication projects that failed were most strongly associated with higher mean annual temperature, increase in island size and presence of agriculture (Holmes *et al.*, 2015). The method used for eradication also impacted the likelihood of success with ground-based operations more likely to fail than aerial. Factors that did not influence the success or failure of a project were whether a secondary eradication method was used, human habitation and use of application exclusion zones (i.e., areas excluded due to sensitivity risk) (Holmes *et al.*, 2015).

9.2.1.4 Eradication failure may also be attributed to the reinvasion of the target species from neighbouring areas, adjacent islands or migration from mainland area (Abdelkrim *et al.*, 2007; Russell *et al.*, 2010; King *et al.*, 2011; Klima and Travis, 2012). This may be via natural reinvasion such as species swimming between areas or human induced such as carrying species across on vessels. Therefore in areas where reinvasion through close proximity, predator control will be enforced rather that one 100% eradication event.

9.2.1.5 Early rat eradication schemes in the UK occurred at Inchgarvie, Ailsa Craig, Handa Island and Puffin Island between 1968 and 1998 (Stoneman and Zonfrillo, 2005). All of these used ground-based methods, however focused on applying bait to specific habitats and locations as opposed to using a systematic grid pattern (Stoneman & Zonfrillo, 2005). This method made it difficult to monitor bait consumption by species and in all cases, monitoring was limited or non-existent. In 2012 rats reinvaded Handa Island (Thomas *et al.*, 2017a) and sightings of rats have been recorded at Inchgarvie since it was declared rat-free.

9.2.1.6 With many projects it is unknown whether eradication failure is due to reinvasion or the failure to fully eradicate all target species. On Bauza island, New Zealand it is unknown whether stoats were ever fully eradicated or whether they recolonised from Secretary Island, only 200m away, as the longest period during which no stoats had been caught was only 2.5 years (Elliot *et al.*, 2010). In August 2011 rat eradication occurred on Henderson Island, South Pacific, however in March 2012 one individual was observed and subsequently the population has recovered (Amos *et al.*, 2016). It was unknown whether this was due to reintroduction or operation failure therefore genetic analysis was conducted on samples from rats caught on the island pre- and post-eradication. Results indicated a bottleneck in diversity suggesting that rats had recovered due to the operation failure of removing all individuals during the eradication process (Amos *et al.*, 2016).

9.2.1.7 Previous eradication projects have also considered the genetic resistance of rats to various types of rodenticides. DNA samples from rat tissues were obtained prior to the Shiants eradication project to show that black rats had not developed resistance (LIFE, 2018).

9.2.1.8 Overall a relatively small number of islands have failed in initial eradications. This has largely been due to a small number of factors which could have been avoided if a more detailed monitoring and biosecurity approach was employed. Sections 7 and Section 8 of this report

highlight necessary implementation, monitoring and biosecurity that have been developed and utilised by more recent eradication programmes, which if followed by future eradication programmes will significantly reduce the chances of failure.

9.3 Potential unintended consequences of eradication schemes

9.3.1.1 Eradication and/ or control schemes have the ability to impact other non-target species. Both primary (direct consumption) and secondary poisoning (consuming a poisoned rodent) can occur from rodenticide use. Significant effort should be made to minimize losses to non-target through correct precautions.

9.3.1.2 In many island situations, the risks to non-target mammals from primary and secondary poisoning use are non-existent or very low because few, if any, native terrestrial mammal species occur on many of those islands. However, birds (particularly corvids and raptors) can be particularly sensitive to poisoning during eradication and/ or control programmes. The Shiant Isles took extra precautions during the eradication scheme by setting up diversionary feeding for white-tailed eagle which nested on the island. Similarly, at Canna adaptions needed to be made to the bait stations to prevent access to bait by corvids, e.g. through corvid proof lids.

9.3.1.3 Luxmoore *et al.,* (2019) found that rabbit populations have increased on both Canna and Sanday islands, thought to be attributed to the absence of rats following the eradication project. Rabbits reached an estimated 15,500 animals in 2013 and were causing considerable damage through grazing, erosion, and disturbance of archaeological remains. An intensive control programme has brought the rabbit population under control at the islands.

9.3.1.4 Alongside potential implications for non-target species, the eradication and/ or control may not produce the expected population response from the beneficiary species. For seabirds in general, there may be various reasons underpinning the reduced increases in recovery of relevant species populations. Productivity is largely driven by prey availability and is therefore dependent on the state of the marine ecosystem surrounding the colony (Thomas *et al.*, 2017a). The removal of a land-based predator may only provide a benefit where prey availability (and potentially other factors such as habitat availability) are not a limiting factor. This therefore promotes the importance of consideration of other factors when short-listing potential suitable locations for predator eradication and/ or control programmes. It is also important that monitoring is cognisant of this, by structuring a multi colony monitoring approach to account for multiple variables.

9.3.1.5 The presence of seabirds on islands, even in significantly reduced numbers, may be an important factor facilitating recovery as most seabirds (particularly guillemot and razorbill) are philopatric and therefore attract other birds to the breeding colony (Thomas *et al.*, 2017a). Once a species has been lost entirely, such as the numerous cases of Manx shearwater and European storm petrel, it is likely that recolonisation will take longer or be overall less certain (Thomas *et al.*, 2017a).

9.3.1.6 Eradication and/ or control schemes may also have positive impacts to other flora and fauna. A far wider number of species have benefited from such eradication schemes including other birds such as waders and passerines, and small mammals, amphibians, reptiles, invertebrates and plants (Thomas *et al.*, 2017a).

10 Proposed implementation

10.1.1.1 The primary aim of the scheme is to completely remove the target species from the chosen area as, in theory, one single pregnant female of the invasive animal could repopulate the area within a short space of time. Two years intensive monitoring for the presence of the eradicated animal is required in order to receive the invasive-free status (Nathan *et al.*, 2015; Russell *et al.*, 2017). For example, this was the process taken for the eradication of rats on Canna and Sanday under contract by Wildlife Management International Ltd, starting in late 2005. By February 2006 the last rat sign was detected, and after a two-year period of intensive monitoring, the island was declared rat-free in 2008 (see Bell, *et al.*, 2011).

10.1.1.2 Consequently, any eradication programme needs to be coupled with adequate biosecurity protocols to prevent the reinvasion or new invasion of an invasive species. It is vital that a set of biosecurity measures are installed to sustain the subsequent population response of breeding seabirds. Note that predator control would aim to maintain a reduced population of predators rather than keep the island completely predator free.

10.2 Summary of proposed implementation criteria

10.2.1.1 As a result of the key considerations given above, a summary of implementation considerations for an eradication programme is:

- Target predator species free status following two years of intensive post-eradication monitoring (Nathan *et al.*, 2015; Russell *et al.*, 2017; Bell *et al.*, 2019);
- Implementation of adequate biosecurity measures; and
- Seabird monitoring of the following[4];
    - Breeding success;
    - Productivity rates;
    - Breeding population; and
    - Distribution of breeding birds.

10.2.1.2 Note that control would not maintain predator free status (due to re-infestation), but instead aim to maintain a reduced population.

11 Summary of evidence

11.1.1.1 The above sections of this report describe the evidence in support of the eradication and/ or control of invasive mammalian predators to benefit guillemot and razorbill at breeding locations. From the evidence presented, it is apparent that a number of positive changes are likely to occur at guillemot and razorbill colonies following the eradication and/ or control of invasive predators. The preceding sections also discuss approaches to site feasibility assessment, multi-stage monitoring of and the implementation of bio-security measures to prevent the re-colonisations of invasive predators. These are all discussed in terms of implementation for Hornsea Project Four if compensation is required.

11.1.1.2 Work has already been undertaken by the Applicant to determine the potential location(s)

[4] Noting that changes in populations and productivity must be considered in the context of natural variation. Any long-term challenges to the effectiveness of predator eradication relating to prey resource should be viewed in a region/national specific context and in consideration of natural variability and climate change.

where a predator eradication and/ or control project could be undertaken, if deemed necessary by the Secretary of State. Potential locations are presented in Section 12 and the relevant roadmap documents (**B2.8.4 Compensation measures for FFC SPA: Predator Eradication: Roadmap**) which also set out the proposed further evidence gathering process for this measure.

11.1.1.3 The remaining sections of this report present the calculations and approach to determining the size of the compensatory population that is required to compensate for the annual loss of the predicted mortality of guillemot and razorbill from FFC SPA due to displacement from Hornsea Four.

12 Identification of potential colony locations

12.1.1.1 This section of the document has been prepared in support of the Hornsea Four's process to identify potential compensation measures for guillemot and razorbill. Appendix 1 of the Evidence Review (Appendix 1 – Guillemot & Razorbill – Potential predator eradication scheme locations (GoBe 2021b)) documented a long-listing exercise containing UK breeding seabird colonies where guillemot and/ or razorbill are present. The aim of the exercise was to provide an overview of the current knowledge base with regard to evidence of predator and auk breeding location overlap, and factors which may influence the likelihood of a predation pressure for each species.

12.1.1.2 The aim of this section is to undertake a short-listing exercise from the initial long-list of guillemot and razorbill breeding sites (Appendix 1 – Guillemot & Razorbill – Potential predator eradication scheme locations) (GoBe 2021b) in order to identify any potential sites that can be taken forward for predator eradication and/ or control in the UK and species biogeographic region.

12.2 Summary of the long-listing

12.2.1.1 Appendix 1 of the Evidence Review – *Guillemot & Razorbill – Potential predator eradication scheme locations* (GoBe 2021b) presented an initial long-list of main guillemot and razorbill colonies or islands/ areas in the UK containing multiple colonies based on those provided in Mitchell *et al.,* (2004) and colonies listed in the Seabird Monitoring Programme (JNCC, 2020d). For each area or colony, a literature search was then undertaken to identify if those colonies listed in the initial step which may host a mammalian predator. Avian predators were not included in this process unless explicitly stated as being an influencing factor at a particular location, due to the prevalence of avian predators at most UK breeding colonies.

12.2.1.2 Additional information which may assist determination of suitable candidate colonies was also sought, where possible. This included for example, predator species present, nesting habitat of auks (i.e., boulder nesting, cliff nesting), species population estimates, area of land (if an island), human population (and therefore potential biosecurity risks), along with a brief site description. Further information on how the exercise was undertaken can be found in Appendix 1 of the Evidence Review (*Appendix 1 – Guillemot & Razorbill – Potential predator eradication scheme locations* (GoBe 2021b)) along with the initial list of colonies.

12.2.1.3 In summary, 95 initial locations with guillemot and or razorbill colonies were identified within the UK (taken from Mitchell *et al.*, 2004 and the Seabird Monitoring Programme database), including sites with no known predators. This included 68 sites in Scotland, 10 sites in

England, 13 sites in Wales and 4 sites in Northern Ireland. Although not all locations will be suitable for eradication and/ or control programmes (i.e. some may lack predators at present, or lack of details means site cannot be ruled out) it provided an initial foundation of evidence for which short-listing of potential sites could be undertaken.

12.2.1.4 Some information, particularly details on the structure of nesting colonies was difficult to locate in the public domain. Where this was the case, site managers were contacted, with information received being incorporated into the short-listing summary below.

12.3 Short-listing

12.3.1 Methods

12.3.1.1 Short-listing was undertaken on the initial long-list of guillemot and razorbill breeding sites identified in Evidence Review *Appendix 1 – Guillemot & Razorbill – Potential predator eradication scheme locations* (GoBe 2021b) to identify any sites where predator eradication and/ or control may be feasible. The short-listing process was undertaken using the information gathered from conservation management reports, literature research and contacting site wardens, estate managers and organisations, when possible. Furthermore, other information sources such as eradication scheme literature and site specific seabird survey reports were also used in order to discount locations where eradication efforts were unlikely to be implemented effectively.

12.3.2 Results

12.3.2.1 In February 2021, Hornsea Four decided to no longer pursue predator eradication and/ or control in Scotland and therefore no Scottish sites were progressed past this short-listing exercise. This decision was made by the project on the basis on the lack of support from Scottish government stakeholders. Furthermore, mainland based colonies were deemed unfeasible due to a lack of information on predation pressure at mainland colonies and based on the widespread prevalence of invasive species on Mainland UK. This, therefore, left a remaining total of 25 sites (27 islands) from the original 95 sites in the long-list, in England, Wales and Northern Ireland. Each of these sites were considered and a decision was taken for each site on an individual basis as to the potential for predator eradication and/ or control and whether the site should be progressed further.

12.3.2.2 In the original short listing, results found that none of the sites identified in the UK long-listing are suitable for predator eradication and/ or control in order to compensate for guillemot and razorbill. The reasons as to why differed between location, these reasons are presented for each site in **Table 9**. A summary of the reasons is provided below:

- Predator eradication programme already undertaken, therefore mammalian predators do not impose risk to guillemot and razorbill;
- A predator eradication programme is already planned which has EU LIFE funding (and therefore can't be funded by the Applicant). Based on EU LIFE funding guidelines, funding cannot be used for compensation projects;
- Large human population on the island which lessens the likelihood of a successful eradication programme (Stanbury *et al.*, 2017); and
- Predators not being present on the island or mammalian predators are not considered to be a limit on the populations or guillemot or razorbill.

12.3.2.3 Since the original screening, new information has identified a number of sites where it may be feasible to undertake predator eradication and/ or control in the UK including islands /islets on the Isles of Scilly, Rathlin Island and several islands/ islets along the south coast of England. The Channel Islands which are British Crown Dependencies have also now been considered, and the Applicant is confident that the Channel Islands (excluding Jersey) can meet the required criteria to be delivered and secured. Consideration of these sites can be found in Table 9.

Table 9: The results of short-listing exercise for potential mammalian predator eradication and/ or control programme for sites in the UK with breeding guillemot and razorbill populations.

