Written Representation

for the

Royal Society for the Protection of Birds

Annex B

Compensation proposals

Comments on selected Deadline 5 and Deadline 5a submissions

Submitted for Deadline 6

27 July 2022

Planning Act 2008 (as amended)

In the matter of:

Application by Hornsea Project Four Limited for an Order

Granting Development Consent for the Hornsea Project Four Offshore Wind Farm

Planning Inspectorate Ref: EN010098

RSPB Registration Identification Ref: 20029909

Contents

1. Introduction

Scope of submission

1.1. Below, the RSPB sets out its comments on the Applicant's compensation proposals based on a review of the documents submitted by the Applicant at Deadlines 5 and 5a. The RSPB's comments are structured as follows:

- Section 2: Strategic compensation;
- Section 3: How we have assessed the compensation measure proposals;
- Section 4: Guillemot and razorbill compensation – introduction;
  - Section 5: Predator eradication compensation measure;
  - Section 6: Bycatch reduction compensation measure;
- Section 7: Kittiwake compensation;
- Section 8: Gannet compensation;
- Section 9: RSPB's overall view on the state of play with species' compensation proposals.

1.2. We have sought to distil our comments on these proposals in order to assist the Examining Authority to identify where significant gaps remain in the evidence base needed to have confidence in the suitability and deliverability of the compensation measures to protect the overall coherence of the National Site Network for each species. Therefore, we have not provided exhaustive comments on the lengthy documents submitted by the Applicant.

1.3. For each compensation proposal, we assess the current proposals against the criteria for compensation set out in our main Written Representation (REP2-089) and subsequent submissions, and accord them each a Red, Amber, Green rating (see section 3). This applies primarily to the guillemot and razorbill compensation measures, for which substantive new information was provided at Deadlines 5 and 5a. Abbreviated versions of this assessment are presented for the kittiwake and gannet compensation measures with relatively minor updates presented at Deadlines 5 and 5a.

2. Strategic compensation

2.1. In this section, we respond to the Applicant's proposals relating to the use of "strategic compensation".

Summary of Hornsea Project Four approach to strategic compensation

2.2. In its various compensation roadmaps and related documents submitted at Deadline 5, the Applicant has set out its revised approach to the matter of strategic compensation. This includes amendments to the compensation scheme set out in substantive revisions to Schedule 16 (Compensation to protect the coherence of the National Site Network).

2.3. The overall approach is set out in REP5-086 (Orsted's approach to strategic ecological compensation, Revision 01). The Applicant outlines:

- the wider context of the British Energy Security Strategy (BESS),
- the Defra "Offshore Wind Environmental Improvement Package" initiative which has only very recently offered an "opportunity to comment" on its initial ideas, and which includes reference to a future possible "Marine Recovery Fund";
- industry-led work on strategic compensation under the auspices of the Offshore Wind Industry Council's Derogation Sub-group, working in partnership with the Pathways To Growth (P2G), most recently focusing on the early development of strategic compensation pilot studies;
- The scope of those proposed pilot studies (section 6, REP5-086) and reference to a recent series of workshops on each pilot study in mid-June 2022 which invited Statutory Nature Conservation Bodies, environmental NGOs (including the RSPB) as well as Government representatives from BEIS and Defra. The topics presented at the four strategic compensation pilot study workshops were:
    - Artificial nesting (offshore) for seabird compensation e.g. through a repurposed asset or new structure;
    - Predator control or eradication for seabird compensation;
    - Habitat creation, primarily for benthic compensation; and
    - Infrastructure removal or repurposing (options include: repurposing for artificial nesting for seabirds; repurposing for artificial reef creation; and removal of defunct infrastructure).

  We make reference to some of the outputs of these workshops below where they are relevant to the Applicant's proposals.

2.4. In practical terms, the Applicant has made amendments to each part of Schedule 16 that covers the different compensation plans. However, they essentially set out the same proposed approach as an alternative to the project level compensation proposals which have been the focus of the Applicant's proposals to date. That approach is:

- The relevant Compensation Implementation and Monitoring Plan (CIMP) is submitted to the Secretary of State for approval, following consultation with the Hornsea Four Offshore Ornithology Engagement Group (OOEG).

- In addition to setting out the information relating to the required project level compensation, the CIMP shall include:
    - Provision for the undertaker to pay a contribution to the Marine Recovery Fund (or its equivalent);
    - That contribution to be wholly or partly in substitution for:
        - The required compensation measure; and/or
        - An adaptive management measure set out in the CIMP;
    - The sum of the contribution is to be included in the CIMP following agreement between the undertaker and Defra, and consultation with the OOEG.
    - Exercising of the option to contribute to the "Marine Recovery Fund" is at the sole discretion of the undertaker.
    - Any decision to exercise this option disapplies the relevant requirement related to project level compensation measures or adaptive management measures.

RSPB views on strategic compensation in the context of the British Energy Security Strategy and Defra Offshore Wind Environmental Improvement Package

2.5. As referred to immediately above, industry (individually and in collaboration through RenewableUK's Pathways to Growth (P2G) workstream) and Government bodies such as Natural England, Defra, NatureScot and Marine Scotland have been exploring the concept of strategic compensation. Strategic compensation has been identified in the BESS as integral to the expansion of offshore wind. Natural England's approach to offshore wind states:[1]

> "Designing a strategic system of compensatory measures allows the early stages of development planning to make compensatory requirements clear at plan-level. Compensatory measures must be ecologically effective, and this is more likely if also delivered at a wider strategic scale than the individual development, as bigger, better measures can be implemented."

2.6. The RSPB has welcomed these efforts in exploring the concept of strategic compensation, it having now been clearly identified as a key solution and therefore integral to the future expansion of offshore wind.

2.7. However, we do not yet know what mechanisms or ecological measures strategic compensation could include in practice. Working strategically and co-operatively clearly presents an opportunity to implement measures at greater geographical scales and across sectors and administrative boundaries. This approach will be essential to delivering meaningful and effective measures for seabirds as will expanding the reach of compensatory measures that benefit nature but are outside the gift of individual offshore wind developers. However, we consider it will be some time before we have all the answers.

2.8. The Defra Marine Recovery Fund and/or centralised coordination of developer funded action could help facilitate strategic measures for nature recovery. To be considered

[1] Natural England (2021) Natural England's Approach to Offshore Wind. Our ambitions, aims and objectives. Technical Information Note TIN181.

compensation, these strategic measures must benefit the impacted species and/habitats. To be considered recovery, measures must go beyond making good ecological losses.

2.9. However, the Marine Recovery Fund itself does not yet exist, nor are there any solid details on when it will be set up, its governance, the standards it will set and adhere to, nor the legal and financial mechanisms it will adopt in respect of both securing, implementing, monitoring and managing compensation and recovery measures. Therefore, with the best will in the world, it would be wholly inappropriate to rely on the Marine Recovery Fund (or some unspecified equivalent) as a mechanism by which to deliver the compensation required for the Hornsea Four project.

RSPB view of Hornsea 4 proposals on strategic compensation

2.10. As stated above, the RSPB welcomes the national level discussions on strategic compensation. However, it is evident that there is no system of strategic compensation currently in place, or which will be in place when the Secretary of State has to make a decision on the Hornsea Four DCO (by February 2023). Therefore, the Secretary of State will not be able to rely on strategic compensation as an alternative to the Applicant's project level compensation.

2.11. The Offshore Wind Industry Council's Derogation Sub-group/Pathways To Growth pilot studies described are embryonic, with no detail available to assess them. The limited information that is available confirms the RSPB's view that no weight should be placed on the Applicant's strategic compensation proposals, including their application to adaptive management measures.

2.12. This is most evident in connection with the repurposing of offshore structures e.g. for artificial nesting. As we set out in more detail in section 7 below, it is evident that the regulators (BEIS and OPRED) have significant concerns regarding the repurposing of offshore infrastructure which has resulted in them requesting a pause in the proposed pilot study work.

2.13. The embryonic nature is also evident in connection with predator eradication following the RSPB's review of the Applicant's current project level proposal (see section 5 below).

2.14. The Defra Marine Recovery Fund and/or centralised coordination of developer funded action could help facilitate strategic measures for nature recovery in the future. However, the Marine Recovery Fund itself does not yet exist, nor are there any solid details on when and how it will be set up and managed.

2.15. Therefore, it is the RSPB's view that "strategic compensation" is not yet at a sufficient stage of development and implementation whereby the Secretary of State can rely on it as an alternative to the Hornsea Four provision of project level compensation measures. Therefore, it cannot be relied on as a compensation measure with a reasonable guarantee of success of protecting the coherence of the UK National Site Network for the impacted species.

3. How we have assessed the compensation measure proposals

3.1. For each compensation proposal, we have assessed the current proposals against the criteria for compensation set out in our main Written Representation and subsequent submissions (and listed them below), and accorded them each a Red, Amber, Green rating.

- Targeted
- Effective
- Technically feasible
- Extent
- Location
- Timing
- Long-term Implementation
- Additionality

3.2. The RSPB's Red, Amber, Green (RAG) rating is assessed as follows:

- RED: Criteria not met and substantive issues relating to viability and feasibility of the measure are unresolved. Substantial evidence gaps remain. Unless complex issues resolved before consent, RSPB advice is that the Secretary of State cannot conclude that the coherence of the National Site Network for the affected species will be protected.
- AMBER: Criteria not fully met: significant issues relating to viability and feasibility of the measure are unresolved. Significant evidence gaps remain. Unless these issues are resolved before consent, the RSPB advice is that the Secretary of State is at risk of agreeing to a compensation measure that will not protect the coherence of the National Site Network for the affected species.
- GREEN: Criteria met. No substantive or significant issues relating to viability and feasibility of the measure remain. Any remaining issues are relatively minor and could be dealt with through requirements under the DCO.

3.3. Abbreviated versions of this assessment are presented for those species' compensation measures with relatively minor updates at Deadlines 5 and 5a: kittiwake and gannet.

3.4. Where possible, we have then set out what additional information, on the feasibility and viability of the compensation measure, we consider the Secretary of State requires before they are able to decide on whether to consent the DCO. This includes whether or not, having received that further information, we think it would be advisable for the Secretary of State to re-open consultation on the compensation proposals with Interested Parties before determining the DCO.

3.5. We have included, where we consider it helpful at this stage, some additional comments specific to matters arising from the documents submitted at Deadlines 5 and 5a.

3.6. We have sought to avoid making exhaustive comments to focus on the key outstanding issues at this stage of the examination to assist the Examining Authority.

A note on the magnitude of compensation required

3.7. Agreement has yet to be reached on:

- The scale of predicted impact on each of the four seabird species, and the extent of the uncertainty around the prediction, from the Flamborough and Filey Coast SPA that would need to be compensated for;
- How that scale of impact is converted into appropriate and robust compensation objectives for compensation measures. For example, for guillemot and razorbill this would need to be based on (i) improving breeding populations outside the UK (predator eradication) and (ii) improving survival of non-breeding birds from unknown populations (bycatch reduction). See section 2 in RSPB REP4-057 (calculation methods) and section 3 in REP5-120 (compensation connectivity) for more detailed comments on these matters.
- How that affects the magnitude of benefit that each compensation measure needs to generate in order to protect the coherence of the UK National Site Networks of the impacted species.

3.8. Currently, the RSPB does not consider the Applicant's description of what scale of compensation is required is appropriate and therefore there is no agreement on this critical issue.

4. Guillemot and razorbill compensation – introduction

4.1. Before setting out its view on the compensation measures for guillemot and razorbill, the RSPB wishes to welcome the work done by the Applicant to date to progress understanding in respect of its proposed compensation measures of predator eradication and bycatch reduction.

4.2. However, we can only assess the feasibility and viability of the compensation measures, and their likelihood of a reasonable guarantee of success in protecting the coherence of the UK National Site Network, based on the information and evidence submitted to the examination. Therefore, the RSPB's assessment and advice to the Examining Authority and Secretary of State is based on the submitted material rather than the theoretical potential of the measure.

5. Guillemot and razorbill compensation – Predator eradication

5.1. In its previous submissions[2], the RSPB has set out what elements it considered essential to be submitted to the Examination before a proposal to deploy island restoration/predator eradication as a compensation measure for specific bird species could be properly assessed. These justifications and assessments are necessary to determine if the proposed work would have a reasonable guarantee of success as a compensation measure for the relevant seabird species, in line with Defra and EC Guidance on compensation. Those elements included:

- Clear assessment of suitable sites where compensation measures will be delivered (i.e. site selection justification) to include:
    - **Assessment of beneficiary seabird species**: presence/absence, historic/current population, habitat suitability survey, vulnerability to the Invasive Non-Native Species (INNS) targeted for removal to show potential benefit;
    - **Up to date survey of INNS**: on both target islands and areas from where they could reinvade;
- **Full-scale Feasibility Study** in line with the Manual of the UK Rodent Eradication Best Practice Toolkit (2017). This would include (but not be limited to) information to answer three overarching questions:
    - Can it be done? (from which follows an assessment of seven key criteria: technical feasibility, eradication sustainability, capacity, affordability, and political/legal, social and environmental acceptability)
    - What will it take? (an overview of the likely operation and biosecurity requirements is provided)
    - Is it worth it? (an assessment of the expected benefits compared to any disbenefits such as risks to non-target species)
- **Explanation as to how the measure would be implemented**: setting out how the selected predator eradication strategy will be implemented on the target islands, and how the benefits will be sustained and monitored. In line with the UK Rodent Eradication Best Practice Toolkit this work entails the production of;
    - **A Project Plan** covering objectives and measurable outcomes, milestones and 'stop points', governance structures, a risk register, and communications planning;
    - **Detailed biosecurity and emergency response plans**: based on proper understanding of the risk of reinvasion of target INNS;
    - **Detailed operational plan**;
    - **Detailed monitoring and evaluation plan**.

5.2. It had been the RSPB's expectation that this information would be submitted at Deadline 5 to enable expert evaluation and provision of advice to the Examining Authority.

5.3. However, the Applicant has amended its roadmap such that only additional preliminary information has been submitted up to and including Deadline 5a, rather than the

[2] See REP2-089 (main written representation) and Annex C (REP2-093) on Predator Eradication.

information described above e.g. full Feasibility Study against the 7 criteria set out in the UK Rodent Eradication Best Practice Toolkit (and associated implementation plans, Biosecurity and Emergency Response Plans). This significant change is evident in the edits made to paragraph 5.1.1.2 in Revision 02 of the "Predator Eradication island suitability assessment: Bailiwick of Guernsey (tracked)" (REP5-058).

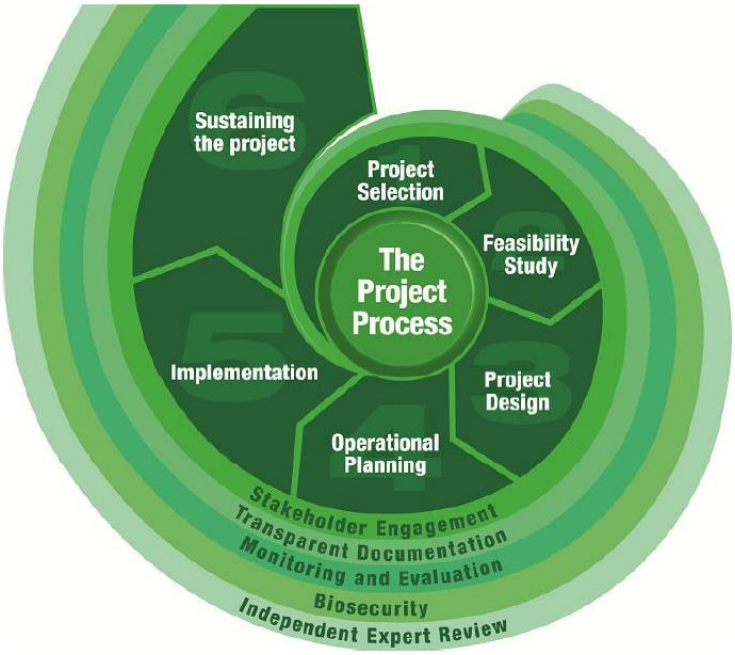
5.4. While we welcome the additional preliminary information and the described ongoing work (gathering further site information on predator presence, seabird populations etc.), the information submitted into the Examination falls substantially short of what was expected and remains preliminary and incomplete in nature. The promised Feasibility Study and Biosecurity Plan is only to be made available to stakeholders "if required" and only after the end of the examination e.g. see paragraphs 1.2.1.1-1.2.1.2 in "Predator Eradication Implementation Study Update" (REP5-082).

5.5. Based on the information provided by the Applicant to date, we consider it has only reached the preliminary phase of the "Project Selection" (Stage 1) in the life cycle of an eradication project. This is set out in Figure 1 of the Manual of UK Best Practice for Rodent Eradication (see Appendix 1 in RSPB REP2-093). We have repeated it here as Figure 1 for ease of reference.

5.6. The Manual of UK Best Practice for Rodent Eradication distils the project life cycle into stages, each with key documentation required. The RSPB would have expected the following stages to have been completed and the relevant documentation submitted to the examination for evaluation by Interested Parties and the Examining Authority:

- **Stage 1**: justified "**project selection**";
- **Stage 2**: **Feasibility Study**;
- **Stage 3**: a "**project plan**" (containing detailed information governance, management and decision making);
- **Stage 4**: various documents including **Operational Plan, Biosecurity Plan** (including emergency response plan), **Monitoring and Evaluation Plan**.

Figure 1: The Process diagram showing the typical stages in the life cycle of an eradication project (modified from the Pacific Invasive Initiative's Resource Kit)(also Figure 1 from the Manual of UK Best Practice for Rodent Eradication)



5.7. Critically, the Applicant has not yet completed a systematic scoping exercise which is an intrinsic part of **Stage 1, project selection.** This starts with a careful assessment of distribution and impact of INNS across potential sites, likely benefit to seabird species of their removal, and risk of INNS reinvasion to a site. From this, it should be apparent which islands would be a priority for further (feasibility) investigation and which should be identified as being unlikely to deliver appropriate benefit (or compensation in the context of Hornsea Four). Islands or groups of islands (as necessary) can then be identified as defendable 'eradication units'[3] and these eradication units should then be the basis on which a feasibility study was undertaken. Project scoping enables islands or island groups to be ruled out where either:

- there is no likely benefit to seabird species; or
- an eradication project is deemed unsustainable due to the nature or extent of measures that would be required in perpetuity to manage the risk of reinvasion.

5.8. As a result, the Applicant has not yet set out:

- a detailed and coherent strategy which describes its island selection strategy;
- how and why it has applied it to finalise its site selection, along with the required information to assess how that strategy will be implemented in both the short and long-term on a sustainable basis; coupled with

[3] An "eradication unit" would comprise one or more islands identified as likely to deliver compensation but may also include one or more islands from which INNS need to be cleared in order to sustain the benefits of the eradication from the priority islands.

- appropriate biosecurity and emergency response plans.

5.9. **In simple terms, the Applicant has failed to set out precisely what it intends to do and where it intends to do it, and how it will meet the compensation objectives.**

5.10. As will be evident from our comments below, we consider the current information falls substantively short of the critical information required to evaluate whether a predator eradication scheme is:

- feasible and also sustainable ('defendable') over the long-term;
- capable of providing benefit to breeding guillemots and razorbills; and
- suitable to form a compensation measure that the Secretary of State can be confident will protect the coherence of the UK National Site Network for each species.

5.11. In order to help the Examining Authority (and Secretary of State) understand how far short the submitted information is compared to the evidence we consider is necessary, we recommend the Examining Authority read the following extracts from the Manual of UK Best Practice for Rodent Eradications. These should be compared against the information provided to date by the Applicant. We provided the first three of these in Appendix 1 to RSPB REP2-093. We have provided the three worked examples as Appendix 1 to this submission:

- Manual – UK Best Practice for Rodent Eradications (see REP2-093)
- Annex 1: Eradication techniques in the UK (see REP2-093)
- Annex 4: Biosecurity Planning and incursion response (see REP2-093)
- Worked example: Feasibility Study
- Worked example: Operational Plan
- Worked example: Biosecurity Plan.

5.12. The RSPB considers this detail cannot be left to the post-consent period. Rather it is fundamental to an assessment of whether or not the proposed eradication strategy passes all seven feasibility criteria and will provide the required benefits to the seabird species, here guillemot and razorbill. This in turn will inform the decision as to whether the measure can be considered a compensation measure with a reasonable guarantee of success and so meet the legal tests.

5.13. Many of the sites of apparent interest to the Applicant will be reinvaded and the Applicant indicates reinvasion will be managed (and hence supposed compensation delivered) via non-toxic lethal control devices. However (where such information is provided) the abundance index of rats across all sites of apparent interest to the Applicant is low. The Applicant should describe how these control devices will significantly reduce the rat abundance index below its already very low level, otherwise those devices will provide no benefit and hence no contribution to the compensation measure.

5.14. Table 1 below synthesises and summarises the RSPB's review of the following documents against the EC criteria on compensation (see Table 4 in REP2-089 for fuller description):

- REP5-082: G5.4 Predator Eradication Implementation Study Update - Revision: 01 (update);

- REP5-058: G1.33 Predator Eradication Island Suitability Assessment: Bailiwick of Guernsey (Tracked) Revision: 02;
- REP5a-019: G5.35 Predator eradication and control opportunities within the Bailiwick of Guernsey - Revision: 02;
- REP5-031: B2.8.4 Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Predator Eradication: Roadmap (Tracked) - Revision: 04.

Table 1: the RSPB's comments on the Hornsea Four predator eradication compensation measure proposal against compensation criteria

EC criteria [See Table 4 in REP2-089 for fuller description]	**RSPB RAG rating (Red, Amber, Green)**	**RSPB key observations based on current proposals and information provided**
Targeted - Appropriate to impact predicted - Shared understanding and agreement on impacts - Address structural/functional aspect of site integrity affected		- Focus of documents is on guillemot (see para 1.1.1.12, REP5-058, Island Suitability Assessment) based on the assumption that the compensation requirements for razorbill are low and suitable nesting sites will be available. (See **Extent** and paragraphs 3.7-3.8 above on magnitude of compensation.) - The Applicant frequently equates presence of a predator (e.g. rat) in a colony of birds with predation. While it presents limited evidence of this in some locations, more substantive evidence is needed to distinguish between scavenging and predation in order to assess any claimed benefit. - Lack of coherent strategy with clear, defendable eradication units, and incomplete information (see **Effective**, **Technically Feasible** and **Location**) mean it is not possible to determine if the measure will target guillemot and/or razorbill in practical terms. - No assessment of impacts of proposed plans on non-target species (see also **Technically Feasible**).

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
Effective - Based on best scientific knowledge. Scientific evaluation carried out - Specific to the location to be implemented - Clearly defined timescales - Feasible and operational in reinstating required conditions - Measures where no reasonable guarantee of success should not be considered		The RSPB welcomes the work to date and the various statements that surveys into breeding birds, habitat suitability and presence of INNS are ongoing. This raises the prospect that relevant, fuller information may be acquired in due course and could be made available to Interested Parties and the Secretary of State as part of a post-examination consultation process. However, due to the lack of a coherent strategy at this stage (which could have given confidence in how such information would be anlaysed and applied by the Applicant in any future Feasibility Study etc), we are unable to rate this as Amber. **Breeding bird presence/habitat suitability** - Variation in quality of source information used for assessment is not clear on a site by site basis. - Methodology on use of pictures of islands is unclear. No explanation given as to why, for islands which were photographed, all areas of suitable cliff not photographed. - Methodology for each site should be summarised in a table. Do not consider sites assessed without local expert knowledge or where oblique images used to make measurements. **Assessing benefit to guillemot/razorbill** - Documents make general assumption (without evidence) that breeding productivity will automatically be enhanced by removal of INNS without ruling out other factors that may explain the absence of guillemot or razorbill or them not occupying all suitable habitat (see also **Targeted**). - This feeds into the strong implication (e.g. paras 5.1.1.1-2 in REP5-082 Predator Eradication Implementation Study Update) that islands will be colonised by guillemot and razorbill after eradication, regardless of whether the Applicant has confirmed presence of rats or not and, in particular, whether the absence of the birds on those islands is due to

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		rats or other factors. For example, the claim of "profound benefits" to guillemot and razorbill from rat eradication in para 3.2.1.3 of REP5a-019 (Predator Eradication and control: Opportunities within the Bailiwick of Guernsey). - Whilst it is not necessary to know if rats are present on every island within an eradication unit (as a precautionary approach should be taken and all islands within the unit should be assumed to host rats and hence be baited) it **IS** necessary to have this information if the calculation of benefits to guillemot and/or razorbill is based on the assumption that rats ARE present, when in fact that information is not known. - Therefore, for some of the possible islands there may be no benefit to guillemots or razorbills, despite the assumptions made by the Applicant. - No productivity analysis is yet presented to demonstrate relevance of this assumption to potential locations. Only one productivity dataset is intended to be provided (post examination): a single season will not account for natural fluctuation. Therefore, assumed benefits are unproven and certainly not site specific at this stage. **Use of A24 traps to reduce predation pressure** - Given rat density is already low, it is unclear what benefit there will be in the use of these traps.
Technically feasible - Design must follow scientific criteria and evaluation in line with best scientific knowledge - See also Effective		- **No feasibility assessment:** the Feasibility Study (which addresses 7 criteria specific to eradication schemes) is explicitly deferred until after the examination (e.g. see para 5.1.3.9-5.1.3.12 in REP5-031, Roadmap Version 4, in particular logistical considerations). Compounded by lack of explicit site selection (see **Location** below). - **Incomplete surveys and results:** Incomplete information, alongside assumptions rather than evidence.

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		Not all sites have yet been surveyed for: o Breeding bird presence or habitat suitability (compounded by inconsistent survey and assessment methods) o Presence/absence of INNS. 9 of the 19 islands/islets listed in Table 6 (REP5-058) were not surveyed to confirm presence/absence. As set out above, while it is appropriate to assume INNS presence from a baiting operation perspective, it cannot be assumed that baiting a site that may or may not host rodents will benefit razorbill or guillemot. - **No clear eradication strategy set out:** lack of detail on how eradication at each island/island group will be undertaken, what the eradication units will be, and what is being committed to e.g. eradication to zero density or merely ongoing control. o Implication that Sark will only be subject to "control" perpetuating risk of continued reinvasion of adjacent islets (see para 5.3.1.1 in REP5-082). - **Use of A24 traps**: the implication that, post-eradication, reliance will be placed on the use of Goodnature A24 kill traps to reduce predation pressure. Given the recorded rat density is low already, it is not made clear what the benefit will be of this measure, nor is evidence provided of A24 efficacy in similar situations. - **Community support:** demonstration of community support inadequate – based on very low sample (see separate comment below, paragraphs 5.15-5.21) - **No assessment of other risk factors:** No assessment/mention of other factors that increase risk of failure/incursion, nor how they would be managed. For example, presence of waste management sites on Alderney close to some potential sites. No data presented that assesses the risks to non-target species (see also **Targeted**).

EC criteria [See Table 4 in REP2-089 for fuller description]	**RSPB RAG rating (Red, Amber, Green)**	**RSPB key observations based on current proposals and information provided**
		- **Lack of biosecurity plan:** no biosecurity plan presented and unclear when it will be put in place e.g. see paragraph 3.1.1.1 in REP5a-019 and reference to use of adaptive management for biosecurity. This cannot replace need for detailed biosecurity plan.
Extent - Relates directly to quantitative and qualitative element of integrity likely to be impaired - Estimated effectiveness of measure - Key uncertainties identified and factored in - [If no reasonable guarantee of success should not be considered]		- Agreement has yet to be reached on the scale of the impact to be compensated for on guillemot and razorbill from the Flamborough an Filey Coast SPA. This is due to the delays in the submission of updated baseline characterisation and revised impact assessment information until Deadlines 5 and 5a (see Annex A for the RSPB's view on the new information). - Agreement would then need to be reached on: o the scale of impact to be compensated for each species; o how that should be converted into relevant population metrics in order to describe robust compensation objectives, including number of birds that need to be recruited into the UK National Site Network population each year (see paragraphs 3.7-3.8 above) o Detailed assessment of the likely effectiveness of the proposed compensation measure in the selected island/island group in respect of improvements in productivity; o Assessment of the likely level of connectivity of birds reared in the selected location to the species' UK National Site Network and the likely level of recruitment of those birds into the population in that National Site Network (see also RSPB REP5-120, section 3 on connectivity, especially paragraphs 3.12-3.23). o From this, an adjustment could be made (ratio) to determine the number of additional breeding pairs and fledged young required each year.

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		- At present we do not have agreement on any of these matters and serious concerns with regard the level of connectivity, let alone the likely level of successful recruitment.
Location - Located where they will be most effective to protect coherence of species' National Site Network - Must be able to provide ecological structure and functions required by species		- **Lack of site selection strategy:** No site selection strategy presented, how islands/islets or groups of islands will be categorised for selection purposes, and no final site selection. - **No coherent approach to site selection:** currently no discernible coherent approach to site selection. Lack of structured approach to island/island group selection, what is scoped in and out. Compounded by incomplete information on INNS presence, evidence of predation, benefit to guillemot/razorbill. - **Opaque approach to reinvasion risk:** the Applicant has, to date, failed to set out its approach to the identification of eradication units. Instead, it has focused on describing individual islands/islets. This non-standard practice makes it difficult to discern its likely eradication strategy. Other issues include: o Lack of biosecurity plan means no current information on how Applicant has identified and intends to manage natural and assisted reinvasion risks. o The RSPB does not accept that a site 50m from a source population of black rat is highly likely to be reinvaded but an island 52, 54 or 55m would be at significantly reduced risk of reinvasion by the species. - **Island characteristics:** Table 6 (island suitability update, REP5-058) requires improvement and confirms view that strategy is not clear: o Refers only to guillemot o Only 10 out of 19 islands confirmed to have rats present. o Does not state which species of rat present. Each poses different risk to guillemot and razorbill (see RSPB REP2-093, section 4).

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		o Does not state distance from each island to those islands where no intention of eradicating rodents. This is an essential characteristic to understand.
Timing - Must provide continuity in ecological processes to maintain structure/functions contributing to species' National Site Network - No irreversible damage before compensation operational - Should be fully functional before damage occurs - All technical, legal or financial provisions completed before project implementation starts to prevent delays to effective compensation		- Significant problems remain that pose challenges in respect of ability to implement a successful predator eradication programme as a compensation measure, and therefore the timing and effectiveness of implementation in respect of compensating for the predicted damage: o Lack of site selection strategy and associated Feasibility Study, Implementation Plan, Biosecurity Plan for expert assessment o Lack of full survey results in respect of breeding seabirds, and presence/absence of INNS o Lack of robust assessment on potential benefit of proposed strategy to guillemot and/or razorbill; o Lack of robust assessment of benefit to UK National Site Network for guillemot and razorbill. - This includes a fuller understanding of: o The timescales over which any benefits to guillemot and razorbill will accrue at the predator eradication sites; o The magnitude of any improvements in productivity against current (baseline) productivity; o The sustainability of any positive changes in population and productivity, including long term recruitment to Guernsey; o The likelihood of any birds reared in Guernsey being recruited into the UK National Site Network for either species and the timescales for achieving that, given the long-delay before fledged birds reach breeding age (typically 5-6 years for guillemot and 4-5 years for razorbill). This

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		is likely to result in a considerable time lag before any benefit to the UK National Site Network occurs (even assuming that such benefits accrue, which the RSPB considers to be unsubstantiated e.g. see comments on connectivity in REP5-120).
Long-term implementation - Legal rights to secure and implement compensation measures in place prior to consent being granted - Financial security secured - Protection, monitoring and maintenance of sites secured before consent - In place for as long as impact on affected SPA occurs		- Lack of precise strategy and locations means legal rights cannot be guaranteed to be secured prior to consent being granted; - Lack of clarity over level of protection to be afforded selected locations (c.f. UK Government policy to afford compensation sites that same level of protection as SPAs and SACs) - Lack of commitment to maintain the compensation in place for as long as impact on affected SPA occurs. Commitment is only for 35 year lifetime of wind farm plus 3 years.
Additionality - Measures must be additional to those already required - Able to demonstrate claimed benefits are additional to current baseline (e.g. breeding population, productivity etc)		- The fundamental challenge is the ability to demonstrate: o If any benefit will accrue at the local (Channel Islands) level e.g. whether any apparent population change is simply birds redistributing or responding to other factors besides the predator eradication o Whether any local (Channel Islands) benefit that is observed will result in benefit to the UK National Site Network for the species. - Using Alderney as an example: o Inclusion of locations (e.g. Fourquie, La Nache) where predator control work is already underway is inappropriate and would not be compensation. In addition, given the proximity of e.g. Fourquie, La Nache to the main island of Alderney, and the ongoing risk of reinvasion, this should not be considered eradication.

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		o A defendable eradication including these islets would need to include Alderney itself. Only Burhou (more than 2km from Alderney) would avoid the need to include Alderney in its eradication unit. o L'Etac de la Quiore: no rats present and no guillemots breeding, with no explanation as to why. Unclear how this could offer additionality.

Additional specific comments

Community support survey

5.15. As the RSPB has set out (see paragraphs 3.9-3.12 in REP2-093), full community support is essential to a successful eradication scheme both in the immediate implementation and over the long-term. Whilst this is particularly the case for eradications on inhabited islands, it is also important for work on uninhabited islands (as neighbouring inhabited islands are often the key risk/source for reinvading rodents).

5.16. The Applicant carried out a questionnaire survey of residents of Herm and Sark to gauge community support for eradication (see REP5-082 Implementation Update). Further community engagement is promised (see para 5.3.1.2 of REP5-082), although the results of that work will not be available to the Examination. The community on Alderney was not surveyed and it is not clear if it will be.