Site	Decision as to whether site should be progressed further	Rationale
SCOTLAND		
All identified sites	Not progressed	The Applicant has decided to no longer pursue predator eradication and/ or control in Scotland. This decision was made by the project on the basis on the lack of support from Scottish government stakeholders.
MAINLAND UK (ENGLAND, WALES, NORTHERN IRELAND) SITES		
All identified sites	Not progressed	Lack of information on predation pressure based on the widespread prevalence of invasive species on Mainland UK.
ENGLAND		
Lundy	Not progressed	Predator eradication programme completed in 2002-2004 (Genovesi and Carnevali, 2011).
Isle of Wight	Not progressed	Human population size is a key limiting factor for eradication feasibility. Rat and other small invasive mammalian predator eradication is deemed feasible if <1,000 humans inhabit an island and if island size is equal or smaller than the largest island where eradication of the species has been accomplished to date (Island Conservation, 2012; Dawson *et al.,* 2015). Therefore, Stanbury *et al.*, (2017) deems it feasible to eradicate rats at islands smaller than 12,873ha. The Isle of Wight is 38,410ha and has a human population size of approximately 140,000, therefore it seems unlikely that a successful and economically viable invasive mammalian eradication will be possible here.
Brownsman and Staple, Farne Islands	Not progressed	There are no non-native predators present on the Farne Islands. The island is deemed at risk to introduction of invasive species by shipwrecks, however the Farne Islands are part of the Biosecurity for LIFE project, therefore these islands are not feasible for mammalian predator eradication programmes (Biosecurity for LIFE).
Isles of Scilly – Multiple Islands*	**Progressed**	**Islands in the archipelago are known to historically or currently support guillemot and razorbill, and populations of rats (and other invasive predators). There is some evidence that much larger populations of guillemot nested here until the late nineteenth century (Clark & Rodd, 1906) and razorbill in much larger numbers in the late nineteenth century and early twentieth century but declined thereafter (Heaney *et al.*, 2008).**
English South Coast – Multiple Islands*	**Progressed**	**Islands along the English south coast are known to historically or currently support guillemot and razorbill, and populations of rats (and other invasive predators).**
NORTHERN IRELAND		
Sheep Island	Not progressed	Sheep Island SPA conservation objectives indicates that rats are present on the island. There is currently a stable population of

Site	Decision as to whether site should be progressed further	Rationale
		guillemot and razorbill on the island (SMP database). Sheep Island, along with four other sites in Northern Ireland that are engaging with the RSPB as part of the Biosecurity for LIFE programme (Allen *et al.*, 2020).
Rathlin Island*	**Progressed**	**LIFE funding for predator eradication has not yet been secured for this location.**
Muck Island, Co Antrim	Not progressed	Information from Ulster Wildlife Nature Reserves Manager shows that annual rat eradications are already undertaken as part of site management plans (*Pers comm, A Crory, 20 January 2021*).
WALES		
Bardsey Island	Not progressed	Listed for biosecurity measures for rats, therefore implying no rats are currently present on the island (Stanbury *et al.*, 2017).
Puffin Island	Not progressed	A rat eradication programme commenced in 1998 undertaken by the Countryside Council for Wales (Genovesi and Carnevali, 2011).
Middle Mouse	Not progressed	No evidence of rats present on the island. Guillemot population increase from 2,464 IND in 2002 to 5,550 in 2016. Razorbill population increase from 90 IND in 2002 to 455 in 2016. Significant population increases mean that if mammalian predators are present, then a population level impact is unlikely.
Ramsey Island	Not progressed	Brown rat and feral cat eradication in 1999/2000 (DIISE, 2018; Bell, 2019).
Bishops and Clerks Island	Not progressed	Information from RSPB shows that no invasive mammalian predators are present on this island (*Pers comm, Andrew Dodd*).
Grassholm	Not progressed	Information from RSPB shows that no invasive mammalian predators are present on this island (*Pers comm, Andrew Dodd*).
Skomer	Not progressed	The Wildlife Trust of South and West Wales state there are no significant ground predators present on Skomer (such as large mammalian predators or snakes) (The Wildlife Trust of South and West Wales).
Skokholm	Not progressed	The Wildlife Trust of South and West Wales state there are no significant ground predators present on Skokholm (such as large mammalian predators or snakes) (The Wildlife Trust of South and West Wales).
Cardigan Island	Not progressed	Brown rat eradication in 1968 (Genovesi and Carnevali, 2011; DIISE, 2018).
Middleholm	Not progressed	Information given from Nature Conservation Advisor of the National Trust shows there are no mammalian ground predators present on the island with access to the island being very limited (*Pers comm, L MacLean 18 February 2021*).
Worms Head	Not progressed	No known rat populations on Worms Head. Guillemot and razorbill ledges are on the shear-cliff face and difficult to access, there are no suitable boulders, therefore unlikely to be predated on my mammalian predators if present on the island.
St Tudwal's Islands East and West	Not progressed	St Tudwal's Island West rat eradication has already been undertaken. St Tudwal's Island East guillemot populations have increased from 728 individuals in 2013 to 1,139 in 2016 and razorbills from 28 individuals in 2013 to 66 in 2016. Significant population increases mean that if mammalian predators are present, then a population level impact is unlikely.
St Margaret's Island	Not progressed	Information from estate manager indicates that rat eradication has already occurred at St Margaret's Island and there are no other non-native mammalian predators are present (*Pers comm, B Childs, 07 January 2021*).
Caldey Island	Not progressed	Information from estate manager indicates that rat eradication has already occurred at Caldey Island and there are no other non-native mammalian predators are present (*Pers comm, B Childs, 07 January 2021*).
Channel Islands		

Site	Decision as to whether site should be progressed further	Rationale
Herm *et al.*, Sark and Alderney*	**Progressed**	**Herm, Channel Islands was identified as having potential for rat eradication by Stanbury *et al.* (2017). The island was identified as one of the top 25 islands prioritised for invasive alien vertebrate eradication in the UK for benefit to seabird species. The island supports populations of both breeding guillemot and razorbill while also having the confirmed presence of black rat, brown rat and wood mouse and probable presence of feral cat, house mouse and European rabbit on the island (Stanbury *et al.*, 2017). The archipelago is also located in proximity to UK breeding guillemot and razorbill colonies. Initial discussions are also being undertaken with site managers at other locations within the Channel Islands (i.e., Alderney, but excluding Jersey) regarding potential impacts from rats at guillemot and razorbill colonies. Further information is being sought from government and site managers on details in relation to feasibility, scale of guillemot and razorbill population, evidence of rat (and other invasive) species and potential recovery following eradication efforts to breeding guillemot, razorbill and other seabirds. It is important to note that indication has been received from site managers and the RSPB that other islands surrounding many islands within the Channel Islands also support both guillemot, razorbill and invasive species. Furthermore, due to the location of the islands, the biogeographic populations of guillemot and razorbill here are the *albionis* and *islandica*, respectively, which is the same as those populations found in southern UK including FFC SPA. Therefore, these additional islands will be included in further investigations.**

* Sites now considered for predator eradication due to further information provided by organisations.

12.4 Conclusion

12.4.1.1 Based on the site selection process outlined above, a number of potential locations which support populations of guillemot and/ or razorbill colonies, rats (brown and/or black rats[5]) and where a predator eradication and/ or control scheme is potentially feasible have been highlighted for further consideration. These are[6]:

- Bailiwick of Guernsey:
  - Alderney: A number of islands/ islets around the main island;
  - Herm: Including Herm, The Humps and Jethou; and
  - Sark: A number of islands/ islets around the main island.
- Isles of Scilly: A number of Islands/ islets;
- Rathlin Island; and
- Several islands/ islets along the south coast of England

12.4.1.2 The anticipated next steps of the site refinement process are detailed in the Guillemot and Razorbill Compensation Plan (**B2.8: FFC SPA: Razorbill and Guillemot Compensation Plan**).

[5] Presence of black rats has been confirmed at least two sites currently being considered as potential locations for predator eradication.
[6] Note that exact island names for some locations are not disclosed due to confidentiality/ on-going discussions which are commercially sensitive.

13 Size of compensatory population required

13.1.1.1 The predicted impact for Hornsea Four on the guillemot and razorbill population of the FFC SPA and the relevant breeding population required to provide a comparable number of young that would survive to adulthood to offset the impact of Hornsea Four is presented in presented in **B2.6 RP Volume B2 Chapter 6 Compensation measures for FFC SPA Overview Table 2**. If the aim of compensation is to fully offset this impact, then sufficient increase in breeding pairs is needed to provide a corresponding increase in the population size.

14 Growth rate of new colonies

14.1.1.1 Projecting the growth rate of guillemot and razorbill at a site where predator eradication has occurred is challenging as data on the impacts on these species for such projects is limited. The proposed predator eradication programme has the potential to both increase numbers at existing colonies and also cause the (re-)colonisation of guillemot and razorbill to whole or parts of islands.

14.1.1.2 Rat eradication occurred at Lundy, leading to population increases at guillemot and razorbill colonies (Booker *et al.*, 2018). **Figure 2** shows the population changes over time since 1986 to 2017 at Lundy. Comparing this to UK national population changes for the two species, it is apparent that the growth of colonies at Lundy is occurring at a faster rate than national average since predator eradication in 2002-2004 (**Figure 3**).

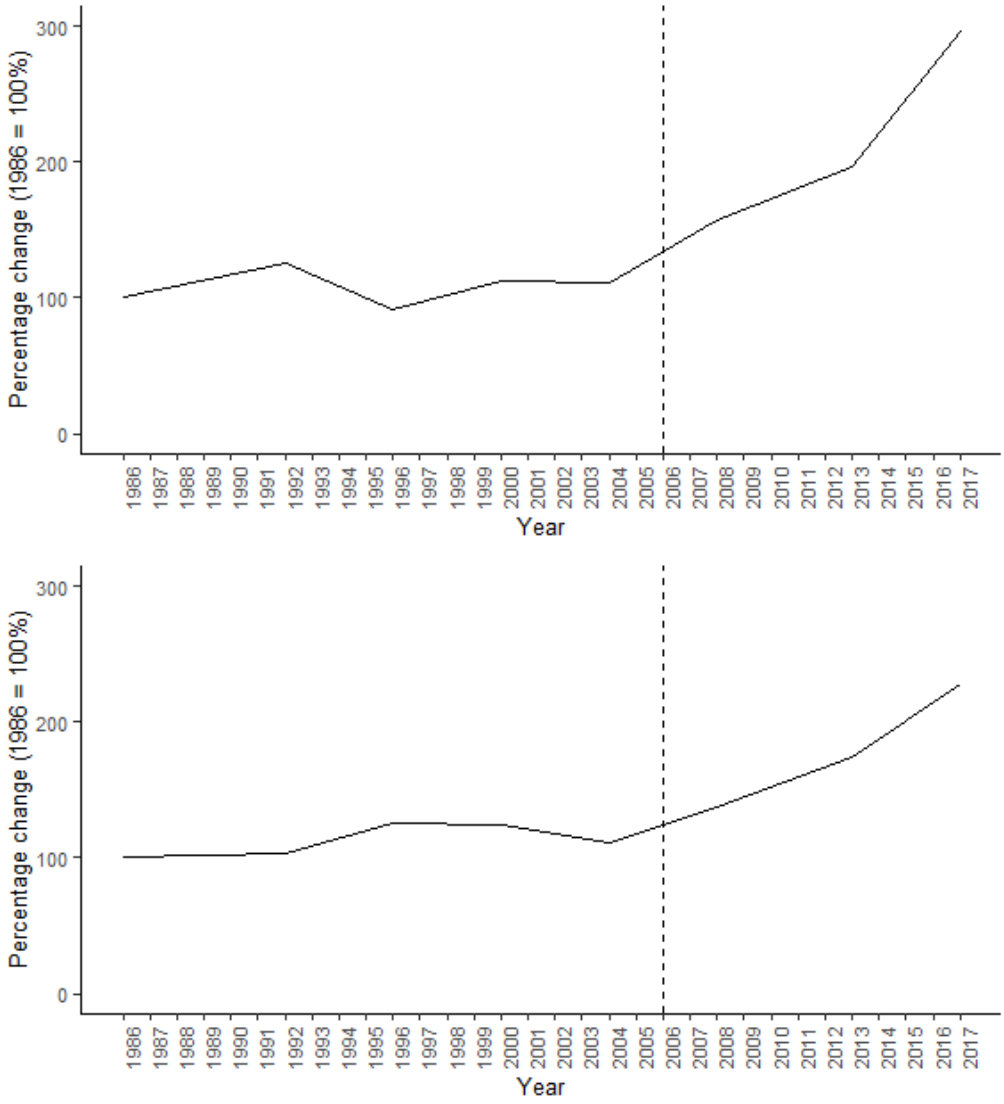

Figure 2: Percentage population change of (top) guillemot and (bottom) razorbill at Lundy 1986-2017 (taken from JNCC, 2020d). Predator eradication occurred 2002-2004 and was declared rat-free in 2006 (as indicated by the dotted line).