5.17. Therefore, we have restricted our brief comments here to the questionnaire and the results presented to date.

- The questionnaire does not contain a structured question relating to determine the level of support for a rat eradication project, relying on a free text box c.f. structured questions used throughout the rest of the questionnaire. Therefore it has been left to interpretation of comments, the text of which has not been supplied;
- The Applicant claims "the majority of people supported control and/or eradication of rats" (para 5.3.1.1). This is misleading given the low number of responses in relation to the populations of the islands surveyed.

5.18. In Table 2 below, we have attempted to place the number of responses received in the context of the population of the islands surveyed. We recognise this will underestimate the level of response as the overall population includes children. However, it gives an indication of the significant amount of additional work required to secure full community support as this will also need to address non-residents and residents of other islands which pose a biosecurity risk e.g. boat operators, tourist operators etc.

Table 2: approximate proportion of island residents completing Applicant's questionnaire survey

Island Group	Completed questionnaires	Current population	Approximate percentage of current population surveyed
Herm & Jethou	9	87[4]	10%
Sark	31	500[5]	6%

5.19. As a consequence, the RSPB considers it is not yet possible to ascertain whether or not there is community support for an eradication project on the two island groups surveyed. There is no equivalent information for Alderney.

5.20. This is exacerbated by the lack of a clear and coherent strategy for predator eradication. This means it is not yet possible to provide relevant information to community members as to what would be involved in any such eradication programme.

5.21. In conclusion, essential community support is not yet in place, placing any proposed predator eradication scheme at significant risk of failure.

Use of A24 traps kill traps to avoid the risk of rodenticide resistance

5.22. In REP5-082 (para 2.1.1.5), REP5-058 (para 3.1.1.4), REP5-031 (para 2.1.1.5) and REP5a-019 (paras 2.1.1.6 and 5.1.1.1), the Applicant proposes the use of kill traps (e.g. Goodnature A24) as an alternative to rodenticide. This is to reduce risk of rodenticide resistance and on-going secondary poisoning risks to non-target species as a means of including islands and islets in close proximity to main islands and therefore at high risk of reinvasion (para 5.1.1.1, REP5a-019).

5.23. Goodnature A24 traps are self-setting traps meaning they can be left in the field without the requirement for frequent servicing. They get their name from their ability to kill 24 rats (or non-target species, they are not species-specific) before needing a new gas canister. The long-term efficacy of these traps for eradication purposes has not yet been established.

5.24. Reference is made by the Applicant to the use of A24 traps on Handa (para 2.1.1.6, REP5a-019). Handa was the subject of an historic eradication project but was subject to reinvasion by rats in 2012. The RSPB's Biosecurity for LIFE project, in conjunction with partners, is currently carrying out an experimental trial on Handa to determine whether the A24 trap can be used to manage rat numbers adjacent to seabird colonies. That trial is ongoing and has not yet published any findings. If the Applicant is looking to rely on the use of A24s to

[4] Table 6.1.1 in Guernsey Government Annual Electronic Census Report 2021: [redacted] (accessed 12 July 2022)

[5] See Sark Government website: [redacted] accessed 12 July 2022)

sustain the assumed benefits of rodent eradication it should provide evidence of where this has been achieved elsewhere to "zero density"[6].

Dealing with reinvasion: Round Island, Isles of Scilly and other case studies

5.25. In section 4 of its most recent submission (REP5a-019), the Applicant sets out information it states relates to the benefits of control as opposed to eradication. One of these observations refers to Round Island in the Isles of Scilly, while others relate to examples from around the world. We take each in turn.

- **Round Island, Isles of Scilly**: various islands across the wider archipelago of Scilly have had control carried out over the last twenty years with varied success (in terms of sustaining removal) and limited known benefits, culminating in a review by the Isles of Scilly Wildlife Trust to determine whether this approach was having any impact and was financially viable. The result was that they stopped all of this work, as they considered that the only sustainable approach would be eradication across all the remaining 'off islands' and uninhabited islands in one go.

  The control of rats on Round Island was carried out as an emergency biosecurity response measure as this island is the second most important, productive site for burrow nesting seabirds on the islands. This island has been considered rat free for a long time (20+ years). Therefore, based upon our historical knowledge it was considered any work would be likely to have at least medium-term benefit and therefore was worth carrying out as an interim measure until wider more sustainable island restoration was possible. This is knowledge that is not available for most, if not all, of the Channel Islands.

- **Studies for other islands (section 4.2):** all of the seabird species mentioned that were deemed to benefit from the additional control measures were burrow nesting. Therefore the stated benefits (increase in reproductive success and survival; population increase; and recolonization) are not comparable to the cliff nesting auk species of concern here (guillemot and razorbill).

Summary of RSPB assessment of predator eradication measure

5.26. The RSPB considers that we are still only part way through the project selection stage in Figure 1 above and therefore, there is not a clear compensation proposal in front of the examination. Based on the above assessment, we have summarised in Table 3 below the key information we consider the Applicant should be required to submit to the Secretary of State before a decision on whether to grant consent for the DCO is made. This will ensure the Secretary of State is in a position to assess whether the compensation measure will have

[6] (Control to) Zero density: an approach used in predator management work in situations where it is known that it is not possible to prevent a predator getting back to an island that has been subject to an eradication programme e.g. usually because the island is within swimming distance of the mainland (from which eradication is not feasible). Following eradication on the island, sufficient predator control effort is made to intercept re-invading/dispersing individuals before they are able to re-establish.

a reasonable guarantee of success in protecting the coherence of the National Site Network for the impacted species.

5.27. Unless the complex issues described are resolved before consent, the RSPB's advice is that the Secretary of State cannot conclude that the compensation measure is fit for purpose and thereby that the coherence of the National Site Network for the affected species will be protected.

5.28. Due to the critical and substantive nature of this additional information in assessing this compensation measure, we recommend that the Secretary of State should consider:

- Requiring the Applicant to submit to them the information set out in Table 3 below; and
- Re-consulting with Interested Parties on that additional information prior to determining the DCO.

Table 3: the RSPB's overall rating of the Hornsea Four predator eradication compensation measure for Guillemot and Razorbill and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL **- Predator eradication**		
Key issues to resolve revolve around the inadequate evidence base underpinning the Applicant's proposals. Below we set out the actions required to address these prior to the Secretary of State carrying out further consultation with interested parties. - Lack of coherent strategy for identifying islands/island groups for predator eradication and associated detailed documents; - Inadequate evidence to demonstrate benefit to breeding guillemot and razorbill of proposed eradication strategy; - Lack of evidence of connectivity of guillemots and razorbills from Channel Islands to respective UK National Site Networks.		
RSPB observation/ Issue	**Action required by the Applicant**	**What would this provide?**
Lack of coherent strategy for identifying islands/island groups for predator eradication and associated detailed technical documents	Prior to determination of DCO by Secretary of State, submit full versions of the following documents for review by Interested Parties: - Project selection, including coherent strategy and rationale for scoping islands/island groups in and out - Feasibility Study - Implementation Plan (Project Plan, Operational Plan, Monitoring & Evaluation Plan) - Biosecurity and Emergency Response Plan.	Full information for review by Interested Parties to assess: - feasibility of predator eradication proposals - benefit to guillemot and razorbill - evidence that guillemots and razorbills reared in Channel Islands will recruit to respective UK National Site Networks at required scale to protect
Inadequate evidence to demonstrate benefit to breeding guillemot and razorbill of proposed eradication strategy	Prior to determination of DCO by Secretary of State, submit full versions of the following for review by Interested Parties:	

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Predator eradication		
	- Provision of full breeding bird and INNS survey and monitoring results; - Detailed rationale and evidence, based on chosen eradication strategy and selected locations, to demonstrate benefit to breeding guillemot and razorbill through increases in productivity and survival over and above existing levels experienced at the selected locations.	coherence of those networks Advice from Interested Parties will ensure Secretary of State can take a fully informed and rational decision in respect of whether the compensation measure will protect the coherence of the UK National Site Network for guillemot and razorbill.
Lack of evidence of connectivity of guillemots and razorbills from Channel Islands to respective UK National Site Networks	Prior to determination of DCO by Secretary of State, submit full version of the following for review by Interested Parties: - Provision of additional evidence to demonstrate level of connectivity between guillemots and razorbills reared in Channel Islands and those recruited into respective UK National Site Networks	

6. Guillemot and razorbill compensation – Bycatch reduction

6.1. In its previous submission (REP2-092), the RSPB highlighted that fishery authorities have an existing obligation to minimise and where possible eliminate sensitive species bycatch within *inter alia* the UK Fisheries Act. It is therefore unclear how the Applicant's bycatch compensation proposals would interplay with regulators' statutory duties. The RSPB considers that bycatch should not be addressed through compensation by developers, instead it should be led by regulators and fishery managers, in collaboration with industry and other supportive stakeholders.

6.2. Despite this, the RSPB set out that any proposed bycatch reduction measures should be assessed against the industry leading ACAP Best Practice Seabird Bycatch Mitigation Criteria and Definition[7]. Currently, due to the fundamental flaw that the data from the Applicant's bycatch reduction trial is not being shared in any meaningful way, the proposed bycatch reduction measures are not fit for review, nor do they meet best practice (see previous RSPB submissions REP2-092 and REP4-058 for further information on this).

6.3. Notwithstanding the absence of data, it had been the RSPB's expectation that robust scientific analysis of the results would be provided, in the documents submitted at Deadline 5, to enable expert evaluation and provision of advice to the Examining Authority. However, the findings provided at Deadline 5 lack robust scientific analysis. Based on the information provided by the Applicant to date, the proposed bycatch measures remain unproven and unsupported by evidence.

6.4. The RSPB considers there are numerous actions the Applicant could take to provide confidence in their findings, even in the absence of data transparency, these are detailed in Table 5 below.

6.5. Table 4 below synthesises and summarises the RSPB's review of the following documents:

- REP5-068: G5.13 Bycatch Reduction Technology Selection Phase Summary - Revision: 01;
- REP5-028: B2.8.2 Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Guillemot and Razorbill Bycatch Reduction: Roadmap - Revision: 04.

Table 4: the RSPB's comments on the Hornsea Four bycatch reduction compensation measure proposal against compensation criteria

EC criteria [See Table 4 in REP2-089 for fuller description]	**RSPB RAG rating (Red, Amber, Green)**	**RSPB key observations based on current proposals and information provided**
Targeted - Appropriate to impact predicted - Shared understanding and agreement on impacts - Address structural/functional aspect of site integrity affected		**Looming Eye Buoys (LEB) remain unproven for bycatch reduction** - The proposed bycatch reduction measures remain unproven as the presented analysis of the trial results are not scientifically robust (see **Effective**). As a result, these

[7] ACAP (2021) ACAP Review of mitigation measures and Best Practice Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds. In: ACAP - Twelfth Meeting of the Advisory Committee. Online

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		measures are currently inappropriate as compensation for impacts on guillemot or razorbill. **Razorbills absent from trial** - No razorbills were caught during the LEB experimental or control trials, therefore there is no way of knowing if LEBs would reduce bycatch of razorbills (to address the impact of the development) even if proven for guillemot. LEBs remain untested for razorbill. **Unclear impact on target site species** - It is unknown if bycatch reduction in the south of England would benefit the birds from FFC SPA given lack of evidence on connectivity (see RSPB REP5-120, section 3, comments on connectivity).
Effective - Based on best scientific knowledge. Scientific evaluation carried out - Specific to the location to be implemented - Clearly defined timescales - Feasible and operational in reinstating required conditions - Measures where no reasonable guarantee of success should not be considered		**Insufficient statistical analysis** - The Applicant "*presents a comparison of proportion of guillemot bycatch in control versus LEB nets in order to assess the potential for LEBs to reduce guillemot bycatch in gillnets.*" (REP5-068, Page 14, 2.5.1.1). - And claims "*LEBs have reduced the level of bycatch of guillemot within a commercial gillnet fishery by approximately 25% within a 50 m radius".* (REP5-068, Page 19, 4.1.1.4). This 25% metric is not scientifically robust because: - It does not highlight if results are statistically significant or coincidental. - It does not allow for adequate scientific scrutiny and the analysis is not presented in a way that is repeatable by others. - This metric seems to be calculated by cross multiplying the percentage of nets that caught at least one guillemot in LEB nets (42.9%) versus control nets (57.1%)- **this is not recognised as an effective way to calculate bycatch reduction**. Standard analyses would require either paired sampling designs, and comparison of bycatch rates (bycatch per unit effort) in LEB and control nets, or zero-inflated models that

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		account for; variation in space, time, effort, and fishing gear on bycatch rates, and can accommodate the large number of fishing events where no bycatch occurs. - It presents the proportion of nets with/without bycatch, which indicates nothing of the magnitude of bycatch events or the overall intensity. - There is no indication of sample size, so 25% could mean control nets caught 4 birds and LEBs 3. - It cannot be used to interpret whether the level of bycatch reduction is credible and of sufficient magnitude to offset any loss from windfarms. - Pseudoreplication- the Applicant states, "where guillemot bycatch were recorded more than once for an individual net, these were considered as separate catching events." (REP5-068, 2.5.1.3, page 14). Modelling events that occur in the same net separately, unless properly accounted for in the modelling strategy (for which no evidence is provided), introduces the risk to erroneously find statistical evidence for an effect that does not exist, because data are effectively duplicated and sample size is artificially increased, thus inflating the power to detect an effect (even though none may exist). Scientific bycatch research treats each net as a single datum with the number of birds per net (effort) providing a bycatch rate- this avoids pseudoreplication. - There is no error distribution specified and it is therefore not possible to independently evaluate whether the assumptions of the model are likely to be met, or what response variable was modelled. The Applicant has not provided any rationale for why they have used bycatch proportions as a metric rather than aggregated numbers and an associated bycatch rate in both control and experimental nets. The bycatch rate

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		(number of birds caught per km per net per day) should be provided as a scientifically recognised metric used in bycatch research. Bycatch rate could be presented in an entirely anonymised way, so as not to implicate individual fishers. The scientific literature on seabird bycatch mitigation provides many examples of how to do this, using specific statistical analysis, which does not appear to have been conducted here. **Scientific data omitted** The Applicant omits key details from the trial findings (REP5-068) that are fundamental to any robust scientific bycatch evaluation, including: - Fishing effort and sample size- data were collected from 9 fishers, but there are no details provided on: the gear that was used (see point below), how long it was in the water, and the number of hauls, along with the sample size used in their analysis. For example, for each fisher, data could be from 1 net over 1 season or 1 net a day. If nets vary in length between 50 and 500 metres, then counting the nets is not the same as accounting for equal fishing effort. - Gillnet type - gillnets vary greatly (mesh size, length, etc.), so this small sample could be from a very diverse range of gillnet types and therefore statistical weight of their sample size might be lower. - Location and time- bycatch is hugely variable in time and space, the Applicant has not provided the range of locations and time of bycatch/ fishing. The RSPB is aware, from its own trials, that there is significant variation in the nets used depending on time of day and location along the south coast of England. Likewise, bycatch risk might be elevated at certain times of day which can also inform mitigation design – see the RSPB's recent paper, Cleasby et al (2022)[8] assessing bycatch risk from

[8] Cleasby, I. R., Wilson, L. J., Crawford, R., Owen, E., Rouxel, Y., & Bolton, M. (2022). Assessing bycatch risk from gillnet fisheries for three species of diving seabird in the UK. Marine Ecology Progress Series, 684, 157-179.

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		gillnet fisheries for three diving seabird species. - Experts that reviewed the data are completely unknown, so it is unclear if they have suitable credentials to analyse the data. - Data collection details: o location of cameras on boats. o proportion of bycatch events that were identifiable (ability to identify species from an image of a bird carcass in a net). o proportion of bycatch self-reported by fishermen versus from cameras. o method to verify self-reported bycatch (e.g with camera footage). o Confirmation that the control nets were identical to the experimental nets. o Bycatch reduction results for the other species they caught. - Variables -The Applicant references statistical models to account for variables, but the results of these are not presented. They present basic percentage of trials with bycatch for sea state, wind speed and time of day; but that does not equal a proper statistical model analysis and does not take into account key variables including those listed above (fishing effort, location etc.). **Insufficient data collection** Whilst the methodology for collecting the data is promising, albeit limited by an absence of transparency, data from one season cannot provide a comprehensive enough scientific sample to confidently assess bycatch reduction (see ACAP guidance[9] and our previous submission REP4-058). **Lack of data transparency** See paragraph 6.2. Unfortunately, without access to the data there is no way to check any of the Applicant's analyses.

[9] ACAP (2021) ACAP Review of mitigation measures and Best Practice Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds. In: ACAP - Twelfth Meeting of the Advisory Committee. Online.

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		See also **Location** and **Timing**.
Technically feasible - Design must follow scientific criteria and evaluation in line with best scientific knowledge - See also Effective		**ACAP best practice** - The proposed bycatch reduction measures are not in line with ACAP Best Practice guidance[10] - The Applicant has not provided sufficient evidence to support their claims - the way results and methodology are presented crucially lacks scientific best practice. **Other research** The Applicant continues to draw incorrect conclusions from scientific studies, principally Rouxel et al (2021). As stated in REP5-120, author of the paper, Yann Rouxel (RSPB Bycatch Project Manager), has confirmed that comparing this paper to the Applicant's research is inappropriate given the fundamental differences between the two studies. Similar trials have not found similar results. Preliminary results from trials conducted in other gillnet fisheries are not supportive of the claimed effectiveness at 25% bycatch reduction of guillemots.
Extent - Relates directly to quantitative and qualitative element of integrity likely to be impaired - Estimated effectiveness of measure - Key uncertainties identified and factored in - [If no reasonable guarantee of success should not be considered]		- Agreement has yet to be reached on the scale of the impact to be compensated for on guillemot and razorbill from the FFC SPA. This is due to the delays in the submission of updated baseline characterisation and revised impact assessment information until Deadlines 5 and 5a (see Annex A for the RSPB's view on the new information). **Integrity of razorbill and guillemot/ target species** - To date the Applicant has not provided qualitative or quantitative evidence that bycatch reduction can compensate for the impacts on the integrity of FFC SPA arising from Hornsea 4 and its impacts on razorbill and guillemot from FFC SPA. Notwithstanding the absence of transparent data and multi-year

[10] ACAP (2021) ACAP Review of mitigation measures and Best Practice Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds. In: ACAP - Twelfth Meeting of the Advisory Committee. Online

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		trials, the lack of a bycatch rate means it is not possible to calculate the scale of bycatch reduction measures (if proven) required for compensation. **LEB remains unproven and uncertain** - Fundamental uncertainties remain around the effectiveness of LEBS (see **Effective**) - In the absence of robust scientific analysis there is no reasonable guarantee of success as LEB remains unproven.
Location - Located where they will be most effective to protect coherence of species' National Site Network - Must be able to provide ecological structure and functions required by species		- It is unknown if bycatch measures in the south of England, even if proven, will benefit razorbill and guillemot from FFC SPA. This is due to: o difficulty in knowing which colony a bycaught bird comes from; and o the lack of evidence on connectivity between the bycatch trial locations (unknown) and the Flamborough and Filey Coast SPA, as well as other SPAs designated for guillemot and razorbill in the UK National Site Network (see RSPB REP5-120).
Timing - Must provide continuity in ecological processes to maintain structure/functions contributing to species' National Site Network - No irreversible damage before compensation operational - Should be fully functional before damage occurs - All technical, legal or financial provisions completed before project implementation starts to prevent delays to effective compensation		- Although the Applicant has stated they can commence the bycatch reduction scheme in one year, this is on the basis of a one season trial which is not in line with best practice. Multi- year trials should be conducted before the measures are agreed and implemented – the Applicant has not committed to, or accounted for, the additional time required to conduct more trials before implementation.
Long-term implementation - Legal rights to secure and implement compensation measures in place prior to consent being granted - Financial security secured		**Uncertainty of participation over 35 years** - No confirmation how the Applicant will ensure there are sufficient participating fishers over the 35 year period (RSPB disputes this time period as too short) or how bycatch compensation measures will

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
- Protection, monitoring and maintenance of sites secured before - In place for as long as impact on affected SPA occurs		interplay with future regulation and fisheries management (see REP2-092). **Long term risk of using an unproven measure** - When implementing bycatch reductions measures over a long timescale it is vital to get the starting point right, with thoroughly tested and proven measures. The economic impacts on fishers need to be considered. If this is not done correctly it will risk damaging relationships with fishers, if measures are found to be ineffective, and could jeopardise trials and uptake of more advanced robust bycatch reduction measures in the future. **Monitoring** - Monitoring of the compensation effectiveness and bycatch rates will be crucial, yet the exact method of monitoring will be decided based upon further evidence gathering and discussion with industry experts- this is not best practice. A monitoring programme needs to be detailed and agreed before the examination closes and before implementation.
Additionality - Measures must be additional to those already required - Able to demonstrate claimed benefits are additional to current baseline (e.g. breeding population, productivity etc)		- There are a series of existing general policy and legislative commitments at national, regional seas and global scales that require the UK Administrations to act on wildlife bycatch in UK waters. - As previously stated in REP2-092, governments are required to monitor and address bycatch of sensitive species – including seabirds. - Developers and decision-makers must recognise 1. there is a question of additionality, when governments are required to address bycatch and 2. that the policy and legislative approach to addressing wildlife bycatch is currently very dynamic. - The UK Administrations are currently developing a series of policies that should see the introduction of further measures to address wildlife

EC criteria [See Table 4 in REP2-089 for fuller description]	RSPB RAG rating (Red, Amber, Green)	RSPB key observations based on current proposals and information provided
		bycatch issues in UK waters, most notably these include: o The UK Fisheries Act (2020) o The UK Marine Strategy (part 3 - programme of measures) o The UK Bycatch Mitigation Initiative and o Seabird Conservation Strategies in each of the four countries - The introduction of regulations and legal frameworks could require fishing practices to change which could impact the developer's compensation proposals or ability to implement them.

Summary of RSPB assessment of bycatch reduction measure

6.6. The information presented by the Applicant does not support the efficacy of the Looming Eyes Buoy (LEB) nor the statistical significance of any apparent differences between the control and experimental LEB trials. By not providing robust data and analysis the Secretary of State will not be able to evaluate the findings of the trials and thus the effectiveness of bycatch as a compensation measure. Based on the Applicant's own information, as no razorbills were caught during the LEB experimental or control trials, this measure remains untested for razorbill and cannot be applied to this species.

6.7. Based on the above assessment, we have summarised in Table 5 below the key information we consider the Applicant should be required to submit to the Secretary of State before a decision on whether to grant consent for the DCO is made. This information should be subject to further consultation with Interested Parties. This will ensure the Secretary of State is in a position to assess whether the compensation measure will have a reasonable guarantee of success in protecting the coherence of the National Site Network for the impacted species.

6.8. Unless the complex issues described are resolved before consent, the RSPB's advice is that the Secretary of State cannot conclude that the compensation measure is fit for purpose and thereby that the coherence of the National Site Network for the affected species will be protected.

6.9. Due to the critical and substantive nature of this additional information in assessing this compensation measure, we recommend that the Secretary of State should consider:

- Requiring the Applicant to submit to them the information set out in Table 5 below; and
- Re-consulting with Interested Parties on that additional information prior to determining the DCO.

Table 5: the RSPB's overall rating of the Hornsea Four bycatch reduction compensation measure for Guillemot and Razorbill and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - **Bycatch reduction**		
Key issues to resolve revolve around the inadequate evidence base underpinning the Applicant's proposals. Below we set out the actions required to address these prior to the Secretary of State carrying out further consultation with interested parties. - Expert (peer) review; - Absence of scientifically robust statistical analysis (bycatch rates) - Lack of detail on variables; - Dataset not comprehensive; - Missing data collection details; - Insufficient modelling of variables; - Pseudoreplication/ Error distribution.		
RSPB observation/ Issue	**Action required by the Applicant**	**What would this provide?**
Expert (peer) review	- Provide detail on the fisheries, ornithologist and statistical experts that conducted the data and statistical analysis including their credentials and who is paying them. - The RSPB requests that the Applicant authorise a confidential review by an independent expert in seabird bycatch data analysis. - The RSPB would like to offer the Applicant the opportunity to share their data confidentially with the RSPB's bycatch experts including Yann Rouxel, Bycatch Project Manager, developer of the LEB, and Steffen Oppel, Senior Scientist and experienced analyst of seabird bycatch data. Alternatively, the RSPB can recommend experts from leading independent scientific organisations (Zoological Society of London, University of Washington or the British Trust for Ornithology).	- Confidence that the results of the trial have been verified by an independent third-party bycatch expert and a robust peer review. - Confirmation and evidence that the results of the bycatch reduction trials to date are as effective as the Applicant states, so that Interested Parties and the Secretary of State can determine the level of confidence that can be placed in the results.
Absence of scientifically robust statistical analysis (bycatch rates).	- Calculate and share the bycatch rates for all birds and specific species (this can be done without sharing the underlying data). - Describe data analysis conducted in the methods such that it is repeatable	- Bycatch rates would allow the Applicant to say how many birds they could save through bycatch reduction measures. - Providing a repeatable analytical method is a basic foundation of sound science.
Lack of detail on variables	Provide detail, for the range of experimental LEB and control nets, on: - Fishing effort - Sample size	- An ability to understand the basis for any analysis and subsequent claims around efficacy.

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Bycatch reduction		
	- Gillnet type - Location and times	
Dataset not comprehensive	- Conduct multi- year trials	- Best-practice, wider diverse sample size, more confidence.
Missing data collection details	Provide detail on the below factors influencing data collection: - location of cameras on boats. - proportion of bycatch events that were identifiable (ability to identify species from an image of a bird carcass in a net). - proportion of bycatch self-reported by fishermen versus from cameras. - method to verify self-reported bycatch (e.g with camera footage). - Confirmation that the control nets were identical to the experimental nets - Bycatch reduction results for the other species they caught	- These are again elements of the experiment which will have an influence on the results – it is important to present these such that the robustness of the results can be scrutinised and assessed. - Ability to evaluate over what area and time horizon the results can be extrapolated. If mitigation works only at certain times of the year the annual mortality reduction would be lower than when you assume that the reduction is constant across all seasons.
Insufficient modelling of variables	- Conduct statistical models to account for variables (including fishing effort), and present findings.	- Reassurance that the described effect is real and supported by valid data and analysis.
Pseudoreplication/ Error distribution	- Data need to be analysed with a Poisson distribution (numerical response), or some other approach must be taken to overcome the pseudoreplication issue for binary data. - If the trials are strictly paired then a simple paired t-test would be sufficient to assess the differences.	- Magnitude of the bycatch reduction (in absolute and not just relative terms) to evaluate whether the scale of mortality reduction can indeed compensate for the scale of windfarm-induced mortality.

Additional comments on matters arising from documents submitted at Deadlines 5 and 5a

Inaccurate Representation of RSPB and BirdLife feedback

6.10. **RSPB and BirdLife were positive about the effort to conduct trials and the opportunity to utilise Electronic Monitoring to collect the data. We have flagged – from the outset – the apparent bias of the Applicant in anticipating a positive result from the tests and the critical importance of presenting and analysing the data appropriately, neither of which have been done. We consider the Applicant's statement, that they received '*positive engagement and***

feedback from all parties to date' (REP5-068, page 19, 4.1.1.3) untrue. This statement ignores concerns that were raised and implies a support for the results presented that we do not agree with. The concerns we raised on data are not referenced anywhere in REP5-068 and have not been adopted, resulting in the unsatisfactory way the results have been written up. The Applicant should address this.

7. Kittiwake compensation

7.1. The Applicant has proposed the use of artificial nesting structures (ANS) as the compensation measures for kittiwakes, with its clear preference for the use of an offshore ANS.

7.2. The RSPB's detailed comments on the Applicant's proposed compensation measures for kittiwake can be found in the following submitted documents:

- REP2-089: RSPB Written Representations (WRs) (section 6);
- REP3-055: RSPB Comments on selected Deadline 1 and Deadline 2 submissions (section 3);
- REP4-057: RSPB Response to Calculation Methods of Hornsea Four's Proposed Compensation Measures for Features of the FFC SPA and Hornsea Four comments on RSPB Written Representation, with reference to the use of metapopulation analysis (reference 6.13).

7.3. The RSPB's views set out in the above documents can be summarised as follows:

- Lack of agreement on the magnitude of impact that is to be compensated for (due to ongoing issues regarding the agreed scale of impact);
- Based on the magnitude of impact, a lack of agreement on the appropriate methodology to determine the scale of compensation required to ensure the coherence of the UK National Site Network for kittiwakes is protected;
- Whether nesting habitat is a limiting factor for the breeding population of kittiwakes in the southern North Sea;
- Lack of a precise location and whether it is technically feasible to provide an artificial nesting structure;
- Whether artificial nesting structures will be colonised and whether these will be additional breeding adults as opposed to existing adults choosing to redistribute themselves;
- Whether and over what timescale any new colony will achieve the target population and recruitment of breeding adults into the Eastern Atlantic Population and thereby to provide benefit to the UK SPA network for kittiwakes, including FFC SPA, and whether or not it will be possible to quantify any benefit;
- Lack of a meta-population analysis to clarify the dynamics between any proposed purpose-built artificial nesting structure and SPA/other colony populations: elucidating the feasibility of establishing the proposed colonies and the consequences of such colony establishment on the populations of other colonies, in particular FFC SPA;
- The reduced lead-in times for the proposed compensation in relation to the point at which damage will occur, and the lifetime of the compensation measure in relation damage;
- Lack of clarity over the regulatory pathway in respect of the repurposing of offshore structures.

7.4. At Deadlines 5 and 5a, the Applicant has provided updates on its proposed compensation measures for kittiwakes in the following documents:

- REP5-017: B2.7 Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Kittiwake Compensation Plan (Tracked) - Revision: 02;
- REP5-019: B2.7.2 Volume B2, Annex 7.2: Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Kittiwake Offshore Artificial Nesting Roadmap (Tracked) - Revision 04;
- REP5-021: B2.7.4 Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Kittiwake Onshore Artificial Nesting Roadmap (Tracked) - Revision: 04;
- REP5-025: B2.7.6 Outline Kittiwake Compensation Implementation and Monitoring Plan (Tracked) - Revision 02.

7.5. These represent relatively minor updates in comparison to those for guillemot and razorbill, which we have addressed in detail in sections 5 and 6 above. Therefore, we have sought to provide a summary overview of the RSPB's position on the kittiwake compensation measures as currently proposed, referring to key issues of concern. These should be read alongside the detailed comments referred to above which remain relevant. We have then summarised our overall position using the Red, Amber, Green rating described in section 3 above.

7.6. The key concerns covered here relate to:

- Location;
- Regulatory issues relating to repurposing of offshore structures.

Location

7.7. The Applicant has stated that it has signed a Memorandum of Understanding with the owners of the Wenlock Platform in the south North Sea (e.g. see paragraph 4.1.1.1 in REP5-019 Kittiwake Offshore Artificial Nesting Roadmap (Tacked). However, the Applicant makes clear that this is still subject to technical studies and that those studies may require the Applicant to "…*explore options and feasibility for repurposing an alternative existing platform*." (para 4.1.1.1, bullet point 3, REP5-019).

7.8. It remains the case that there is no secured location for the Applicant's proposed offshore ANS. It therefore remains high risk and wholly uncertain as to whether such a structure will be secured at this stage. This lack of security is of particular concern given the associated uncertainty relating to the regulatory regime in respect of repurposing an offshore structure (see below).

Regulatory issues relating to repurposing of offshore structures

7.9. This is closely intertwined with the Applicant's stated preference for an offshore ANS located on a repurposed offshore oil or gas structure (see Location immediately above).

7.10. In various places, the Applicant states its confidence in its ability to navigate the regulatory requirements in respect of the repurposing of an oil and gas platform (e.g. para 4.1.1.1, bullet point 4 and section 10 in REP5-019):

- in para 4.1.1.1: it states that it is in ongoing engagement with the North Sea Transition Authority (NSTA) and has shared a note with the relevant stakeholders setting out (its view we presume) of the proposed regulatory framework to reclassify the platform. This note is not in front of the examination to the best of our knowledge;
- in section 10 it sets out its preferred approach (para 10.1.1.7), but notes that this relies on securing alignment with the various regulators and stakeholders (BEIS, OPRED, NSTA) on its proposed approach (para 10.1.1.8).

7.11. The overriding message the RSPB takes from the latest information is that there is, as yet, no regulatory certainty regarding the ability to repurpose an offshore structure which is due to be decommissioned for the purposes of kittiwake compensation (also relevant to gannet compensation). No regulatory pathway has been secured on this fundamental and critical issue.

Implications of recent strategic compensation pilot study workshops

7.12. The RSPB's concerns on this issue have been underlined following the outputs from the recent workshops on potential strategic compensation pilot studies held by Offshore Wind Industry Council Derogation Sub-Group/Pathways to Growth collaboration. These are referred to by the Applicant in section 6 of its REP5-086 submission and we have described them in section 2 above.

7.13. There were two relevant workshops held: one on artificial nesting structures and a subsequent workshop on Infrastructure removal or repurposing (options included: repurposing for artificial nesting for seabirds; repurposing for artificial reef creation; and removal of defunct infrastructure).

7.14. It is the output of the second workshop that we need to bring to the Examining Authority's attention as it raises questions over the level of certainty and therefore the level of confidence that can currently be placed on a regulatory pathway with respect to the re-purposing of offshore structures.

7.15. The key point from the summary of the infrastructure removal or repurposing workshop:

- Clear steer from OPRED and BEIS on the challenges associated with this issue. This resulted in consensus that this [strategic compensation pilot] work needs to pause until a scoping piece has been completed by BEIS, Defra and Devolved Administrations to identify the opportunities and challenges associated with repurposing and removal of offshore oil and gas and other infrastructure as compensation. OPRED are developing a briefing note to support on this topic.

7.16. This highlights the central and critical role of the regulators and associated Government departments in determining whether there is a regulatory pathway to secure the repurposing of an offshore oil or gas platform for kittiwake compensation. Without clarity from them on the legality of the Applicant's proposed pathway, and how it would apply to a

specific platform, it is the RSPB's view that, currently, there can be no confidence as to whether regulatory approval can be obtained.

7.17. Therefore, the Examining Authority has no robust information in front of it that the Applicant's proposed approach can be legally secured.

7.18. Unless a submission to this effect can be obtained from the relevant regulator and Government departments before the end of the examination, it is the RSPB's view that this matter is so critical that it would merit the Secretary of State re-consulting with interested parties before deciding whether to consent the DCO.

7.19. It is also our understanding that in other nations of the UK, ANS for kittiwake are not being actively pursued as a strategic or project level compensation measure, because the effectiveness of the measure has not been proven and it is food supply rather than nesting sites which is believed to be limiting the species' population.

Summary of RSPB position on kittiwake compensation measures

7.20. The RSPB's concerns with both offshore and onshore artificial nesting structures for kittiwake remain, as per our comments in previous submissions. The key concerns raised in this submission underline our concerns: failure to secure a location and, closely related, a failure to set out a regulatory pathway to legally secure the repurposing of offshore structures that has been agreed with the relevant regulators.

7.21. At this point in time, there remains very significant doubt in both respects. Therefore, the RSPB concludes that the Applicant has not yet put forward a specific compensation measure for kittiwake that can or will be secured and which has a reasonable guarantee of success in protecting the coherence of the UK National Site Network for kittiwake. Our overall rating is red.

7.22. Due to the critical and substantive nature of this additional information in assessing this compensation measure, we recommend that the Secretary of State should consider:

- Requiring the Applicant to submit to him the information set out in Table 6 below; and
- Re-consulting with Interested Parties on that additional information prior to determining the DCO.

Table 6: the RSPB's overall rating of the Hornsea Four artificial nesting structure compensation measure for Kittiwake and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURES FOR KITTIWAKE **- Artificial nesting structures (offshore and onshore)**
Summary Detailed concerns set out in previous submissions remain: - Lack of agreement on magnitude of impact to be compensated for (see section 2, Annex A) - Lack of agreement on the methodology to convert those impacts to compensation objectives; - whether nesting habitat is a limiting factor for breeding kittiwakes in the southern North Sea and whether any new structure will be used by additional breeding adults as opposed to existing adults choosing to redistribute; - whether and over what timescale any new colony will achieve the target population and also recruit breeding adults to the UK National Site Network for kittiwakes, including FFC SPA; - lack of a meta-population analysis to clarify the dynamics between any proposed artificial nesting structure and SPA/other colony populations: elucidating the feasibility of establishing the proposed colonies and the consequences of such colony establishment on the populations of other colonies, in particular FFC SPA; - the lead-in time for the proposed compensation in relation to the point at which impact will occur and the lifetime of the compensation measure in relation to damage. Review of the most recent materials confirms **fundamental issues remain relating to the securing of (i) a location and (ii) a regulatory pathway agreed with the relevant regulators to allow the repurposing of an offshore oil or gas structure for compensation purposes**. Further information is required on the Applicant's proposals, with particular reference to: - A secured location for the proposed Artificial Nesting Structure - If this is a repurposed offshore structure, details of agreement with the relevant regulatory authorities on the regulatory pathway that will secure that structure for the lifetime of the compensation measure. - If it is an alternative ANS, details of the relevant agreements that secure the location and any regulatory requirements. - Details of the design of the relevant ANS, compensation objectives, implementation, monitoring, reporting and adaptive management strategies. Due to the uncertainty on these critical matters in respect of a repurposed offshore ANS, there is currently significant doubt as to whether the Applicant will be able to bring forward an artificial nesting structure, where that structure will be, what form it will take and whether any other barriers remain in respect of securing the compensation measure.

8. Gannet compensation

8.1. The Applicant has proposed bycatch reduction and Artificial Nesting Sites as a compensation measure for gannet.

8.2. The RSPB's detailed comments on the Applicant's proposed compensation measures for gannets can be found in the following submitted documents:

- REP2-089: RSPB Written Representations (WRs) (Section 6);
- REP2-092: RSPB Annex B Derogation case: Bycatch reduction (Section 5);
- REP4-057: RSPB Response to Calculation Methods of Hornsea Four's Proposed Compensation Measures for Features of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) and Hornsea Four comments on RSPB Written Representation (reference 6.6);
- REP4-058: RSPB Annex A – Comments on the Applicant's Bycatch reduction documents submitted at Deadlines 1 and 2 (Section 2);
- REP5-120: RSPB Comments on selected Deadline 3 and Deadline 4 submissions (Section 4).

8.3. The RSPB's views set out in the above documents can be summarised as follows:

- **Bycatch reduction:** there are fundamental details missing from the Applicant's proposals. None of the potential bycatch reduction techniques suggested by the Applicant for gannet have been tested or proven in a potential target longline fishery. The available evidence on gannet bycatch in the UK is limited. Without a firm understanding of how and where gannets experience bycatch it is not possible to assess the efficacy of any proposed reduction measures (i.e. if we do not know the nature of the problem we cannot assess if the solution is effective). The Applicant has not provided any information on the exact methodology or monitoring proposed for gannet bycatch reduction as a compensation measure. The RSPB recommends any potential bycatch reduction measures adhere to the ACAP best practice and, for clarity, that the Applicant state which of the methods have been endorsed as best practice (or not) by ACAP. The RSPB considers it imperative that any proposed measures (proven and/or experimental) require at-sea trials, in a target fishery to confirm if they work and to what extent, with results made accessible for peer review (see in particular Section 2 REP4-058).
- **Artificial nesting sites:** The Applicant has provided no evidence of a Northern Gannet colony establishing and sustaining itself on a long-term basis on an artificial structure, the evidence of such behaviour is limited to three case studies of Australasian gannets. Therefore, the RSPB considers the concept of artificial nesting structures is a wholly unproven compensation measure for Northern Gannets (see section 6, REP2-089 for further detail).

8.4. At Deadline 5, the Applicant provided updates on its proposed compensation measures for gannet in the following documents:

- REP5-069: G5.15 Outline Gannet Compensation Implementation and Monitoring Plan Bycatch Reduction - Revision: 01;

- REP5-070: G5.16 Outline Gannet Compensation Implementation and Monitoring Plan: Artificial Nesting Structures - Revision: 01;
- REP5-071: G5.17 Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Gannet Compensation Plan - Revision: 1;
- REP5-072: G5.18 Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Gannet Bycatch Reduction: Roadmap - Revision: 01;
- REP5-073: G5.19 Compensation measures for Flamborough and Filey Coast (FFC) Special Protection Area (SPA): Gannet Artificial Nesting: Roadmap - Revision: 01.

8.5. The RSPB considers that little new or additional information has been provided within these documents.[11] Fundamental problems with each of the proposed compensation measures remain. Therefore, the RSPB concludes there are no viable and effective compensation measures proposed for gannet that have a reasonable guarantee of success in protecting the coherence of the UK National Site Network for gannet. Our overall rating is red.

Table 7: the RSPB's overall rating of the Hornsea Four compensation measures for Gannet

RSPB's OVERALL RATING OF COMPENSATION MEASURES FOR GANNET - **Bycatch reduction** - **Artificial nesting structures (offshore and onshore)**
Summary **Fundamental problems exist with each proposed compensation measure such that neither can be considered a credible or feasible compensation measure for gannet at this time.** **Bycatch reduction:** there are fundamental details missing from the Applicant's proposals. None of the potential bycatch reduction techniques suggested by the Applicant for gannet have been tested or proven in a potential target longline fishery. The RSPB considers it imperative that any proposed measures require at-sea trials, in a target fishery, to confirm if they work and to what extent, with results made accessible for peer review. **Artificial nesting structures:** no evidence of a Northern Gannet colony establishing and sustaining itself on a long-term basis on an artificial structure. The concept of artificial nesting structures is a wholly unproven compensation measure for Northern Gannets.

[11] Our comments relating to kittiwake artificial nesting structures in section 7 above apply similarly to any consideration of artificial nesting structures in relation to gannet. However, our concerns in relation to gannet are of an even more fundamental ecological nature.

9. Overall state of play with species' compensation proposals

9.1. This section collates the summaries from each of the above sections on species' compensation measures.

9.2. Collectively, the Hornsea Project Four compensation proposals continue to have significant uncertainties attached to them, even at this late stage of the examination process. We consider this results from a general failure to:

- Identify specific locations and associated specific mechanisms in sufficient detail for each compensation measure;
- Set out robust evidence to justify the choice of location and mechanism, notwithstanding claims to the contrary. For the reasons set out elsewhere, the RSPB considers the proposed measures fall short in significant ways that bring each measure into serious doubt based on the information made available in both the application documentation and submissions to the examination;
- Set out in detail how significant legal and regulatory barriers associated with each measure will be overcome, instead asserting confidence these barriers will be in the future once DCO consent has been granted.

9.3. We consider these all undermine the ability to assess and determine whether a specific compensation measure can meet the ecological, technical and legal requirements, to enable the Secretary of State to have confidence that it will have a reasonable guarantee of success, and thereby protect the overall coherence of the relevant species' National Site Network. For some proposals, the issues are so fundamental as to question whether the measure should be considered as a possible compensation measure.

9.4. Due to the significant uncertainties that remain, we have recommended where we consider it would be necessary for the Secretary of State to consider requesting further, detailed information from the Applicant and to then consult with Interested Parties on that information before deciding whether to consent the DCO. At this stage we consider this is necessary for the compensation proposals for each species (kittiwake, guillemot and razorbill) with the exception of gannet where we consider there is no credible or feasible compensation proposal in front of the examination.

9.5. We consider it deeply regrettable that these issues have not been resolved through a combination of fuller application documentation and submission of more substantive information during the examination. Depending on the Secretary of State's response, this could lead to delay in reaching a decision on the DCO.

9.6. For each compensation proposal, we assessed the current proposals against the criteria for compensation set out in our main Written Representation and subsequent submissions, and accorded them each a Red, Amber, Green rating. This applies primarily to the guillemot and razorbill compensation measures. Abbreviated versions of this assessment were presented for those species' compensation measures with relatively minor updates at Deadlines 5 and 5a: kittiwake and gannet. Below we have collated the summary from each of the sections on species' compensation measures.

Strategic compensation

9.7. The RSPB welcomes the national level discussions on strategic compensation. However, it is evident that there is no system of strategic compensation currently in place, or which will be in place when the Secretary of State has to make a decision on the Hornsea Four DCO (by February 2023). Therefore, the Secretary of State will not be able to rely on strategic compensation as an alternative to the Applicant's project level compensation.

9.8. The Offshore Wind Industry Council's Derogation Sub-group/Pathways To Growth pilot studies described are embryonic, with no detail available to assess them. The limited information that is available confirms the RSPB's view that no weight should be placed on the Applicant's strategic compensation proposals, including their application to adaptive management measures.

9.9. This is most evident in connection with the repurposing of offshore structures e.g. for artificial nesting. As we set out in more detail in section 7 above, it is evident that the regulators (BEIS and OPRED) have significant concerns regarding the repurposing of offshore infrastructure which has resulted in them requesting a pause in the proposed pilot study work.

9.10. The Defra Marine Recovery Fund and/or centralised coordination of developer funded action could help facilitate strategic measures for nature recovery in the future. However, the Marine Recovery Fund itself does not yet exist, nor are there any solid details on when and how it will be set up and managed.

9.11. Therefore, it is the RSPB's view that "strategic compensation" is not yet at a sufficient stage of development and implementation whereby the Secretary of State can rely on it as an alternative to the provision of Hornsea Four project level compensation measures. Therefore, it cannot be relied on as a compensation measure with a reasonable guarantee of success of protecting the coherence of the UK National Site Network for the impacted species.

Summary of the RSPB's views on the species' compensation measures and recommended actions prior to consenting the DCO

9.12. This section draws together the summary conclusions from sections 5-8 above.

9.13. Due to the critical and substantive nature of the additional information in assessing the various compensation measures, we have recommended that the Secretary of State should, prior to determining the DCO, consider:

- Requiring the Applicant to submit to them the information set out in Tables 8-10 below; and
- Re-consulting with Interested Parties on that additional information.

9.14. The only exception to this relates to gannet (Table 11) where we have concluded there are no credible or feasible compensation measures for this species in front of the examination.

Guillemot and razorbill compensation measures

9.15. **Tables 8 and 9 below summarise the RSPB's overall rating of the Hornsea Four compensation measures for guillemot and razorbill, together with recommended actions to resolve the substantive issues that remain.**

Predator eradication measures

Table 8: the RSPB's overall rating of the Hornsea Four predator eradication compensation measure for Guillemot and Razorbill and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL **- Predator eradication**		
Key issues to resolve revolve around the inadequate evidence base underpinning the Applicant's proposals. Below we set out the actions required to address these prior to the Secretary of State carrying out further consultation with interested parties. - Lack of coherent strategy for identifying islands/island groups for predator eradication and associated detailed documents; - Inadequate evidence to demonstrate benefit to breeding guillemot and razorbill of proposed eradication strategy; - Lack of evidence of connectivity of guillemots and razorbills from Channel Islands to respective UK National Site Networks.		
RSPB observation/ Issue	**Action required by the Applicant**	**What would this provide?**
Lack of coherent strategy for identifying islands/island groups for predator eradication and associated detailed technical documents	Prior to determination of DCO by Secretary of State, submit full versions of the following documents for review by Interested Parties: - Project selection, including coherent strategy and rationale for scoping islands/island groups in and out - Feasibility Study - Implementation Plan (Project Plan, Operational Plan, Monitoring & Evaluation Plan) - Biosecurity and Emergency Response Plan.	Full information for review by Interested Parties to assess: - feasibility of predator eradication proposals - benefit to guillemot and razorbill - evidence that guillemots and razorbills reared in Channel Islands will recruit to respective UK National Site Networks at required scale to protect coherence of those networks Advice from Interested Parties will ensure Secretary of State can take a fully informed and rational decision in respect of whether the compensation measure will protect the
Inadequate evidence to demonstrate benefit to breeding guillemot and razorbill of proposed eradication strategy	Prior to determination of DCO by Secretary of State, submit full versions of the following for review by Interested Parties: - Provision of full breeding bird and INNS survey and monitoring results; - Detailed rationale and evidence, based on chosen eradication strategy and selected locations, to demonstrate benefit to breeding guillemot and razorbill through increases in productivity and survival over and above existing	

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Predator eradication		
	levels experienced at the selected locations.	coherence of the UK National Site Network for guillemot and razorbill.
Lack of evidence of connectivity of guillemots and razorbills from Channel Islands to respective UK National Site Networks	Prior to determination of DCO by Secretary of State, submit full version of the following for review by Interested Parties: - Provision of additional evidence to demonstrate level of connectivity between guillemots and razorbills reared in Channel Islands and those recruited into respective UK National Site Networks	

Bycatch reduction measures

Table 9: the RSPB's overall rating of the Hornsea Four bycatch reduction compensation measure for Guillemot and Razorbill and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Bycatch reduction		
Key issues to resolve revolve around the inadequate evidence base underpinning the Applicant's proposals. Below we set out the actions required to address these prior to the Secretary of State carrying out further consultation with interested parties. - Expert (peer) review; - Absence of scientifically robust statistical analysis (bycatch rates) - Lack of detail on variables; - Dataset not comprehensive; - Missing data collection details; - Insufficient modelling of variables; - Pseudoreplication/ Error distribution.		
RSPB observation/ Issue	**Action required by the Applicant**	**What would this provide?**
Expert (peer) review	- Provide detail on the fisheries, ornithologist and statistical experts that conducted the data and statistical analysis including their credentials and who is paying them. - The RSPB requests that the Applicant authorise a confidential review by an independent expert in seabird bycatch data analysis. - The RSPB would like to offer the Applicant the opportunity to share their data confidentially with the RSPB's bycatch experts including Yann Rouxel, Bycatch Project Manager, developer of the LEB,	- Confidence that the results of the trial have been verified by an independent third-party bycatch expert and a robust peer review. - Confirmation and evidence that the results of the bycatch reduction trials to date are as effective as the Applicant states, so that Interested Parties and the Secretary of State can determine the level of confidence

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Bycatch reduction		
	and Steffen Oppel, Senior Scientist and experienced analyst of seabird bycatch data. Alternatively, the RSPB can recommend experts from leading independent scientific organisations (Zoological Society of London, University of Washington or the British Trust for Ornithology).	that can be placed in the results.
Absence of scientifically robust statistical analysis (bycatch rates).	- Calculate and share the bycatch rates for all birds and specific species (this can be done without sharing the underlying data). - Describe data analysis conducted in the methods such that it is repeatable	- Bycatch rates would allow the Applicant to say how many birds they could save through bycatch reduction measures. - Provide a repeatable analytical method- a basic foundation of sound science.
Lack of detail on variables	Provide detail, for the range of experimental LEB and control nets, on: - Fishing effort - Sample size - Gillnet type - Location and times	- An ability to understand the basis for any analysis and subsequent claims around efficacy.
Dataset not comprehensive	- Conduct multi- year trials	- Best-practice, wider diverse sample size, more confidence.
Missing data collection details	Provide detail on the below factors influencing data collection: - location of cameras on boats. - proportion of bycatch events that were identifiable (ability to identify species from an image of a bird carcass in a net). - proportion of bycatch self-reported by fishermen versus from cameras. - method to verify self-reported bycatch (e.g with camera footage). - Confirmation that the control nets were identical to the experimental nets - Bycatch reduction results for the other species they caught	- These are again elements of the experiment which will have an influence on the results – it is important to present these such that the robustness of the results can be scrutinised and assessed. - Ability to evaluate over what area and time horizon the results can be extrapolated. If mitigation works only at certain times of the year the annual mortality reduction would be lower than when you assume that the reduction is constant across all seasons.
Insufficient modelling of variables	- Conduct statistical models to account for variables (including fishing effort), and present findings.	- Reassurance that the described effect is real and supported by valid data and analysis.

RSPB's OVERALL RATING OF COMPENSATION MEASURE FOR GUILLEMOT AND RAZORBILL - Bycatch reduction		
Pseudoreplication/ Error distribution	- Data need to be analysed with a Poisson distribution (numerical response), or some other approach must be taken to overcome the pseudoreplication issue for binary data. - If the trials are strictly paired then a simple paired t-test would be sufficient to assess the differences.	- Magnitude of the bycatch reduction (in absolute and not just relative terms) to evaluate whether the scale of mortality reduction can indeed compensate for the scale of windfarm-induced mortality.

Kittiwake compensation measures

9.16. **Table 10 below summarises the RSPB's overall rating of the Hornsea Four compensation measures for kittiwake, together with recommended actions to resolve the substantive issues that remain.**

Table 10: the RSPB's overall rating of the Hornsea Four artificial nesting structure compensation measure for Kittiwake and recommended actions

RSPB's OVERALL RATING OF COMPENSATION MEASURES FOR KITTIWAKE - Artificial nesting structures (offshore and onshore)
Summary Detailed concerns set out in previous submissions remain: - Lack of agreement on magnitude of impact to be compensated for (see section 2, Annex A) - Lack of agreement on the methodology to convert those impacts to compensation objectives; - whether nesting habitat is a limiting factor for breeding kittiwakes in the southern North Sea and whether any new structure will be used by additional breeding adults as opposed to existing adults choosing to redistribute; - whether and over what timescale any new colony will achieve the target population and also recruit breeding adults to the UK National Site Network for kittiwakes, including FFC SPA; - lack of a meta-population analysis to clarify the dynamics between any proposed artificial nesting structure and SPA/other colony populations: elucidating the feasibility of establishing the proposed colonies and the consequences of such colony establishment on the populations of other colonies, in particular FFC SPA; - the lead-in time for the proposed compensation in relation to the point at which impact will occur and the lifetime of the compensation measure in relation to damage. Review of the most recent materials confirms **fundamental issues remain relating to the securing of (i) a location and (ii) a regulatory pathway agreed with the relevant regulators to allow the repurposing of an offshore oil or gas structure for compensation purposes**. Further information is required on the Applicant's proposals, with particular reference to: - A secured location for the proposed Artificial Nesting Structure - If this is a repurposed offshore structure, details of agreement with the relevant regulatory authorities on the regulatory pathway that will secure that structure for the lifetime of the compensation measure. - If it is an alternative ANS, details of the relevant agreements that secure the location and any regulatory requirements. - Details of the design of the relevant ANS, compensation objectives, implementation, monitoring, reporting and adaptive management strategies.

Due to the uncertainty on these critical matters in respect of a repurposed offshore ANS, there is currently significant doubt as to whether the Applicant will be able to bring forward an artificial nesting structure, where that structure will be, what form it will take and whether any other barriers remain in respect of securing the compensation measure.

Gannet compensation measures

9.17. **Table 11 below summarises the RSPB's overall rating of the Hornsea Four compensation measures for gannet.**

Table 11: the RSPB's overall rating of the Hornsea Four compensation measures for Gannet

RSPB's OVERALL RATING OF COMPENSATION MEASURES FOR GANNET - **Bycatch reduction** - **Artificial nesting structures (offshore and onshore)**
Summary **Fundamental problems exist with each proposed compensation measure such that neither can be considered a credible or feasible compensation measure for gannet at this time.** **Bycatch reduction:** there are fundamental details missing from the Applicant's proposals. None of the potential bycatch reduction techniques suggested by the Applicant for gannet have been tested or proven in a potential target longline fishery. The RSPB considers it imperative that any proposed measures require at-sea trials, in a target fishery, to confirm if they work and to what extent, with results made accessible for peer review. **Artificial nesting structures:** no evidence of a Northern Gannet colony establishing and sustaining itself on a long-term basis on an artificial structure. The concept of artificial nesting structures is a wholly unproven compensation measure for Northern Gannets.

Appendix 1 – Extracts from the Manual – UK Best Practice for Rodent Eradications (see section 5 above)

- Worked example: Feasibility Study
- Worked example: Operational Plan
- Worked example: Biosecurity Plan

Feasibility Study for the eradication of brown rats *Rattus norvegicus* from the Stewart Islands, Outer Hebrides

[N.B. This is a fictitious example intended for training purposes, based on real islands and some real places and references, but with some details altered to present an illustrative scenario. The project story, all names, organisations and incidents portrayed in this document are fictitious. No identification with actual persons (living or deceased), organisations or buildings is intended or should be inferred].

Acknowledgements:

This document draws on both the worked examples devised by the Pacific Invasives Initiative as part of their Resource Kit for Rodent and Cat Eradication [redacted] and on the project documents produced by Wildlife Management International Ltd during their extensive work on UK islands. We are very grateful to both organisations.

Report produced by: S. Thornhill[1] and R. Mitchell[2]

[1]UK Seabird Conservation Trust: *A local non-governmental organisation based in Lewis*
[2]Scottish Wildlife and Conservation Agency: *A local government agency based in Lewis*

Funded by the Seabird Conservation Foundation

Reviewer(s): P. Hill, New Zealand Institute of Eradication [redacted]; G. Pollard, Independent eradication expert, UK [redacted]

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1	10/1/2016	S. Thornhill & R. Mitchell	Initial draft as circulated to technical advisors
2	16/2/2016	S. Thornhill & R. Mitchell	Final document as circulated to stakeholders, following review and input from technical advisors

Citation:

This report should be cited as: Thornhill, S. & Mitchell, R. (2016) Feasibility Study for the eradication of brown rats *Rattus norvegicus* from the Stewart Islands, Outer Hebrides, UK. Unpublished report prepared for the Scottish Wildlife and Conservation Agency (SWCA) and UK Seabird Conservation Trust (UKSCT).

Executive Summary

1. This report considers the feasibility of UKSCT and SWCA eradicating Brown rat *Rattus norvegicus* from Farnuff and Tuchlose Islands from the Stewart Island group, Outer Hebrides, Scotland.

2. The Stewart Islands group consists of three islands: Farnuff, Tuchlose, and Dull. Farnuff (147ha) and Tuchlose (89 ha) are inhabited islands with a population of 34 and 12 respectively. Dull Island (38ha) is uninhabited.

3. Farnuff and Tuchlose have been identified as highly significant sites for conservation. They hold populations of Manx shearwater, a highly restricted species, as well as an assemblage of more widespread but declining seabirds including puffin, shag and razorbill. They hold an endemic sub-species of vole – the Stewart Island vole – and both islands have one pair of breeding white-tailed eagles. European storm-petrel were extirpated from the islands several decades ago. Dull is not currently considered an important site for conservation, although it is possible that Manx shearwater and European storm-petrel once bred there.

4. A key step in restoring Farnuff and Tuchlose islands is the eradication of introduced mammalian species. Brown rats are known to occur on all three islands. Introduced rabbits are also present on Farnuff and Tuchlose. No other non-native species occur in the wild on the islands.

5. The feasibility study concludes that a ground-based rodenticide operation using bait stations is the only viable eradication technique that is available in the UK. Some important issues have been raised during the Feasibility Study and most, but not all of these are considered resolvable. As such, although the Study concludes that eradication of brown rats from **Farnuff** is **feasible**, eradication from **Tuchlose** has been deemed **unfeasible.**

6. The issues raised are:
   a) Tuchlose is only 600m offshore from the island of Lewis, which itself is too large for eradication to be achievable using available techniques. Reinvasion of Tuchlose can be anticipated
   b) Dull island is only 300m away from Farnuff and so will need to be incorporated into any eradication project for Farnuff if it is to meet the 'sustainable' criterion.
   c) The application of rodenticides may pose a risk to the residents of Farnuff, the endemic sub-species of vole, and White-tailed eagles.
   d) The rabbit population of Farnuff cannot be eradicated and is likely to increase in the absence of rats with potential implications on the wider island ecosystem.
   e) Community support for the eradication will need to be sustained.
   f) There will need to be strong community participation and leadership in biosecurity measures if reinvasion is to be avoided, particularly on Farnuff.
   g) A number of approvals will be required.
7. SWCA will be the lead implementing agency on the project. SWCA will be assisted by UKSCT as a project partner. Gaps in expertise, such as leading a ground-based eradication operation and homing a captive population of voles, will be met by contracting external experts.

8. The project is estimated to cost around £350,000. Breakdown by stage: Project Design: £4,000, Operational Planning: £46,800, Implementation: £282,200 and Sustaining the Project: £17,400. Costs for five years of biosecurity measures are included. Following that, funding for biosecurity will be the responsibility of SWCA. Funding for the initial phase of the project will be sought from the Seabird Conservation Fund. Some of the match funding will be provided

by SWCA as the project will help deliver government's international obligations. The rest will be sought from private donors.

Contents

1 INTRODUCTION

The UK Seabird Conservation Trust (UKSCT) have provided expertise *pro bono* to the Scottish Wildlife & Conservation Agency (SWCA) to undertake a Feasibility Study for the eradication of brown rats *Rattus norvegicus* from Farnuff and Tuchlose islands in the Stewart Island group, Outer Hebrides, Scotland. The study was undertaken in November 2015, with a site visit to the islands from 1st-10th November. This Feasibility Study can be used as the basis for an application to the Seabird Conservation Fund funding stream to part fund a full eradication project and help demonstrate the project need to SWCA and other private donors who will be asked to help match funding.

The purpose of this Feasibility Study is to assess the feasibility and viability of eradicating brown rats from Farnuff and Tuchlose islands. It asks three key questions: Why do it? Can it be done? and What will it take?

The remainder of this section explains the regional and international context of the proposed project. The 'Why do it?' section (parts 2,3,4) details the goal, objectives and outcomes of the proposed project, and describes the islands, the impacts brown rats are having on them and the anticipated benefits of eradication. The 'Can it be done?' section (part 5) assesses the proposed project against seven feasibility criteria and determines whether or not it is feasible. The 'What will it take?' section (part 6) identifies the issues that will need to be resolved before the project can commence. We then conclude, all things considered, whether or not the proposed project is likely to be a success.

The UK government has international obligations to tackle the threats from invasive non-native species, including those to seabirds from rodents on offshore islands, through:

- the Convention on Biological Diversity (Article 8(h) requires the control or eradication of alien species which threaten ecosystems, habitats or species)
- the EU Directive on the Conservation of Wild Birds (to protect bird species and the habitats on which they depend)
- the Bern Convention of European Wildlife and Natural Habitats 1979 (Article 11(2b) which requires strict control of the introduction of non-native species)
- the Marine Strategy Framework Directive (whereby a measure of Good Environmental Status is the predation pressure on important seabird breeding colonies).

The seabird populations on Farnuff and Tuchlose are of international importance and both islands are designated as part of a Special Protection Area (SPA). They are also identified as Important Bird Areas by BirdLife International. Building resilience into Manx shearwater and European storm-petrel populations, by bolstering existing colonies and helping the species to colonise/recolonise new areas, forms an integral part of the UKSCT's Saving Nature strategy.

The need for a rat eradication project on the Stewart Islands is identified by the 2014 UK, Isle of Man and Channel Islands prioritisation exercise undertaken by leading conservation organisations in the UK. The exercise sought to identify islands where the greatest conservation benefits could be achieved through the eradication of invasive non-native species and took into account the impacts of invasive species on a range of birds and other species present on islands.

Both Farnuff and Tuchlose ranked within the top 20 islands for conservation gain via invasive species eradication. When reinvasion risk was considered, Tuchlose dropped out of the ranking but the potential conservation gains were deemed sufficiently high as to merit more detailed consideration of the risks via a more detailed feasibility study.

Additional resources used in the production of this report included reports from previous site visits for biological monitoring, rat stomach content analysis and conversations with island residents.

This Feasibility Study will be made available to all relevant UK government authorities, to island residents, partner organisations and other key stakeholders.

We would like to acknowledge the assistance of the following people in the production of this report:

All of the residents of Farnuff and Tuchlose for their interest and willingness to discuss the project proposals and for their support. Thanks also to Jenny Luscombe and Jim Hunter for their hospitality during our stays on the island, and to Mike Broad for the use of his boat to reach Dull Island.

Phil Hill and Gill Pollard for their independent review of the draft feasibility study report.

1.1 The Site

The Stewart Islands

The Stewart Island group is located on the west coast of the Outer Hebrides, Scotland, off the island of Lewis and Harris.

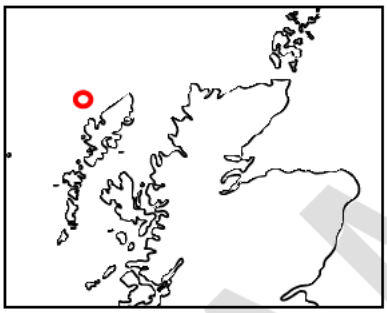


Figure 1: Map showing position of Stewart Island Group in relation to the Outer Hebrides and Scottish mainland.

They are comprised of three islands:

- Farnuff Island, 147ha, permanent population 34
- Tuchlose Island, 89ha, permanent population 12
- Dull Island, 38ha, population 0 (permanent or seasonal)

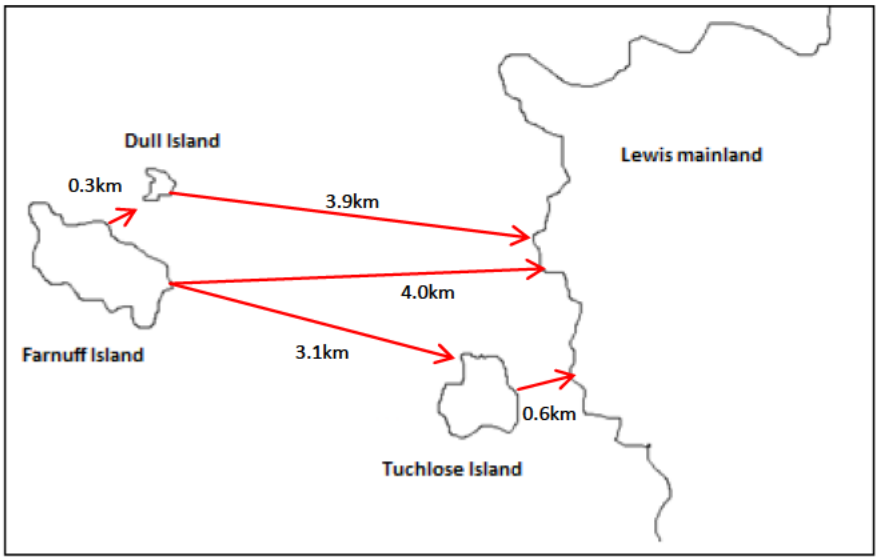


Figure 2: Map showing position of islands within the Stewart Islands group and their distances from each other and the Isle of Lewis

The islands are privately owned by the Clipper family. Farnuff and Tuchlose islands form part of the Stewart Island Special Protection Area (SPA). There are no other offshore islands within 15km of the Stewart Island group.

Farnuff Island

Farnuff Island is an inhabited island (34 permanent inhabitants) of 147ha. It has a saddle shaped topography, rising to 138m above sea level (a.s.l.) with sheer cliffs along the north and west coast and to 85m on the south east. The rest of the coastline is either rocky with boulders that can be scrambled over, or comprised of grassy slopes that can be traversed, with care. The island's residents live along the central, low lying belt of the island – there are three farms, a shop (groceries/post office/general store), and ten houses. The majority of houses and the shop are situated close to the jetty on the north coast. There are a number (c.20) of other buildings/sheds/stores around the inhabited area. The farms predominantly keep sheep although one farm has a very small number of cattle as well. Two households keep chickens and both pet cats and dogs are kept on the island. The population lives year-around on the island, but the (currently eight) children are all at secondary school on the mainland and are present only at weekends and school holidays.