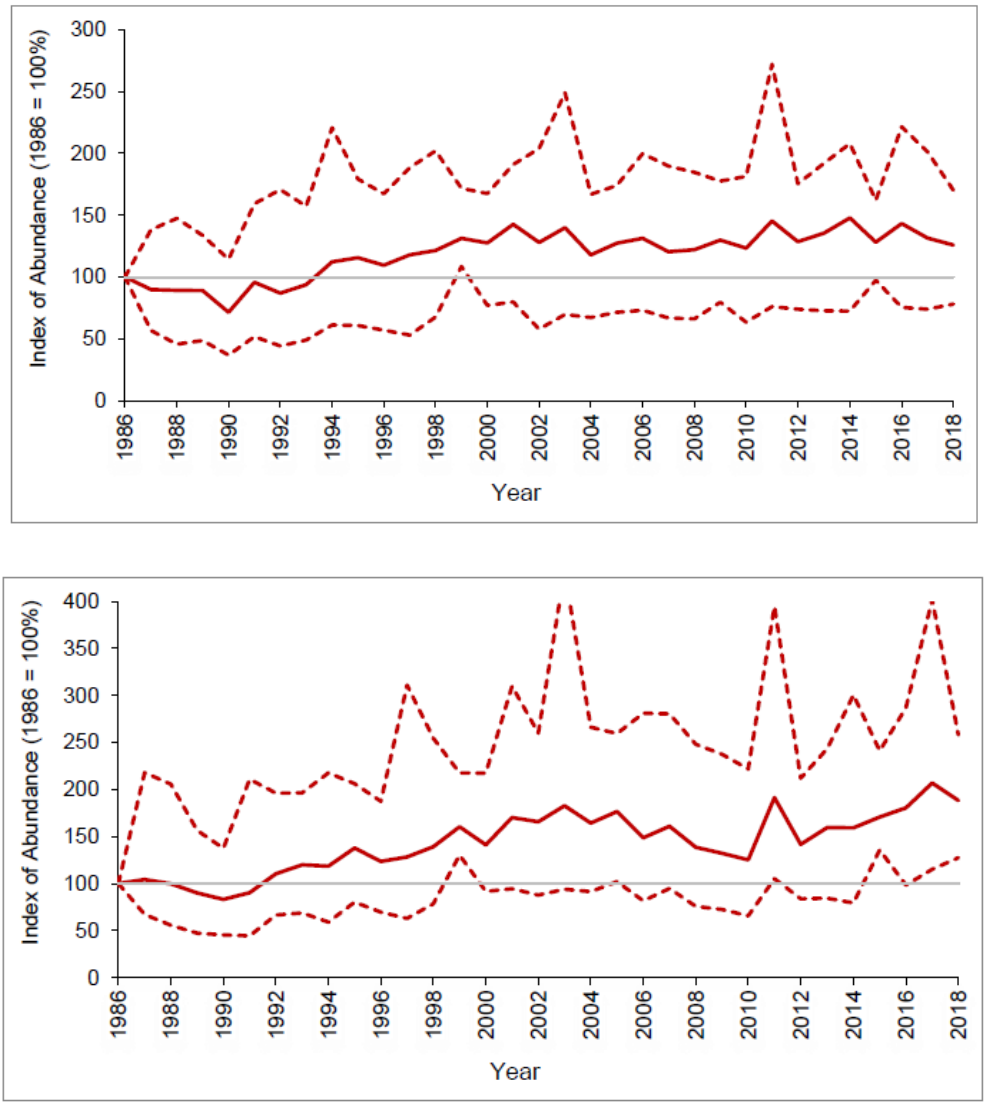

Figure 3: Trend in UK abundance index (solid line) of (top) guillemot and (bottom) razorbill 1986-2018 with 95% confidence limits (dotted lines). Based on SMP data (taken from JNCC, 2020d).

14.1.1.3 Where there are already established populations of guillemot and razorbill, it should therefore be expected that predator eradication will increase guillemot and razorbill numbers at a faster rate than natural fluctuation soon after an eradication programme has been conducted (Booker *et al.*, 2018). Currently there is limited evidence of what is expected to occur long-term, whether populations will continue to increase or become stable and how long this may take, however evidence from Canna and Sanday showed that numbers of razorbill increased rapidly soon after eradication and then became stable, with fluctuations (Swann *et al.*, 2018).

14.1.1.4 Many seabirds including alcids have colonial nesting habits, mate and breeding-site fidelity and colony-site philopatry (Thibault, 1993; Halley *et al.*, 1995; Harris *et al.*, 1996; Gaston and Jones, 1998). As a result of these characteristics, individuals often fail to colonise new habitat or return to former nesting sites after the loss of the colony. For sites where (re-)colonisation of guillemot and razorbill occurs, it is unlikely that these alcids, that will have originated from other colonies, will rapidly re-establish former breeding sites following extirpation of nesting colonies as they tend to either return to breed at their natal colony or

occasionally join other existing colonies (Parker *et al.*, 2007).

14.1.1.5 Guillemots and other alcids have strong philopatry and minimal changes in nesting habitats over time has led to stable locations for colonies, thus new colonies rarely form and abandoned colonies rarely recolonise (Gaston and Jones, 1998; Manuwal and Carter, 2001; Carter, 2004). Recolonisation of sites by guillemots and razorbills is not well studied (Carter *et al.*, 2001; Capitolo *et al.*, 2005), and therefore there is little information on colony formation or recolonisation of these species.

14.1.1.6 However, some examples have shown that the use of social attraction techniques in Central California previously occupied by guillemot rapidly increased their breeding response. The initial recolonisation event alongside further restoration efforts prompted further colony growth to 190 pairs within 10 years from the initial use of social attractants (Parker *et al.*, 2007).

14.1.1.7 (Re-)colonisation post-eradication has been recorded to occur such as razorbill in Finland. Razorbill were already extinct in one of the removal areas pre-eradication, however it was recorded that they had returned to breed in the area post-eradication (Nordstrom *et al.*, 2003), although only in small numbers. As well as at Lundy it was reported by Booker *et al.* (2018) that guillemot and razorbill were exploiting previously unoccupied areas of broken ground post-eradication that were previously occupied by rats. Therefore, where predator eradication occurs, there may be the (re-)colonisation of guillemot and razorbill where there is suitable habitat.

14.1.1.8 Colony growth rates are also dependent on availability of food resources. The availability of food resources in an area can be implied by proxy by choosing a location near an existing colony with good productivity rates.

15 Seabird monitoring of the effectiveness of the compensatory measure

15.1.1.1 The implementation of both the eradication of invasive species and subsequent biosecurity measures, as well as the recovery of breeding birds and increases inbreeding success, would need to be monitored through observations. The methodology used for seabird monitoring should follow that of Walsh *et al.* (1995) as specified by JNCC's Seabird Monitoring Programme. This is consistent and therefore comparable to on-going monitoring at existing colonies in the UK. The monitoring should comprise whole colony counts and productivity monitoring.

15.1.1.2 Where applicable, it may be appropriate to monitor adjacent colonies as well as target island(s) in order to establish whether trends at island(s) where predator eradication is being undertaken are location or regional specific. In this instance, monitoring should be undertaken before predator eradication is undertaken on the target island as well as surrounding colonies, as this will provide better understanding of guillemot and razorbill population changes e.g., whether this is due to the eradication project or other external factors.

15.2 Whole colony counts/ population monitoring

15.2.1.1 Guillemot breed at high densities and do not build nests, therefore it is difficult to quantify their populations accurately and identifying individual breeding attempts is not practical for

whole colonies of any size. Currently, the most suitable technique for quantifying guillemot populations for monitoring purposes is based on counts of individuals in randomised study-plots (Harris *et al.*, 1983). Where possible, guillemot counts should be conducted 5-10 days in the first three weeks of June (incubation/early nesting period), between 0800 and 1600 BST. Counts in late May or late June are acceptable if counts are not available for the optimal period. Counts in July are not recommended as numbers decline rapidly after chicks begin to fledge. The count unit for guillemot is individual adult on land as counts of breeding pairs are virtually impossible without highly intensive observations of mapped study-plots (Walsh *et al.*, 1995).

15.2.1.2 Whole-colony counts for razorbill usually rely on counts of individuals at cliff sites, and estimates or corrected counts of individuals in boulder colonies. The ease with which razorbill colonies can be counted varies according to the type of nest-sites in use. Monitoring counts follow the established practice for guillemots and rely on repeat counts of individuals in randomly selected study-plots. Counts should be done between 0800 and 1600 BST on 5-10 days in the first three weeks of June. Counts should be spaced out within the sampling period and all plots counted on each date. The count unit for razorbill is individual adult on land as counts of apparently occupied sites are often difficult to define unambiguously (Walsh *et al.*, 1995).

15.3 Productivity monitoring

15.3.1.1 For guillemot, photographs of randomly selected study-plots should be taken when birds appear to be incubating. At least three visits should be made late in the incubation period or early in the chick-rearing-period until most occupied sites have been found. The positions of all active sites should be recorded. Active sites should be numbered and contents should be recorded every 1-2 days adding new active sites as necessary. Any young that disappear when aged 15 days or older can be considered as having been reared successfully. Further information can be found in Walsh *et al.* (1995).

15.3.1.2 Razorbills may breed in large numbers either on open cliffs or among boulders or scree, therefore no uniform method of productivity monitoring is appropriate for the species. Methods have been adapted from those used for guillemot and puffins (Harris, 1989). It is important to monitor all major types of breeding site used by a colony, as productivity may vary between the types (Hudson, 1982). The methods used for each type of breeding site are as follows:

- (1) for use at plots on open cliffs, this method is similar to that used for guillemot;
- (2) for use in areas where the site cannot be observed directly and involves examination of sites at least twice in the breeding season; or
- (3) for nests where direct observation cannot occur a more labour-intensive but less intrusive method can be used. These are outlined further in Walsh *et al.* (1995).

16 Conclusion

16.1.1.1 Based upon this review of literature, predator eradication and/ or control programmes offer the opportunity to benefit guillemot and razorbill at UK islands / the Channel Islands (excluding Jersey). Pre- and post-monitoring reports from the case studies presented in this report, noting that the aims of previous eradication projects often were not targeted at guillemot and razorbill, have shown that the eradication of mammalian predators has

benefited both of these species through increases in productivity, nesting populations and recolonisation/ colonisation of new areas previously occupied by invasive species. Predator eradication and/ or control in appropriate locations is therefore a feasible and evidenced compensatory measure for guillemot and razorbill.

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Appendix A – Long List

1 Introduction

1.1.1.1 One of the compensation measures being proposed by the Applicant to compensate for potential impacts on guillemot and razorbill (auks) is implementation of a predator eradication and/ or control programme. The Applicant has undertaken work over the last 12 months to identify the best location(s) for such a programme. This Appendix (Appendix 1) presents the initial long listing of the main UK and Channel Islands breeding seabird colonies where guillemot and razorbill are present, with a particular focus on island colonies in support of the **Annex 2.8.4 to the GGRCP Gannet, Guillemot and Razorbill Predator Eradication: Ecological Evidence**. The aim of the exercise was to identify potential locations for predator eradication and/ or control by providing an overview of the current knowledge base with regard to evidence of predator and auks location overlap, and factors which may influence the likelihood of a predation pressure for each species.

2 Method

2.1.1.1 This report presents an initial long list of main guillemot and razorbill colonies or islands/ areas containing multiple colonies based on those provided in Mitchell *et al.*, (2004) and colonies listed in the Seabird Monitoring Programme. It is important to note that not all existing colonies have been included in this list (for example the long list currently only includes sites where both guillemot and razorbill nest and do not include sites with small or historic populations). These may be explored if deemed suitable at a later stage.

2.1.1.2 These locations are presented in in Table A 1. They have been presented and discussed with stakeholders during compensation workshops during development of Hornsea Four. It is noteworthy that some sites have been added to the long list during development of the project, as information has come to light on the potential feasibility of predator eradication and/ or control schemes in certain locations.

2.1.1.3 For each area or colony, a literature search was undertaken and where possible, wardens/ site manages/ site owners were contacted, to identify if those colonies listed host a mammalian predator. This was based primarily on either confirmed records from wardens/ site manages/ site owners or confirmed records noted in the National Biodiversity Network (NBN) Atlas (https://www.nbnatlas.org/). Predators assessed include brown rat, black rat, ferret, polecat, polecat/ferret, European otter, American mink, feral cat, cat, wild cat hybrid. An asterisk in Table A 1(*) denotes the predator is recorded outside the site itself but within a denominal distance of ~5km (for all species).

2.1.1.4 The focus of this review was on mammalian predators and not avian predators, unless explicitly stated as being an influencing factor at a particular location, due the prevalence of avian predators at most UK breeding colonies.

2.1.1.5 Additional information which may assist determination of suitable candidate colonies has also been provided, where available. This includes for example, predator species present, nesting habitat of auks (i.e., boulder nesting, cliff nesting), species population estimates, area of land (if island), human population (and therefore potential biosecurity risks), along with a brief site description. Some information, particularly details on the structure of nesting

colonies was difficult to locate in the public domain. Where this was the case, site managers have been contacted and all information received has also been incorporated Table A 1.

2.1.1.6 A link to site management has also been provided, where available. As the majority of SPAs do not have an SPA specific management plan, information has been gleaned from overlapping Sites of Special Scientific Interest (SSSI) and National Nature Reserve (NNR) site management plans.

3 Results

3.1.1.1 In summary, 101 initial main areas with guillemot and or razorbill colonies have been identified within the UK and the Channel Islands (taken from Mitchell *et al.*, 2004 and the Seabird Monitoring Programme database), including sites with no known predators. Although not all locations will be suitable for eradication and/ or control programmes (i.e., some may lack predators at present, or a lack of details means site cannot be ruled out) it provides an initial foundation of evidence for which shortlisting of potential sites can be undertaken.

Table A 1: Overview of main guillemot and razorbill colony locations within the UK and the Channel Islands.