The area around the island is fished, mostly by the island's inhabitants, although a few boats travel from Lewis and Harris to fish. The island is serviced three times a week by a passenger ferry run by Caledonian MacBrayne from Lewis and Harris. There is a weekly rubbish collection boat and a larger supply boat which occasionally brings farming equipment or a larger stock run for the shop. There is a secondary landing site on the south coast which is mainly used by residents to launch fishing boats. Tourism is not an important feature of the island, although some small yachts usually moor up in summer and once a week during seabird breeding season a tripper boat circumnavigates the island to view the seabird colonies – this vessel does not land on the island.

The island is covered in grassland with wet heath on the more exposed areas. Low-lying scrub covers some of the slopes on the northern coast where it is more sheltered. This is predominated by European gorse. There are no known non-native invasive plants on the island. The main conservation interest on the island is around the north and south cliffs and adjacent grassy slopes which house the main seabird colonies (razorbills, shags, puffins, Manx shearwater, guillemot, kittiwake). Lesser black-backed gulls and carrion crows are also present. One pair of white-tailed eagles nests on the northern cliffs. A number of passerines are recorded from the island, including wheatears, skylarks and twite.

The Stewart Island vole is found across the island, but is less common in the heath/wetter parts. Common shrew is the only other native mammal, although otters have been recorded in the past. Rabbits are prevalent in the grassland areas and are seen to cause damage to the stone walls due to burrowing. House mice are thought to be absent from the island (historically present but last reported in the 1970s), but brown rats are recorded.

Farnuff Island is only 300m away from Dull Island, but all other islands are outside of rodent swimming distance.

Dull Island

Dull Island (38ha) lies 300m off the north coast of Farnuff. It is not within rodent swimming distance of any other island. It is mostly a low-lying island, although it rises to around 48m to the west. It is predominated by grasses with some scrubby patches in sheltered areas. It is uninhabited, but has two small landing sites and three buildings – a bothy and two smaller buildings used as stores/shelter by fishermen. It is not thought to attract any other visitors. The cliffs are not sheer here and are largely vegetated - they may once have supported Manx shearwater and puffin. Similarly, the eastern coast has a field of boulders that would appear to be ideal habitat for European storm-petrel, but none have been recorded from the island. It is possible that the presence of brown rat has lead to the extirpation of these species. There are no known species of conservation interest on the island, although it is home to a small colony of seabirds predominated by gulls. The Stewart Island vole and house mice have never been recorded on the island, but common shrews and brown rats are known to be present.

Tuchlose Island

Tuchlose Island has 12 permanent inhabitants and lies 600m from the Lewis and Harris coast. It is 89ha in size with a sloping topography from the western cliffs (115m a.s.l.) down to the eastern coast. There are a number of sheltered beaches and landing sites on the east, whilst the west is not accessible by boat. The island is covered in grasses with patches of heath and scrub. Rhododendron has been recorded in small patches, but these are being treated as part of an initiative to clear the island of this invasive non-native species.

There are nine dwellings on the island, including one farm (cattle) and three holiday cottages (mostly inhabited in the summer months). There are at least 18 other buildings on the island, including a shop and a pub. The island has a year-round tourism interest, with people landing to see breeding grey seals along the east coast over winter and the large seabird colony on the west coast in summer. The island is serviced three times a week by the Caledonian MacBrayne ferry (and experiences a large number of day trippers) and has a weekly rubbish collection. Two tourism operators also land boats throughout the year. Most boat traffic goes to the main jetty at Southport on the South coast of the island. The two more northerly landing sites are used as alternatives when landing at the main jetty is prohibited by bad weather or rough seas.

A dwindling population of Manx shearwater are recorded from the western colony, along with shag, razorbill, guillemot and a small number of puffins. The role of predation by brown rats on the seabird colony is unquantified, but assumed to be a significant part of its decline. A pair of white-tailed eagles breeds on the island, and it is home to the Stewart Island vole.

All three islands experience typical eastern Atlantic coastal weather patterns of wet, windy and mild winters and cool, unpredictable summers. Winter storms are frequently at gale force 8 or more, whilst snow almost never settles. Frequent rain means the vegetation is often slippery and can become very muddy along well-trodden routes, including around livestock areas. On gloomy days in midwinter there can be as few as 5.5 hours of daylight. Landing on all three islands can be difficult in winter, and

scheduled boats are often cancelled due to weather conditions. There are designated helicopter landing sites on the inhabited islands in case of medical emergency at such times.

- *A map or an aerial photo with key features is essential.*

1.2 Target Species: Brown rat *Rattus norvegicus*

The brown rat *Rattus norvegicus* is thought to be present across the entirety of all three islands, with greater abundance around the coast, seabird colonies and around areas of habitation. Distribution information has been gleaned both from historic research (Ding, 2002) and is supported by the index trapping undertaken as part of this study. They are assumed to depend upon the human population and rabbits for sustenance during winter on Farnuff and Tuchlose, but no winter dietary studies have been undertaken.

It is not known how the rats survive on Dull Island over winter – it is possible they do not, but instead reinvade the island periodically from Farnuff. However, since Dull is only 300m from Farnuff, well within the known swimming distance for brown rats, both islands need to be treated together as a single 'eradicable unit'.

Typically, it is assumed that brown rats do not breed this far north throughout the year. However, examination of a preserved carcass brought in by a cat indicates that a female was still lactating in late November. With the presence of people, livestock and prey items such as rabbits and voles, it is possible that rats are able to breed all year on the islands.

1.3 Impacts

No brown rat dietary studies have been undertaken outside of summer. Results from summer indicate predation on seabird eggs and chicks, hence it is very likely that brown rats are having a negative impact on the seabird interest of the Stewart Islands (Goldwire 2009). This study also showed that rats are predating upon vegetation and invertebrates, thus causing impacts to species throughout the islands' ecosystem. It is likely that they are also preying upon mammal species, including young rabbits and the endemic Stewart Island vole. Rats will therefore be impacting on the whole ecosystems of the three islands and at all trophic levels.

The Stewart Islands are designated as a Special Protected Area due to their nationally and internationally important breeding seabird colonies. However, numbers of many species are in decline and bird species sensitive to the presence of rats, such as Manx shearwaters, appear to be particularly badly affected. Numbers of Manx shearwaters, puffins, razorbills and shags have all been declining in the Stewart Islands for the last twenty years (SWCA 2014), while rat numbers are reported to currently be at high levels after a series of mild winters. Brown rats are implicated in this decline as they are known to have an impact of the breeding success and range of these seabird species. It is likely that the presence of rats on the islands is restricting bird populations to significantly lower levels than would otherwise be expected.

On Tuchlose and Farnuff islands, the rat population is controlled most years around the farms and houses using second generation anticoagulant baits containing bromadiolone. Such baiting has been conducted for at least 15 years. The effect of this on the Stewart Island vole is unquantified, but voles elsewhere are known to consume such bait, and to be affected by it.

The cost of rats to the farming businesses on the islands are approximately £4000 per year in spoilt feed, damage to machinery (through chewing through wires), and the cost of poison and labour. The costs to the tourist businesses are around £500 per year for bait, labour and repairing damage caused by rats.

Social and health costs associated with rats are less easily quantified. Rats carry diseases and while there are no suspected cases from the islands, the risk of their transmitting diseases such as Leptospirosis and Salmonella poisoning always remains. The majority of householders on Farnuff and Tuchlose reported ongoing problems with rat infestation of their homes, with damage to property and stored food supplies. The islanders on Farnuff and Tuchlose are keen to support complete eradication for a number of reasons, including economic, social and health.

1.4 Benefits of eradication

Eradicating brown rats from Farnuff and Dull will create valuable habitat free from invasive mammals within the Stewart Islands SPA. It will make resident seabird populations more secure and enable other seabird species to establish on the islands. As detailed above, rats are known to be predating upon a wide range of species and it is likely that removal, while not restoring all the damage they have caused during their tenure, will at least stop further damage and will allow key species to regenerate. It is highly likely that the islands' bird populations will increase markedly in the short to medium term, especially for species highly vulnerable to the presence of rats such as Manx shearwaters and European storm petrels. Populations of these species are known to have increased following rat eradication projects on other UK islands, including Lundy, Ramsey and St Agnes. Numbers of Manx shearwaters are expected to increase following the eradication of rats and it is likely that European storm petrels will recolonise the island. The nearest European storm petrel colony is found on Shillay, some 35km south of Farnuff and it is possible that prospecting birds from this colony may reach the Stewart Islands.

Benefits to other species are also likely, including vegetation and invertebrates which are likely to make up the majority of rats' diet, especially in the months when seabirds are not nesting. It will also protect and enhance populations of land birds present on the islands, including wheatears, skylarks and twite. Migratory waders and waterfowl species, such as barnacle and Greenland white-fronted geese, that use the islands will also benefit.

Eradication of brown rats will also help to meet the conservation obligations of the UK government in the following ways:

- It will protect and enhance the seabird populations present on the islands, under the requirements of SPA designation under the EU Directive 79/409/EEC on the Conservation of Wild Birds to protect bird species and the habitat upon which they depend (`the Birds Directive').
- As UK Government is a signatory to the Convention on Biological Diversity, Article 8(h) requires the control or eradication on alien species that threaten ecosystems, habitats or species.
- Under the UK Biodiversity Action Plan there need to be operations to remove rats affecting breeding seabirds on maritime cliff and slope sites identified by Seabird 2000 and other surveys.
- As UK Government is a signatory to the Bern Convention on European Wildlife and Natural Habitats 1979, Article 11(2b) requires strict control of the introduction of non-native species.
- The EU Marine Strategy Framework Directive (2008/56/EC) requires that all member states' waters are considered to be in 'Good Environmental Status' by 2020. The conservation status of seabirds is one measure of this, another is that non-native introduced species do not adversely alter the ecosystems.

There will also be economic benefits to local residents, due to an end to rat damage to personal and business equipment and in a likely increase in tourism as the seabird potential of the islands improves. Health benefits are also likely to occur, due to an end of the risks of rat-borne diseases, as well as an end to the risks to island children and livestock (as well as non-target wildlife) through the ongoing use of rodenticide bait.

2 GOAL, OBJECTIVES AND OUTCOMES

The goal of the project is to conserve the natural bird communities and wider ecosystem of the Stewart Islands, preventing further losses to invasive rats and allowing the populations of key species to increase. The objectives that this project will achieve and the outcomes that will be seen as a result of achieving these objectives are:

Objectives	Outcomes
1. Eradicate brown rats (*Rattus norvegicus*) from Farnuff Island	1.1 No brown rat population on Farnuff
	1.2 Increase in population size of Manx shearwater on Farnuff
	1.3 Recolonisation of Farnuff by European storm-petrel
2. Eradicate brown rats (*Rattus norvegicus*) from Tuchlose Island	2.1 No brown rat population on Tuchlose
	2.2 Increase in population size of Manx shearwater on Tuchlose
	2.3 Recolonisation of Tuchlose by European storm-petrel
3. Safeguard native populations of conservation interest/importance	3.1. Stewart Island vole population exceeds pre-eradication level two years after eradication is complete
	3.2 No mortality of white-tailed eagles on either island attributable to rodenticide use during the eradication phase of the project
4. Improve the capacity of partner organisations to undertake complex eradication projects	4.1 Partner organisation staff have skills to lead eradication projects of a similar size and complexity to current project
5. Maintain invasive-rodent-free status of islands via appropriate biosecurity measures	5.1 Islands remain free of invasive rodents

3 FEASIBILITY

In this section we present and analyse the information available for each of the seven feasibility criteria to enable the feasibility of eradication brown rats from the Stewart Islands to be determined.

3.1 Technical feasibility

The relatively low vegetation and flat terrain of most of the islands mean that a ground based project is considered technically feasible. The biggest technical challenge comes from the presence of vegetated ledges on the cliffs

Brown rats can be targeted using a 50m grid, but we advise reducing this around areas of habitation to an approximate 25m grid (stations should be placed in appropriate sites based around this bait point density, equating to 16 stations per hectare). Extra stations should be placed along stone walls and reduced grid size should be considered around the seabird colonies, particularly as wintering gulls may provide an important food source for rats in winter. Bait stations locations will be determined using GIS with staff then using handheld GPS units to locate and mark their positions on the ground. The largely open nature of the terrain (almost entirely low grassland with occasional areas of scrub) mean that little track cutting will be required. The project should be carried out in the winter when the availability of natural food for rats is at its lowest. This has proven successful in other UK rat eradication including on Canna and the Shiant Isles in the Hebrides.

Specialist rope workers will be required to service some of the areas of cliffs on both Farnuff and Tuchlose. A specialist rope access worker was invited to join the site visit as part of this feasibility study and concluded that all areas could be accessed safely and that the rocks were sufficiently stable to put in anchor points where necessary. He suggested a team of three rope workers would be required to undertake the work safely. These people would need to be on the islands for the duration of the operation in order to achieve the required frequency of checks of bait stations. Whilst feasible, this will add to the costs of the operation.

Access to Farnuff is unlikely to present any problem due to the regular scheduled ferry service operating from mainland Lewis. While the occasional ferry may be cancelled due to bad weather, this is extremely unusual. Figures from the ferry's operator, CalMac, show that the ferry has been cancelled on fewer than five occasions in each of the last three years. Boat access to Dull will be more likely to be affected by the weather. However, the necessary field team of four people, including one rope access worker) can be safely and securely accommodated in the bothy on Dull, once it has been adequately renovated. We propose that the team on Dull stay there for around a week at a time, and are relieved by a different team at the end of this time. Substantial stores of food, water and fuel for the generator, heating and cooking facilities (at least a six-week supply) should be stored on the island in case the weather conditions prevent boat access.

Voles and mice

Stewart Island voles will be susceptible to the bait used on the eradication project. While their home ranges are smaller that the proposed grid size and it is highly likely that some would survive the baiting operation this would be a high risk option. We propose that a captive population of shrews is established for the duration of the poisoning and long term monitoring phase, and returned to the island once the eradication has been declared a success (two years after the last sign of rats). A suitable project partner would need to be found to house the captive animals. Possibilities include Edinburgh Zoo, the Scottish Animal Park or the University of Glasgow.

The presence of house mice would complicate the project and would add considerably to the financial cost of the operation and the amount of work required. It was therefore important to find out whether nice were present on any of the islands. House mice have never been recorded from either Tuchlose or Dull islands. Island residents report domestic cats occasionally bringing in voles, shrews and rats but not house mice. There are reports from other islands of house mice coexisting in very low numbers with rats, but their populations increasing sharply following the removal of rats (e.g. Witmer et al. 2007). Animals at low densities may not be obvious to the island's human population so it is important to check whether or not they are present. As part of this study we used tracking tunnels and live-capture small mammal traps (Longworth traps) to survey the island's small mammal fauna. Stewart Island voles and common shrews were both caught in the live capture traps and their footprints were recorded from tracking tunnels, but no evidence of house mice was found. We therefore recommend proceeding on the assumption that mice are not present, but with plans in place to adapt the eradication to include mice should evidence of them be found later.

3.1.1 Choice of method

Options for reducing impacts of brown rats

Table A presents the pros and cons and practicality of the control and eradication methods considered for the proposed eradication of rats from the Stewart islands. While long term control is an option it is likely to lead to larger long-term cumulative costs in terms of animal welfare, rodenticide and equipment and financial commitment. The only realistic option to reduce rodent impacts on seabirds (and the islands' ecosystem) is the eradication of rats.

Options for brown rat management

The different management options for the rat population on Farnuff and Dull are explored in table B. Of the methods available, the use of anticoagulant rodenticides is currently the most widely recognised effective method of eradicating rodents from islands.

The use of anticoagulant rodenticides is considered inhumane (Pesticides Safety Directorate 1997), however, the lack of alternatives and the ultimate outcome of preserving and restoring the breeding seabird colonies on the Stewart Islands have to be weighed against their use.

In the UK, aerial or hand broadcasting operations cannot be carried out as the risks to the environment, people and other non-target species from toxic bait will be considered too high. This leaves us to consider the feasibility of deploying a hand baiting operation using bait stations. This technique has been used in most UK rat eradication projects to date, including on Ramsey, Lundy, Canna and St Agnes, with great success.

Options for rodenticide choice

We recommend that the project use a wax block bait formulation, as has been successfully used on other UK eradication projects. Experiments using non-toxic wax bait blocks (Detex Blox, manufactured by Bell laboratories) on all three Stewart Islands showed a high level of acceptability by rats. Two 20g bait blocks were set out at each of 30 sites for three days and checked daily. 80% showed take by rats within 2 days and 93% within 3 days. For the active ingredient of the bait we recommend considering first generation compounds, such as coumatetralyl. This will reduce non-target risks to the vole population as well as to Farnuff's resident pair of white tailed eagles and other visiting raptors. While it is unusual to use a first generation compound as the primary rodenticide in a rat eradication project, the project on the Isle of Canna in 2005-6 successfully used the first generation diphacinone for almost the entirety of the project, using a second generation back-up product for targeting just a few remaining rats. However, diphacinone is no longer registered for use in the EU and coumatetralyl is not available in a wax block formulation. Second generation compounds are therefore a more realistic option. The range of toxins considered for use is detailed in table C.

Table 1: Alternative options for reducing the impacts of brown rats on the Stewart Islands

Option	Outcome	Decision
1. Do nothing	The natural ecosystem of the Stewart Islands will continue to degrade, especially the survival of breeding seabirds on the islands. This would also contravene both national and international obligations.	UNACCEPTABLE
2. Undertake long-term rodent control	The rat population would be controlled through lethal or non-lethal means. However, targeted rat control measures would have to take place prior to and throughout the seabird breeding season in perpetuity. The costs of an on-going control operation would be considerable: • Welfare cost. The long-term cumulative effect could be greater than a one-off eradication operation • Financial cost. The implementation of a regular rat control programme would require personnel and equipment to be present for at least six months (or year round) on the islands • Ecological and environmental cost, risk of resistance and persistence of toxin greatly increased.	IMPRACTICAL
3. Relocate the entire rodent population	The safety of breeding seabirds and the islands' ecosystem would be protected while trying to ensure the highest standards of welfare for rodents. However, for this option to succeed every rat would have to be caught and relocated (remaining rats would quickly multiply, rendering any biodiversity gains only temporary). This option is simply not feasible as it is too challenging (and time-consuming and expensive) for personnel to be able to capture the entire rat population on the Stewart Islands. In addition, it would be difficult to obtain permission to relocate the rats that would satisfy community, conservation, disease and welfare concerns.	IMPRACTICAL
4. Eradicate the entire rodent population	This involves lethal eradication of all rats on the Stewart Islands using anticoagulant rodenticides. Although the one-off welfare cost of this option would be high, it offers a sustainable and financially cost-effective solution with possibly fewer welfare costs to rats and non-target species in the long-term than ongoing control. Options were considered to determine eradication methods that could be used (Table B). Trapping, gassing, glue boards, repellents, prevention and alternative toxin options were considered not feasible due to labour requirements, welfare issues, access, number required or non-target impacts. The only suitable option to eradicate rats from the Stewart Islands is a ground-based operation (i.e. apply anticoagulant rodenticide bait in bait stations) and eradicating the entire rat population *in situ*. This option is considered technically feasible as islands larger than the Stewart Islands have had invasive rat populations eradicated using this method in the UK and around the world (Howald et al. 2007, Thomas et al. 2017).	PRACTICAL: RECOMMENDED

Option	Advantages	Disadvantages	Decision
1. Prevention (i.e. rat-proofing)	• Non-lethal • Environmentally clean • Proofing areas prevents damage and effects of rats	• Useful for buildings and small areas only • Does not deal with rats already present (which can still cause damage or have impacts) • Rat-proof fencing expensive • Non-lethal; can move problem to another location • Usually combined with other methods • Best suited for small areas • Little value alone	INEFFECTIVE
2. Repellents	• Sound or chemical options • Non-lethal • Targeted control • No welfare impacts	• Little to no success (Mason & Litten 2003) • Rats habituate to repellent • Non-lethal • Can move problem to another area • Little to no use in an island-wide situation	INEFFECTIVE
3. Aluminium phosphide (fumigation)	• Targeted control (burrows only) • Lethal method	• Needs knowledge of habitat and location of all rat burrows • Risks to general public • Risks to other non-target species • Professional use only • Outdoor use only • Ethical concerns • Untested for island-wide eradication projects	IMPRACTICAL
4. Immuno-contraception	• Could be long-term solution • Humane • Environmentally clean	• At research stage only • Concerns regarding loss of control • Non-target species concerns • Irreversible • Public concern	IMPRACTICAL (EXPERIMENTAL ONLY)

5. Biological control	• Long-term solution • Involves releasing another possible problem animal	• Non-target impact concern • Ethical concerns • Legal issues	IMPRACTICAL
6. Kill traps (i.e. snap, spring or break-back traps)	• Lethal (rapid death) • Targeted control • Environmentally clean • Can be used by general public • Range of traps commercially available	• Labour-intensive • Expensive • Welfare issues and ethical concerns • Need to be checked twice daily (if set permanently) • Only legal traps can be used (under relevant UK and Scotland Pest Control and Trapping Acts) • Experienced trappers required for large-scale operations • Requires good accessibility • Non-target issues • Untested for island-wide eradication projects • Risk to non-target species (particularly lizards)	IMPRACTICAL (LEGALITY ISSUES & UNTESTED)

7. Live trapping	• Humane • Environmentally clean • Non-target species can be released unharmed • Targeted control • Range of traps commercially available • Can be used by the general public • Rats can be released to an alternative location	• Labour-intensive • Expensive • Need experienced trappers for large-scale operations • Requires good accessibility • Welfare issues (while animal in trap & kill method) • Need to be checked twice daily • Only legal traps can be used (under relevant UK and Scotland Pest Control and Trap Acts) • Rats have to be humanely killed (under relevant UK and Scotland Animal Welfare Acts) • Untested for island-wide eradication projects • Release of rats may have impacts at release site or welfare issues for animals • Ethical concerns	IMPRACTICAL (LEGALITY ISSUES & UNTESTED)
8.Glue boards	• Targeted control • Environmentally clean • Non-toxic	• Labour-intensive • Welfare issues and ethical concerns • Need to be checked twice daily (if set permanently) • Animals must be killed humanely (under relevant UK and Scotland Animal Welfare Acts) • Non-target issues • Untested for island-wide eradication projects • May be removed from international markets shortly as perceived to be inhumane	IMPRACTICAL (LEGALITY ISSUES)
9.Alphachloralose	• Humane	• Illegal for use on rats in UK • Use of toxin • Non-target impacts • Ethical concerns • Untested for island-wide eradication projects	IMPRACTICAL (ILLEGAL)

10.Anticoagulant rodenticides	• Efficient • Large areas covered quickly • Most widely used approach to control rats • Most cost-effective method of controlling substantial infestations • Tested and successful method for one-off island-wide eradication projects • Range of application methods • Can be used in bait stations to reduce risk to non-target species • Antidote available • Range of rodenticides available (e.g. first generation or second generation) • Range of formulation available (e.g. grain, wax block, pellets etc.) • Available for use by the public and professionals	• Use of toxin • Persistence in environment (toxin dependent) • Non-target impacts • Ethical concerns • Resistance issues with prolonged use • Legal requirements for certain rodenticide use (i.e. brodifacoum restricted to indoor use only, bait station use required for some rodenticides, etc.) • Implies coverage of whole area • Requires use of adequate baits and bait stations • Disposal requirements • Health and Safety concerns	PRACTICAL & RECOMMENDED (TESTED AND EFFECTIVE)

Table 2: Different rodenticides considered for the brown rat eradication on the Stewart Islands (adapted from Bell 2013)

Toxin	Advantages	Disadvantages	Outcome
FIRST-GENERATION			
Warfarin	• Low potency • Delayed onset of symptoms (i.e. prevents neophobia and bait shyness) • Less persistent than second generation anticoagulants • Reduced risk of non-target poisoning • Reduced secondary poisoning risk • Very low risk to raptors • Cheaper than second generation anticoagulants • Antidote available	• Low potency • Multiple feed • Large quantity required • Repeated applications required • Longer access to bait required • Low persistence (metabolised quickly) • Non-target species have longer to access bait (i.e. competition with rats) • Not currently available in wax block formation in the UK • Resistance issues	NOT RECOMMENDED
Pindone	• Low potency • Delayed onset of symptoms • Less persistent than second generation anticoagulants • Reduced secondary poisoning risk • Reduced risk of non-target poisoning • Cheaper than second generation anticoagulants • Antidote available • Low solubility in water • Binds strongly to soil and breaks down slowly • Not registered for use in UK	• Low potency • Moderate risk to birds • Multiple feed • Large quantity required • Repeated applications required • Non-target species have longer to access bait (i.e. competition with rats) • Low persistence (metabolised quickly) • Untested for island-wide rat eradications	NOT REGISTERED FOR USE IN UK

Diphacinone	• Low potency • Delayed onset of symptoms • Less persistent than second generation anticoagulants • Reduced secondary poisoning risk • Reduced risk of non-target poisoning • Low toxicity to raptors (and mice) • Used successfully on island eradications in UK • Cheaper than second generation anticoagulants • Antidote available • De-registered in UK (unavailable for use)	• Low potency • Repeated applications required • Longer access to bait required • Less persistent (metabolised quickly) • Non-target species have longer to access bait (i.e. competition with rats)	NOT REGISTERED FOR USE IN UK
Coumatetralyl	• Low potency (higher than warfarin and pindone) • Delayed onset of symptoms • Less persistent than second generation anticoagulants • Reduced secondary poisoning risk • Reduced risk of non-target poisoning • Cheaper than second generation anticoagulants • Antidote available • Binds to soil and breaks down slowly	•Not available in a wax block formulation in the UK •Low potency • Multiple feed • Repeated applications required • Longer access to bait required • Less persistent (metabolised quickly) • Non-target species have longer to access bait (i.e. competition with rats) • Few successful island-wide eradications	COULD BE USED AS BACK UP TO A WAX BLOCK FORMULATION

SECOND-GENERATION			
Bromadiolone	• Moderately potent • Single feed • Delayed onset of symptoms • Effective on rats (Rattus norvegicus in particular) • Antidote available • Not readily soluble in water • Binds strongly to soil and breaks down slowly • Previously successfully used in UK eradications	• Persistence issues (> 9 months in some species) • High secondary poisoning risks • Slightly less potent than brodifacoum and flocoumafen • Some resistance issues suspected • Limited data on non-target impacts	RECOMMENDED
Difenacoum	• Moderately potent • Single feed • Delayed onset of symptoms • Effective on rats • Antidote available (but long-term treatment required) • Insoluble in water • Binds strongly to soil and breaks down slowly • Previously successfully used in UK eradications	• Persistence issues (> 9 months in some species) • High secondary poisoning risks • Limited data on non-target impacts • Slightly less potent than bromadiolone • Less potent than brodifacoum and flocoumafen	NO ADVANTAGES OVER BROMADIOLONE AS MAIN RODENTICIDE

Flocoumafen	• Very potent • Single feed • Delayed onset of symptoms • Effective on rodents • Good availability • Antidote available (but long-term treatment required) • Not readily soluble in water • Binds strongly to soil and breaks down slowly	• Not registered for use in open areas in UK • Not widely used in eradications • Persistence issues (> 9 months in some species, and can be longer than with brodifacoum) • High secondary poisoning risks • Limited data on non-target impacts • Expensive	NOT REGISTERED FOR USE IN OPEN AREAS IN UK
Brodifacoum	• Very potent • Single feed • Delayed onset of symptoms (i.e. prevents neophobia and bait shyness) • Very effective on rodents • Insoluble in water • Binds to soil (slowly degraded) • Widely used in eradications • Successfully used in island eradications worldwide • Efficacy data widely available • Non-target impact data widely available • May be possible to get permit from HSE to allow use in open areas • Widely available • Range of bait formulations available • Antidote available (long-term treatment required)	• Not registered for use in open areas in UK • Persistence issues (> 9 months) • High secondary poisoning risks • Non-target impacts recorded • Expensive	NOT REGISTERED FOR USE IN OPEN AREAS IN UK

3.1.2 Non-target impacts

Table 3: Risk assessment for non-target species during the eradication of brown rats on the Stewart Islands

Species	Impact risk (1°/ 2° poisoning, or trophic)	Description of impacts and possible mitigation measures	Risk of impact
Stewart Island Vole	1°: High 2°: Low T: High	Cannot be excluded from bait stations. Likely to take the bait and be killed by it. However, bait station grid size means that many individuals will not encounter bait stations and will survive. Numbers likely to increase, possibly sharply, following rat eradication due to an end to predation and competition.	High
Common shrew	1°: Low 2°: Low T: High	Cannot be excluded from bait stations. May take the bait and be killed by it, although as insectivores they are unlikely to eat significant quantities. May consume invertebrates which have eaten bait and be killed via secondary poisoning. However, bait station grid size means that many individuals will not encounter bait stations and will survive. Numbers likely to increase, possibly sharply, following rat eradication due to an end to predation and competition.	Medium
Rabbit	1°: Low 2°: Low T: High	Use of wires to reduce size of entrance holes in bait stations. Only young animals will then be able to enter bait stations and, as herbivores, they are unlikely to consume wax block bait in harmful quantities. Numbers are likely to increase following rat eradication as predation decreases.	Medium
White tailed eagle	1°: Low 2°: Medium T: Low	Birds of prey may take poisoned rats. This can be mitigated by carefully searching for and disposing of dead and dying rats.	Low
Feral cats	1°: Low 2°: Medium T: Low	Too big to enter bait stations and unlikely to eat wax block bait. May consume poisoned rodents and thus be at risk of secondary poisoning. This risk can be reduced by diligently collecting and disposing of dead and dying rodents.	Low

Pet cats	1°: Low 2°: Low T: Low	Too big to enter bait stations and unlikely to eat wax block bait. May consume poisoned rodents and thus be at risk of secondary poisoning. This risk can be reduced by diligently collecting and disposing of dead and dying rodents. Antidote can be offered to any individuals known or suspected to have eaten bait	Low
Pet dogs	1°: Low 2°: Low T: Low	Too big to enter bait stations, though may eat wax block bait if encountered. May take bait crumbs dropped by operators or dislodged by rats. This can be mitigated by taking care not to drop crumbs and to pick up bait fragments found outside of stations. May consume poisoned rodents and thus be at risk of secondary poisoning. This risk can be reduced by diligently collecting and disposing of dead and dying rodents. Antidote can be offered to any individuals known or suspected to have eaten bait	Low
Domestic poultry (chickens and geese)	1°: Low 2°: Low T: Low	Too big to enter bait stations and in any case will be kept in areas with no bait stations. Granivorous species may take bait crumbs dropped by operators or dislodged by rats. This can be mitigated by taking care not to drop crumbs and to pick up bait fragments found outside of stations. Antidote can be offered to any birds known or suspected to have eaten bait	Low
Cows	1°: Low 2°: Low T: Low	May kick over any bait stations they find and eat bait but can be kept away from areas with bait stations. Antidote can be offered to any individuals known or suspected to have eaten bait	Low
Sheep	1°: Low 2°: Low T: Low	May kick over any bait stations they find and eat bait but can be kept away from areas with bait stations. Antidote can be offered to any individuals known or suspected to have eaten bait	Low
Crows	1°: Low 2°: Medium T: Low	Crows may try to open bait stations by sliding the doors but can be deterred by using 'crow clips' to prevent doors moving. They will eat bait fragments found outside bait stations. This risk can be mitigated by taking care not to drop crumbs and to pick up any bait fragments found outside of bait stations. They may also eat poisoned rats, rabbits, other small animals or invertebrates. Diligently collecting and disposing of dead or dying rodents will reduce this risk.	Low

Gulls	1°: Low 2°: Medium T: Low	Unable to enter bait stations but likely to eat bait fragments if found outside bait stations. This risk can be mitigated by taking great care not to drop crumbs and to pick up any bait fragments found outside of bait stations. They may also eat poisoned rats, rabbits, other small animals or invertebrates. Diligently collecting and disposing of dead or dying rodents will reduce this risk.	Low
Land birds (passerines)	1°: Low 2°: Low T: Low	Cannot be excluded from bait stations but unlikely to enter. Granivorous species may take bait crumbs dropped by operators or dislodged by rats. This can be mitigated by taking great care not to drop crumbs and to pick up any bait fragments found outside of bait stations. Insectivorous species may be at risk of secondary poisoning by eating invertebrates which have themselves eaten the bait	Low

3.1.3 Key issues to resolve before operation proceeds

1. Renovate bothy and outbuildings
2. Identify suitable project partner for housing captive vole population
3. Determine numbers needed for captive population and collect sufficient voles for it
4. Carry out resistance testing for coumatetralyl and difenacoum in the rat populations on Farnuff and Dull Islands
5. Produce action plan for what to do if mice are found to be present on Farnuff or Dull

3.2 Sustainability

Table 4: Potential invasion pathways for the Stewart Islands

Species	**Source**	**Pathway**	**Risk**	**Prevention Strategy**
Species Name	*Where will invasive species come from?*	*How will it travel to the island? And how likely is it to happen?*	*How severe would the impacts of establishment be?: Critical(C) High(H) Medium(M) Low(L)*	*How will you prevent the species using the pathway to re-invade*
Brown rat	Lewis and Harris	Swim – **Tuchlose** Likelihood not known without connectivity study, but within known swimming distance. Swim – **Farnuff / Dull** considered extremely unlikely as is more than twice the furthest known swimming distance for brown rats	Critical	Could use rat traps on likely dispersal points on coast of Lewis (ongoing rodenticide use not recommended) Focus monitoring devices in parts of island where dispersing rats are likely to arrive.
Brown rat	Lewis and Harris, possibly elsewhere	Ferry and leisure boats – **Tuchlose, Farnuff & Dull** Possible	Critical	Bait stations on ferry. Inform & educate boat users (inc. ferry passengers). Focus monitoring devices around piers & moorings. Unpack cargoes with care. Install rodent proof room for unpacking bulky high-risk cargoes e.g. animal feed & building materials
House mouse	Lewis and Harris, possibly elsewhere	Ferry and leisure boats – **Tuchlose, Farnuff & Dull** Possible	Medium	(as for brown rat)
Black rat	Passing ship	Swim – no known	Critical	(as for brown rat)

		colonies within swimming distance, though could swim from a passing infested ship. Unlikely but possible		
Black rat	Lewis and Harris, possibly elsewhere	Ferry and leisure boats – **Tuchlose, Farnuff & Dull** Unlikely but possible	Critical	(as for brown rat)

The proximity of Tuchlose to islands from which rats cannot be eradicated (Lewis and Harris) means we recommend that sustainable eradication on Tuchlose be considered unfeasible. A DNA connectivity study should be considered to help understand the reality of this risk in practice. This is likely to cost around £10,000, however it should be noted that its results cannot be conclusive as established populations can prevent new arrivals from settling and breeding, giving the appearance that dispersal is less likely than it actually is (Fraser et al. 2015). Although rats would have to swim against a current to reach Tuchlose, there are small 'stepping stone' rocks between the island and the mainland of Lewis and Harris which further add to the risk of reinvasion. Experience from other restoration projects has found that there can be periods of slack either side of the tide turning. The risks of reinvasion are considered too high and the degree of biosecurity that would be needed to mitigate these risks is considered unrealistic for an island with such a small resident population.