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
MAINLAND UK – England								
Flamborough Head and Bempton Cliffs, Northeast Coast	Flamborough and Filey Coast SPA	Whole SPA = 7857.99 ha	-	Guillemot: 84,647 IND (2017) Razorbill: 27,967 IND (2017) (JNCC 2020a; JNCC 2020b)	Gannet, kittiwake, razorbill, guillemot, fulmar, puffin and herring gull	NBN - Stoat Feral ferret* Polecat* Brown rat	There are two sections – Flamborough in the south and Filey in the north – both encompassing clifftop, sea cliff and intertidal rock habitats and offshore to 2km and extends inland. Largest mainland seabird colony in England with largest guillemot colony in England. The colonies are situated along the cliffs on the southern and northern sides of Filey Bay and the north and south sides of Flamborough Head, supporting over 200,000 seabirds in the breeding season. The sheer cliffs provide nesting sites and act as a deterrent to mammalian predators.	Not included as FFC SPA identified by SNCBs as not having predation issue.
St Bees Head, Northwest Coast	St Bees Head RSPB	-	-	Guillemot: 12,250 IND (2020) Razorbill: 146 IND (2020) (JNCC, 2020c database)	Fulmar, kittiwake, guillemot, razorbill, herring gull, cormorant	NBN - European otter Stoat Polecat / ferret Brown rat*	No further information received	No further information received
MAINLAND UK – Scotland								
St Abb's Head, Southeast Coast	St Abb's Head to Fast Castle SPA and NNR	Whole SPA = 1,736.75 ha (10.9% of which is land)	-	Guillemot: 42,905 IND (2018) Razorbill: 2,683 IND (2018) (JNCC 2020a; JNCC 2020b)	Herring gull, kittiwake, razorbill, guillemot, shag	NBN - None	No further information received	Part of the site forms a National Nature Reserve and is managed for nature conservation (and for recreational enjoyment) by the National Trust for Scotland. Management is agreed through a Management Plan which is approved by the National Trust for Scotland (NTS), Scottish Natural Heritage and the Scottish Wildlife Trust. This Plan could not be located. However, Management Actions for the site are listed by the NTS **here**. Predator control is not listed.
Buchan Ness to Collieston, East Coast	Buchan Ness to Collieston Coast SPA	Whole SPA = 5,400.76 ha (2.9% of which is land)	-	Guillemot: 29,187 IND (2019) Razorbill: 165 AON (2019) (JNCC, 2020c database)	Fulmar, herring gull, kittiwake, guillemot, razorbill, shag	NBN - Otter Stoat Feral ferret* Brown rat	No further information received	No management plan located. However, a Site Management Statement for Bullers of Buchan Coast SSSI (mentions the SPA) is located **here**.
Troup, Pennan and Lions Head	Troup, Pennan and Lions Head SPA	Whole SPA = 3,365.2 ha (3.5% of which is land)	-	Guillemot: 23,626 IND (2017) Razorbill: 4,422 IND (2017)	Guillemot, razorbill, fulmar, herring gull, kittiwake	NBN – European otter* American mink	The site is a 9km coastal stretch of sea cliffs along the Aberdeenshire coast with cliffs supporting large colonies of breeding seabirds.	No further information received

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				(JNCC 2020a; JNCC 2020b)				
Fowlsheugh	Fowlsheugh SPA	Whole SPA = 1,303.23 ha (0.6% of which is land)	-	Guillemot: 69,828 IND (2018) Razorbill: 14,063 IND (2018) (JNCC 2020a; JNCC 2020b)	Guillemot, razorbill, kittiwake, fulmar, herring gull	NBN – European otter American mink* Stoat Ferall ferret* Polecat* Brown rat*	No further information received	Fowlsheugh SSSI site management plan can be found at Site Management Statement (snh.gov.uk)
North Caithness Cliffs	North Caithness Cliffs SPA	Whole SPA = 14,628.79 ha (3.6% of which is land)	-	-	Fulmar, kittiwake, puffin, razorbill, guillemot	NBN – Cat American mink* Stoat Ferall ferret Polecat Brown rat	No further information received	No further information received
East Caithness Cliffs	East Caithness Cliffs SPA	Whole SPA = 11,696.38ha (2.8% of which is land)	-	-	Cormorant, fulmar, GBB gull, guillemot, herring gull, kittiwake, razorbill, shag	NBN – Wild cat hybrid Cat European otter Stoat Ferall ferret Polecat* Brown rat	No further information received	No further information received
Cape Wrath, North Coast	Cape Wrath SPA	Whole SPA = 6,734.48 (14.1% of which is land)	-	-	Fulmar, kittiwake, puffin, razorbill, guillemot	NBN - European otter Stoat* Polecat / ferret* Brown rat*	The cliffs support large colonies of breeding seabirds. In the Site Management Statement for Cape Wrath SSSI (SNH, 2010) it is stated in relation to seabird colony that: "The steep cliffs make the nests inaccessible to land-based predators such as foxes whilst the large numbers of wheeling seabirds and the densely packed ledges of birds defending their nests make it difficult for black-backed gulls or skuas to attack eggs or chicks."	No management plan located. However, a Site Management Statement for Cape Wrath SSSI (with overlapping features) is located here.
MAINLAND UK – Northern Ireland								
Gobbins, Northeast Coast	-	-	-	Guillemot: 2,617 IND (2019) Razorbill: 679 IND (2019) (JNCC, 2020c database)	Fulmar, kittiwake, guillemot, razorbill, puffin, shag	NBN - European otter Stoat* Polecat / ferret Brown rat	No further information received	No further information received
UK ISLANDS – Offshore of Scotland Mainland								
Isle of May, east coast	Forth Islands SPA	53	0	Guillemot: 18,705 IND (2018) (JNCC, 2020c database)	Terns, gannet, herring gull, kittiwake, lesser black-backed gull, puffin, razorbill,	NBN - None	The other guillemot colonies part of the Forth Islands SPA are; Bass Rock (2,510), Craigleith (2,530 sea based survey, 307 land based survey), The Lamb (1,970) and Fidra (538), populations given as individuals (2019 from the JNCC, 2020c database).	Management Plans could not be located for: Craigleith or The Lamb which are also both privately owned and are managed by the Scottish Seabird Centre or; Fidra which is owned by and managed by the RSPB.

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				Razorbill: 4,867 IND (2018) (JNCC, 2020c database)	guillemot, cormorant, shag		The other razorbill colonies part of the Firth Islands SPA are; Bass Rock (170), Craigleith (105 sea based survey, 159 land based survey), The Lamb (119) and Fidra (136), populations given as AOS (2019 from the JNCC, 2020c database). The Isle of May is approximately 8km off the coast of mainland Scotland. It is 1.8 km long and <0.5 km wide. The island is owned and managed by NatureScot as a NNR. Isle of May is identified as the 14th ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	The Management Plan for the Isle of May component of the SPA is located here. It states that "The Isle of May is currently free from mammal predators such as rats and mink." The Isle of May SSSI site management plan can be found at Site Management Statement (snh.gov.uk) Bass Rock SSSI site management plan can be found at Site Management Statement (snh.gov.uk) Forth Islands SSSI site management plan can be found at Site Management Statement (snh.gov.uk) The Isle of May NNR management plan can be found at The Management Plan for the Isle of May National Nature ...
Inchkeith Island, Forth Estuary, southeast coast		23	0	Guillemot: 278 IND (2020) Razorbill: 178 IND (2020) (JNCC, 2020c database)	Fulmar, puffin, razorbill, guillemot, lesser black-backed gull, herring gull, great black-backed gull, kittiwake, cormorant, shag	NBN – None Stanbury *et al.*, 2017 - Brown rat, house mouse, European rabbit	Inchkeith island is number 12 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication.	No further information received
Sanda Island, southwest coast	-	127	Yes - unknown	Guillemot: 5,200 IND (2019) Razorbill: 430 IND (2019) (JNCC, 2020c database)	Herring gull, lesser black-backed gull, fulmar, shag, cormorant, GBB gull, puffin, guillemot, razorbill	NBN – None	Sanda Island is a privately owned island in Argyll and Bute.	Sanda Island SSSI site management plans can be found at Site Management Statement (snh.gov.uk)
UK ISLANDS – Orkney Islands, Scotland								
Sule Skerry	Sule Skerry and Sule Skerry SPA	7	0	Guillemot: 10,068 IND (2018) Razorbill: 15 AON (2018) (JNCC, 2020c database)	Gannet, guillemot, razorbill, Leach's petrel, puffin, shag, storm petrel	NBN – None Mitchell *et al.*, 2018 - No invasive mammalian predators, medium invasion risk, no biosecurity measures	Sule Skerry is ranked number 10 for the priority of brown rat biosecurity measures (Stanbury *et al.*, 2017).	Sule Skerry SSSI site management statement found at Site Management Statement (snh.gov.uk).
Sule Stack		3	0	Guillemot: 1,062 IND (1998) Razorbill: 10 IND (1998) (JNCC, 2020c database)			No further information received	Sule Stack SSSI site management statement found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Hoy and South Walls	Hoy SPA	14,360	419	Guillemot: 9,020 IND (2007) (JNCC, 2020a) Razorbill: -	Arctic skua, fulmar, great black-backed gull, great skua, guillemot, razorbill, kittiwake, puffin, red-throated diver	Norway rat, house mouse, hedgehog and feral cat (*pers comm* Chris Bell, Orkney RSPB) Additionally, due to reported stoat sightings, there is ongoing incursion response monitoring, however currently no conclusive evidence of stoat presence (*pers comm* Chris Bell, Orkney, RSPB)	Hoy and South Walls is a mountainous island in the south-western end of the Orkney archipelago. There is an SPA located in the northern and western two-thirds of Hoy. The upland areas and high sea cliffs at the coast support an important assemblage of breeding seabirds and moorland breeding birds. There are ten guillemot colonies across the north and west coast of the island, with one colony at Hoy RSPB and two colonies in the south, one of which is on the South Wall island. There are nineteen razorbill colonies across the south, west and north coast including the Hoy RSPB. Hoy is the number 14 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	Part of the site is managed by the RSPB and there are management agreements over about two thirds of the site to manage grazing intensity. Hoy SSSI site management statement found at Site Management Statement (snh.gov.uk)
Flotta	-	938	80	Guillemot: 64 IND (2019) over two colonies Razorbill: 267 IND (2019) over two colonies (JNCC, 2020c database)	Fulmar, razorbill, guillemot, GBB gull, shag	Norway rat, house mouse, hedgehog and feral cat (*pers comm* Chris Bell, Orkney, RSPB)	Two colonies of guillemot on the east coast. One colony has 2 individuals (2019) declined from 30 in 2002. The other colony has 62 individuals (2019) (JNCC, 2020c database). Two colonies of razorbill on the east coast. One colony has 240 IND (2019) and the other has 27 IND (2019). Flotta is the number 15 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	No further information received
Switha Island	Switha SPA	41	0	Guillemot: 82 IND (2019) Razorbill: 231 IND (2019) (JNCC, 2020c database)	Fulmar, guillemot, razorbill, puffin	NBN – European otter Stoat* Brown rat*	No further information received	Switha SSSI site management statement found at Site Management Statement (snh.gov.uk)
South Ronaldsay	-	4980	909	See further details for colony counts	Black-headed gull, GBB gull, herring gull, fulmar, shag, kittiwake, guillemot, razorbill, black guillemot, puffin	NBN – European otter Stoat Brown rat Black rat Auld *et al.*, 2019 - Stoats	Four colonies of guillemot, two in the north west coast and two in the south (one on the west and one on the east side) (JNCC, 2020c database). Windwick colony (east coast) – 2,906 IND (2016). Burwick colony (south west coast) – 10 IND (2016). Quindry-Hoxa-Dam of Hoxa (north-west coast) – 20 IND (2000). The Altar-Quindry (north-west coast) – 460 IND (2000). Five colonies of razorbill, two in the north west coast and two in the south (one on the west and one on the east side) and one on the north east coast. Honeysgeo-Stews (north east coast) – 1 IND (2000)	Ward Hill Cliffs SSSI on the east coast of South Ronaldsay site management statement found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
							Windwick colony (east coast) – 319 IND (2016). Burwick colony (south west coast) – 16 IND (2016). Quindry-Hoxa-Dam of Hoxa (north-west coast) – 22 IND (2000). The Altar-Quindry (north-west coast) – 77 IND (2000). **Stoat eradication programme in progress (DIISE, 2018).**	
Shapinsay	-	2947	307	See further details	Fulmar, shag, guillemot, razorbill, black guillemot, puffin	NBN – European otter Stoat* Brown rat Black rat*	There are three colonies of razorbill and guillemot on the east coast. The three guillemot colonies have the following populations; 4 (2002), 81 (2016) and 6 (2016). The three razorbill colonies have the following populations; 14 (2002), 90 (2016) and 21 (2016).	No further information is available
Orkney Mainland	Marwick Head SPA	52,318	17,162	-	-	NBN – Cat and feral cat European otter Stoat Brown rat Black rat Auld *et al.*, 2019 - Stoats, feral cats, rats, hedgehogs	Number of colonies around the coast of Orkney Mainland including a population at Marwick Head with 11,985 IND guillemots (2018) (JNCC, 2020a). Large colonies of breeding seabird are supported by the cliffs at Marwick Head. Introduction of stoat in 2010, by 2013 they were present across the mainland and connected isles of Burray and South Ronaldsay. In 2016 SNH and RSPB formed partnership for an eradication scheme (Auld *et al.*, 2019). **Stoat eradication at South Ronaldsay and Burray in progress (DIISE, 2018) and stoat eradication on Orkney Mainland and the 'linked isles' is currently underway (*pers comm* Chris Bell, Orkney, RSPB).**	**Advice to Support Management** (undated) of North Orkney proposed Special Protection Area (pSPA) - sets out management options based on the sensitivities of the qualifying bird species. Also potentially relevant is the "Selection of suitable sites for marine birds and advice on management in the Scottish Marine Protected Areas network" (2016) available **here**. The Orkney Native WildLIFE project aims to eradicate the introduced non-native stoat from the Orkney Islands by 2023. Project objectives include a number of project actions are detailed here and include "The removal of stoats from their entire introduced range across the Orkney Mainland." Marwick Head SSSI site management plan can be found at **Site Management Statement (snh.gov.uk)**
Copinsay	Copinsay SPA	77	0	Guillemot: Main colony: 18,454 IND (2015) (JNCC, 2020c database). Razorbill: Main colony: 525 IND (2015)	Fulmar, great black-backed gull, kittiwake, guillemot, razorbill	NBN – European otter Stoat* Brown rat* Mitchell *et al.*, 2018 - High invasion risk minimized by biosecurity measures	There are four guillemot and five colonies of razorbill in Copinsay SPA with the main colony at Copinsay Island. The SPA comprises a group of islands 4km off the east coast of Orkney Mainland. The islands have a cliffed rocky coastline and maritime vegetation that support large colonies of breeding seabirds. The three main SPA islands are a total 78 ha. Copinsay is identified as number 18 joint ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	No management plan located. However, a Site Management Statement (2010) for Copinsay SSSI (overlaps with the SPA) is located **here**. It is noted that "the isolation of the site means that predators such as rats or cats are not present." Copinsay SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Auskerry	Auskerry SPA	85	4	Guillemot: 91 IND (2016) (JNCC, 2020c database) Razorbill: 45 IND (2016)	Arctic tern, storm petrel, guillemot, razorbill	NBN – None	All counts of guillemot and razorbill were found on the west coast.	Auskerry SSSI site management statement found at **Site Management Statement (snh.gov.uk)**