Should the eradication plans proceed then a full biosecurity plan will be produced. The essence of island biosecurity is to identify the pathways by which invasive species might reach the island and to then place multiple obstacles along that pathway. Briefly, there are three opportunities for preventing rats reaching the island – to prevent them leaving their current location, prevent them from reaching the island and, finally, to prevent them from forming breeding populations if they do reach the island. Table 4 above suggests some of the measures that could be used to minimise the risks of rodents invading or reinvading the islands. These include placing bait stations and/ or appropriate traps or other monitoring devices on boats travelling to the islands as well as at the harbours they are likely to travel from and also where they will moor when reaching the islands. Training and awareness-raising of boat users, particularly staff on the CalMac ferry, is extremely important. A set of protocols informing ferry staff, other boat users and island visitors what to do in the event of finding rat sign will also be produced. A surveillance strategy for both Farnuff and Dull islands will be developed, using a range of different techniques including flavoured wax blocks and tracking tunnels. A full incursion response plan will also be produced, detailing exactly what should happen in the event of rodent sign being found on the islands.

3.3 Political & legal acceptability

A number of regulatory requirements may need to be fulfilled for the proposed eradication programme, including:

- Animal Ethics approval to undertake many of the research and monitoring components of the plan,
- Review of the Feasibility Study and Operational Plan by a member of the UK Island Restoration Advisory Group (UK-IRAG) to ensure the proposed techniques comply with best operating practises for island rat eradications.
- Review of the Feasibility Study and Operational Plan by the Health and Safety Executive (HSE) to ensure the safety of operational staff, volunteers and visitors.
- Training personnel in rodent management and safe bait use and handling (an appropriate training course is available for this, managed by the Campaign for Responsible Rodenticide Use's Stewardship Scheme.)

- Ensure operation is valid under the Control of Pesticides Regulations 1986
- Apply for permission from SWCA for any track cutting that may be needed, since the islands are an SSSI

SWCA will also need to give permission for the temporary removal of a captive population of Stewart Island voles

3.4 Social acceptability

The communities on Farnuff and Tuchlose and the islands' owner have been involved in preliminary discussions over the possibility of a rat eradication project over the last three year. When the islands were identified as priorities for rat eradication in the prioritisation exercise carried out by the UKSCT further discussions were held and all parties agreed to a feasibility study being carried out, with no obligations on any of the parties involved.

Table 5 : Key Stakeholders on Farnuff Island

Name	Capacity of stakeholder	What will they have to do for project to succeed?	Notes/comments incl details of all previous communication
Bob Clipper	Owner of islands	Write letters of support, e.g. for funding applications, allow (and facilitate) access to the islands, allow improvements to accommodation on Dull	Historic connection with SWCA over land management as part of SPA, lead contact at SWCA **Bill George.** Long running interest in conservation and Hebridean natural history
Graham MacDonald, Jan & Jock Fry, Alice MacLeod	Farmers on Farnuff	Comply with mitigation and biosecurity measures, potentially be prepared to move livestock around island	Supportive of the idea of eradication, though some concerns over risks to animals.
Jenny Godber, Paul & Jim MacLeod, Frank Day (plus farmers)	Pet owners on Farnuff	Comply with mitigation measures for pets during poisoning operation	Supportive of the idea of eradication, though some concerns over risks to animals.
Pam & Jack Francis, Alice Macleod, Julie & Guy Soady, Ed Roberts	Parents of Farnuff children	Assist with education of children over toxin risks	Supportive of the idea of eradication, though some concerns over risks to children.
All residents	Farnuff residents	Adhere to biosecurity measures	Some questions about practicality of quarantine and biosecurity measures that will be needed.

Public meetings were held on Farnuff and Tuchlose as part of this feasibility study, though only the results of the public consultation on Farnuff are included here. We met with all island residents on two occasions, at the beginning and end of the trip. On the first meeting we introduced ourselves and gave a brief presentation on the aims, objectives and methods of the proposed eradication project, followed by an open question and answer session. Over the course of the week we then visited every household on the island and spoke in more detail about the plans, focussing on the potential implications for island residents (both positive and negative) as well as the conservation benefits that could be expected. We then held another meeting at the end of the week to discuss our findings, give more detail on what would need to be done and to take any further questions about the project.

The main concerns about the project were the safety of people and domestic animals and the impacts that could be expected to peoples' daily lives. Residents were reassured to hear about how the use of bait stations would minimise the chances of livestock coming into contact with the bait and also that there was an antidote available. The farmers asked if the costs of testing any animals for rodenticide residues before shipping them to market would be covered by the project. This will need to be considered by the project finders and is not currently included in the estimated budget included in this report.

3.5 Environmental acceptability

The eradication of brown rats from Farnuff and Dull islands are likely to have strong positive environmental benefits. Rat predation of seabirds on the islands, believed to be a major factor in the decline of several species, will end, as will their impacts upon other prey species including many of the islands' plants and invertebrate species. The biggest potential negative impact from removing rats is likely to be an upswing in the numbers of rabbits, leading to impacts on the islands' vegetation caused by increased grazing pressure. The rabbit population should therefore be monitored before and after the rat eradication and we recommend that the Operational Plan includes provision for controlling rabbits if their populations increase above a pre-determined threshold.

The poisoning phase of the operation is likely to cause some losses to non-target mammal species, including Stewart Island voles, common shrews and rabbits. Impacts on rabbits will be reduced by using wires to reduce the size of the bait station entrance holes. No population level impact on rabbits is considered likely. Population level impacts on shrews are also considered to be unlikely as the species have home range sizes smaller than the proposed 50m x 50m baiting grid, meaning that many shrews are unlikely to encounter bait stations. The Stewart Island vole is likely to be similarly protected, as the available data suggest their home range size is only around 200m^2 (equating to a circle approximately 16m in diameter) (Hausberg 2006). However, the endemic status of the vole means that serious consideration should be given to establishing a captive population for the duration of the project. We recommend drawing up plans to collect and maintain a captive vole population, either on Farnuff or elsewhere. This should be included in the Operational Plan.

By reducing the risk of primary poisoning for these three mammal species we will also be reducing the risk of secondary poisoning to the white-tailed sea eagles and other raptors. The use of a first generation rodenticide as the primary bait for the eradication project will also decease the chance of secondary poisoning of non-target raptor species since it is markedly less potent than the second generation compounds more commonly used in eradications and does not persist in biological tissues to the same extent. It is estimated that a white tailed eagle would have to eat It will also reduce the theoretical risk of secondary poisoning to insectivorous birds such as skylarks, which may eat invertebrates which have themselves eaten the bait.

Risks to livestock are also extremely low. While some interference with bait stations has been reported from the rat eradication projects on Lundy and Canna, caused by ponies and cows, this did not lead to any harmful effects for the animals involved. However, it is best practice to avoid any unnecessary consumption of bait by on-target species. If livestock are found to be interfering with bait stations additional efforts will be made to reinforce the stations (e.g. by weighing them down with rocks) or, if it does not conflict with the operational plan, the bait could be wired into the stations. Discussions with the animals' owners could also take place to see if any animals known or suspected to be interfering with the bait stations could be moved to a different location for the remainder of the poisoning phase. The details of this should be presented in the operational plan.

The long term impacts on any of the islands' native vertebrate species are likely to be extremely positive once the pressure of competition and predation by rats. The islands' birds are likely to be at

extremely low risk from the eradication if it is carried out safely – i.e. bait only deployed inside fixed bait stations.

The overall impacts of removing invasive brown rats from the ecosystems of Farnuff and Dull are likely to be extremely positive. Ecological networks are delicate and complex systems however and there is always the possibility of unwanted unforeseen effects. Theoretically, any of the species currently subject to predation or competition by rats could increase once these pressures are removed, potentially markedly so. Consequently we recommend that a range of invertebrate and plant species are included in the pre- and post-eradication monitoring plans, as well as rabbits, seabirds and land birds and the remaining mammal fauna. Impacts on these species are often overlooked in post-eradication monitoring studies. Detailed protocols for the pre- and post-eradication ecological monitoring surveys will be provided in the monitoring and evaluation plan.

3.6 Capacity

Table 6: Key Skills needed to complete the project to eradication brown rats from the Stewart Islands

KEY SKILL	PURPOSE	METHOD TO OBTAIN SKILLS
Leadership of rat eradication projects	Lead technical phase of rat eradication	Tender for specialist
GIS expertise	Create and maintain maps of islands and associated rat eradication data (locations of bait stations, monitoring equipment etc.)	Tender for specialist
Boat handling skills	Transporting staff and equipment safely between islands	Locally available
Overall project management skills	Oversee project management	Available within SWCA and UKSCT
Community liaison expertise	Advise on how to engage with and advocate to the community	Available within SWCA and UKSCT, may consider tendering for specialist expertise
Climbing expertise	Set up rope access points where needed and use these to safely and effectively monitor rat activity	Hire experienced climbers as part of eradication team
Rodent trapping and husbandry skills	Capture and maintenance of captive vole population	Available within Scottish Animal Park (project partner)

3.6.1 Project management

The UKSCT have the necessary skills in-house to manage the project, including several highly experienced project managers.

3.6.2 Specialist input

The project will also employ an experienced rodent eradication contractor to the lead the eradication and intensive monitoring phases of the project. Experienced climbers will be used for the rope access work, while boat operators familiar with local sea conditions will be used for work needing boat access.

3.6.3 Staffing

Project manager: The UKSCT and SWCA have allocated Kate Vickerman to the role of project manager for the duration of the project. She has extensive project management and rat eradication experience.

Operations (Technical) Manager: A technical rat eradication expert will be required to act as the technical co-ordinator in the project team. They will provide technical expertise, guidance and take responsibility for completing the technical activities. They will assist the PM in planning the technical activities. The role of operations manager will be put out to tender in order to attract a world-class eradication specialist.

Deputy Operations Manager: Sam Peason of SWCA will take the role of Deputy Operations Manager. Sam has worked as a team leader on previous UK rat eradication projects in addition to his experience of invasive species projects overseas. Sam's involvement at this level will continue to build capacity for practical rat eradication skills within UK conservation organisations.

Independent Rat Eradication Technical Advisor: The project will appoint an independent expert to review project documents and conduct the eradication readiness check. The advisor will not be involved with the actual completion of the project but will remain independent in order to provide objective reviews of planning and progress. We will consult the UK Island Restoration Advisory Group for assistance in sourcing a suitable advisor or advisors.

Vole capture and husbandry specialist: An experienced small mammal expert will be needed to design and run a trapping programme to collect a captive population of Stewart Island voles. The voles will also need to be maintained in captivity until the island is declared rat–free. Specialist facilities will need to be available for this on a site with appropriate facilities.

Rope workers: The rope work needed for the project will be put out to tender to find specialists with the appropriate skills and experience.

Boat handler(s): Experienced boat handlers will be needed to transport staff and equipment between Farnuff and Dull Islands. It is likely that appropriate skills, boats and required certifications will be available among the community on Farnuff.

3.6.4 Institutional Support

The project will need the support of the relevant agencies, both government and NGO. Approval by SWCA will be required. SWCA and UKSCT will also need to ensure that agreements to allocate set amounts of staff time to the project are met.

Currently the project management structure and responsibilities between agencies (e.g. SWCA, UKSCT and the landowners) have not been finalised. A clear management structure and consistent support is critical to the outcome of the project and will need to be confirmed.

3.7 Financial viability

Table 7: Indicative project costs for the eradication of brown rats from the Stewart Islands

Item	Details	Cost (£)
Project Design Stage		
Salary: project manager	Planning and writing Project Plan	2 000
Contractors	Planning and writing Project Plan	2 000

	Project Design Stage: sub-total	4 000
Project Design Stage, Expected cost		**4 000**
Operational Planning Stage:		
Contractors	Planning costs – development of biosecurity, monitoring and operational plans	6 000
Salary: Project manager/ administrator	Part time for one year. Covers all stages of project	15 000
Salary: Deputy operations manager	Part time for one year. Covers all stages of project	12 000
Field trip costs	Contract eradication expert, plus project manager	6 000
Operational Planning Stage, Sub-total		39 000
Operational Planning Stage, Contingency (20%)		7 800
Operational Planning Stage, Expected cost		**46 800**
Implementation Stage:		
Bait purchase (primary)	5.5 tonnes Contrac (bromadiolone) blocks	37 400
Bait purchase (back-up)	100kg Neosorexa (difenacoum blocks)	700
Bait transport costs	Road transport, Bristol to Stornoway	2 200
Local storage and transport	Storage in Stornoway	500
Bait shipping costs	Boat, Stornoway to Farnuff	1 200
Contracted Operations manager	7 months @ £3000 per month	21 000
Other contracted staff costs	6 staff for a total of 37 person-months @ £2400	88 800
Staff transport	Travel for staff and volunteers to Farnuff	2 200
Accommodation, en route	Hotel/ B&B for staff travelling to/ from Farnuff, two nights each for up to 15 people	1 500
Accommodation, Farnuff	House rental for 7 months @ £1200/ month (2 properties, includes all utilities)	8 400
Food & subsistence	Food for project staff and volunteers for 62 person-months @ £320	19 840
Bait stations	Plastic tube bait stations, 1000 @ £4 each (10 x 100m rolls of unperforated drainage tube, plus wires for fixing to ground and crow clips	4 000
Bait stations	Wooden boxes with hinged lids (for long term monitoring purposes), 50 @ £25 each	1 250
Monitoring points	Wire for fixing monitoring items to ground, 4 x 200m rolls @ £100 per roll	400
Other equipment for eradication monitoring phase	Includes: flagging tape, marker poles, poison warning labels, vitamin K1, stationery and office supplies, two-way radios, wet weather gear, tools, first aid supplies, safety equipment	12 000

Other equipment for intensive monitoring phase	Includes: tracking tunnels, cards and ink, wax monitoring block materials, soap, cordless drill for making holes in monitoring wax, soap etc.	15 000
Boat hire, transport from Farnuff to Dull	2 x return trips per week for up to 26 weeks @ £50 per trip	2 600
Vole capture and maintenance in captivity	Includes two week trip to Farnuff, trapping equipment and maintenance at Highland Wildlife Park for two years	15 000
Operational review	Contractor, with local input for two weeks	1 200
Implementation Stage, Sub-total		235 190
Implementation Stage, Contingency (20%)		47 038
Implementation Stage, Expected cost		**282 228**
Sustaining the Project Stage:		
Biosecurity: set up	Equipment: tracking tunnels, traps, labour costs etc.	4 000
Biosecurity: Annual running costs	Transport, replacement equipment, labour costs	2 500
Post-operational ecological monitoring	Transport, labour costs, equipment and consumables	4 000
Long term rat monitoring	Transport, labour costs, equipment and consumables (may be able to combine with ecological monitoring trips)	4 000
Sustaining the Project Stage running costs for 5 years (A)		10 500
Sustaining the Project Stage Set up costs (B)		4 000
Sustaining the Project Stage sub-total(C=A+B)		14 500
Sustaining the Project Stage Contingency (D=20% of C)		2 900
Sustaining the Project Stage, Expected 5-year cost		**17 400**
PROJECT TOTAL		**350 428**

No definite sources of funding have been identified at the present time. The Seabird Conservation Fund fund is the most likely source of primary funding. The necessary match funding could come from a variety of sources, with a donation of time and resources from SWCA and UKSCT.

4 CONCLUSION

The eradication of brown rats from Farnuff Island is feasible and, if rats are also eradicated from nearby Dull Island, is also likely to be sustainable in the long term since this pair of islands is beyond brown rats' known swimming distance. Eradicating rats from Tuchlose, however, while technically feasible, is not likely to be sustainable due to its proximity to the island of Lewis and Harris, which is well within the known swimming distance for brown rats. This makes the proposed eradication of rats from this island unfeasible overall.

A joint eradication project on Farnuff and Dull meets all the requirements set out in the 'Can it be done?' section of this report. A proven technical approach is available, and there are no physical reasons why this approach cannot be taken on Dull and Farnuff. With the use of appropriate rope access all sections of the islands can be reached. Once the bothy and outbuildings have been renovated on Dull there will be suitable accommodation and storage space on both islands. The eradication project has the full support from the local community, subject to finalising a few issues around livestock safety. The landowner and SWCA both support the project and the legal permits required should be easily achieved. The environmental impacts of the project can be kept to an acceptable minimum, with very few negative impacts on non-target species envisaged due to the use of regularly checked bait stations and an operational plan following international best practice guidance. The project also has, or can realistically hope to employ the necessary capacity. Sourcing the necessary funding is currently the biggest challenge facing the project; this kind of work is expensive and requires the full funding amount to be secured before it can begin. However, the conservation gains which this project will provide are significant and, coupled with its high chance of success, this should prove appealing to funding agencies.

In addition to securing the necessary funding, the feasibility of this project is however conditional on the following factors. The farming community on Farnuff must commit to adopting new methods of feeding their livestock as the current system involves animal feed pellets being left out in fields overnight. The community will also need to adapt to the biosecurity mindset needed on islands which have been cleared of invasive rodents.

Table 8: The issues considered during the feasibility study for eradication of brown rats on the Stewart Islands and recommendations to resolve these.

Issue	Recommendation
1. Tuchlose is only 600m offshore from the island of Lewis and Harris, which is too large for eradication to be achievable using available techniques.	Consider the merits of a DNA connectivity study which can help establish how likely it is rats would swim to Tuchlose after an eradication. If the study indicates this may be unlikely, eradication could be taken forward, subject to a new feasibility study.
2. Dull Island is 300m away from Farnuff and so will need to be included into any eradication work on Farnuff if it is to meet the 'sustainable' criterion.	Include Dull Island in the project area. Consider the pros/cons of assisted colonisation by Manx shearwater and European storm-petrel, as this may maximise the benefits of its inclusion in the project.
3. The application of rodenticides may pose a risk to the residents of Farnuff, the endemic sub-species of vole, and white-tailed eagles.	Risks to residents can be handled via a good communication and education strategy. Lockable plastic bait stations are recommended for use inside buildings. At least one viable population of the Stewart Island vole should be taken in to captivity off island. Consider diversionary feeding for white-tailed eagles. Conduct resistance testing of the rats to the less potent rodenticides and use the least potent bait that will still be efficacious. Reserve a more potent bait for the latter stages of the eradication where it will be available for a shorter period of time and when there should be few/no rats left.
4. The rabbit population of Farnuff cannot be eradicated and is likely to increase in the absence of rats with potential implications on the wider island ecosystem.	Discuss the implications with the island residents (rabbits will be competing with livestock for grass). Some residents may be prepared to undertake control measures in the long-term.
5. Community support for the eradication will need to be sustained	Continue close communication with island owner and residents, encourage them to discuss any concerns.
6. Issues surrounding the feeding of livestock and how to deal with any potential bait take by these animals need to be finalised in liaison with the local farming community.	Continue close communication with farmers. Organise an additional face to face meeting to discuss these issues, develop a plan for what changes need to be made and seek consensus with farmers.
7. There will need to be strong community participation and leadership in biosecurity measures if reinvasion is to be avoided, particularly on Farnuff.	Discuss the implications with the island residents. Some residents may be prepared to undertake biosecurity measures in the long-term.
8. A number of approvals are required.	We recommend early application for the following permits and permissions: • overall project approval by SWCA • permit from SWCA for track cutting on Farnuff and Dull • permission from SWCA to collect population of Stewart Island voles and remove them from the island

Acknowledgements

We would like to acknowledge the assistance of the following people in the production of this report:

All of the residents of Farnuff and Tuchlose for their interest and willingness to discuss the project proposals and for their support. Thanks also to Jenny Luscombe and Jim Hunter for their hospitality during our stays on the island, and to Mike Broad for the use of his boat to reach Dull Island.

Phil Hill and Gill Pollard for their independent review of the draft feasibility study report.

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Genuine references are listed here. Others included in the text are fictional.

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6 APPENDICES

Appendix 1: Site visit

Sylvie Thornhill and Ruben Mitchell visited the Stewart Islands from 4-18th October 2013, including eight nights on Farnuff and six on Tuchlose. Dull Island was visited overnight on 8-9th October, with additional trips to check and set snap traps and Longworth traps on the morning and evening of 10th and 11th October.

Activities

Community liaison

Meetings with the communities of Farnuff and Tuchlose were held on two occasions during the visits to the islands, once at the beginning and once at the end. During the first visit we spoke to the residents about the proposed rat eradication projects, what they would entail, the benefits that could be expected for local wildlife and the impacts it would be expected to have on their daily lives. At these preliminary meetings we also handed out questionnaires (see below) to gather the residents' views on issues such as their perceived severity of the rat problem, to them, their livestock and the islands' wildlife. We also asked about the costs incurred in rat control. In addition we made individual visits to all island households during our visits, completing their questionnaires, discussing their individual experiences of rats and answering any questions they might have. A meeting with the landowner, Bob Clipper, was held at his home in Ruanish on the Isle of Lewis on the 3rd October and a further telephone meeting on October 20th.

Overall, the communities were very positive about the proposed eradication projects. The main questions raised concerned safety to children, domestic animals and livestock. While people were content that the risks to children and domestic animals were minimal (and were reassured to hear about the effective antidote available for anti-coagulant poisons), there were ongoing concerns about the possibility of livestock consuming the bait. The project staff also outlined the issues around current feeding practices for the sheep on Farnuff, where feed pellets are often left out in fields overnight.

Studies of rat and other small mammal activity

We carried out a range of activities to monitor for the presence, distribution and abundance of rats, as well as Stewart Island voles, common shrews and, potentially, house mice.

Index trapping for rats: 25 pairs of T-rex break-back rat traps were placed at 30 m intervals in areas of suitable habitat. They were placed in locations likely to be used by rats, such as along the edges of walls and other linear features, between rocks etc. Rat traps were tied down so that injured rats (or other rats eating the carcasses) could not drag them away. Traps were baited with peanut butter (which was replaced as necessary) and set in the evening and checked and set off the following morning to minimise non-target captures. One index line was run on each of the three islands for three consecutive nights in each location.

Tracking tunnels were also used to find evidence of mammal species present on the islands. Twenty tunnels (Black Trakka tunnels from [redacted]) were set on each of Farnuff and Tuchlose islands and fifteen on Dull. These tunnels, each sited in a location likely to appeal to small mammals, were held in place with wire pegs. They were each lined with an inked tracking card and baited with peanut butter.

Longworth traps were also used to survey for small mammals, in particular to see if house mice were present on Farnuff (they are anecdotally reported to have died out there in the 1970s), Tuchlose and Dull (where they have never been recorded). Twenty traps were set in pairs, each pair 30m apart, for three nights on each of the three islands. The traps were baited with peanut butter and a small

amount of casters (blowfly pupae) to sustain any shrews which may have been caught). The traps were set in places likely to appeal to small mammals such as along linear features and in natural tunnels between rocks.

Non-toxic bait blocks (Detex Blox, manufactured by Bell laboratories) were set out on all three Stewart Islands in sites of likely rat activity (e.g. along walls, near feed stores and in seabird colonies), two 20g blocks at each of 30 sites. These were checked daily for signs of rat activity.

Results

Index trapping: Forty-six rats were caught across the three islands, 20 on Farnuff, 19 on Tuchlose and 10 on Dull, comprising of 21 males and 25 females. Indices of abundance (also referred to as rat densities) were calculated for each site using the methods of Cunningham & Moors (1996) and are shown below. Indices under 10% are considered 'low', those between 11 and 25% 'moderate'.

Island	Number of corrected trap nights	Rat captures	Index of abundance
Farnuff	133	20	15.0
Tuchlose	130	19	14.6
Dull	135	10	7.4

Tracking tunnels: The tracking tunnels showed footprints of rats, Stewart voles (on Farnuff and Tuchlose) and common shrews but no sign of house mice. The number of cards that had rat tracks present were used to estimate the tracking index (TI, or abundance, e.g. 4 out of 10 tunnels with rat tracks = 40% abundance). The TI values varied slightly between islands but broadly in line with the rat densities calculated from the rat traps. Farnuff had a TI of 25% (5 out of 20 cards), Tuchlose 20% (4 out of 20 cards) and Dull 13% (2 out of 15 cards)

Longworth traps: Over the course of the three nights trapping Stewart Island voles were caught on both Farnuff and Tuchlose (12 and 8 animals respectively). Common shrews were caught on all three islands (Farnuff = 3, Tuchlose = 1, Dull = 6). No house mice were caught, or encountered, on any if the three islands.

Non-toxic bait: The blocks showed a high level of acceptability by rats. Overall, 80% showed take by rats within 2 days and 93% within 3 days. There were no significant differences between the rates of take by rats between the three islands – all showed take of between 90 and 95% after three days.

Index trapping and tracking tunnels are an effective way of monitoring changes to rodent densities and activity in specific habitats (Brown et al. 1996, Blackwell et al. 2002). However, it is important to place tracking tunnels in similar or the same habitat (Blackwell et al. 2002). It is also important to realise that the tracking tunnels are susceptible to the same individual tracking through a number of tunnels and that the spacing needs to take into account the home range of the rat (Blackwell et al. 2002).

Habitat assessment

We also surveyed the three islands extensively to check for access (all parts of the island will need to be accessed during any future rat eradication project), in particular to see which areas would require rope access, trail cutting or other special requirements. Cliffs in parts of the north and west coasts of Farnuff will require rope access or at least guidance ropes, as will the cliffs on the west of Tuchlose. No cliff access will be needed on Dull, though guide ropes in some steep parts of the west of the

island are advisable. Small sections of trails will need to be cut on both Farnuff and Dull, through gorse and other low scrub vegetation.

Biosecurity measures

Where possible, equipment was transported in plastic crates with sealable lids. These were all checked for signs of rodent gnawing before loading onto boats for the trips to the various islands. All other equipment was repacked on the day of departure to dislodge any small mammals which may have sneaked in overnight. Boots and other outdoor equipment (particularly the camping equipment used on Dull) were checked and cleaned thoroughly before leaving the mainland to ensure no seeds or invertebrates were inadvertently carried to the islands.

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[redacted]

Questionnaire for island residents:

1. Which Island do you live on?
2. Do you think seabirds are an important part of the Stewart Islands?
3. Were you aware that their populations were declining?
4. Do you think that their populations should be protected and enhanced?
5. Have you noticed more rats recently?
6. Do you think rats are a problem on your island?
7. Would you like something done about the rats?
8. Have rats been a problem for you?
9. If so, specify how (Damage to: food, crops, property, animals, home, business, farm, boat. Attacking animals or people. Bites, fleas, other)
10. Would you support a programme to remove rats from your island if it was found to be feasible?
11. Rodenticide is already used on the islands to control rats. This currently is the most effective method of removal. Would you support this method?
12. Would you advocate another method?
13. Any work would need to be carried out between October and March. Would this be a problem? If yes, why?
14. How much you spend privately on controlling rats, repairing any damage, rat proofing your property, etc?
15. What is the estimated cost from loss of products caused by contamination, damage or consumption by rats?
16. Please rank the following issues in terms of their importance to you: Waste Management, Public and Animal Health, Access to Private Land, Private Gardens or Farms, Non-Target Species, Project Management, Communication, Community Involvement, Transport, Cargo Movements, Re-Invasion, Livestock, Keeping Chickens, Pets, Terrain, Weather and Adequate Funding.
17. Do you use the following methods of waste storage and disposal? Rat-proof dustbin, unprotected bin bags, private burning of waste, rat-proof wheelie bin, compost heaps, private dumps (home/ farm/ garden waste)
18. Would you be happy to change this temporarily/permanently if this helped remove food for rats?
19. Even if you did not consider that rats were present, would you be happy to have rat bait stations located on your property?
20. Would there need to be any conditions applied to their presence (Please state)?
21. Do you keep any livestock on your property and if so, which is it?
22. Do you store anything that would be a potential food source for rats on your property and if so, what?
23. Would you be happy to provide access? To which areas: all, buildings, gardens, other land
24. Do you have, or are you aware whether the following animals are present on your land? Pet cat, pet dog, any other pets which go outside
25. Do you own a boat and use it for travelling between/to the islands?
26. Do you transport any potential food sources for rats? Food, livestock feed, other (please state)
27. Do you store this on any of the quays?
28. If it was thought that there was a risk of transportation of rats on your vessel, would you be happy to install a bait station?
29. Would you be interested in assisting with any contingency/ incursion response operation?
30. Would you like training in rodent detection and identification?
31. Would you like to be trained in interview and site inspection procedures and methods?
32. Would you want to be involved in long-term monitoring for rodents?
33. Would you be happy to check for rodent damage to your own cargo?
34. Would you be happy to install and maintain a bait station on your vessel and/or property?
35. Would you be happy to transport food to and between islands in rodent-proof containers?
36. Would you be interested in supporting or getting involved in the project in addition to above? Becoming a partner, in-kind logistical support, volunteering time, financial, other

37. Do you have any comments/ suggestions/ concerns you would like answering?
38. Would you like more information on the project?

Operational Plan for the eradication of brown rats from Farnuff and Dull Islands, Outer Hebrides, UK

[N.B. This is a fictitious example intended for training purposes, based on real islands and some real places and references, but with some details altered to present an illustrative scenario. The project story, all names, organisations and incidents portrayed in this document are fictitious. No identification with actual persons (living or deceased), organisations or buildings is intended or should be inferred].

Acknowledgements:

This document draws on both the worked examples devised by the Pacific Invasives Initiative as part of their Resource Kit for Rodent and Cat Eradication [redacted] and on the project documents produced by Wildlife Management International Ltd during their extensive work on UK islands. We are very grateful to both organisations.

Report produced by: P. Smith[1] and M. Burns[2]

[1]UK Seabird Conservation Trust: *A local non-governmental organisation based in Lewis*
[2] Scottish Wildlife and Conservation Agency: *A local government agency based in Lewis*

Funded by the Seabird Conservation Foundation

Reviewer(s): M. Byrne (UK Island Eradication Specialist, [redacted]), P. Hunter (NZ Rat Eradication Specialist [redacted]

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1.0	10th Jan 2017	P. Smith	Draft version sent for review
2.0	5th Feb 2017	P. Smith	Changes made after independent review
3.0	18th Feb 2017	P. Smith	Changes made following consultation

This report should be cited as: Smith, P. & Burns, M. (2017) Operational plan for the eradication of brown rats from Farnuff and Dull Islands, Outer Hebrides, UK. Unpublished report for Stewart Islands Restoration Project Partnership.

Executive Summary

1. This document contains the detailed plans needed to eradicate introduced brown rats from Farnuff and Dull Islands, part of the Stewart Islands in the Outer Hebrides, UK.
2. The project is funded by the Seabird Conservation Foundation with support from the Stewart Islands Restoration Partnership, comprising UK Seabird Conservation Trust (UKSCT), Scottish Wildlife and Conservation Agency (SWCA) and the Clipper family (the landowners). The UKSCT are the implementing agency and will also lead on biosecurity prevention activities in partnership with SWCA.
3. The project will use anti-coagulant rodenticide bait presented inside bait stations. A wax-block rodenticide containing either of the second generation compounds bromadiolone or difenacoum will be used. Plastic pipe stations set out in a 50m grid pattern (denser in areas of likely high rat activity) will be used for the majority of the outdoor areas while commercially available lockable stations will be used inside houses and other buildings as required.
4. Considerable preparatory work will be needed before the start of the poisoning phase: removing harbourage and food sources for rats (e.g. food waste on Farnuff), liaising with the local community, marking out the baiting grid and setting out bait stations.
5. A captive breeding programme for Stewart Island vole is currently being developed, and will run concurrently with the preparatory work.
6. The project will require a core team of around 12 workers for the main six-month body work (Sept-March) who will likely be housed in out-of-season holiday accommodation.
7. The intensive poisoning phase of the project will last approximately three months and be carried out between November and February, leading in to an intensive monitoring phase lasting a similar length of time.
8. A list of all the equipment needed for the project is given in section 8. A task schedule for all the phases of the project is given in section 10.
9. Biosecurity measures will be needed in perpetuity to protect the islands from the risk of rats reinvading, most likely from Lewis. A full Biosecurity Plan will be produced by the Operations Manager before the end of the eradication work, detailing the pathways by which rats could reach the outer islands, a programme for monitoring for rat sign, and an incursion response plan, describing exactly what to do in the event of known or suspected rat sign being found on any of the islands.