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Rousay	Rousay SPA	4,697	216	See further details	Arctic skua, arctic tern, fulmar, guillemot, razorbill, kittiwake	NBN – European otter Stoat* Brown rat Stanbury *et al.*, 2017 – brown rats, feral cat, house mouse, European rabbit. Biosecurity measures only partially effective.	There are 10 guillemot colonies and 11 razorbill colonies across the west and north coast of Rousay (JNCC, 2020c database) with the following population sizes; Site "Rousay 1" – guillemot; 274 IND (2016), razorbill; 33 IND (2016) Site "Rousay 2" – guillemot; 23 IND (2016), razorbill; 21 IND (2016) Site "Rousay 3" – guillemot; 2231 IND (2007), razorbill; 158 IND (2007) Site "Rousay 4" – guillemot; 2800 IND (2016), razorbill; 144 IND (2016) Site "Rousay 5" – guillemot; 1915 IND (2016), razorbill; 103 IND (2016) Site "Rousay 6" – guillemot; 700 IND (2016), razorbill; 44 IND (2016) Site "Rousay 7" – guillemot; 5 IND (2016), razorbill; 4 IND (2016) Site "Rousay 8" – guillemot; 10 IND (2016), razorbill; 6 IND (2016) Site "Rousay 11" – guillemot; 500 IND (2016), razorbill; 42 IND (2016) Site "Rousay 12" – guillemot; 28 IND (2016), razorbill; 64 IND (2016) Site "Rousay 13" – razorbill; 8 IND (2016) Rousay is the number 4 joint ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	Rousay SSSI site management statement found at Site Management Statement (snh.gov.uk)
Stronsay	-	3,362	349	Guillemot: 751 IND (2018) Razorbill: 14 IND (2018) (JNCC, 2020c database)	Fulmar, razorbill, guillemot, kittiwake	Norway rat, house mouse, hedgehog and feral cat. There is also a history of escapee or feral polecat ferrets (*pers comm* Chris Bell, Orkney, RSPB)	There are two colonies of guillemot on Stronsay, on the south east coast, Carlin Geo has a colony of 741 IND (2018) and on the south west coast there is a colony of 10 IND (2018) (JNCC, 2020c database). There are three colonies of razorbill on Stronsay, on the south east coast there are two colonies, one with a population of 2 IND (2018) and the other also with 2 IND. On the south west coast there is one colony with 10 IND (2018) (JNCC, 2020c database). Stronsay is the number 18 joint ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	Mill Bay SSSI site management statement found at Site Management Statement (snh.gov.uk)
Calf of Eday and Eday island	Calf of Eday SPA	217 (Calf of Eday) 2,745 (Eday)	0 (Calf of Eday) 160 (Eday)	Guillemot: 5,524 (2018) Razorbill: 101 (2018) (JNCC, 2020c database) Counts have been combined for Calf of Eday and Eday island colonies.	Cormorant, fulmar, kittiwake, GBB gull, razorbill, guillemot	NBN – European otter Brown rat	The SPA includes the Calf of Eday and the north and north east coast of the adjacent Eday island. All colonies of guillemot and razorbill are within the SPA. There is one colony of guillemot on the Calf of Eday of 5,504 IND (2018) and three colonies along the north coast of the adjacent Eday island with populations of; 5 IND, 7 IND and 8 IND (2018, JNCC, 2020c database). There is one razorbill colony on the Calf of Eday of 70 IND (2018) and a total of four colonies on Eday island along the northern and north-eastern coast with populations of; 6 IND, 8 IND, 4 IND and 13 IND (2018, JNCC, 2020c database).	Calf of Eday SSSI site management statement found at Site Management Statement (snh.gov.uk)
Westray	West Westray SPA	4,742	588	Guillemot: >22,930 IND (2017) Razorbill: >982 IND (2017) (JNCC, 2020c database	Arctic skua, arctic tern, fulmar, kittiwake, razorbill, guillemot	House mouse and feral cat (*pers comm* Chris Bell, Orkney, RSPB)	There are seven guillemot colonies on Westray including those in West Westray SPA, ranging from 76 to 3,286 IND (2017, JNCC, 2020c database) in the West Westray Cliff colonies and 22,930 IND (2017, JNCC, 2020c database) in Noup Cliffs RSPB. There are seven razorbill colonies, including six within the SPA, ranging from 68 to 583 IND in the West Westray Cliff colonies and 982 IND in the Noup Cliffs RSPB (2017, JNCC, 2020c database).	West Westray SSSI site management statement found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
							The SPA is an 8km stretch of sea cliffs, grassland and heathland along the west coast of Westray island in Orkney. The cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland supports breeding colonies of skuas and terns. Westray is the number 3 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and ranked number 4 for brown rat biosecurity measure priority.	
North Hill RSPB (Papa Westray)	Papa Westray (North Hill and Holm) SPA	858	90	Guillemot: >898 IND (2019) Razorbill: >220 (2019) (JNCC, 2020c database)	Arctic skua, arctic tern, guillemot, razorbill	House mouse, historically feral cat but possibly now died out (*pers comm* Chris Bell, Orkney, RSPB)	Papa Westray (North Hill and Holm) SPA is situated in the north of Papa Westray island (North Hill) and the adjacent Holm of Papa island (Holm). North Hill is an area of maritime grassland and heath at the northern tip of Papa Westray in Orkney. It has a low lying rocky coastline with steep cliffs up to 10m high on the eastern side. Holm is a low-lying grassy island with a rocky coastline off the east coast of Papa Westray. There is currently one population of guillemot and razorbill on Papa Westray island at North Hill RSPB in the north. Population estimates are minimum as boats could only make partial counts. Papa Westray is the number 11 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and ranked number 16 for brown rat biosecurity measurement priority.	North Hill SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Muckle Skerry	Pentland Firth Islands SPA	34	0	Guillemot: 438 IND (2002) Razorbill: 178 IND (2002) (JNCC, 2020c database)	Arctic tern, guillemot, razorbill	NBN – European otter*	No further information received	Pentland Firth Islands SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Swona		92	0	Guillemot: 118 IND (2002) Razorbill: 67 IND (2016) (JNCC, 2020c database)		NBN – Stoat* Polecat* Black rat* Brown rat*	No further information received	
Stroma Island	North Caithness Cliffs SPA	375	0	Guillemot: 7,008 IND (2016) Razorbill: 549 IND (2016) (JNCC, 2020c database)	Fulmar, kittiwake, guillemot, razorbill, puffin	NBN – European otter* Stoat* Polecat* Feral ferret* Brown rat*	No further information received	Stroma SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
UK ISLANDS – Shetland Islands Scotland								
Fair Isle	Fair Isle SPA	786	68	Guillemot: 20,924 IND (2015) Razorbill:	Arctic skua, fulmar, arctic tern, gannet, great skua, kittiwake, puffin,	NBN – None Stanbury *et al.*, 2017 – feral cat, house mouse,	Fair Isle, the most southernly island in Shetland is made up of a rocky, cliff coastline and adjacent coastal waters, heather moorland, acidic grassland, maritime grassland and crofting in-bye. The SPA is made up of 176 islands totaling 798 ha. The main island is Fair Isle, where the only colony of guillemot and razorbill in the SPA nest.	Fair Isle SSSI site management statement found at **Site Management Statement (snh.gov.uk)**

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				1,930 IND (2015) (JNCC, 2020c database)	razorbill, shag, guillemot	wood mouse, European hedgehog	There are currently no biosecurity or surveillance undertaken to minimize further incursion of predators. Fair Isle is the number 2 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and ranked number 9 for brown rat biosecurity priority. It is thought that a reasonable number of razorbill nest in boulder beaches (*pers comm* Helen Moncrieff, RSPB).	
Foula	Foula SPA	1,302	38	Guillemot: 24,799 IND (2007) Razorbill: 559 IND (2007) (JNCC, 2020c database)	Arctic skua, arctic tern, fulmar, great skua, guillemot, kittiwake, Leach's petrel, puffin, razorbill, red-throated diverm shag	NBN - None Stanbury *et al.*, 2017 – feral cat, house mouse, European rabbit, wood mouse, European hedgehog	Foula is the most westerly Shetland Island, lying 20km west of Shetland Mainland. The SPA is made up of rocky coastline, large areas of mire and coastal waters supporting internationally important breeding seabird populations. The SPA comprises of 62 islands, totaling 1,305 ha, with the main island being Foula, where the only colony of breeding guillemot and razorbill in the SPA nests. There are no biosecurity or surveillance measures undertaken to reduce further incursion by predators. Foula is the number 1 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and ranked number 3 for brown rat biosecurity priority.	Foula SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Sumburgh Head, Shetland Mainland	Sumburgh Head SPA	96,979 (mainland)	18,765	Guillemot: 7,749 IND (2018) Razorbill: 227 IND (2018) (JNCC, 2020c database)	Arctic tern, fulmar, kittiwake, guillemot, razorbill	NBN – European otter Stoat Feral ferret / polecat* JNCC – large gulls	Sumburgh Head SPA covers part of the cliffs and boulder beaches at the southern tip of Shetland Mainland with other colonies of guillemot and razorbill spread across the south, west and north coast of the mainland. Razorbill at Sumburgh Head tend to nest in small loose groups on the cliffs (*pers comm* Helen Moncrieff, RSPB).	Sumburgh Head SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Noss	Noss SPA	321	0	Guillemot: 24,456 IND (2015) Razorbill: 533 (2015) (JNCC, 2020c database)	Fulmar, gannet, great skua, kittiwake, puffin, guillemot, razorbill	NBN – European otter* Black rat* Mitchell *et al.*, 2018 – high invasion risk, no biosecurity	The SPA comprises of 14 islands totaling 344 ha, the largest island is Noss, where the only guillemot colony in the SPA breeds. The offshore island lies 5km east of Lerwick, supporting breeding seabirds on cliffs and inland heathlands and grasslands Ranked joint 18th for brown rat biosecurity measurement priority in the UK (Stanbury *et al.*, 2017).	Noss SSSI site management statement found at **Site Management Statement (snh.gov.uk)** Noss NNR management plan can be found at **The Management Plan for Noss National Nature Reserve 2014-2024**
Bressay	Part of the east coast forms Noss SPA	2,805	368	See further details for colony counts.	Guillemot, razorbill, fulmar, herring gull, kittiwake, shag	NBN – European otter Stoat* Polecat* Black rat*	There are four colonies of guillemot with the following counts; 5 IND (2000), 120 IND (1986), 1 IND (2019), 9 IND (2019) and five colonies of razorbill with the following counts 111 IND (1986), 32 IND (2019), 1 IND (2019), 2 IND (2019) and 32 IND (2019) . The majority of the populations are along the south coast with one population on the east coast part of the Noss SPA.	Part of the coast forms the Noss SPA (see above for Noss SSSI site management statement)
Papa Stour	Papa Stour SPA	828	15	Guillemot: Minimum of 582 IND (1999) Razorbill:	Arctic tern, guillemot, razorbill	NBN – European otter	No further information received	Papa Stour SSSI site management statement found at **Site Management Statement (snh.gov.uk)**

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				Minimum of 311 IND (1999) (JNCC, 2020c database)				
Gruney and Ramna Stacks	Ramna Stacks and Gruney SPA	-	-	See further details	European storm petrel, guillemot, razorbill	NBN – none	There are six guillemot colonies with the largest at Fladda (492 IND, 2018). The other colonies are Gruney (178 IND, 2019), Ofoora (25 IND, 2018), Turla (56 IND, 2001), Scordar (76 IND, 2019) and Outer stack (322 IND, 2019). There are seven razorbill colonies at Gruney (18 IND, 1986), Fladda (22 IND, 2018), Ofoora (4 IND, 2018), Hyter (2 IND, 2001), Turla (8 IND, 1986), Scordar (3 IND, 2019) and Outer Stack (5 IND, 2019). All data from JNCC, 2020c database.	Ramna Stacks and Gruney SSSI site management statement found at Site Management Statement (snh.gov.uk)
Fetlar	Fetlar SPA	4,042	61	Guillemot: Two colonies; 36 IND (1999) 136 IND (2000) (JNCC, 2020c database) Razorbill: See further details	Arctic skua, artic tern, fulmar, great skua, guillemot, razorbill	NBN – European otter Stanbury *et al.*, 2017 - Feral cat, house mouse, wood mouse, European rabbit, European hedgehog	Fetlar island lies to the east and south respectively of the larger islands of Yell and Unst. The island is made up of species-rich heath, bog with the cliffs, rocky shores and adjacent coastal waters important for breeding seabirds. There are two guillemot colonies on the island, one on the south coast at Klifts to Big Holm with 36 IND (1999) and one on the north coast at East Neap with 136 IND (2000) (JNCC, 2020c database). There are seven colonies of razorbill each with the following populations; 1 IND (1999), 11 IND (1999), 26 IND (1999), 5 IND (1999), 4 IND (1999), 3 IND (1986) and 2 IND (2000). Fetlar is the number 12 joint ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and is number 1 joint ranked island for brown rat biosecurity.	North Fetlar SSSI site management statement found at Site Management Statement (snh.gov.uk)
Yell	Various SPAs including Otterswick and Graveland	21,103	966	See further details	Fulmar, shag, guillemot, razorbill, kittiwake, arctic tern, puffin, GBB gull, herring gull	NBN – European otter Stanbury *et al.*, 2017 - Feral cat, house mouse, European hedgehog, European rabbit	One guillemot colony on the east coast of Yell with 208 IND (1999) and one on the north coast with 11 IND (1986). One razorbill colony on the east coast with 2 IND (2018) and one on the north coast with 2 IND (2001). Yell is the number 9 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) and ranked number 7 for brown rat biosecurity priority.	Graveland SSSI site management statement can be found at Site Management Statement (snh.gov.uk)
Unst	Hermaness NNR, Hermaness, Saxa Vord and Valla Field SPA	12,135	632	See further details	Gannet, great skua, puffin, fulmar, kittiwake, guillemot, razorbill, red-throated diver, shag	NBN – European otter Cat / feral cat Brown rat Stanbury *et al.*, 2017 - Brown rat, feral cat, house mouse, European rabbit, European hedgehog	There are 10 guillemot colonies around the west and north coast of the island (Herma Ness) including one on Muckle Flugga Stack and including Hermaness NNR with a population of 5,808 IND (2016) (JNCC, 2020c database). There are 8 razorbill colonies around the west and north coast including Hermaness NNR with a population of 139 IND (2016) (JNCC, 2020c database). The NNR site covers most of the headland of Herma Ness and surrounding stacks with nesting on cliffs for more than 100,000 breeding seabirds. A seasonal site manager/warden lives on the island to manage visitors and monitor birds. The SPA consists of 100-200m high sea cliffs with adjoining grassland, heath and blanket bog. Most seabirds nest on the cliffs, however some birds nesting among cliff foot boulders, moorland or cliff tops and are particularly vulnerable to predation. There is a management plan for cat control programme (SNH, 2017)[7].	Hermaness SSSI site management statement found at Site Management Statement (snh.gov.uk) Hermaness NNR management plans can be found at Management Plan for Hermaness National Nature Reserve 2016 ...

[7] https://www.nature.scot/sites/default/files/201802/The%20Management%20Plan%20for%20Hermaness%20NNR%202016-2026.pdf

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
							The island of Unst is the number 7 joint ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	
UK ISLANDS – North / Northwest Scotland								
Handa Island, northwest coast	Handa SPA	309	0	Guillemot: 54,664 IND (2016) Razorbill: 8,207 IND (2019) (JNCC, 2020c database)	Fulmar, great skua, kittiwake, razorbill, guillemot	NBN – Brown rat European Otter Mitchell *et al.*, 2018 - brown rats, biosecurity only partially effective.	Handa SPA is an island surrounded by high sea-cliffs and coastal waters a short distance from the west coast of Sutherland in Scotland. Most of the island is vegetated with sub-maritime grasslands and heaths and provides nesting grounds for important breeding seabirds that forage in the northern Minch outside of the SPA. There are 7 islands within the SPA, the main island being Handa, where the only guillemot colony in the SPA are present. The combined area of all islands is 330 ha.	Handa Island SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
North Rona	North Rona and Sula Sgeir SPA	115	0	Guillemot: 4,961 IND (2012) Razorbill: 513 IND (2012) (JNCC, 2020c database)	Fulmar, gannet, GBB gull, guillemot, kittiwake, razorbill, Leach's petrel, puffin, storm petrel	NBN – none	The uninhabited islands of North Rona and Sula Sgeir, together with several outlying rocky islets and adjacent waters, lie 65 km north of Lewis. The coastlines of both islands consist mainly of cliffs except for two low-lying peninsulars on North Rona. North Rona is well covered by peat or soil, and vegetated by submaritime grassland. Sula Sgeir lies about 15 km west of North Rona. It is much the smaller of the two islands and has little soil or vegetation. Sule sgeir and Rona are ranked number 13 for brown rat biosecurity measurement priority in the UK (Stanbury *et al.*, 2017).	North Rona and Sula Sgeir SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Sula Sgeir				Guillemot: 20,877 IND (1998) Razorbill: 801 IND (1998) (JNCC, 2020c database)				
UK ISLANDS – The Minch, Scotland								
Garbh Eilean and Eilean an Taighe	Shiant Isles SPA	141	0	Guillemot: Garbh Eilean = 1,665 IND (2015) Eilean an Taighe = 454 IND (2015) Razorbill: Garbh Eilean = 6,402 IND (2015) Eilean an Taighe = 925 IND (JNCC, 2020c database)	Whole SPA; Fulmar, kittiwake, puffin, razorbill, guillemot, shag	NBN – European otter* Mitchell *et al.*, 2018 - Whole SPA; No – black rat eradication in 2015-16, high risk of invasion, no biosecurity	The Shiant Isles SPA comprises of four main islands and their skerries. These are situated 6km east of Harris in the Western Isles of Scotland. The combined size of the islands and skerries is approximately 177ha. The largest seabird colony is at Garbh Eilean in a large boulder field and grassy slopes beneath the northern and eastern cliffs (Stapp, 2002). Guillemots nest in the cliffs on all the islands with a combined population of 9,054 IND (2015) with the largest colony at Eilean Mhuire. **Complete black rat eradication programme across the Shiant Isles in 2016.** Garbh Eilean and Eilean an Taighe were number 4 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication and ranked number 11 for brown rat biosecurity priority.	Shiant Islands SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Eilean Mhuire		32	0	Guillemot: 5,624 IND (2015) Razorbill: 371 IND (2015)			See above. Eilean Mhuire contains the largest guillemot colony of the Shiant Isles. Eilean Mhuire was number 18 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication.	

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				(JNCC, 2020c database)				
Galta Beag Group		-	-	Guillemot: 434 IND (2015) Razorbill: 201 IND (2015) (JNCC, 2020c database)			See above.	
Galta Mor Group		-	-	Guillemot: 877 IND (2015) Razorbill: 130 IND (2015) (JNCC, 2020c database)			See above.	
UK ISLANDS – Western Isles, Scotland								
Mingulay	Mingulay and Berneray SPA	647	0	Guillemot: 19,384 IND (2017) Razorbill: 11,453 IND (2017) (JNCC, 2020c database)	Fulmar, guillemot, kittiwake, puffin, razorbill, shag	There are mice on Mingulay,(and potentially on Boreray) however these are a well established populations hundreds of years ago. There are no other invasive mammalian predators on Mingulay and Berneray (*pers comm* Susan Bain, NT for Scotland)	Mingulay is ranked number 12 for brown rat biosecurity priority in the UK (Stanbury *et al.*, 2017).	Mingulay and Berneray SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
Berneray		212	138	Guillemot: 9,949 IND (2014) Razorbill: 9,167 IND (2014) (JNCC, 2020c database)			Berneray is identified as number 20 joint ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	
Haskeir	West Coast of the Outer Hebrides SPA	-	-	Guillemot: 760 IND (2005) Razorbill: 151 IND (2005) (JNCC, 2020c database)	Fulmar, shag, kittiwake, GBB gull, herring gull, arctic tern, guillemot, razorbill	NBN - none	No further information received	Small Seal Islands SSSI site management statement can be found at **Site Management Statement (snh.gov.uk)**
Soay and Stacs Islands	St Kilda SPA	97	0	Guillemot: 2,057 IND (2015) Razorbill: 68 IND (2015) (JNCC, 2020c database)	Fulmar, guillemot, razorbill, gannet, great skua, kittiwake, Leach's petrel, Manx shearwater, puffin, storm petrel	There are fieldmice on Hirta and Dun, however these were estimated to be introduced to the archipelago over 1,000 years	Soay, St Kilda is identified as number 22 ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	St Kilda SSSI site management statement found at **Site Management Statement (snh.gov.uk)** St Kilda World Heritage Site management plans for 2012-17 can be found at **St Kilda World Heritage Site Management Plan (pub-prod-sdk.azurewebsites.net).**

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Boreray and Stacs		86	0	Guillemot: 2,072 IND (2016) Razorbill: 103 IND (2016) (JNCC, 2020c database)		ago. No other mammalian predators in the St Kilda archipelago (*pers comm* Susan Bain, NT for Scotland)	Boreray, St Kilda is identified as number 15 ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	
Hirta		661	0	Guillemot: 5,098 IND (2015) Razorbill: 494 IND (2015) (JNCC, 2020c database)-			Hirta and Dun are identified as number 1 joint ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	
Dun				Guillemot: 1,076 IND (2015) Razorbill: 155 IND (2015) (JNCC, 2020c database)				
Levenish		-	-	Guillemot: 60 IND (1999) Razorbill: 16 IND (1999) (JNCC, 2020c database)			No further information received	
West Group	Flannan Isles SPA	-	-	Guillemot: 4,619 IND (1998) Razorbil: 337 IND (1998) (JNCC, 2020c database)	Fulmar, guillemot, kittiwake, Leach's petrel, puffin, razorbill	NBN - None	No further information received	Flannan Isles SSSI site management statement found at **Site Management Statement (snh.gov.uk)**
South Group		-	-	Guillemot: 4,144 IND (1998) Razorbill: 379 IND (1998) (JNCC, 2020c database)		NBN - None	No further information received	
East Group		-	-	Guillemot: 3,997 IND (1998) sea based surveys		NBN - None	No further information received	