Contents

1 INTRODUCTION

The purpose of this plan is to detail how to eradicate invasive brown rats (*Rattus norvegicus*) from Farnuff and Dull, part of the Stewart Islands group in the Outer Hebrides, Scotland, using a ground-based bait station operation following best practice guidelines. The project will mainly be funded by the Seabird Conservation Foundation, with additional funding and in-kind support from the UK Seabird Conservation Trust (UKSCT) and the Wildlife and Conservation Agency (SWCA). UKSCT will be the main implementing agency, with technical support and expertise from SWCA, and a team of contracted and volunteer workers for the field operation. This plan will be the main guiding document used by project leaders and staff in executing the eradication project. It draws on previous work contained in the Feasibility Study (Thornhill & Mitchell 2015) and the Project Plan *(would reference here*) and follows best practice guidance as outlined in the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017).

We would like to thank colleagues at UKSCT and SWCA for help and support during the preparation of this document, as well as Kate Barnett and Simon Jones of the New Zealand government for technical advice. Warm thanks also to the Clipper family and to the community on Farnuff for their enthusiasm and support for the project and help with the practicalities of working on their islands.

1.1 The Site

1.1.1 Farnuff Island

Farnuff Island is an inhabited island (34 permanent inhabitants) of 147ha situated 4km from Lewis (Fig 1). It has a saddle shaped topography, with sheer cliffs along the north and west coast and also on the south east. The rest of the coastline is either rocky with boulders that can be scrambled over, or comprised of grassy slopes that can be traversed, with care. The island's residents live along the central, low lying belt of the island – there are three farms (mainly farming sheep but with a small number of cattle), a shop (groceries/post office/general store), and ten houses. The island is serviced three times a week by a passenger ferry run by Caledonian MacBrayne from Lewis. The main pier is on the north side of the island, with a secondary landing site on the south coast which is mainly used by residents to launch fishing boats.

The island is covered in grassland with wet heath on the more exposed areas. Low-lying scrub covers some of the slopes on the northern coast where it is more sheltered. The main conservation interest on the island is around the north and south cliffs and adjacent grassy slopes which house the main seabird colonies. The Stewart Island vole, common shrews and rabbits are also present.

1.1.2 Dull Island

Dull Island (38ha) lies 300m off the north coast of Farnuff, situated 3.9km from Lewis (Fig. 1). It is not within rodent swimming distance of any other island. It is mostly a low-lying island, although it rises to around 48m to the west. It is predominated by grasses with some scrubby patches in sheltered areas. It is uninhabited, but has two small landing sites and three buildings – a bothy and two smaller buildings used as stores/shelter by fishermen. The cliffs are not sheer here and are largely vegetated. There are no known species of conservation interest on the island, although it is home to a small colony of seabirds predominated by gulls. Common shrews and introduced brown rats are the only mammal species present.

Both Farnuff and Dull islands are privately owned by the Clipper family.

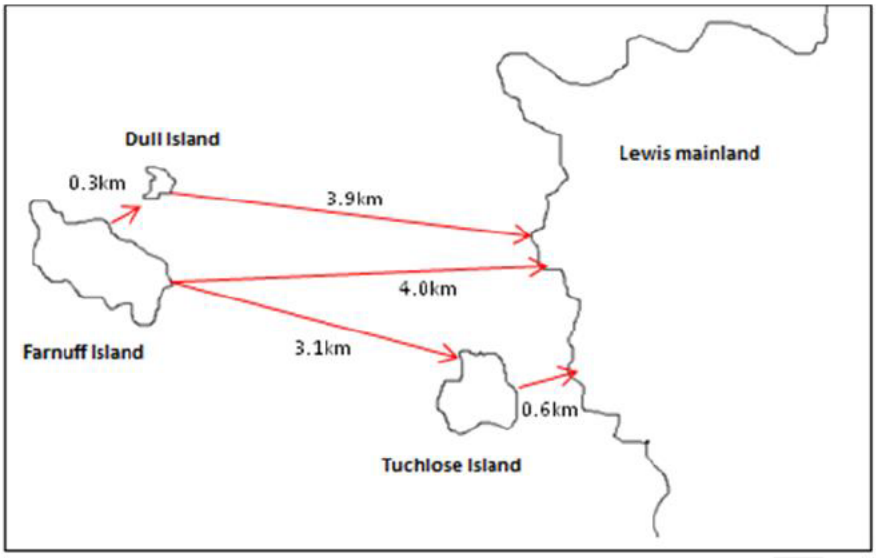

Figure 1: Map showing position of islands within the Stewart Islands group and their distances from each other and the Isle of Lewis, which are beyond the known swimming distances for brown rat.

A detailed description of the site can be found in the accompanying Feasibility Study, *(would reference here)*, and Project Plan *(would reference here)*.

1.2 Target Species: brown rat *Rattus norvegicus*

The target species is the brown rat, *Rattus norvegicus*, a highly omnivorous species known to impact on a wide range of species including birds, mammals, invertebrates and plants. Native to central Asia it has been expanding rapidly from its native range over the last three hundred years and is now found on all continents except Antarctica. Invasive species in the genus *Rattus* are found on 82% of the world's island groups (Atkinson 1985) and are having a disproportionately severe ecological impact on island species, many of which have evolved in the absence of terrestrial predators (Towns *et al.* 2006).

A detailed description of the target species can be found in the accompanying Feasibility Study, *(would reference here)*, and Project Plan *(would reference here)*.

2 GOAL, OBJECTIVES and OUTCOMES

2.1 Goal

The goal of the project is to restore functioning ecosystems over Farnuff and Dull Islands, Stewart Islands, Hebrides, through the process of removing the invasive non-native populations of brown rats found on these islands. Removing the highly omnivorous rats, which are known to predate upon many native species in the Isles of Scilly, including birds, invertebrates and plants, is highly likely to lead to outcomes such as enhanced populations of many species, including iconic seabirds such as Manx shearwaters and European storm-petrels.

2.2 Objectives & outcomes

The objectives that this project aims to achieve, and the outcomes that will be seen as a result of achieving these objectives, are described in Table 1. These objectives relate specifically to the operation to remove rats, which will be a subset of any wider project which will aim to undertake wider island restoration work and community engagement and empowerment activities.

Table 1: The objectives that this project will achieve and the outcomes that will be seen as a result of achieving these objectives.

Objectives	Outcomes
1. Eradicate brown rats from Farnuff Island	1.1 No brown rat population on Farnuff
	1.2 Increase in population size of Manx shearwater on Farnuff
	1.3 Recolonisation of Farnuff by European storm-petrel
2. Eradicate brown rats from Dull Island	2.1 No brown rat population on Dull
	2.2 Increase in population size of Manx shearwater on Dull
	2.3 Recolonisation of Dull by European storm-petrel
3. Safeguard native populations of conservation interest/importance	3.1. Stewart Island vole population exceeds pre-eradication level two years after eradication is complete
	3.2 No mortality of White-tailed eagles on either island attributable to rodenticide use
4. Improve the capacity of partner organisations to undertake complex eradication projects	4.1 Partner organisation staff have skills to lead eradication projects of a similar size and complexity to current project
5. Maintain invasive-rodent-free status of islands via appropriate biosecurity measures	5.1 Islands remain free of invasive rodents

3 OPERATION DETAILS

The project will follow the same methods as have been successfully used in other UK rat eradication projects, as outlined in the UK Rodent Eradication Best Practice Toolkit (Thomas *et al*. 2017). A grid of bait stations will be laid across the surface of all the islands included in the project and baited with rodenticide bait for a period of up to six months over the winter. The operational phase will involve five implementation stages, which are outlined in Table 2, along with the timings for delivery.

Table 2: Time line of the implementation stages of the eradication operation

	2018					2019		
Activity	**Prior to Sept**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**
Implementation stage 1: Pre-eradication phase								
Implementation stage 2: Establishment of rodenticide grid								
Implementation stage 3: Rodenticide baiting phase								
Implementation stage 4: Intensive monitoring phase								
Implementation stage 5: Install long-term biosecurity equipment								

3.1 Implementation Stage 1: Pre-eradication phase

3.1.1 Team recruitment

As outlined in the Project Plan *(would reference here*), the Project Manager will be recruited by the UK Seabird Conservation Trust (UKSCT) by the end of 2017, and in position early 2018. The Operational Manager will be recruited by UKSCT for in early 2018, so they are able to be in the position by July 2018. The operational team will be fully recruited by September 2018. The operation team will comprise of:

- The Project Manager, based on Lewis with regular visits to Farnuff;
- The Operational Manager, based on Farnuff, Dull and Lewis;
- Two Team Leaders, rotated between Farnuff and Dull;
- Eight volunteers, rotated with six based on Farnuff and two based on Dull;
- Short-term staff from UKSCT and SWCA to learn about the project; and
- The Farnuff community.

The operation team will be assembled in Lewis in September 2018, and the volunteers will complete an appropriate course to ensure the safe use of rodenticides and to comply with guidance under the stewardship scheme (a list of suitable courses can be found here: [redacted] or an online course is available from [redacted]). Those members of the team who will undertake the rope access will also undergo rope-access training so that they are fully qualified to undertake the work.

A volunteer agreement form will be provided to all volunteers so that their roles and responsibilities are clear, and to highlight any medical conditions or personal limitations (e.g. fear of heights; ability to swim etc) that the Operational Manager and team leaders should be aware of.

3.1.2 Transport and purchasing / constructing equipment

Where possible, the Project Manager and Operational Manager should support the local businesses in Farnuff Island, which will not only benefit the local economy over the off-season but will further engage the community with the project.

A contract with a local commercial boat operator (with the correct MCA licence for insurance purposes) will be in place by September 2018. A suitable boat operator has been identified (Farnuff Boating Company, which has a vessel deemed appropriate for the transport of all the equipment and personnel. The boat operator will be responsible for the transport of staff and equipment between Lewis and Farnuff and Dull.

The Project Manager and Operational Manager will ensure all required permits will be in place by the end of September 2018.

The Project Manager, Operational Manager and team leaders will purchase all the necessary equipment in August/September 2018 (see Section 8) which will be stored at the UKSCT office on Lewis. The equipment will be stored in rat-proof containers where possible, and biosecurity measures will be put in place at the office on Lewis and checks will be completed prior to transport.

The operation will primarily use 75cm long, 10cm diameter bait stations constructed from corrugated drainage pipe in outdoor areas of the islands, the same design as has been used in previous UK rat eradication projects (Thomas *et al*. 2017). The bait stations will be produced in the work centre at the UKSCT office by UKSCT staff and volunteers in August, and transported to Farnuff and Dull in September 2018. The equipment and rodenticide will be stored in a secure, lockable metal shed on one of the farmers' land on Farnuff and in one of the storage sheds on Dull (following refurbishment in 2017).

3.1.3 Accommodation and subsistence

The team will be housed in a holiday cottage on Farnuff, which will be rented throughout the operation. SWCA are funding the repairs required on the bothy and outhouses during August-October 2017, resolving an issue identified in the feasibility study (Thornhill & Mitchell 2013). The Clipper family has agreed that the bothy and outhouses can be used by the eradication team during the operation.

On Farnuff, drinking water will be available in the rented property, and non-perishable food will be purchased through a bulk order through the local shop. Perishable foods will be purchased in a weekly shop undertaken by the team, using the local businesses (i.e. milk from the local farmer). On Dull, food and water will be transported from Farnuff or Lewis when the team is swapping over. Water will be stored in large containers on island and food will be stored in rat-proof containers.

3.1.4 Community engagement

Once on island, the team will work with the community to minimise harbourage and alternative food sources, such as providing and assembling rat-proof compost bins, clearing fishermen storage sheds etc. so that they can be easily accessed to deploy bait stations and / or rodent monitoring tools. The farming community will be engaged and will be asked to adjust their livestock feeding methods during the baiting phase such that animal feed pellets are not left out in the fields overnight, therefore not providing an alternative food source for the rats.

The Operational Manager and team leader(s) will spend time with the community showing them the bait stations, snap traps and rodenticide, explaining that if there are any concerns regards to pets there will be an antidote available on island which can be administered by certain members of the team, and if anyone notices anything amiss that they should contact the team.

3.1.5 Kill trapping for genetic samples

Once the team is on island, 20 snap traps will be deployed in locked Protecta boxes around the buildings. These will be baited with peanut butter and set at dusk and disarmed at dawn daily to reduce the possibility of non-target mortality, and following Best Practice (Thomas *et al.* 2017). The rats caught will be collected daily, and tail samples will be collected and stored in alcohol to be used for genetic analysis if rats are found on island following the operation. This will enable the team to determine if the operation failed, or if there has been a reincursion. If time, the team will dissect the rats to determine stomach contents and breeding status.

3.1.6 Establishing captive breeding population of Stewart Island vole

The completed trials and methods for establishing a captive population of Steward Island vole to mitigate for non-target mortality during the baiting phase are detailed in a separate Plan, please refer to Horton *et al*. 2017. Voles will be captured from Farnuff in 2017 to establish breeding in spring 2018.

3.2 Implementation Stage 2: Establishment of rodenticide grid

The grid will be marked out across the island in October 2018 in a 50 x 50m grid across the islands. For the main grid, GIS will be used to generate bait station locations which will then be loaded into handheld GPS units. These units will be used by field staff to pinpoint bait station sites on the ground, which will then be marked with bamboo canes and flagging tape. Grid points around inhabited buildings and in seabird colonies will be set in the best locations using a bait point density of 16/ ha (equating to a 25 x 25m grid). The locations of these points will be mapped using GIS to ensure the stations are at the correct density.

Once the entire grid is in place the team will start to set out bait stations. These will be carried in dumpy bags across the islands (the low, grassy terrain is ideal for this), and one station left at each marker cane. Another team will follow behind, wiring stations into place. Once the entire network of stations is in place individual uniquely numbered tags will be attached to each station. These numbers will also be uploaded into a geo-referenced GIS database, allowing all data relating to each station to be mapped.

One of the team leaders will be responsible for visiting each of the houses of Farnuff to assist with the installation of a Protecta box within each household.

Some monitoring tools (chocolate wax, soap, chocolate, candles and apple etc.) will be deployed around the buildings on Farnuff to obtain samples showing rat sign for training purposes for the team and community.

3.3 Implementation Stage 3: Rodenticide baiting phase

The project will need to use a wax block grain based anticoagulant rodenticide bait, the formulation which has been successfully used in the majority of ground-based bait station operations in the UK and worldwide. Bromadiolone, a second generation anti-coagulant bait, will be used for the main part of the poisoning phase, with difenacoum (also a second genereation anti-coagulant rodenticide) being used as the second bait type.

Prior to baiting, all project staff will be trained in the deployment of bait, health and safety precautions, data recording, and roles and responsibilities will be made clear. The team will hold daily briefings to ensure clear communications between volunteers, team leaders and Operational Manager. It is also important that the project provides radios for each person or ensures that all team members have cell phones. Communication between groups in different areas of the islands is vital. Not only for safety, but it will give also the opportunity for one team to assist another if they have finished the work in their assigned area early. It is particularly important for the boat team to have a VHF radio for

communication with the eradication team and Coastguard. The team will be rotated between Farnuff and Dull to reduce the possibility of fatigue.

One the first day of baiting, eight blocks will be placed loosely into each station. This is to allow the rats to remove the bait and cache within their burrows, making bait accessible to nursing mothers, and young which have not yet left the nest. Once rat take has dropped off significantly, the number of blocks will be reduced to four, and wired in to reduce the amount entering the environment.

Bait stations should be checked every 1-2 days for the first two weeks and every 2-3 days thereafter, except for the rope access sites on the cliffs which will be checked 2-3 times per week, on days when it is safe to do so. Bait blocks should be replaced as they are taken by rats and partially eaten bait will be replaced with a new block. Old or partially eaten bait blocks will be disposed off at a registered landfill as recommended by the bait manufacturers (Annex 1). The amount of bait consumed by rats (or non-target species) will be recorded on every visit, along with the number of new blocks added.

Regular checking of bait stations enables constant monitoring of bait take and the resulting die-off of rats. It also reduces the risks of baits stations running out of bait (this is particularly critical in this project where any product requiring multiple feeds, such as bromadiolone is used as the primary bait) and keeps the project team informed about bait take by non-target species. Closely monitoring bait take by non-target species means any problems can be picked up early and risks to non-targets minimised. Bait take (and consumption) will be accurately recorded into notebooks in the field for immediate inputting into the GIS-linked database back at base for ongoing analysis. Refinements to the poisoning programme can be made from this real time data. Hot spots of rat activity can be identified quickly and targeted throughout the programme.

The poisoning should start at the beginning of November and continue through to March 2019, overlapping with the early intensive monitoring phase of the programme. Any surviving rats or problem areas should be obvious by the end of December and could be treated with an alternative poison (e.g. Neosorexa blocks, containing difenacoum) or techniques such as targeted trapping. Although most of the rats will die underground, if carcasses are found exposed they will be removed and disposed of appropriately according to the material safety data sheets (Annex 1) and local authorities.

3.4 Implementation Stage 4: Intensive monitoring of rodents

After about six weeks, bait take should be reduced to nil, with all the rats on Farnuff and Dull having been poisoned. During the following three months it is vital to establish an intensive monitoring programme to detect any rats which may have avoided poisoning. A grid of rat-attractive food and monitoring items (chocolate wax, soap, chocolate, candles and apple etc.) as well as chew sticks (small wooden sticks soaked in vegetable oil) or chew cards are pegged out as monitoring tools. Tracking tunnels will also be used to detect the footprints of any surviving rats.

Rats in low numbers (i.e. towards the end of an eradication operation or during an invasion phase) can be difficult to detect and fussy over food types. In a number of recent eradications, non-toxic chocolate wax blocks have been used to detect the last rat. The teeth marks left in these blocks by rodents and other animals are easy to interpret and identify to species and last well in a range of climates.

Monitoring points will be set at each bait station and also in between the stations on each line (resulting in a 25 x 50m grid of monitoring points). All intensive monitoring points would be recorded on GPS, entered into the GIS-linked database and mapped to ensure coverage of the island. Each monitoring site will be checked every 2-3 days to detect rat sign (usually teeth marks or foot prints). If any rat sign is detected, an intensive targeting programme (e.g. alternative bait, reduced spacing in the bait station grid, trapping etc.) will be set in place until rat sign in the area ceases. This would

involve setting a 20x20 grid around the target area with daily checks, plus additional monitoring. If the rat is still avoiding the bait, kill traps baited with peanut butter will be set around the areas of rodent sign, follow best practice protocols (Thomas *et al.* 2017).

It is expected that the monitoring phase of the programme would begin from mid-December. The bait station grid can be removed once the intensive monitoring phase has been completed and rat sign is absent. If rats are detected at the end of winter (i.e. February and/or March) a second baiting (i.e. during the following winter) and continued monitoring operation would have to be completed to finish the eradication, using the same methods described here.

3.5 Implementation Stage 5: Install long-term biosecurity equipment

Long-term monitoring for surviving (or reinvading) rats generally continues for two years after the end of the eradication phase. If no rat sign is detected during this period the island can then be declared rat-free. This is based on the average life expectancy of a wild adult rat (c. 18 months) and their reproductive biology – a single pregnant female rat can give rise to a colony of around 300 rats in approximately 8 months (Russell, Towns & Clout 2008). A surviving rat population should therefore be easily detected after a period of two years using the long term monitoring methods detailed here.

The two-year long-term monitoring checks should be carried out at least every four weeks year-round in order to confirm the success of the eradication project. Permanent bait and monitoring stations will be placed at suitable locations around the island, such as within known seabird areas, optimum rat habitat and in sites of likely rat incursion. This monitoring will be undertaken by UKSCT staff or volunteers. All long-term monitoring points should be recorded on GPS, entered into the GIS-linked database and mapped to ensure coverage of the islands. Any sign or indication of rodents should be photographed and if possible collected or sampled for expert opinions on identification.

This long-term monitoring for the presence of rodents after an eradication operation is done as part of the biosecurity programme. It is important to monitor using a range of detection devices (such as wax (chocolate and plain), chew cards, traps, rodent motels and trail cameras) and have a regular search effort. Low numbers of rats may take a long time to detect. It may also be possible to use the recovery of vulnerable species (such as puffin) or establishment of prospecting species (such as Manx shearwater and storm petrel) to indicate that rats have been successfully eradicated.

It is very important that the Biosecurity Plan is effective and fully implemented, with a clear incursion response in place. The Farnuff community will be integral to the long-term biosecurity of the islands, therefore appropriate training should be provided to them to allow them to effectively carry out necessary biosecurity checks and to recognise rat sign. It is important to be able to distinguish between the failure of the eradication and a biosecurity failure should rodents be detected during the long-term monitoring. DNA samples of rats from Farnuff and Dull, as well as rats from Tuchlose and the Lewis mainland, should be collected and stored to enable comparison with any rats subsequently found on Farnuff and Dull.

4 NON-TARGET SPECIES

The non-target species potentially at risk during the operation, and the mitigation methods to reduce this risk, are outlined in Table 3 below.

Table 3: Risk assessment for non-target species during the eradication of brown rat on Farnuff and Dull Islands.

Species	Potential impact	Preventative action	Risk
Stewart Island vole	Direct or secondary poisoning, potential to impact at a population level	• Captive breeding programme at the Scottish Animal Park	High
Common shrew	Direct or secondary poisoning, unlikely to impact at a population level	• Grid size	Low
Domestic pets (cats, dogs)	Direct poisoning Secondary poisoning	• Use of bait stations • Community to keep cats in at night • Community to only walk dogs on leads during baiting phase • Antidote for rodenticide available • Search for, collect and safely dispose of rodent carcasses	Low
Livestock	Direct poisoning	• Use of bait stations • Movement of livestock may be required if interfering with stations • Antidote for rodenticide available	Low
Rabbits	Direct poisoning, unlikely to impact at a population level	• Use of bait stations with a reduced aperture	Low
White-tailed eagle	Secondary poisoning, potential to impact at a population level	• Rodenticide choice Complete baiting phase outside of breeding season • Supplementary feeding to provide alternative food source • Search for, collect and safely dispose of rodent carcasses	Low

4.1 Stewart Island voles

The potential impacts of primary poisoning (i.e. direct bait consumption) on the endemic Stewart Island vole will be mitigated by the fact that the grid spacing exceeds the home range size, thus many animals will not encounter any bait stations. However, given the species' endemic status, plans have been made for a temporary captive population to be established at the Scottish Animal Park for the duration of the poisoning phase, which is detailed in a separate Plan (Horton *el al.* 2017; Hodges 2013). Although a second population on Tuchlose island will be unaffected by the eradication project,

studies show that the two populations are genetically distinct (Henderson 2013), thus maintaining a captive population of Farnuff voles will ensure their genetic heritage is preserved.

A licence from Scottish Natural Heritage to capture the voles to hold in captivity will be in place by September 2018.

4.2 Other wild mammals

Of the remaining mammal species on the island, only common shrews are small enough to enter the bait stations and consume the bait directly. Shrews are unlikely to take bait in large quantities since they are insectivorous, though they may be more likely to eat the bait in winter time when their natural prey may be scarcer. However, while some shrews may be killed by anticoagulant poisoning it is extremely unlikely to have an effect on the population as a whole. The small home range size of common shrews means that many individuals will not encounter a bait station and thus any poison bait, within their home range.

As herbivores, rabbits are unlikely to take the bait directly in dangerous quantities. However, the potential impacts will be further decreased through the use of wires to reduce the aperture size on bait stations. This method has proved effective at excluding all but the smallest rabbits from the stations in similar projects elsewhere.

If any carcasses of wild animals are found during the operation they will be collected by the team and will be dissected by the Operational Manager or team leader(s) to determine if the cause of death was from rodenticide poisoning (i.e. blue stomach contents; obvious signs of internal bleeding).

4.3 Livestock

The livestock on Farnuff (approximately 800 sheep and 30 cows) are unlikely to be able to reach the bait inside stations. The only way larger animals can access the bait is by crushing the stations or by kicking them until the bait comes out. Sheep have never been observed to interfere with bait stations on UK islands though a small number of cows have occasionally done so on other UK islands . Although it would be virtually impossible for a sheep or cow to consume enough bait to cause it any harm, as animals due to enter the food chain it is important to reduce bait take by livestock to an absolute minimum. Accordingly, bait stations in paddocks will be monitored very closely for signs of damage or interference by livestock. If any signs are found (e.g. bait stations kicked out of position) then the bait in those paddocks will be wired into stations for the remainder of the project. If any persistent signs of interference are found then arrangements will be made with the farmers to move any animals known to be causing problems. In the case of repeated damage by a number of animals the project will arrange with farmers to remove the stations from fields with animals in for a few days, then move the animals to another field while the first is baited again. The animals would need to be moved ideally twice a week. The farmers on Farnuff have agreed in principle to these measures but a formal note of agreement still needs to be drawn up.

In case of possible poisoning, the team will have a supply of antidote, Vitamin K^1, plus a trained member of staff to administer through injection. Who to contact in case of livestock consuming rodenticide will be clearly communicated to the community.

4.4 Pets

On Farnuff there are two pet cats, three farm cats and four pet dogs owned by the community. The owners will be advised to keep cats and dogs in at night, to only walk dogs on leads during the baiting phase and to be caution with letting cats outside at the start of the baiting phase (the risk will decrease once rat take has dropped off significantly). In case of possible poisoning, the team will

have a supply of antidote, Vitamin K[1], plus a trained member of staff to administer through injection. Who to contact in case of pets consuming rodenticide will be clearly communicated to the community.

4.5 Raptors

White-tailed eagles are known to breed on Farnuff and Dull islands. White-tailed eagle is a protected species under Schedule 1 of the Wildlife and Countryside Act (1981). Additional raptors, kestrel and buzzards, are also present on Farnuff and Dull islands. All of these are resident species, and are therefore likely to be present during the baiting phase. There is the possibility that these species may be at risk from secondary poisoning from consuming poisoned rat carcasses.

Impacts on raptor populations will be mitigated in three ways, Firstly, by diligently searching for, collecting and safely disposing of any rat carcasses found on the surface of the island, thus reducing the possibility of secondary poisoning. Secondly, by reducing direct bait consumption by non-target mammal species likely to be preyed upon by raptors, including rabbits (through use of wires to reduce entrance size) and voles and shrews (by having a baiting grid smaller than their home range sizes. Thirdly, we will also provide an alternative food source for eagles and other raptors, by placing dead rabbits (these will be shot for the project by local residents) on feeding tables, set at a height of approx. 1.5m and protected from rats by the presence of a 40cm high smooth aluminium sleeve around the tables' support poles.

A disturbance licence from Scottish Natural Heritage is required for this work and will be in place by September 2018.

If any carcasses of raptors are found during the operation they will be collected by the team and will be sent off for detailed analysis to determine cause of death.

5 ENVIRONMENTAL EFFECTS

5.1 Rodenticide risks to humans

If used appropriately, this risk of rodenticides to human health is very low. All staff members handling rodenticide bait will have undergone an approved training course in safe rodenticide use and will be fully informed of the potential risks it poses to human and animal health. In case of accident, any impacts of rodenticides are readily reversed by the timely application of Vitamin K[1].

Protective equipment will be required, such as latex gloves for handling and touch bait and breathing masks if the bait is stored in an enclosed environment, will be provided to the team prior to the baiting phase.

The local community will be informed of the risks of rodenticides, what they look like, what the bait stations look like, and how to report any concerns.

Signs will be placed on the ferry and at the landing sites on Farnuff, informing visitors to the islands of the potential risks of rodenticides and warning them not to touch bait or bait stations.

5.2 Ecological effects

The environmental impacts of the rat eradication project are considered likely to be strongly positive, benefitting all species preyed upon by rats including seabirds, plants and invertebrates. We recognise that unexpected ecological consequences of rat eradications are possible (e.g. mesopredator release, prey release) and thus have measures in place to manage the most likely effect (of overgrazing caused by an increased rabbit population). Rabbits will be controlled if the population exceeds a threshold of 30 animals per hectare, a figure agreed with UKSCT, SWCA and the landowner. This control will be carried out by local farmers in line with an agreed protocol. The ongoing ecological monitoring activities outlined in the Monitoring and Evaluation Plan will hopefully detect any impacts on other taxa, both positive and negative, adding to our body of knowledge about the likely ecological consequences of rat eradication.

5.3 Disposal of rubbish

Any general waste produced by the project will be removed from Farnuff on the regular weekly scheduled rubbish collection services. Waste on Dull will be brought across to Farnuff on the boat used to transport project staff, supplies and equipment.

5.4 Leftover bait

Leftover bait falls into two categories – used and unused.

5.4.1 Used bait

Used bait (i.e. that which has been set out in bait stations during the eradication and removed at the end of the poisoning phase or due to weathering, being partially eaten or as part of routine bait refreshing activities) will be collected and kept in sealed buckets in the bait store (separately from the main bait). At the end of the project it will be removed from the island and disposed of in accordance with the requirements listed on the product label and relevant legislation. It is likely to be disposed of by incineration at an appropriately registered waste disposal site.

5.4.2 Unused bait

100kg of bait will be kept on Farnuff for six months after the end of the project to respond to any subsequent rat sign while the remainder will, where possible, be made available to other island restoration projects in the region.

5.5 Consents

A number of regulatory requirements may need to be fulfilled for the proposed eradication programme, including:

- Animal Ethics approval to undertake many of the research and monitoring components of the plan;
- Review of the Feasibility Study and Operational Plan by either the Island Eradication Advisory Group (IEAG) or independent experts to ensure the proposed techniques comply with best operating practises for island eradications.
- Review of the Feasibility Study and Operational Plan by the Health and Safety Executive (HSE) to ensure the safety of operational staff, volunteers and visitors.
- Ensure operation is valid under the Control of Pesticides Regulations 1986 and the EU Biocidal Product Regulations 2015
- Permission from local authority for working in SPA/ SSSI

6 HEALTH AND SAFETY

See the Health and Safety Plan (Smith *et al. In prep.*) for full details.

6.1 The operational team

All members of the team will undergo an accredited training course on the safe use of rodenticides, focussing on the safety of island residents, visitors, livestock and wildlife as well as the team members themselves.

The staff members who will be doing rope-access work are highly experienced and have had all the appropriate training. The whole operational team will receive regular briefings on safety issues at their daily meetings. Face masks will available for use when moving bait between containers (although the bait is in wax block form and produces little dust).

Life jackets will be worn by all team members on all boats other than scheduled ferry services. These will be bought by the project and used exclusively by them. At least four project staff will hold a relevant first aid qualification and the island also has a registered nurse who is prepared to administer vitamin K1 injections in cases of accidental poisoning.

6.2 Island residents

A detailed presentation on the methods to be used by the project and the potential risks of touching or consuming bait will be given to all island residents, all of whom have already been consulted about the project and are supportive of it. Project staff will discuss with parents how best to get the message across to the island's children, through activities and explanations tailored to them.

6.3 Island visitors

Visitors to the island will be notified by signs at Southport, the main harbour on Farnuff, as well as at other potential anchoring spots on both Farnuff and Dull. Visitors arriving via the scheduled CalMac ferry service from Lewis will also receive information via a short onboard announcement and directed to further sources of written information (leaflets and signs) on the ferry as well as the Southport Harbour Office. The signs and leaflets will explain the background to the project and the nature of the poison being used, as well as photographs of both bait blocks and bait stations and warnings of the potential dangers, especially to children and pets. All bait stations will carry a sign warning that they contain rodenticide bait and should not be touched.

7 LOGISTICS

The bulky project equipment (bait, bait stations, wires, bamboo canes for marking grid points etc, monitoring equipment) will travel to Farnuff via a chartered boat from the Lewis mainland. The bait will be transported by road from the factory to Uig, then across to Tarbert on a chartered boat and then transported by road to the ferry terminal on Lewis that deals with transport to the Stewart Islands. The bait will be carefully packed onto pallets at the factory and transported via experienced haulage companies to ensure it arrives safely and in good condition. The journey is estimated to take no longer than 18 hours and the bait will be not be subject to any extremes of temperature. Bait and other equipment will be unloaded on Farnuff and transported by tractor and trailer to a large shed/ workshop near the harbour that has been rented for the duration of the project.

The operational team will get to Farnuff via the scheduled CalMac ferry service, which runs three times a week year round. From Farnuff they will travel to Dull via boat. Several Farnuff residents have expressed an interest in transferring personnel between the two islands. It is envisaged that staff will stay on Dull for a week at a time (depending on the weather) before being replaced by other staff from the larger part of the project team on Farnuff. Extensive food and water supplies will be stored on Dull in the case of bad weather affecting boat transport. Three sound but currently unused farm buildings are available for storage of equipment, fuel, food and water supplies and the project team will stay in the island's bothy, a solid stone built structure capable of comfortably housing a team of four staff (though in need of some renovation work – see task schedule). The bothy has an outbuilding suitable for housing a diesel powered generator for electricity and heating, and also has space for propane-fuelled cooking facilities in the kitchen area. The team on Farnuff will stay in one or more houses/ holiday let properties on the island, which are under-occupied in the winter season. Several island residents have indicated a willingness to rent accommodation to the project team.

Due to the small size of the islands the team will mainly move around on foot. On Farnuff the team will also have access to a quad bike and trailer, which will be useful for transporting bait and bait stations around the island. On Dull everything will have to be transported on foot, with depots of bait stations and bait being stored in several locations across the island. Operational staff will all have walkie-talkie radios to keep in touch with each other as well as laminated maps showing the locations of all bait stations. They will also all have compasses, for both marking out grid lines and general orientation. Mobile phone reception is moderately good on both islands and the team on Dull will make nightly contact at a pre-arranged time with the main team on Farnuff to check on team safety and also the progress of the work.