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				1,878 IND (1998) land based surveys Razorbill: 724 (1998- sea based counts) 121 (1998 – land based counts) (JNCC, 2020c database)				
UK ISLANDS – Hebrides, Scotland								
Isle of Lewis and adjacent islands (including Coppay, Campay, Eilean Mor Bayble)	Various SPAs including North Harris Mountains	176,896	18,500	See further details	-	NBN – European otter American mink Polecat Feral ferret Black rat Brown rat	Isle of Lewis has 6 colonies of guillemot and razorbill on the north east coast and 6 guillemot and 8 razorbill colonies on the east coast on the eye Peninsula. These colonies have the following populations: Bauaile nan Caorach – guillemot; 37 IND (2019) Spainneavaig – guillemot; 230 IND (2019), razorbill; 5 IND (2019) Druim Hallagro – razorbill; 5 IND (2019) Leum Langa – guillemot; 8 IND (2019), razorbill; 17 IND (2019) Cellar Head – razorbill; 12 IND (2019) Lobaid – guillemot; 61 IND (2019), razorbill; 42 IND (2019) Tolsta Head – guillemot; 60 IND (2019), razorbill; 13 IND (2019) Mullach Skarisgeir – guillemot; 8 IND (2019) Eye Peninsula: Tiumpan Head – guillemot; 147 IND (2019), razorbill; 27 IND (2019) Bagh a Tuath – guillemot; 6 IND (2019), razorbill; 15 IND (2019) Rubh' Asvik – guillemot; 26 IND (1999), razorbill; 5 IND (2019) Knoch Ibidale – guillemot; 1 IND (2019), razorbill; 16 IND (2019) Cnoc na h-lolair – guillemot; 9 IND (1999), razorbill; 14 IND (1999) Loch Cuile Coastline – razorbill; 4 IND (2019) Chicken Head – guillemot; 4 IND (2019), razorbill; 8 IND (1999) Stac Shurardail – razorbill; 2 IND (2019) The adjacent islands of Lewis have the following populations; Coppay – guillemot; 102 AON (1988), razorbill – 60 IND (2002) Campay – razorbill; 1 IND (1988) Eilean Mor Bayble – guillemot; 36 IND (2019); razorbill – 26 IND (2019) The Western Isles has a total land mass of 2,800km2 and the nearest point is 15km from mainland Scotland. Across the whole of the Isles the population is 20,000. The habitats on the islands are varied and include large areas of blanket bog, numerous lochs and streams. Hilly with a maximum altitude of 719m. Mink escaped from fur farms in the 1950s and by 1999 had spread across nearly the whole of the island chain. Betweeen 2001-2006 mink were eradicated from 1,100km^2 from North Uist, Benbecula and South Uist and were heavily	North Harris SSSI site management statement can be found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
							controlled in South Harris to prevent reintroduction (Roy, 2011), this was the first phase, phase two was to eradicate all mink from the Outer Herbrides. Info on the different phases and the impacts to birds can be found at Hebridean Mink Project | NatureScot. By early 2019 the campaign had been almost, but not entirely, effective (Macleod *et al.*, 2019).	
Isle of Skye and adjacent islands	Cuillins SPA	165,604	10,008	See further details	Fulmar, kittiwake, guillemot, razorbill, GBB gull, herring gull, shag	NBN – Cat American mink Stoat Polecat Feral ferret Brown rat	Isle Of Skye and adjacent small islands: 12 guillemot colonies and 20 razorbills with the following populations: Biod Ruadh to Stac a' Mheadais – guillemot; 132 IND (2001), razorbill; 86 IND (2001) Tarner Island - razorbill; 21 IND (2001) Wiay - razorbill; 11 IND (2001) Idrigill Point to Camas na h-Uamha - razorbill; 1 IND (2001) Biod a Mhurain to Flossnan - guillemot; 108 IND (2001), razorbill; 2 IND (2001) Waterfall to Biod a Mhurain - guillemot; 12 IND (2001), razorbill; 5 IND (2001) Gob na Hoe to Ramasaig Bay - guillemot; 514 IND (2000), razorbill; 23 IND (2000) Neist Lighthouse to Mointeach nan Tarbh - guillemot; 14 IND (2000), razorbill; 24 IND (2000) Geodha a Gamnha to Guala Mhor - razorbill; 5 IND (2000) Am Famhair to Gob na Hoe – razorbill; 15 IND (2000) Clett – razorbill; 20 IND (2001) Ard Beag to Ardmore Point – razorbill; 3 IND (2001) Waterfall to Ard Beag – guillemot; 217 IND (2001) Vaternish Point to Waterfall - guillemot; 148 IND (2001), razorbill; 15 IND (2001) Biod a' Choltraiche to Creag an Fhithich - guillemot; 93 IND (2001), razorbill; 2 IND (2001) Cnoc Dubh Mor to Biod a' Choltraiche – razorbill; 2 IND (2001) Ascrib Islands 1 - guillemot; 33 IND (2000), razorbill; 24 IND (2000) An t-lasgair Group – guillemot; 4,080 IND (2018), razorbill; 34 IND (2018) Fladda Chuain to Gearran Island – guillemot; 2,704 IND (2018); razorbill; 216 IND (2018) The Aird – Rubha Hunish - guillemot; 50 IND (2000), razorbill; 43 IND (2000) Creag na h-Eiginn – The Aird – guillemot; 45 IND (2000), razorbill; 80 IND (2015)	Cuillins SSSI site management statement found at Site Management Statement (snh.gov.uk)
Canna and Sanday	Canna and Sanday SPA	1,130 (Canna)	15-20	Guillemot: Minimum 2,850 IND (2018) Razorbill: Minimum 545 IND (2018) (JNCC, 2020c database)	Guillemot, herring gull, kittiwake, razorbill, puffin, shag	NBN – European otter Brown rat	Canna and Sanday – owned by National Trust for Scotland, inhabited by 15-20 people. **Complete brown rat eradication in 2005/6 (Luxmoore *et al.*, 2019).**	Canna and Sanday SSSI site management statement found at Site Management Statement (snh.gov.uk)
UK ISLANDS – Small Isles, Scotland								
Rum	Rum SPA	10,726	22	Guillemot: 2,454 IND (2000)	Guillemot, kittiwake, Manx	NBN – European otter	There are 16 islands that make up Rum SPA, with the only guillemot colony being on the main island, Rum.	Rum SSSI site management statement found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				Razorbill: 94 IND (2000) (JNCC, 2020c database)	shearwater, razorbill, red-throated diver	Brown rat Stanbury *et al.*, 2017 - Brown rat, feral goat, house mouse, wood mouse	Rum is number 10 ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication.	Rum NNR site management plans can be found at **Management Plan for Rum National Nature Reserve 2016 2026** and habitat management plan at **Rum National Nature Reserve Habitat Management plan 2018-2022**
Isle of Muck, Scotland	-	523	27	See further details	Fulmar, guillemot, razorbill, shag, kittiwake, herring gull, GBB gull, puffin	NBN – European otter Brown rat*	There are 4 guillemot and razorbill colonies on Muck and 2 on the adjacent islands. The combined Muck Island colonies have populations of guillemot; 377 IND (2001) and razorbill; 136 IND (2001). The adjacent islands have populations of the following; Eilean nan Each – guillemot; 120 IND (2018), razorbill; 40 IND (2018) Eagamol – guillemot; 300 IND (2018), razorbill; 60 IND (2018) Muck is the number 22 ranked island prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017).	Camas Mor, Muck SSSI site management statement can be found at **Site Management Statement (snh.gov.uk)**
UK ISLANDS – Inner Hebrides, Scotland								
Ceann a Mhara (Tiree – Argll and Bute)	Coll and Tiree SPA	7,920	653	Guillemot: 3,610 IND (2018) Razorbill: 372 IND (2018) (JNCC, 2020c database)	Razorbill, guillemot	Invasive mammal predators including rats and mice. Otters are also present as are great skuas and greater black-backed gulls (*pers comm* Ian Boyd, Hebridean Trust)	There is the Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast) SPA on Tiree, however this does not cover the Ceann a Mhara, where the only colony of guillemot on Tiree nests. Tiree is number 16 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication. On Ceann a Mhara, auk species do not nest in easily accessible sites for non-avian predators. They are confined to steep, near-vertical, cliffs with narrow ledges (*pers comm* Ian Boyd, Hebridean Trust).	Ceann a' Mhara to Loch a' Phuill site management statement can be found at **Site Management Statement (snh.gov.uk)**
Lunga and Sgeir a' Chaisteil and Fladda	Treshnish Isles SPA	-	-	See further details	Storm petrel, guillemot, razorbill	No land-based mammalian predators on either Sgeir a' Chaisteil or Fladda except possibly otters, which are an indigenous species. Lunga has no invasive mammal predators, but does have otters (occasionally but unlikely to be resident), great skuas and greater black-backed gulls (*pers comm* Ian Boyd, Hebridean Trust).	The population of guillemot at Lunga and Sgeir a' Chaisteil is 10,495 IND (2018) and minimum 580 IND (2018) razorbill. The population at Fladda is a population of 65 IND (2018) razorbill. On Lunga, both guillemot and razorbills nest in locations which are accessible to land predators although the main concentrations of guillemots on Lunga nests on an isolated rock stac which would probably be inaccessible to land predators. Razorbills breed in both accessible and inaccessible locations. Based on an educated guess, the likely proportions of guillemot nesting in accessible locations is approximately <10% and likely to be higher for razorbills. Where land predators are present, adaptation by razorbills to avoid predators may bring this down to zero (*pers comm* Ian Boyd, Hebridean Trust).	Treshnish Isles SSSI site management statement found at **Site Management Statement (snh.gov.uk)**

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Stac Mhic Mhurchaidh	-	-	-	Guillemot: 161 IND (2016) Razorbill: 33 IND (2016) (JNCC, 2020c database)	Fulmar, guillemot, razorbill, shag, black guillemot, puffin	NBN – European otter American mink* Brown rat*	No further information received	No further information received
Colonsay and Oronsay	North Colonsay and Western Cliffs SPA	4,549 ha	132	Guillemot; 19,288 IND (2018) Razorbill; 2,423 IND (2018) (JNCC, 2020c database)	Guillemot, kittiwake, razorbill	NBN – European otter American mink Brown rat Stanbury *et al.*, 2017 - Brown rat, feral cat, feral goat, house mouse, wood mouse, European rabbit	Colonsay contains 15 colonies of guillemot and 19 colonies of razorbill across the north and western cliffs of the island. There are currently no colonies on Oronsay for either species. The combined populations of the colonies are given under the population column. The combined Colonsay and Oronsay are number 7 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication.	North Colonsay SSSI site management statement found at Site Management Statement (snh.gov.uk)
Islay	Various SPAs including the Oa SPA, Rinns of Islay SPA and Gruinart Flats, Islay SPA	61,956	3,228	See further information	Guillemot, razorbill	Brown rats are present all along Islay's coastline, introduced stoats, feral ferrets and hedgehogs are present on the island but it is unknown whether they have access to seabird colonies (*pers comm* David Wood, RSPB)	There are 4 colonies of guillemot and 7 colonies of razorbill including The Oa RSPB and Smaull Farm RSPB with the following populations (JNCC, 2020c database); Islay-Texa – guillemot; 11 IND (2018), razorbill; 47 IND (2018) The Oa RSPB – guillemot; 171 IND (2018), razorbill; 163 IND (2018) Islay 11 – guillemot; 18 IND (2018), razorbill; 132 IND (2018) Islay 12 – razorbill; 53 IND (2000) Islay 10 – razorbill; 3 IND (2018) Coul Point – guillemot; 2 IND (2019), razorbill; 1 IND (2019) Smaull Farm RSPB – razorbill; 17 IND (2019) Guillemot and razorbill all nest on cliff ledges on The Oa, therefore access is likely to be restricted for mammalian predators (*pers comm* David Wood, RSPB).	The Oa SSSI site management statement found at Site Management Statement (snh.gov.uk) Rinns of Islay SSSI site management statement found at Site Management Statement (snh.gov.uk) Gruinart Flats SSSI site management statement found at Site Management Statement (snh.gov.uk)
Ailsa Craig	Ailsa Craig SPA	89	0	Guillemot: 6,180 IND (2019) Razorbill: 580 IND (2019) (JNCC, 2020c database)	Gannet, herring gull, kittiwake, lesser black-backed gull, guillemot, razorbill	NBN – European otter American mink Stoat Ferel ferret Polecat Brown rat Stanbury *et al.*, 2017 - Brown rats eradicated in 1991 Medium risk minimized by biosecurity measures	The Ailsa Craig SPA is an island rising to 338m in the outer part of the Firth of Clyde. Cliffs up to 100m encircle the island and provide nesting sites for breeding seabirds including one of the largest gannet colonies in the world. Complete brown rat eradication in 1992, following a failed programme in 1925 (DIISE, 2018). The island is ranked number 24 in the UK for prioritization of brown rat biosecurity measures (Stanbury *et al.*, 2017). Ailsa Craig is privately owned and managed by RSPB.	Ailsa Craig SSSI site management statement found at Site Management Statement (snh.gov.uk)

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Scare Rocks, Luce Bay	-	-	-	Guillemot: 350 IND (2016) (JNCC, 2020c database)	Kittiwake, guillemot, gannet, shag	NBN – European otter	No further information received	Scare Rocks SSSI site management statement can be found at Site Management Statement (snh.gov.uk)
UK ISLANDS – Northern Ireland								
Sheep Island	Sheep Island SPA	3.5	-	Guillemot: 439 IND (2000) Razorbill: 963 IND (2000) (JNCC, 2020c database)	Cormorant, guillemot, razorbill	NBN – European otter* Brown rat*	Sheep Island SPA conservation objectives indicates that rats are present on the island. There is currently a stable population of guillemot and razorbill on the island (JNCC, 2020c database). Sheep Island, along with four other sites in Northern Ireland that are engaging with the RSPB as part of the Biosecurity for LIFE programme (Allen *et al.*, 2020).	No further information received
Rathlin Island	Rathlin Island SPA	1,438 ha	100	Guillemot: 130,445 IND (2011) Razorbill: 22,975 IND (2011) (JNCC 2020a; JNCC 2020b)	Razorbill, kittiwake, fulmar, common gull, lesser black-backed gull, herring gull, puffin	NBN – European otter Stoat* Feral ferret Polecat Brown rat* Stanbury *et al.*, 2017 - Brown rat, feral cat, feral ferret, feral goat, house mouse, wood mouse, European rabbit	Rathlin Island is number 4 joint ranked islands prioritized for vertebrate eradication in the UK based on feasibility and sustainability when a medium reinvasion risk is assumed (Stanbury *et al.*, 2017) prior to their eradication. **Funding for five years has been granted for a predator eradication scheme at this location.**	No further information received
Muck Island, Co Antrim	-	-	-	Guillemot: 2,782 IND (2019) Razorbill: 1,118 IND (2019) (JNCC, 2020c database)	Fulmar, shag, kittiwake, guillemot, razorbill	Brown rats are present, but annual rat eradication is undertaken using rodenticide (*pers comm* Andrew Crory, Ulster Wildlife)	Nearly all auks on the islands nest on the cliffs, however there is no current information available on the proportion of other nesting habitats (*pers comm* Andrew Crory, Ulster Wildlife).	Site management is as follows (*pers comm* Andrew Crory, Ulster Wildlife): - Sheep grazing from September to March - A limited amount of scrub control - Bracken spraying (c.05ha) - Seabird monitoring following JNCC guidelines - Rat eradication
UK ISLANDS – Wales								
Bardsey Island, northwest coast	Aberdaron Coast and Bardsey Island SPA	179	11	Guillemot: 1,413 AON (2019) Razorbill: 1,917 AON (2019) (JNCC, 2020c database)	Manx shearwater, guillemot, razorbill	NBN - None	Bardsey Island is identified as number 23 ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	No further information received
Puffin Island	Puffin Island SPA	69	0	Guillemot: 3,606 IND (2019)	Cormorant, guillemot, razorbill	NBN – European otter	**Complete brown rat eradication in 1998 undertaken by the Countryside Council for Wales (Genovesi and Carnevali, 2011; DIISE, 2018).**	No further information received

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				Razorbill: 434 IND (2019) (JNCC, 2020c database)		Stoat* Brown rat		
Middle Mouse	Anglesey Terns/ Morwenoliaid Ynys Mon SPA	3.7	0	Guillemot: 5,550 IND (2016) Razorbill: 455 IND (2016) (JNCC, 2020c database)	Cormorant, herring gull, LBB gull, guillemot, razorbill, kittiwake	NBN - European otter* American mink* Polecat* Stoat* Polecat / ferret* Brown rat*	No evidence of rats present on the island. Guillemot population increase from 2,464 IND in 2002 to 5,550 in 2016. Razorbill population increase from 90 IND in 2002 to 455 in 2016. Significant population increases mean that if mammalian predators are present, then a population level impact is unlikely.	No further information received
Ramsey Island	Ramsey Island RSPB	259	2	Guillemot: 4,497 IND (2019) Razorbill: 1,599 IND (2019) (JNCC, 2020c database)	Fulmar, kittiwake, guillemot, razorbill, GBB gull, herring gull, LBB gull, puffin	NBN - European otter* American mink* Polecat* Stoat* Brown rat	**Complete brown rat and feral cat eradication in 1999/2000 (DIISE, 2018; Bell, 2019).** Owned and managed by RSPB.	No further information received
Cardigan Island	-	38	0	Guillemot: 97 IND (2018) Razorbill: 98 IND (2018) (JNCC, 2020c database)	LBB gull, fulmar, guillemot, razorbill, herring gull	NBN - European otter* Brown rat*	**Complete brown rat eradication in 1968 (Genovesi and Carnevali, 2011; DIISE, 2018).**	No further information received
Bishops and Clerks Island, southwest	Bishops and Clerks Island RSPB	-	-	Guillemot: 48 IND (2018) Razorbill: 380 IND (2018) (JNCC, 2020c database)	GBB gull, herring gull, LBB gull, guillemot, razorbill, puffin, storm petrel	No invasive mammalian predators present (*pers comm* Andrew Dodd, RSPB)	No further information received	No further information received
Grassholm	Grassholm SPA	11	0	Guillemot: 2,462 IND (2018) Razorbill: 39 IND (2018) (JNCC, 2020c database)	Gannet, guillemot, razorbill	No invasive mammalian predators present (*pers comm* Andrew Dodd, RSPB)	No further information received	No further information received
Skomer	Skomer, Skokholm and the Seas off Pembrokeshire SPA	291	2	Guillemot: 11,241 IND (2017) sea based surveys 13,547 IND (2017) land based surveys	Storm petrel, LBB gull, Manx shearwater, puffin, guillemot, razorbill, kittiwake	NBN - European otter American mink* Polecat* Stoat* Brown rat*	Skomer is identified as number 5 joint ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017). At Skomer whole-island populations were counted in the Seabird Monitoring programmes between 1999-2002. Populations of guillemot were recorded at study plots; Bull Hole, High Cliff and South Stream and populations of razorbill were recorded at study plots; Bull Hole, High Cliff, South Stream and The Wick.	Mention of biosecurity in Conservation Objectives **New/extended marine SPAs: Suggested approach to Reg 35 advice (cyfoethnaturiol.cymru)** Seabird and annual reports available:

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
				Razorbill: 4,668 IND (2018) sea based surveys 2,861 IND (2018) land based surveys (JNCC, 2020c database)				WTSWW Publications and Reports 2019 – The Wildlife Trust of South and West Wales (welshwildlife.org)
Middleholm		9	-	Guillemot: 302 IND (2018) Razorbill: 410 IND (2018) (JNCC, 2020c database)		Currently there are no mammalian ground predators present (*pers comm* Lauri MacLean, National Trust)	Access is very limited. Prior to 2018, due to difficulties with access, there was little or no census of the seabirds but in 2018 the island was surveyed along with the Skomer and Skokholm in partnership with the South & West Wildlife Trust who manage these two sites – the focus was on the manx shearwater population (*pers comm* Lauri MacLean, National Trust).	Biosecurity measures are in place, the site is designated and has some management restrictions in place relating to designations as well as SMS statements and lists of potentially damaging operations (*pers comm* Lauri MacLean, National Trust).
Skokholm		99	2	Guillemot: 4,654 IND (2019) Razorbill: 2,755 IND (2019) (JNCC, 2020c database)		NBN - European otter* American mink* Polecat* Stoat* Brown rat*	Failed rabbit eradication in 1938 (DIISE, 2018). Skokholm is identified as number 20 joint ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	Seabird and annual reports available: WTSWW Publications and Reports 2019 – The Wildlife Trust of South and West Wales (welshwildlife.org)
St Tudwal's Islands East and West	-	-	-	East: Guillemot: 1,139 IND (2016) Razorbill: 66 IND (2016) West: Guillemot: 352 AON (2016) Razorbill: 62 AON (2016) (JNCC, 2020c database)	Shag, cormorant, kittiwake, guillemot, razorbill, herring gull, GBB gull	NBN - European otter* American mink* Polecat* Stoat* Brown rat*	St Tudwal's Island West rat eradication has already been undertaken. St Tudwal's Island East guillemot populations have increased from 728 individuals in 2013 to 1,139 in 2016 and razorbills from 28 individuals in 2013 to 66 in 2016. Significant population increases mean that if mammalian predators are present, then a population level impact is unlikely.	No further information received
Caldey Island and St Margaret's Island	-	538	40	Combined populations: Guillemot: 1,831 IND (2019) Razorbill: 325 IND (2019) (JNCC, 2020c database)	Fulmar, herring gull, LBB gull, guillemot, razorbill, cormorant, kittiwake, GBB gull	Rat eradication has already been undertaken, no other known predators present (*pers comm* Ben Childs, Estate Manager).	The separate populations of the two islands are (JNCC, 2020c database); Caldey Island – guillemot; 72 IND (2019), razorbill; 90 IND (2019) St Margaret's Island – guillemot; 1,759 IND (2019), razorbill; 235 IND (2019). Brown rat eradication programme in progress (DIISE, 2018).	Currently there are no management plans (*pers comm* Ben Childs, Estate Manager).

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Worms Head	Bae Caerfyrddin/ Carmarthen Bay SPA	-	-	Guillemot: 169 IND (2018) Razorbill: 83 IND (2018) (JNCC, 2020c database)	Guillemot, razorbill	NBN - European otter* American mink* Polecat* Stoat* Brown rat*	The guillemots and razorbills tend to nest on the inaccessible cliff ledges however predators will potentially be able to reach the cliffs given that the causeway is accessible depending on the tides (*pers comm* Lauri MacLean, National Trust). Guillemot and razorbill eggs have been found to be predated upon, expected to be great-black backed gulls, however could also being impacted by other predators. Fox scat and otters have been recorded around Worms Head and are likely to be able to reach ledges that are occupied by guillemots and razorbills (*pers comm* Mark Hipkin, National Trust). Auks nest on ledges on the shear face of the outer head and are likely to be difficult to access. There are no suitable boulders on more accessible slopes being used by either species (*pers comm* Mark Hipkin, National Trust).	Biosecurity measures are in place, the site is designated and has some management restrictions in place relating to designations as well as SMS statements and lists of potentially damaging operations. The last part of Worm's Head (Outer Head) is closed between 1st March and the 31st August to protected nesting seabirds (*pers comm* Lauri MacLean, National Trust). Other than these restrictions no other management takes place on the outer head. No management takes place on middle head (however no seabirds are present here). There is some grazing and a small amount of scrub clearance on inner head (however no seabirds are present there) (*pers comm* Mark Hipkin, National Trust).
UK ISLANDS – England								
Lundy, southwest	-	445	Yes	Guillemot: 6,198 IND (2017) Razorbill: 1,735 IND (2017) (JNCC, 2020c database)	GBB gull, herring gull, LBB gull, Manx shearwater, fulmar, shag, kittiwake, guillemot, razorbill, puffin	NBN - Stoat Brown rat Black rat	**Complete black and brown rat eradication 2002-2004 (Genovesi and Carnevali, 2011; DIISE, 2018).**	No further information received.
Isle of Wight	Solent and Dorest Coast SPA	38,410	140,000	Guillemot: 300 IND (2017) Razorbill: 4 IND (1985) (JNCC, 2020c database)	Cormorant, herring gull, guillemot, razorbill	NBN – Cat European otter American mink Feral ferret Polecat Stoat Brown rat	Populations of guillemot and razorbill breed at Needles Rocks and Main Bench Cliffs on the west coast of the Isle of Wight.	No further information received.
Brownsman and Staple Island, Northeast	Farne Islands SPA	11	No	Guillemot: 64,042 IND (2019) Razorbill: 427 IND (2019) (JNCC, 2020c database)	Terns, kittiwake, shag, cormorant, puffin, guillemot, razorbill	There are no non-native predators present on the Farne Islands. The island is deemed at risk to introduction of invasive species by shipwrecks, however the Farne Islands are part of the Biosecurity for LIFE project (Biosecurity for LIFE).	Farne Islands is a group of rocky Islands between 2.4 to 7.6km offshore. The total area of land is 35 ha consisting of 13 islands. Managed by the National Trust with permanent rangers stationed on the main island. Islands are visited by tourists. Internationally important assemblage of seabirds, supporting total of 142,490 individual breeding seabirds. The sole population of guillemots and razorbill of Farne Islands SPA breed at Brownsman and Staple island. This island is recognized as the 17th ranked island in the UK prioritized for brown rat biosecurity measures (Stanbury *et al.*, 2017).	Site Improvement Plan (SIP) located **here**. Predation listed as a pressure/threat for guillemot (but not razorbill). Stated measure in the SIP is to "develop an appropriate management plan, and ongoing surveillance." Prioritised issues listed in the plan concern large gull predation on terns (see page 17).
UK ISLANDS – Isles of Scilly, England								

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
Gorregan	Isles of Scilly SPA	1.57	0	Guillemot: 99 IND (2015) Razorbill: 53 IND (2015) (JNCC, 2020c database)	Whole SPA: LBB gull, storm petrel, shag, great black-backed gull, herring gull, kittiwake, razorbill, Manx shearwater, guillemot, fulmar, puffin, common tern, cormorant	NBN – Brown/ black rat*	Gorregan is a 26 ft high group of fissured rocks found in the Western Rocks, along with Melledgan in the Isles of Scilly. Men-a-vaur is to the north-west of St Helen's and consists of three granite stacks rising to 125 ft in height. It is part of the SSSI for seabirds. **Complete brown rat eradication at Annet in 2004 and complete brown rat eradication at St Agnes and Gugh in 2013/14 (DIISE, 2018).** Biosecurity measures are undertaken on some islands (however the locations are not explicitly mentioned) (Mitchell *et al.*, 2018).	Annual reports found: Technical Reports | Isles of Scilly Wildlife Trust Limited (ios-wildlifetrust.org.uk)
Melledgan		0..96	0	Guillemot: 2 IND (2015) Razorbill: 36 IND (2015) (JNCC, 2020c database)		NBN – Brown/ black rat*		
Mincarlo		4.86	-	Guillemot: 20 IND (2015) Razorbill: 120 IND (2015) (JNCC, 2020c database)		NBN – Brown/ black rat*		
Scilly Rock			-	Guillemot: 60 IND (2015) Razorbill: 70 IND (2015) (JNCC, 2020c database) -		NBN – Brown/ black rat*		
Men-a-vaur		0.55	0	Guillemot: 110 IND (2015) Razorbill: 88 IND (2015) (JNCC, 2020c database)		NBN – Brown/ black rat*		
Other Norrad Rocks		-	0	See further information		NBN – Brown/ black rat*	In addition to the above islands within the Norrad Rocks, additional islands host potential of razorbill, only. These are as follows (JNCC 2020c): Shipman Head – 2 AON (2016) Gweal – 8 IND (2015) Caslte Bryher – 26 IND (2015) Illiswilgig – 8 IND (2015)	
Eastern Isles		-	0	See further information		NBN – Brown/ black rat*	No guillemot nest on the Eastern Isles. However the following populations of razorbill have been recorded (JNCC 2020c): Hanjague – 2 IND (2006) Great Innisvouls – 13 IND (2015) Menawethan – 4 IND (2015)	

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
							Ragged Isle – 18 AON (2015) Little Ganinick – 2 IND (2015)	
UK ISLANDS – South coast England								
Multiple islands / islets, south coast England	-	-	0	Present but variable	-	NBN – European otter* Brown rat*	No further information received	No further information received
Channel Islands								
Herm (including Jethou and the Humps)	-	Herm: 199 Jethou: 18 The Humps: -	Herm: 62 (2012) Jethou: 3 (1996) The Humps: -	See further information	-	Brown rat and/ or black rat	Herm: 3 IND razorbill (2020) were recorded in the south west of the island. 2015 numbers of guillemot were recorded as 130-150 IND and 43 IND razorbill (Vernon and Vernon, 2015). Jethou: 1 IND razorbill (2020) recorded in south of Jethou The Humps: 1 IND (2020) razorbill recorded at Amfroque (grand amfroque) 27 IND (2020) razorbill recorded at Longue Pierre 50-70 Guillemot (2020) recorded at Longue Pierre 11 razorbill (2020) recorded at Godin & Galeu Jethou is located off the southwest coast of Herm and is currently closed to the public. With smaller islands to the north and the south. The Humps are located off the northeast coast of Herm, comprising of 9 rocky islets and 6 sand banks. The Humps are privately owned are therefore boats cannot land on the islands. Common Guillemot (*Uria aalga*): Guillemot was one of the worst affected species by the 2014 Seabird Wreck with 14,339 emaciated corpses being washed up on the shores of the Channel Islands, France and Southern England. It was pleasing then to find a large colony on Longue Pierre, surpassing ringing teams observations in previous years, with as many as 120 individuals occupying the North-Eastern face of the islet. Whether all of these birds were attempting to breed could not be definitively stated as the surveying team did not land on the island; however their abundance can certainly be seen as a positive sign for local populations and our maritime ecosystems. Razorbill (*Alca torda*): Razorbill populations were found to remain relatively stable in the 2015 Seabird Count. Nine individuals were observed amongst the Guillemot colony on Godin; with a further 20 on Longue Pierre's North Eastern face seen emerging from fault in the rock face.	No further information received
Alderney (multiple islands/islets)	-	Alderney: 780	Alderney: 2,020 (2015)	Guillemot: 225 IND (2021) Razorbill: 99 IND (2021)	Fulmar Shag Storm petrel Gannet Herring gull LBB gull	Brown rat and/ or black rat	No further information received	No further information received

Area	Designation (where relevant)	Size (ha)	Inhabited by Humans?	Bird Population	Other Key Species	Predators (NBN source)	Additional Information	Site management plans
					GBB gull Common tern Puffin			
Sark	-	545	500	Guillemot: 257-327 IND (2015) Razorbill: 45 IND (2015) (Vernon and Vernon, 2015)	-	Brown rat and/ or black rat	Common Guillemot (*Uria aalga*): Guillemot was one of the worst affected species by the 2014 Seabird Wreck with 14,339 emaciated corpses being washed up on the shores of the Channel Islands, France and Southern England. Razorbill (*Alca torda*): Razorbill populations were found to remain relatively stable in the 2015 Seabird Count. However, once again it was on Sark where the healthiest populations were found, with a count of 45 individuals, the majority of which were found at Grand Moie.	No further information received

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