8 EQUIPMENT LIST

The following equipment detailed in Table 4 is required to undertake the preparation, implementation of the eradication operation, intensive monitoring and long-term monitoring on Farnuff and Dull islands. This is not a complete list; other equipment may be needed throughout the project or recommended by the researcher(s) who undertake the pre- and post-eradication monitoring aspect. As such, a 20% contingency amount has been added to the budget.

There are a number of items that can be used throughout the operation (such as project laptop, radios, first aid kits, notebooks, marking canes, flagging tape etc.). Although the list is detailed, it is likely that a number of other items will be needed; as such a 20% contingency cost has been added to the budget. It is possible that many of these items will be able to be provided in-kind by partner organisations or other agencies. All products listed are required for the success of the project. It is possible that sponsorship and donations may also reduce costs further.

It is important that a 20% contingency amount is built into the budget to allow for the possibility of rats being detected at the end of poisoning phase or aspects of the project go over the allocated time. This additional funding should allow for a second baiting operation (i.e. during the following winter as it is more difficult to target rats successfully during spring and summer when natural food is widely available) to complete the eradication programme. Although, based on similar eradication projects in the UK this should not be necessary, it is important to plan for every outcome.

Table 4: The essential equipment list for the eradication of brown rats from Farnuff & Dull islands

PROJECT STAGE	Item	unit size	number	unit cost (£)	total cost (£)
Implementation stage 1. Pre-eradication phase					
Notebooks	Waterproof notebooks		210	8.99	1887.90
Pencils	Pencils, HB, 4 per person	12 pack	18	2.86	51.48
Pens	Pens , biros, blue, black and red, 1 per person	12 pack	18	2.86	51.48
Laminator	To produce field maps for team		4	34.99	139.96
Laminator pouches	To produce field maps for team	100 pack	8	35.00	280.00
Cell phone and credit	For maintaining contact between Team Leaders		4	150.00	600.00
Radio	Hand held (line of site) radios (such as Motorola XTR446)	2 pack	40	74.75	2990.00
Headlamps	1 for each team member		80	39.95	3196.00
Wet weather gear	Jackets, over-trousers and gaiters		80	500.00	40000.00
Batteries	Rechargeable AA and/or AAA batteries for headlamps etc., including recharge unit	4 batteries plus charger	80	12.49	999.20
First aid kits	First aid kits, field type for team members		80	12.30	984.00
Safety blankets	Emergency or safety blankets		80	3.95	316.00
A4 paper	A4 paper, for reports, info, letters or maps	ream (500 pages)	12	2.29	27.48
Map	Enlarged maps of Scillies	OS Map	20	6.99	139.80
Notice board	Notice board, for team notices, etc.		4	21.99	87.96
Whiteboard	Whiteboard for team notices and field locations		4	29.00	116.00

Whiteboard pens	Whiteboard pens for team notices and field locations	4 pack	6	10.00	60.00
Whiteboard eraser	Whiteboard eraser		4	5.00	20.00
Stuff sacks	1 per team member, for carrying all emergency equipment	Outdoor designs (large)	100	3.49	349.00
Tools	For construction of wooden bait stations; handsaw (£16), hammer (£16), nails (£2.86 for 100), hinges (£10.75 for 12)		10	29.61	296.10
Whistles	1 per team member, 'referee' type, for safety		100	3.35	335.00
Hi-visibility vests	1 per team member, for safety		100	1.65	165.00
Pocket knives	1 per team member, for scraping wax blocks clear	Spartan	80	19.95	1596.00
Thermos flasks	1 per team member	500 ml	80	14.95	1196.00
Lunch box	1 per team member		80	11.95	956.00
Waterproof bags (small)	1 per Uninhabited Islands Team Member, for transporting personal equipment to islands	e.g. Lomo Dry Bag Walking Rucksack 40L	12	40.00	480.00
Waterproof bags (large)	For transporting Uninhabited Island Team equipment to islands	e.g. North Face Base Camp Duffel bags, XL	6	100.00	600.00
Lifejackets	For Uninhabited Islands Team. Seek advice from locals on best models to use		12	150.00	1800.00
Wetsuits, gloves and boots	For Uninhabited Islands Team. Seek advice from locals on best models to use		12	280.00	3360.00
VHF radios	For Uninhabited Islands Team. Seek advice from locals on best models to use		12	200.00	2400.00
Vegetation management tools & PPE	For vegetation control, in order to reduce rat harbourage and natural food supply	Brush cutters etc.	6	400.00	2400.00
Storage shed	For vegetation management tools and PPE		1	500.00	500.00

Wheely bins for all households	To reduce food supply available to rats	240l	300	70.00	21000.00
Wheely bins for businesses producing food waste (e.g. Restaurants, campsites)	To reduce food supply available to rats	500l - 770l	50	230.00	11500.00
Compost bins for all households	To reduce food supply available to rats e.g. Green Johanna bins	e.g. Green Johanna bins (with winter jackets)	300	170.00	51000.00
Trail cameras	To detect rats and identify non-target interference with bait stations		50	200.00	10000.00
Laptop	For data entry and GIS work		4	700.00	2800.00
Hats	Coloured hats for use by all project workers		80	10.00	800.00
Camping mats	For use on Dull Island		12	60.00	720.00
Sleeping bags	For use on Dull Island	4 season	12	60.00	720.00
Camping stoves, 2 ring	For use on Dull Island		3	60.00	180.00
Fuel for camping stoves	For use on Dull Island		6	40.00	240.00
Crockery	For use on Dull Island		12	8.00	96.00
Cutlery	For use on Dull Island		12	4.00	48.00
Saucepans	For use on Dull Island		6	8.00	48.00
					167,532.40
Implementation stage 2: Establishing rodenticide grid					
Marking poles	8 ft bamboo poles (these will be cut in half)	3 m x 100 mm diameter (100 pack)	28	77.98	2183.44
Flagging tape	Hazard tape, red and white striped	75 mm (500 m)	50	9.49	474.50
Plastic tags	2 inch square, holed, for numbering bait stations	250 tags (75 x 50 mm)	22	77.00	1694.00
Marker pens	Permanent marker pens, good quality, to	12 pack	24	8.99	215.76

	number tags				
Poison labels	Poison labels (poison, do not touch)		5500	0.86	4730.00
Bait stations (plastic tubes) plus wires	For setting up the outdoor baiting grid		5000	4.81	24050.00
Protecta boxes	For use in and around buildings		300	10.00	3000.00
Metal bait boxes	For use in houses with domestic animals, if preferred by homeowners		100	20.00	2000.00
Spray paint	Orange, red and blue, to mark end of bait station lines	(6 of each)	18	5.00	90.00
GPS	For recording locations of grid points		8	150.00	1200.00
Snap traps	Collecting rats for DNA sampling and for poison-free rat control ahead of poisoning phase	Trapper T-rex traps	300	5.00	1500.00
A24 rat traps	Collecting rats for DNA sampling and for poison-free rat control ahead of poisoning phase	Goodnature A24 self-resetting traps	100	90.00	9000.00
					50,137.70
Implementation stage 3: Rodenticide baiting phase					
Primary bait	Bromadiolone (Contrac©)	Per kg (25kg/ha)	20450	8.00	163600.00
Secondary (back up) bait	Difenacoum (Neosorexa©)	Per kg (0.5kg/ha)	410	8.00	3280.00
Vitamin K1	Vitamin K1, both injections and tablets	10 doses	6	22.00	132.00
Nitrile gloves	Nitrile gloves, thick surgical gloves, 100 per box, for handling bait and rats	1 box (100 gloves) of each (S, M and L)	12	5.52	66.24
Deb Skin Safety station	Deb Skin Safety station, for cleaning hands after using bait and handling carcasses		4	89.32	357.28
Deb Skin Safety station refills	Deb Skin Safety station refills, for cleaning hands after using bait and handling carcasses	3 of each	12	51.27	615.24

					168,050.80
Implementation stage 4: Intensive monitoring of rodents					
Marking poles	8 ft bamboo poles (these will be cut in half)	3 m x 100 mm diameter (100 pack)	30	77.98	2339.40
Flagging tape	Hazard tape, red and white striped	75 mm (500 m)	20	9.49	189.80
Plastic tags	2 inch square, holed, for numbering monitoring stations	250 tags (75 x 50 mm)	10	77.00	770.00
Plastic bags	Self sealing, 25 ml, to collect samples and unclear monitoring items	3.5" x 4.5" (1000 pack)	10	22.98	229.80
Materials for making flavoured non-toxic wax monitoring blocks	Wax beads (e.g. Chandler 280P, 4candles.com)	20kg	40	63.80	2552.00
	Cocoa powder	250 g	30	2.18	65.40
	Creamed coconut	200g	30	1.00	30.00
	Peanut butter	340g	30	1.50	45.00
	Saucepan	12 cm, 0.7 L	3	25.00	75.00
	Muffin trays	24, mini	16	8.00	128.00
	Gas cooking Ring	single	3	21.60	64.80
	Gas bottles	9 kg	3	17.85	53.55
Candles	Candles, 50 mm lengths or tea lights	50 pack (tea lights)	250	8.50	2125.00
Soap	Soap, small hotel type	144 bars per box	200	15.36	3072.00
Chew cards	Commercially available	20 pack	200	3.20	640.00
Tracking tunnels		Trakka (with wires)	400	10.00	4000.00
Tracking cards		Trakka (50 pack)	100	31.00	3100.00
Tracking ink		Black track (100 ml)	15	9.00	135.00

Waxtags	Commercially available	peanut flavoured	2000	0.50	1000.00
Cordless drill	For making holes in monitoring items (e.g. chew cards, chocolate wax, soap etc.)	18 V	4	52.99	211.96
Drill bits	6 mm	6 pack	4	19.99	79.96
					20,906.67
Implementation stage 5: Install long-term biosecurity equipment					
Bait	Bromadiolone (Contrac(C)), wax blocks, 10 kg buckets	10 kg	5	68.00	340.00
Protecta boxes	For use as permanent bait stations as part of long-term biosecurity		100	10.00	1000.00
Wooden rat motels	Stained, hinged and lockable, individually numbered with warning labels, etc. To be made by project staff		200	30.00	6000.00
Tracking tunnels		Trakka (with wires)	400	10.00	4000.00
Tracking cards		Trakka (50 pack)	100	31.00	3100.00
Tracking ink		Black track (100 ml)	10	9.00	90.00
Candles	Candles, 50 mm lengths or tea lights	50 pack (tea lights)	200	8.50	1700.00
Soap	Soap, small hotel type	144 bars per box	100	15.36	1536.00
Chew cards	Commercially available (connovation.co.nz)	20 pack	100	3.20	320.00
Flavoured wax	Wax beads, 360kg	20kg	18	63.80	1148.40
	Cocoa powder	250 g	15	2.18	32.70
	Creamed coconut	200g	15	1.00	15.00
	Peanut butter	340g	15	1.50	22.50
	Gas bottles	9 kg	5	17.85	89.25

Notebooks	Waterproof notebooks		20	8.99	179.80
Pencils	Pencils, HB	12 pack	2	2.86	5.72
Pens	Pens , biros, black	12 pack	2	2.86	5.72
Notebooks	Waterproof notebooks		6	8.99	53.94
Pencils	Pencils, HB	12 pack	2	2.86	5.72
					19,644.75
TOTAL					**426,272.20**

9 OPERATIONAL TEAM

The operational team, the organisations, roles and responsibilities are provided in Table 5.

The Terms of Reference for Project Manager and Operations Manager can be found in Annex 2.

Table 5: The Operational Team, the organisations involved, and their roles and responsibilities for the delivery of the eradication of brown rats from Farnuff and Dull islands.

Name	Organisation	Role	Responsibilities
Louise Small	UK Seabird Conservation Trust	Project Executive	• The accountable person on the project – overall (ultimate) accountability for the project. • Leadership role – setting and guiding the overall direction and management of the project • Involved from the start of the project and is ultimately accountable for the project. This includes defining the project in conjunction with the Project Manager
Kate Vickerman	UK Seabird Conservation Trust	Project Manager	• The responsible person on the project – overall responsibility for the project. • Leading the project effectively to deliver the agreed outputs and meet the agreed objectives (in order to achieve the agreed outcomes) • Leading on planning, relationship building, listening and communicating (including defining the project, setting objectives, planning the work etc.) • Creating and maintaining project documentation.
Philippa Connolly	UK Seabird Conservation Trust	Operations Manager	• Day to day project management of poisoning, intensive monitoring and final check phases. • Co-ordination of Operational Team leaders and staff • Producing technical reports
Sam Peason	Wildlife and Conservation Agency	Deputy operations manager/ team leader	• Assisting operations manager and leading a team of field staff and volunteers
Sarah Trellis	Wildlife and Conservation Agency	GIS technician	• All GIS and mapping work
Richard Narracott	UK Seabird Conservation Trust	Team Leader	• Leading team of field staff and volunteers
John Macsween	UK Seabird Conservation Trust	Team Leader / Lead rope access worker	• Setting up and using system of rope access points for baiting cliffs

Lydia Steeple	UK Seabird Conservation Trust	Rope access worker	• As above
Elliot Graves	UK Seabird Conservation Trust	Rope access worker	• As above
Emily Adamson	UK Seabird Conservation Trust	Rope access worker	• As above
Volunteers (8 needed at any one time)	UK Seabird Conservation Trust	Field workers	• General field work duties – mainly checking bait stations and monitoring equipment

10 TASK SCHEDULE

The task schedule for eradicating brown rats from Farnuff and Dull islands is presented in Table 6 below.

Table 6: A checklist of key tasks for the delivery of the eradication of brown rats from Farnuff and Dull islands. Month 0 = start of project (assumed to be 1st January) and that the intensive six-month poisoning and monitoring part of the eradication will start around month 9 (September) with the poisoning phase starting around month 11 (November) and running for around 3 months, before moving into the intensive monitoring phase.

Actions for each project stage	Responsible party	Timeframe
Operational Planning Stage		
Funding secured.	Project Executive	
Stewart Island vole plan in place	Project Executive; Project Manager	
Implementation stage 1: Pre-eradication phase		
Recruit Project Manager	Project Executive	Month 0
Liaise with and inform island communities about the project, encouraging community involvement and ownership	Project Executive; Project Manager	Month 0-ongoing
Put operational side of the eradication project out to tender and appoint appropriate Operations Manager	Project Executive; Project Manager	Months 0-3
Recruit Admin Manager to deal with finding and recruiting volunteers, and travel and accommodation for all staff and volunteers	Project Executive; Project Manager	Months 0-3
Recruit lead boat operator(s) for transporting field workers on the uninhabited islands part of the project. Sign contract.	Project Manager; Operations Manager	Months 0-3
Establish captive population of Stewart Island vole at the Scottish Animal Park	Project Manager; vole specialist group	Months 0-6
Ensure suitable accommodation and workspace is available on Farnuff and Dull and repairs are completed on the bothy and outhouses	Project Manager; Operations Manager; Admin Manager	Months 0-6
Ensure all rodenticide use stops on the islands at least 6 months before the start of the poisoning phase	Project Manager	Months 0-6
Ensure farmers are fully aware and compliant to change livestock feeding methods during the baiting phase to prevent an alternative food source for the rats	Project Manager	Months 0-6
Find source for the rodenticide bait that will be required and order well in advance (this can take months to make and further time to be delivered)	Project Manager; Operations Manager; Admin Manager	Months 0-6

Ensure all necessary permits are in place to carry out the work - agreements from landowners, statutory bodies	Project Executive; Project Manager	Months 0-9
Review food waste collection on Farnuff, ensuring no accessible food is left for rats	Project Manager; Operations Manager	Months 0-9
Review procedures on Farnuff Quay to minimise chances of rodents being inadvertently transported to any of the outer islands	Project Manager; Operations Manager	Months 0-9
Source all necessary equipment (see list in section 10): bait stations, monitoring equipment, snap traps, flagging tape, PPE for staff and volunteers	Project Manager; Operations Manager; Admin Manager	Months 0-9
Get Farnuff 'rat-removal ready' - encourage homeowners and businesses to clear out sheds and outbuildings etc.	Project Manager; Operations Manager	Months 0-11
Recruit other operational staff as necessary - team leaders and deputy leaders	Project Manager; Operations Manager	Months 3-6
Ensure all staff and as many volunteers as is practicable are trained in safe and responsible rodenticide use (1-day course)	Project Manager; Operations Manager; Admin Manager	Month 6-ongoing
Source, buy and distribute rat-proof bins to all households and businesses on the inhabited islands	Project Manager	Months 6-9
Implementation stage 2: Establishment of rodenticide grid		
Establish network of bait stations across all islands included in the eradication project, including inside all buildings	Project Manager; Operations Manager	Months 9-11
Record position of all stations on GIS database	Operations Manager	Months 9-11
Produce maps of bait station locations for staff and volunteers to use in the field	Operations Manager	Months 9-11
Buy Vitamin K1 (anticoagulant rodenticide antidote) for emergency use on all three inhabited islands	Project Manager and Admin Manager	Months 9-11
Ensure sufficient numbers of trained people are available to administer Vitamin K (at least one person available on each of the inhabited islands at all times)	Project Manager	Months 9-11
Implementation stage 3: Rodenticide baiting phase		
Train staff and volunteers in recognising field and feeding sign left by rats and key non-target species	Operations Manager	Month 10-ongoing
Thoroughly brief staff and volunteers on how to check bait stations safely and effectively	Operations Manager	Month 10-ongoing

Carry out daily briefing and feedback sessions for field staff and volunteers	Operations Manager; team leaders	Month 10-ongoing
Carry out briefing and feedback sessions for local residents around rodenticide use, prior to and throughout the poisoning phase. Ensure clear lines of communication should anyone need to report suspected accidental poisoning or other issues	Operations Manager; team leaders	Months 10-15
Place agreed number of blocks in every bait station	Operations Manager; team leaders, volunteers	Months 10-15
Ensure all livestock and other domestic animals are protected from accidental poisoning – cows, sheep, horses etc may need to be kept in areas away from bait stations if they show signs of interfering with them. If so, alternative plans will need to be made to ensure all areas are baited (e.g. moving stock between fields)	Operations Manager	Months 10-15
Check bait stations as frequently as possible, ideally every 1-3 days	Operations Manager, team leaders, volunteers	Months 10-15
Store used bait safely and dispose of in accordance with manufacturer's instructions	Operations Manager	Months 10-15
Search for, collect and dispose of any dead rodents in accordance with bait manufacturer's instructions and local guidelines	Operations Manager; team leaders, volunteers	Months 10-15
Implementation stage 4: Intensive monitoring of rodents		
Thoroughly brief staff and volunteers on how to set and check monitoring tools effectively	Operations Manager	Month 12-ongoing
Carry out daily briefing and feedback sessions for field staff and volunteers	Operations Manager, team leaders	Month 12-ongoing
Check monitoring stations as frequently as possble, ideally every 1-3 days	Operations Manager; team leaders, volunteers	Month 12-15
At the end of the baiting and monitoring phases: remove all remaining bait, bait stations and the majority of monitoring tools	Operations Manager	Month 15
Clean and safely store equipment which could be used in ongoing biosecurity and incursion response work	Project Manager; Operations Manager	Month 15
Make and safely store flavoured wax blocks for use in ongoing biosecurity and incursion response work	Project Manager; Operations Manager	Month 15
Implementation stage 5: Install long-term biosecurity equipment		
Produce a full biosecurity plan for the islands	Operations Manager; Project Manager	Month 12-15
Establish network of permanent monitoring stations on the three inhabited as well as key uninhabited islands	Operations Manager; Project Manager	Month 15-ongoing

Establish and maintain long term rat control actions on the Quay on Lewis	Project Manager	Month 15-ongoing
Identify and train people (ideally volunteers) able to check the monitoring stations on a regular (ideally monthly) basis	Project Manager	Month 15-ongoing
Carry out 2 year check after last sign of rats to determine rat-free status	Project Manager; Operations Manager	Month 36-39

11 REFERENCES

Genuine references are listed here. Others included in the text are fictional.

Would also include reference to Feasibility Study, Project Plan and Health and Safety Plan

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Russell, J.C., Towns, D.R. & Clout, M.N. (2008) Review of rat invasion biology: implications for island biosecurity. *Science for Conservation 286*. Department of Conservation, Wellington, New Zealand.

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Towns, D.R., Atkinson, I.A.E. and Daugherty, C.H. (2006). Have the harmful effects of introduced rats on islands been exaggerated? *Biological Invasions* 8(4): 863-891

12 ANNEX 1: BROMADIOLONE (CONTRAC©) MATERIAL SAFETY DATA SHEET (MSDS)

[Example obtained from: (Bell, 2013)]

PRODUCT NAME: CONTRAC® All-Weather Blox	
MANUFACTURER'S ADDRESS: BELL LABORATORIES, INC. 3699 KINSMAN BLVD. MADISON, WI 53704, **TELEPHONE NO:** (608) 241-0202	
USE: Anticoagulant Rodenticide	
BAIT FORM: Formulated Dry Bait	
EPA REGISTRATION NO: 12455-79	
SECTION I. HAZARDOUS INGREDIENTS	
INGREDIENT NAME % BY WEIGHT CURRENT TLV: **Bromadiolone** [3-[3-(4'-Bromo-[1,1'-biphenyl]-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-2H-1-benzopyran-2-one] CAS No. 28772-56-7 0.005 % N/A	
This product contains no components subject to the reporting requirements of Section 313 of the Superfund. Amendment and Reauthorization Act (SARA) of 1986	
SECTION II. PHYSICAL DATA	
APPEARANCE: Polygonal Block	**WATER REACTIVITY:** N/A
COLOUR: Blue	**EVAPORATION RATE:** N/A
ODOUR: Sweet, grain-like	**VAPOR PRESSURE:** N/A
SPECIFIC GRAVITY: 0.629 gm/cc	**BOILING POINT:** N/A
VAPOR DENSITY: N/A	**SOLUBILITY:** Not soluble in water
MELTING POINT: N/A	**BULK DENSITY:** N/A
SECTION III. FIRE AND EXPLOSION DATA	
FLASH POINT (Method Used): N/A	
FLAMMABLE LIMIT: Upper Limit: N/A **Lower Limit:** N/A	
AUTO-IGNITION TEMP: N/A	
EXTINGUISHING MEDIA: Extinguish with water, foam or inert gas	
SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should be equipped with protective clothing and self-contained breathing apparatus.	
UNUSUAL FIRE OR EXPLOSION HAZARDS: None	
SECTION IV. REACTIVITY HAZARD DATA	
STABILITY: Stable	
CONDITIONS TO AVOID: None	
POLYMERIZATION: Will not occur	
CONDITIONS TO AVOID: None	
INCOMPATIBILITY (MATERIALS TO AVOID): Strongly alkaline materials	
HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of carbon	
SECTION V. TOXICITY DATA	
LD50, ORAL (INGESTION): >5000 mg/kg (rats)	
LD50, DERMAL (SKIN CONTACT): > 2000 mg/kg (rats)	
LC50, INHALATION: N/A	
EYE IRRITATION: None (rabbits)	
SKIN IRRITATION: None (rabbits)	
DERMAL SENSITIZATION: Not Considered a Sensitizer	
SECTION VI. HEALTH HAZARDS	
PRIMARY ROUTE OF ENTRY: Ingestion	
SIGNS & SYMPTOMS OF EXPOSURE: Nausea, vomiting, loss of appetite, extreme thirst, lethargy, diarrhea, bleeding	

EMERGENCY FIRST AID PROCEDURES: **Eyes:** Flush with cool water for at least 15 minutes. If irritation develops, obtain medical assistance. **Skin:** Wash with soap and water. **Ingestion:** Call physician or emergency phone number immediately. Do not give anything by mouth or induce vomiting unless instructed by physician. **Inhalation:** None.
NOTE TO PHYSICIAN: If ingested, administer Vitamin K1 intramuscularly or orally as indicated by bihydroxycoumarin overdoses. Repeat as necessary as based upon monitoring of prothrombin times.
SECTION VII. CONTROL AND PROTECTIVE MEASURES
RESPIRATOR TYPE: Not required
EYE PROTECTION: Not required
GLOVES (Recommended): Rubber Gloves
VENTILATION: Not required
OTHER PROTECTIVE MEASURES: Not required
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS: HEALTH: 1 (Caution) **FIRE:** 0 (Will not burn) **REACTIVITY:** 0 (Stable) **SPECIFIC HAZARD:** None
HAZARDOUS MATERIAL INFORMATION (HMIS) RATINGS: HEALTH: 2 (Moderate) **FLAMMABILITY:** 0 (Minimal) **REACTIVITY:** 0 (Minimal) **PROTECTIVE EQUIPMENT:** B
SECTION VIII. SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN THE EVENT MATERIAL IS RELEASED OR SPILLED: Sweep up spilled material, place in properly labelled container for disposal or re-use.
WASTE DISPOSAL METHOD: Wastes resulting from use may be disposed of on-site or at an approved waste disposal facility. Dispose of all wastes in accordance with all Federal, state and local regulations.
SECTION IX. SPECIAL PRECAUTIONS AND STORAGE DATA
STORAGE TEMPERATURE: Room temperature
AVERAGE SHELF LIFE: Bait is stable for a minimum of 1 year when stored at room temperature
SPECIAL SENSITIVITY (HEAT, LIGHT, MOISTURE): Avoid exposure to light and extreme humidity
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store in a cool, dry place inaccessible to children, pets and wildlife. Keep container tightly closed when not in use. Avoid contamination of lakes, streams and ponds by use, storage or disposal. Wash thoroughly with soap and water after handling.
SECTION X. SHIPPING DATA
DOT SHIPPING NAME: None required
DOT HAZARD CLASSIFICATION: Non-hazardous
DOT LABELS REQUIRED: None required
FREIGHT CLASSIFICATION: LTL Class 60
WARRANTY: The information provided in this Material Safety Data Sheet has been obtained from sources believed to be reliable. Bell Laboratories, Inc. provides no warranties; either expressed or implied, and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your consideration and investigation. The user is responsible to ensure that they have all current data relevant to their particular use.

13 APPENDIX II: DIFENACOUM (NEOSOREXA©) MATERIAL SAFETY DATA SHEET

[Example obtained from: (Bell, 2013)]

1	Identification of the preparation and the supplying Company	**Neosorexa® Blocks**	
		BASF (The Chemical Company), BASF PLC, PO Box 4, Earl Road, Cheadle Hulme, Cheshire, SK8 6QG, UK, Tel: +44-161-4856222, Fax: +44-161-4274, Email: product-safety-north@basf.com	
2	Composition and information on ingredients	Difenacoum	0.005%w/w
		Rodenticide, biocide, bait	
3	Hazards identification	No specific dangers known, if the regulations/notes for storage and handling are considered.	
4	First Aid measures	General:	Avoid contact with skin, eyes and clothing. Take off immediately all contaminated clothing. First Aid personnel should pay attention to their own safety. If the patient is likely to become unconscious, place and transport in stable sideways position (recovery position). If difficulties occur obtain medical attention. Show container, label and/or safety data sheet to doctor.
		Ingestion:	DO NOT INDUCE VOMITING. Rinse mouth immediately with water. Seek medical attention if necessary.
		Skin contact:	After contact with skin, wash immediately with plenty of water and soap. If irritation develops, seek medical attention.
		If inhaled:	Remove the affected individual into fresh air and keep the person calm. Seek medical attention if necessary.
		Eye contact:	Immediately wash affected eyes for at least 15 minutes under running water with eyelids held open. Consult an eye specialist.
		Advice to doctor: Difenacoum is an indirect anticoagulant. Vitamin K1 (phytomenadione) is antidotal. Poisoning is unlikely unless large quantities have been ingested. In case of suspected poisoning, determine prothrombin times not less than eighteen hours after consumption. If elevated, administer vitamin K1 and continue until prothrombin times normalise. Continue determination of prothrombin times for three days after withdrawal of antidote and resume treatment if elevation occurs in that time. For comprehensive medical advice on the treatment of poisoning contact the nearest Poisons Information Centre. Symptoms include coagulation disorders, blood in urine, internal bleeding, shock, weakness and loss of appetite.	
5	Fire-fighting measures	Use water spray; dry chemical, carbon dioxide or foam fire extinguishers.	
		Toxic fumes (including carbon monoxide, carbon dioxide and nitrogen oxides) can be released in a fire.	
		Self-contained breathing apparatus and chemical-protective clothing should be worn by fire-fighters.	
		Keep containers cool by spraying with water if exposed to fire. In case of fire and/or explosion do not breathe fumes. Collect contaminated extinguishing water separately, do not allow to reach sewage or effluent systems. Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.	
6	Accidental release measures	Personal precautions:	Use personal protective clothing. Avoid contact with skin, eyes and clothing.
		Environmental precautions	Do not discharge into the subsoil or soil. Do not discharge into drains, surface water or groundwater.
		Spillage (containment and disposal):	Collect waste in suitable containers, which can be labelled and sealed. Clean contaminated floors and objects thoroughly with water and detergents, observing environmental regulations. Incinerate or take to a special

			waste disposal site in accordance with local authority regulations.
7	Handling and storage	Handling:	No special measures necessary if stored and handled correctly. Keep in original container, tightly closed, in a safe place. If dead or dying rats or mice are found during and after the control programme, these must be cleared away immediately in order to avoid secondary poisoning. Do not apply in the open (use bait stations, bait cartons or foil bags).Avoid all contact by mouth.
			Avoid all contact by mouth, wash hands and exposed skin before meals and after work.
			Prevent access to the bait by children, birds and domesticated animals, particularly dogs, pigs and poultry.
			Do not use baits where food, feed or water could become contaminated.
			Remove all remains of bait, bait containers and carcasses after treatment and incinerate or take to a special waste disposal site in accordance with local authority regulations.
		Protection against fire and explosion	The product is combustible, but not self-combustible or explosive and does not add to the spreading of fire. Dust can form an explosive mixture with air. Avoid dust formation. Avoid deposition of dust. Prevent electrostatic charge; keep sources of ignition well clear. Fire extinguishers should be kept handy.
		Storage and transport precautions:	Store in original container, tightly closed under cool and dry conditions in a safe place.
			Protect form moisture, keep away from heat, protect from direct sunlight.
			Segregate from food ad animal feed.
			Store and transport away from products which have an odour.
			Store for 24 months.
8	Exposure controls and personal protection	Breathing:	Dust mask if sweeping up or aerosols or dust is formed [Particle filter with medium efficiency for solid and liquid particles such as EN 143 or 149 with Type P2 or FFP2 filter]
		Hands:	Although gloves are not necessary for the safe use of this product, they are recommended for protection against rodent-borne diseases. Unlined synthetic rubber, 300 mm in length, e.g. Solvex nitrile.
		Body:	Protection depends on activity and possible exposure likelihood. Basic heavy duty polycotton or disposable, dust resistant overalls are recommended. In spills chemical protection suits (such as EN 14605 or EN ISO 13982) should be available.
		Eyes:	Safety glasses with side shield (frame goggles) such as EN 166 should be worn.
9	Physical and chemical properties	Appearance:	Green, wax blocks
		pH:	Not tested
		Flash point:	Non-volatile solid
		Flammability:	Does not ignite. Not considered a fire hazard but it will burn. Not explosive. Not fire-propagating.
		Solubility:	Not soluble in water.
		Odour:	No significant odour.
10	Stability and reactivity	Chemically stable. Not a reactive preparation. No decomposition if stored and handled as indicated.	

11	Toxicological information	LD50:	1.8 mg/kg (rats - oral) 0.00346- 0.005848 mg/l/h (rat – inhalation) 63 mg/kg (rat – dermal)
		Irritants:	Non-irritant in rabbits, skin-sensitising effects were not observed in animal studies.
12	Ecological information	Hazardous to mammals (including domestic animals) and birds if ingested. Access to bait by non-target animals must be prevented.	
13	Disposal considerations	Unused, old or contaminated packaging must be dumped or incinerated in accordance with local regulations. The UK Environmental Protection (Duty of Care) Regulations and amendments should be noted. This product and any unclean containers must be disposed of as hazardous waste in accordance with the 2005 Hazardous Waste Regulations and amendments.	
14	Transport information	Not classified as hazardous or dangerous goods for transport under transport regulations for land, inland waterway, sea or air transport.	
15	Regulatory information (EU)	This product does not require a hazard warning label in accordance with EC Directives. The data should be considered when making any assessment under the Control of Substances Hazardous to Health Regulations (COSHH), Health & Safety at Work Act and related guidelines. The information contained in this data sheet does not constitute the user's own assessment of workplace risks as required by legislation	
16	Other information	Use only in accordance with label instructions. Observe statutory conditions of use on label. Read the label before use. Use pesticides safely.	

Biosecurity Plan for Farnuff and Dull: Protocols and procedures to address the risk of re-introduction of rodents to Farnuff and Dull Islands, Outer Hebrides, Scotland

[N.B. This is a fictitious example intended for training purposes, based on real islands and some real places and references, but with some details altered to present an illustrative scenario. The project story, all names, organisations and incidents portrayed in this document are fictitious. No identification with actual persons (living or deceased), organisations or buildings is intended or should be inferred].

Acknowledgements:

This document draws on both the worked examples devised by the Pacific Invasives Initiative as part of their Resource Kit for Rodent and Cat Eradication ([redacted] and on the project documents produced by Wildlife Management International Ltd. during their extensive work on UK islands. We are very grateful to both organisations.

NOTE: This worked example is to provide guidance on the details required for the reporting, and does not include a site visit or detailed knowledge/explanation of the site and stakeholders involved. Therefore it should be noted that this example is not as thorough or as detailed as a real biosecurity plan will likely be.

Report produced by: T.Burke[1], P. Smith[2] and M. Burns[3]

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Funded by the Seabird Conservation Foundation

Reviewer(s): M. Byrne (UK Island Eradication Specialist, [redacted], P. Hunter (NZ Rat Eradication Specialist [redacted]

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1.0	10th April 2017	T. Burke	Draft version sent for review
2.0	5th June 2017	T. Burke	Changes made after independent review

Citation:

This report should be cited as: Burke, T., Smith, P. & Burns, M. (2017) Biosecurity plan for the eradication of brown rats (*Rattus norvegicus*) from Farnuff and Dull Islands, Outer Hebrides, UK. Unpublished report for Stewart Islands Restoration Project Partnership.

Executive Summary

1. Invasive non-native rodents, (i.e. rats and mice) have led to the extinction or extirpation of many native species of birds from islands around the world, including in the United Kingdom. Preventing them from becoming established on new islands is one of the most effective things we can do to prevent further extinctions. 'Biosecurity' refers to actions preventing the arrival and establishment of new invasive species.

2. Following the eradication of brown rats from Farnuff and Dull islands, although not officially confirmed until 2019, both islands currently appear to be free of invasive rodents, which will greatly benefit the island's seabirds as well as other native animals and plants. However, with the current increase in development on the island, the risks of pest species arriving are increasing and it is important to put biosecurity measures in place to a) minimise the chances of new arrivals reaching the island, b) quickly detect any which do arrive and c) respond quickly and effectively to remove any new arrivals.

3. Installing effective biosecurity measures will require investment in, among other things, training staff, buying monitoring equipment and improving the island's waste management system. Any investment in this area will, however, be a very small fraction of the costs of eradicating or of long-term control of invasive species if they become established across the island.

4. The most common routes ('pathways') by which invasive mammals reach new islands are by stowing away on boats, especially when transporting food supplies and building materials or swimming (e.g. rats and mice).

5. This plan focuses on preventing non-native rodent species (rats and mice) from reaching and becoming established on Farnuff and Dull following the eradication operation in 2017/18. Farnuff and Dull are too far away from other islands for rats and mice to swim there, but they could arrive either on the Caledonian MacBrayne ferry, on the inter-island freight vessel *MV Alastair* or on private boats. Currently the ferry and the *MV Alastair* are the most likely pathways but measures should be taken to deal with all potential routes by which rodents could reach the island.

6. Routine surveillance monitoring should take place in order to actively search for any invasive rodents which may arrive. This will involve a network of monitoring stations set out in areas where rodents are most likely to arrive (e.g. the Farnuff quay), and where there are likely to become established (e.g. in areas around human habitation). These stations should be checked monthly by trained staff and the results recorded. A variety of non-toxic methods should be used including wax blocks in a range of flavours, and ink tracking tunnels.

7. All island residents and visitors should be informed about the threat invasive species pose to the island's natural heritage and encouraged to report any sightings or suspected sign of invasive species to project and SWCA staff with a designated responsibility for the islands. Keeping the island free of invasives is to the benefit of everyone living and working on the island, as well as to the island's native species.

8. If <u>possible</u> (but not <u>probable/ definite)</u> signs of rats or mice are found the intensive monitoring actions described in section 6.2.1 should be immediately implemented, ideally within 48hrs.

9. If probable/ definite signs of rodents are found then the incursion response plan described in section 6.2.2 should be immediately implemented, ideally within 48 hrs.

Contents

1 INTRODUCTION

The purpose of this plan is to detail the protocols and procedures required to reduce the likelihood of rodents being re-introduced to Farnuff and Dull, part of the Stewart Islands group in the Outer Hebrides, Scotland, and how to respond in the event of a (re)incursion. This plan will be in place following the operation to eradicate of brown rats (*Rattus norvegicus*) using a ground-based bait station operation following best practice in 2018-19.

Rats are among the most successful of invasive species and have been recorded on 80% of the world's islands (Atkinson 1985). They have had devastating impacts on native wildlife through predation, competition and habitat modification (Moors & Atkinson 1984, Moors *et al.* 1992, Towns *et al*. 2006, Jones *et al*. 2008). Rodents have been successfully removed from islands ranging in size from 1 to 12,780 ha throughout the world using technology developed in New Zealand (Towns & Broome 2003, Howald *et al*. 2007).

Once rats and other invasive species have been removed from islands, it is important that re-incursions do not occur and as such biosecurity measures have to be established. This plan will be the main guiding document used by the Stewart Islands Restoration Project Partnership (SIRPP) and local community in executing the long-term biosecurity and will be used in the event of a (re)incursion. It draws on previous work contained in the Feasibility Study (Thornhill & Mitchell 2013) and the Operational Plan (Smith & Burns, 2017). The UK Rodent Eradication Best Practice Toolkit outlines best practice protocols for island biosecurity building on guidance that has been developed in New Zealand and has been expanded by other agencies, such as ISSG and Pacific Invasives Initiative, PII (Russell *et al*. 2005, Russell *et al*. 2008, Roberts 2008, PII, 2011). This Biosecurity Plan builds on these documents and international experience to provide practical and sustainable actions for SIRPP and local community. This plan focuses on rodents (rats and mice) only, but can easily be expanded to other species as required.

The project has mostly been funded by the Seabird Conservation Foundation, with additional funding and in-kind support from the UK Seabird Conservation Trust (UKSCT) and the Scottish Wildlife and Conservation Agency (SWCA). UKSCT will be the main implementing agency, with technical support and expertise from SWCA. The primary responsibility for decision-making and the implementation of incursion responses is with the Project Manager with the advice of the Steering Group for the duration of the project. A number of other partner agencies and the local community on Farnuff Island have also agreed to assist with incursion response and implementing the rest of the plan.

This plan should be reviewed and updated as new technology becomes available, revised approaches are recommended following research on Farnuff and Dull or as any situation on the islands change. SIRPP personnel should **follow an adaptive management approach (i.e. responding to reported sightings, completing regular monitoring and surveillance) and adjust the biosecurity programme as required, particularly in regards to capacity, training and equipment.**

We would like to thank colleagues at UKSCT and SWCA for help and support during the preparation of this document, as well as Kate Barnett and Simon Jones of the New Zealand government for technical advice. Warm thanks also to the Clipper family and to the community on Farnuff for their enthusiasm and support for the project and help with the practicalities of working on their islands.

1.1 The Site

1.1.1 Farnuff Island

Farnuff Island is an inhabited island (34 permanent inhabitants) of 147ha situated 4km from Lewis (Fig 1). It has a saddle shaped topography, with sheer cliffs along the north and west coast and also on the south east. The rest of the coastline is either rocky with boulders that can be scrambled over, or comprised of grassy slopes that can be traversed with care. The island's residents live along the central, low lying belt of the island – there are three farms (mainly farming sheep but with a small number of cattle), a shop (groceries/post office/general store), and ten houses. The island is serviced three times a week by a passenger ferry run by Caledonian MacBrayne from Lewis. The main pier is on the north side of the island, with a secondary landing site on the south coast which is mainly used by residents to launch fishing boats.

The island is covered in grassland with wet heath on the more exposed areas. Low-lying scrub covers some of the slopes on the northern coast where it is more sheltered. The main conservation interest on the island is around the north and south cliffs and adjacent grassy slopes which house the main seabird colonies. The Stewart Island vole, common shrews and rabbits are also present.

1.1.2 Dull Island

Dull Island (38ha) lies 300m off the north coast of Farnuff, situated 3.9km from Lewis (Figure 1). It is not within rodent swimming distance of any other island. It is mostly a low-lying island, although it rises to around 48m to the west. It is predominated by grasses with some scrubby patches in sheltered areas. It is uninhabited, but has two small landing sites and three buildings – a bothy and two smaller buildings used as stores/shelter by fishermen. The cliffs are not sheer here and are largely vegetated. There are no known species of conservation interest on the island, although it is home to a small colony of seabirds predominated by gulls. Common shrews and introduced brown rats are the only mammal species present.

Both Farnuff and Dull islands are privately owned by the Clipper family.

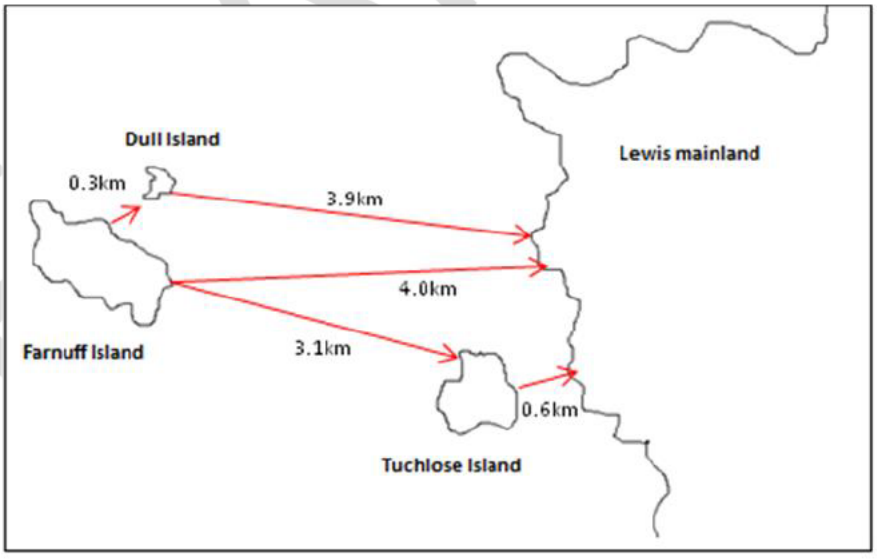

Figure 1: Map showing position of islands within the Stewart Islands group and their distances from each other and the Isle of Lewis, which are beyond the known swimming distances for brown rat.

A detailed description of the site can be found in the accompanying Feasibility Study (*would add reference here*) and Project Plan (*would add reference here*).

2 RISK SPECIES

The risk species covered in this Biosecurity Plan are non-native rodent species which pose an incursion risk to Farnuff and Dull islands. Non-native rodent species are likely to have severe impacts on the endemic and native fauna and flora of the islands and each species is covered separately below (Sections 2.1 to 2.3). The distance between Farnuff and Dull and the neighbouring islands in the Outer Hebrides is shown in Figure 1. An assessment of rodent species' invasive potential and impacts is given in Table 2, classification details of impact severity are given in Table 1 and a summary of their ecology and behaviour is given in Table 2.

Incursion risk has been classified as either 'High' where the number of potential pathways onto Farnuff and Dull for a species is five or higher or 'Low' where the number of pathways is less than five (or in the case of black rats related to the limited distribution range of this species within the UK). A pathway is the route or method in which an invasive species moves from one location to another.

Rodents are generally classified as high risk as they are able to exploit many ways of reaching offshore islands, e.g. swimming, being transported by boat or within freight and bulk supplies. Impact speed has been classified as 'Rapid', 'Moderate' or 'Slow'. Rapid impacts can potentially cause effects within weeks or months of incursion, moderate impacts within two years after incursion and slow impacts more than two years after incursion.

Table 1: The potential biosecurity risk species and assessment of impact severity if these species were to (re)invade Farnuff and Dull islands.

Invasive species	Incursion risk	Incursion speed	Impact severity	Description of possible impacts
Brown rat	High	Rapid	Critical	• Decline and loss of native vertebrates, invertebrates and plants through predation and competition • Potential transmitter of disease to community and visitors leading to a loss in tourism and recreation value
Black rat	Low (due to limited range in the UK)	Rapid	Critical	• Decline and loss of native vertebrates, invertebrates and plants through predation and competition • Potential transmitter of disease to community and visitors leading to a loss in tourism and recreation value
House mouse	High	Rapid	Moderate	• Decline and loss of native invertebrates through predation and competition • Competition for food and nesting sites with endemic Stewart Island vole and native shrew

Impact severity has been based upon the Pacific Invasives Initiatives classification (PII, 2011) and is summarised in Table 2. Biodiversity impacts are based on the number and type of native species (vertebrate, invertebrate or plant) or conservation status of the native species effected (particularly species of significance) and how many or widespread the impact is. Economic impacts are based on tourism, agriculture or horticulture features on the islands. Cultural impacts are based on residential, archaeological or historic sites on Farnuff and Dull.

Incursions by brown rats or black rats would be 'Critical', but house mouse or wood mouse incursion would be 'Moderate' as mice are believed to have fewer impacts on archaeological features and native species such as birds and other mammals.

Table 2: The Impact Severity criteria used for the assessment in Table 1, based on the Pacific Invasives Initiative's classification (PII, 2011).

Impact category	**Explanation of severity of impact: Feature on Farnuff and Dull islands**		
	Biodiversity	**Economic**	**Cultural**
Critical	Loss of a threatened species from the island	No income from tourism, and/ or high costs in management.	Extinction or permanent destruction of cultural value.
High	Loss of at least one native species from island.	Loss of major crops, income from tourists, or high control costs.	Major degradation of cultural significance.
Moderate	Decline in populations of many native species.	Decrease in tourism Continued costs in managing rodents	Degradation of residential, archaeological or historic features
Low	Decline in population of at least one species	Small decrease in tourism	Small changes in abundance of culturally significant native species or quality of an area on the island.

2.1 Brown rats *Rattus norvegicus*

The brown rat *Rattus norvegicus* is a highly omnivorous species known to impact on a wide range of species including birds, mammals, invertebrates and plants. Native to central Asia it has been expanding rapidly from its native range over the last three hundred years and is now found on all continents except Antarctica. Invasive species in the genus *Rattus* are found on 82% of the world's island groups (Atkinson 1985) and are having a disproportionately severe ecological impact on island species, many of which have evolved in the absence of terrestrial predators (Towns *et al.* 2006). Adult brown rats are relatively large (up to 275mm without tail), with a stout body, heavy tail and small ears. Although brown rats have been recorded weighing up to 600g in the UK, the average weight is 450g; with males larger than females (Perry 1945, Cunningham & Moors 1996, King 1990, Novak 1999). Brown rats usually have a grey belly with a brown back, with long black guard hairs (Novak 1999). When males mature, they have prominent scrotum at the base of the tail and only breeding females have visible nipples (King 1990, Novak 1999). See Tables 3 & 4 for a summary of the key features of brown rats.

2.2 Black rats *Rattus rattus*

The black rat *Rattus rattus* is a highly omnivorous species known to impact on a wide range of species including birds, mammals, invertebrates and plants. Originally from India, black rats are found throughout the world (Novak 1999). They are relatively large (up to 230mm without tail), with a slender body, long scaly tail, large ears and dark hairy feet and weigh up to 300g (King 1990, Cunningham & Moor 1996, Novak 1999). There are three colour phases; *rattus* (black back and dark grey belly), *alexandrinus* (brown back and pale grey belly) and *frugivorus* (brown back and white or cream belly) (King 1990, Cunningham & Moors 1996). The proportion of colour phases can vary depending on the location, although *frugivorus* is usually the most common colour phase (King 1990, Cunningham & Moor 1996). Black rats are rare and localised in the UK, however, due to their association with ships (another common name for them is the ship rat) it is possible that they could be present on ships travelling to the UK from places where black rats are more common, and therefore there is an ongoing biosecurity risk. See Table 3 & 4 for a summary of the key features of black rats.

2.3 House mouse *Mus domesticus*

The house mouse (*Mus domesticus*) originated from Asia (Nowak 1999). Formerly considered to be one variable species, following taxonomic examination several species are now recognised (Boursot *et al.* 1996, Nowak 1999). Two of these species are highly commensal (*Mus musculus* and *Mus domesticus*) and have been spread throughout the world, but only *Mus domesticus* is thought to be present in western Europe (King 1990, Boursot *et al.* 1996, Nowak 1999, Harris & Yalden 2008). House mice are small, 70-90 mm long, have long tails, large eyes and round ears and only weigh 10-25 g, with no significant difference in size between males and female (Lawrence & Brown 1974, King 1990, Nowak 1999, Harris & Yalden 2008). They are a dull brownish grey colour, with a grey, brown or white belly (Lawrence & Brown 1974, King 1990, Nowak 1999, Harris & Yalden 2008). Mice feet are uniformly grey on the top side, which can be used in combination with ear size and foot size to distinguish them from juvenile rats (King 1990, Nowak 1999, Harris & Yalden 2008). See Tables 3 & 4 for a summary of the key features of house mice.

Table 3: Key features of risk rodent species in the UK (from Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017)).

	Brown rat	Black rat	House mouse
Senses	Acute smell, touch and hearing	Acute smell, taste, touch and hearing	Acute sight, smell and hearing: Large eyes (but smaller than wood mouse)
Habitat preference	Associated with water (but live in range of habitats). Move along edges of structures, rather than out in the open	Associated with forests and vegetated areas (but live in range of habitats): tracks and runs on the ground are common despite arboreal preferences	Full range of habitats (commonly associated with humans)
Swimming ability	Excellent swimmers up to 4 km	Known to swim up to 750m	Excellent swimmers up to 500 m
Climbing ability	Agile (but less so than black rats) Can jump up to 1m	Incredibly and often unbelievably agile (and skilful) – can jump up to 1m	Agile and can jump up to 0.5m
Activity	Predominately nocturnal – may be seen in day	Predominately nocturnal – but can be seen in day	Predominately nocturnal – but often seen in day, esp. in summer
Behaviour	Neophobic (wary of new things)	Neophobic (but less so than brown rats)	Neophilic (investigate new things)
Breeding habitat	Extensive burrow nesters	Nest in trees or under vegetation	Burrow and cavity nesters (wood piles, banks, buildings)
Nesting materials	Grass, human materials (e.g. newspaper, cardboard), leaves, feathers	Usually vegetation (twigs, leaves) or feathers, but can use paper/card	Vegetation, feathers, human materials (e.g. newspaper)
Approximate life span	12 to 24 months	12 to 18 months	12 to 18 months
Approximate home range	0.1 to 3 ha depending on food availability/ habitat quality	0.1 to 1 ha depending on food availability/ habitat quality	0.5 to 2.5 ha
Feeding	Often cache food in burrows. Omnivorous, opportunistic. Eat 30g/day	Often cache food. Eat 15g/day	Omnivorous, opportunistic. Do not need a water source.
Breeding cycle	Can breed all year round	Can breed all year round	Can breed all year round
Gestation Weaning & Sexual maturity	24 days 28 days 2-3 months	20-22 days 21-28 days 3 months	19-21 days 20-23 days 6-8 weeks
Number of young	3-10 (usually 6-8)	3-10 (usually 5-6)	2-12 (usually 6-8)
Other	Small groups live in colonies: young males evicted as they mature or when the colony becomes overcrowded	Do not live in colonies (unless in urban areas): prefer to disperse throughout the available area	Can be found in environments with no water (obtain water requirements from food)

Table 4: The identifying features of the key risk species in the UK (from Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017)).

	Brown Rat ***Rattus norvegicus***	**Black Rat** ***Rattus rattus***	**House mouse** ***Mus musculus***
Tail	Heavy short tail: no longer than head-body Pale underside	Long scaly tail ≤ 250mm: no shorter than head-body Uniform colour	Long tail, 50-100mm: similar to head-body length Uniform colour
Ears	Small ears: do not cover eyes 14-22mm Obvious hairs extend beyond edge of ear	Large ears: cover eyes when pulled down 19-26mm Fine hairs do not extend beyond edge of ear	Large, round ears 12-15mm
Hind feet	Pale 30-42mm long	Dark, hairy 28-38mm long	Small, thin, grey 15-19mm long
Body & head-body length	Long, stout body Up to 275mm	Long, slender body Up to 230mm	Slender body 70-100mm
Average weight	450g (can be up to 600g)	Up to 350g	10-25g
Colouration	Brown back with long, dark guard hairs Pale grey belly	**Three colour morphs** ***rattus:*** black back, dark grey belly ***alexandrinus:*** brown back, pale grey belly ***frugivorous:*** brown back, white or cream belly	Dull brownish grey back Grey, brown or white belly
Nipples	12	10-12, usually 10	10-12

3 PATHWAYS

A 'pathway' is the route or method by which a rodent species moves from one location to another. The most effective way of minimising introduction risks is to identify the invasion pathways and to establish barriers or protocols with the aim of preventing the introduction as far back along the introduction pathway as possible. There are a number of pathways by which invasive species can reach Farnuff and Dull, including swimming, accidental transport by boats or tourists and deliberate introduction.

Pathways are categorised High Risk, Moderate Risk or Low Risk based upon frequency of movement between islands, likelihood of transporting rodents and exposure to source populations. Pathways with a High Risk ranking should be considered as requiring close attention and vigilance. The categorisation of each pathway, description of pathways to Farnuff and Dull and the risk ranking and the relative level of risk for each pathway are shown in Tables 5 and 6. Further details regarding each pathway and possible incursion point is covered separately in Section 3.1 to 3.12.

Table 5: Risk categorisation of invasive species pathways to Farnuff & Dull.

Category	Definition
High risk	Movement between islands occurs frequently. Originates from an area with known and abundant rat or mice populations. Likely to provide an attractive mode of transport for rats or mice.
Moderate risk	Movement between islands occurs often (but less frequently than in cases of High Risk pathways). Originates from an area with known rat or mice populations. Possibly provides an attractive mode of transport for rats or mice.
Low risk	Movement between islands rarely occurs. Originates from an area with few, if any, rat or mice populations. Unlikely to provide attractive mode of transport for rats or mice.

The accidental (re)introduction of rodents to an island may occur at a number of sites such as quays, beaches and aircraft landing sites. The possible incursion points on Farnuff and Dull have been identified as Farnuff Quay, east coast of Farnuff and south west coast of Dull *(Figure 2 – this would be an annotated satellite image*).

Other potential pathways, particularly boats and associated transport activities or swimming or floating on debris from neighbouring islands are also shown in Figure 2 *(note: this would be an annotated satellite image*. It should be recognised that the risk from shipwrecks is high and any part of the islands' coast could be a potential incursion location.

Table 6: Pathway and risk ranking, based on Table 3, to an invasive species incursion on Farnuff and Dull.

Pathway	Risk rank	Invasive species
Small/medium vessels	High	Brown rat; house mouse
Farm supplies (i.e. stock feed/bedding)	High	Brown rat; house mouse
Bulk food supplies	High	Brown rat; house mouse
Shipwrecks	Moderate	Brown rat; black rat; house mouse
Bulk equipment and building supplies	Moderate	Brown rat; house mouse
Private yachts	Moderate	Brown rat; black rat; house mouse
Residents' private boats	Moderate	Brown rat; house mouse
Overnight visitors	Moderate	Brown rat; house mouse
Residents' private supplies	Moderate	Brown rat; house mouse
Day visitors	Low	Brown rat; house mouse
Cruise ships	Low	Brown rat; house mouse
Swimming from nearby islands	Low	Brown rat; house mouse
Storm enhanced dispersal (rafting/floating on debris)	Low	Brown rat; house mouse
Deliberate release by public	Low	Brown rat; black rat; house mouse

Would include an aerial map here

3.1 Small/medium service vessels

Rats and mice are the most commonly transported invasive mammals using boats or tourist or cargo transport (Atkinson 1985, Pocock *et al*. 2005). The CalMac ferry *Lady Campbell* and the MV *Alastair* have the greatest chance of bringing a rat or mouse to Farnuff. The ferry visits three times per week from Lewis, bringing passengers and light cargo and remains moored at Farnuff Quay for between 1-3 hs, depending on the schedule. The MV *Alastair* is the main inter-island freight transport vessel and makes weekly scheduled visits from Lewis bringing bulk stores and supplies and removing waste. It only very briefly moors (usually 30-45 minutes) on Farnuff quay when loading and unloading. There are known to be brown rats at the Quay on Lewis. Generally bulk supplies and goods are transferred on the day they arrive which reduces the chance of rodents stowing away. Neither vessel moors overnight on Farnuff.

3.2 Farm supplies (i.e. stock feed/bedding)

Farm supplies, such as hay and sacks of grain, seeds and stock feed, provide rodents with a great opportunity to stow away to the islands. As these are attractive foods for rodents, and are generally stored in places which harbour rodents prior to being shipped to the islands, special care must be taken to prevent access.

3.3 Bulk food supplies

Food purchased on the same day it is brought to Farnuff poses little risk. However when food is purchased in large amounts and is stored before going onto the islands, the risk increases.

3.4 Shipwrecks

Although shipwrecks are less common with modern navigational equipment, they still occur occasionally. Rats and mice are the likely invasive species that could reach an island via this method as they are the most commonly occurring 'stowaway' on vessels.

3.5 Bulk equipment and building supplies

Farnuff has a resident community with farming and tourist enterprises which provide high risk opportunities for the accidental introduction of rodents. Equipment, particularly boxes, can harbour small rodents (particularly mice). Rodents can become trapped when a box or bulk bag is closed after being left open for long periods.

Rodents can also live in camping equipment (such as tents or bedding) that has been stored for extended periods. The risk of rodents stowing away is reduced if the equipment is well packed and does not contain food stuff or suitable nesting material. The risk increases if the equipment is loosely packed and/or stored on the mainland (or other high risk site) for extended periods.

3.6 Private yachts

There is a mooring area to the east of Farnuff where approximately 200 yachts moor per year (G. Ransome, pers. comm.). Most private yachts and other vessels do not use the Farnuff quay, but close anchorage to the island can also be a risk. Summer is the period of highest risk as this is when the most vessels visit the area. Risk increases if any yacht has come directly to the Stewart Islands from a high-risk overseas location.

3.7 Residents private boats

Several residents' own boats which are moored off Farnuff throughout the year. The greatest risk of accidental introduction of rodents is from Lewis. The risk from any vessel increases if they are moored against quays overnight, moored close to shore or bought onto shore (for maintenance or repairs), if they have food (e.g. bait, groceries, etc.), bedding material (e.g. hay, paper, etc.) or equipment (e.g. fishing or camping equipment, boxes, bags, etc.) on board or if they have places where rodents can hide such as closed cabins or holds.

3.8 Overnight visitors

Farnuff attracts small-scale tourism, with a small campsite and two holiday lets. Overnight visitors to Farnuff represent a risk to biosecurity, but the level of risk depends on the length of time staying on the island and what they choose to bring with them. Bags of personal clothing and equipment are possible routes for rodents to reach Farnuff and Dull and although the risk is low, it increases if the bags have been stored for extended periods or left open and unattended in high-risk locations (such as on quays or farms).

3.9 Residents' private supplies

The Farnuff community provide moderate risk opportunities for the accidental introduction of rodents. The purchase of food, equipment and other supplies, particularly transported in boxes, can harbour small rodents (particularly mice). Food purchased on Lewis on the same day it is brought to Farnuff poses little risk. The risk increases when boxes or bags are unattended or stored in high-risk areas, such as on the quay on Lewis.

3.10 Day visitors

People visiting Farnuff for a day trip represent a low risk of accidentally bringing a rodent ashore. Day visitors generally have small bags containing little food, and bags are usually packed on the same day they visit the island.

3.11 Cruise ships

Approximately 50 cruise ships visit the Outer Hebrides per year with some passengers visiting Farnuff. Although the biosecurity risk from these vessels is lower than from freight vessels, cruise ships still provide a pathway for rodents to reach the islands, particularly if they have come directly from high risk locations on the mainland or overseas.

3.12 Swimming from nearby islands

Farnuff and Dull are separated from Lewis by relatively large stretches of water. The closest point on Farnuff is 3.1 km away from Tuchlose (to the closest stepping stone), or 4 km from shore to shore (Figure 1). Dull island is 3.9 km from Lewis. Scientific opinion suggests that only islands that are separated by over 2 km of open water are safe from incursion by rats (Russell *et al.* 2008). However strong currents, current direction, cold water temperatures and marine predators reduce the chances of rats surviving long distance swims (Russell *et al.* 2008). Male rats are more likely to swim than females (King 1990, Russell *et al.* 2008).

Mice can swim (Evans *et al.* 1978, King 1990, Nowak 1999), but although many studies have shown that the mice can tolerate up to 3 hours of continuous swimming, food, body condition, water temperature and current can affect orientation, movement and general swimming abilities (Dawson & Horrath 1970, Dohm *et al.* 1996, Ershoft 1954). It appears that house mice do not swim as a method of dispersing to islands as all recorded house mouse incursions have been via transport of stores and equipment (Taylor 1978, Russell & Clout 2005). The maximum recorded swimming distance for mice is 500 m (Duncan *et al.* 2008).The channel between Farnuff and Dull and Lewis is deep with a strong current (G. Ransome, pers. comm.) which reduces the risk of both rats and mice swimming across. There is also a wide range of habitats and food sources on Lewis and the pressure to disperse from that island is likely to be smaller than the other off-islands.

3.13 Storm enhanced dispersal (rafting/floating on debris)

Storms often carry debris washed from land (i.e. mainland UK or adjacent islands) directly into the sea or via river estuaries. Debris can form rafts that can hold rodents, particularly those with the ability to swim long distances. Although this is a low risk to Farnuff and Dull, there may be situations when this may occur.

3.14 Deliberate release by public

This is the least likely pathway, but is always a possibility if the wider community (or someone from mainland UK) do not understand the conservation importance of Farnuff and Dull, and the social and economic enhancement following the rat removal for the community.

4 PREVENTION

Prevention is critical to the strategy of maintaining the biosecurity of Farnuff and Dull and there are a number of measures that can be implemented to reduce the risk of rodents reaching the islands (see Sections 4.2.1-4.2.9). These measures should be practiced by the local community and other stakeholders living on, visiting or managing projects on the islands. Precautions need to be taken not only in obvious situations, but also when the risk may be mistakenly thought to be negligible. The measures outlined below are designed to reduce to a minimum the risk of rodents being accidentally introduced, without being too much of a hindrance to the local community, ongoing projects and visitors.

A biosecurity log and a biosecurity checklist for quarantine measures are included in Appendices 1 and 2. Biosecurity practices, information brochures and equipment from other islands (such as New Zealand, St Kilda, Lundy Island, Isle of Canna, etc.) may be able to be adapted for use on Farnuff and Dull.

4.1 Stakeholders

There are a range of stakeholders involved on Farnuff and Dull (e.g. local community, the Seabird Conservation Trust, Wildlife Conservation Agency, the Clipper family etc.) who can assist in ensuring the biosecurity of Farnuff and Dull. Their involvement is covered in Sections 4.1.1 to 4.1.7 and summarised in Table 7. Most agencies and interest groups in Lewis and Farnuff have committed to meeting their obligations in regards to biosecurity for Farnuff and Dull, and the partnership team will work closely with them to ensure they have the support, equipment, information and training to complete their responsibilities.

Table 7: The stakeholders and their roles in the biosecurity of Farnuff and Dull.

Stakeholder	Role in the biosecurity of Farnuff and Dull
Farnuff community	Check goods coming to island Store stock feed in rodent-proof containers Advise visitors on rat- and mouse-free status Maintain good waste management procedures Maintain permanent monitoring stations Remain vigilant for incursions Report sightings rapidly Assist with incursion response
Local boating company	Check goods coming to island Advise visitors on rat- and mouse-free status Maintain bait stations on board all vessels Report sightings rapidly
Private yachts and other vessels	Check vessels before reaching island Check goods coming ashore or use rodent-proof containers Moor offshore Inform passengers of rat- and mouse-free status Ensure good waste management procedures Report sightings rapidly
Project personnel	Advise visitors on rat- and mouse-free status Consultation with Farnuff community Consultation with off-island and St Mary's communities Check goods coming to islands or use rodent-proof containers

	Maintain permanent monitoring stations Remain vigilant for incursions Management of incursion response (interviews, site inspections, establishment of monitoring/baiting grids) Data management Training of local community, volunteers and other agencies in biosecurity measures and protocols
The Clipper family	Advise visitors and visiting yachts on rat- and mouse-free status Maintain bait stations on island quays Provide waste management options for visiting yachts Provide adequate signage and publicity Report sightings rapidly
Other conservation agencies	Advise visitors on rat- and mouse-free status Check goods coming to islands or use rodent-proof containers Maintain good waste management procedures Maintain permanent monitoring stations Assist with incursion response Remain vigilant for incursions Report sightings rapidly
Visitors	Check luggage and goods coming to islands or use rodentproof containers Pack on day of travel Maintain good waste management procedures Report sightings rapidly

4.1.1 Farnuff community

The local residents on Farnuff have the greatest role to play in biosecurity and prevention. They are the 'eyes and ears' of the project and will be able to assist with the reporting of any sightings and rapid response in the event of an incursion. They will also be able to provide on the spot information to visitors, particularly those who stay in guest accommodation on the islands.

Movement of bulk supplies and food will need to be managed, moved in rodent-proof containers where possible and the items checked as they reach the islands. Waste management systems have been established (rodent-proof wheelie bins and compost bins) and will need to be maintained by the residents long-term.

It is important that the Farnuff community remain vigilant and that they continue to support and maintain ownership of the project and are involved in all aspects of the long-term biosecurity of the islands.

4.1.2 Local boating company

As the main boat operators on Farnuff, both CalMac and the local-authority operated MV *Alastair* have a vital role in the on-going biosecurity of the islands; their procedures to prevent rodents reaching Farnuff and Dull should include maintaining bait stations on their vessels, advising visitors on the rat- and mouse-free status of Farnuff and Dull including providing newsletters and project pamphlets, reporting sightings and other comments from visitors and assisting with rapid response in the event of an incursion.

4.1.3 Private yachts and other vessels

Visiting yachts, fishing boats and other vessels should be advised of the rat-free status of Farnuff and Dull and be given information on simple quarantine measures to prevent the accidental introduction of non-native rodents. Where possible, they should be asked to carry bait stations and undertake a thorough search for rodents and to moor offshore whenever possible (especially overnight). Any waste should be disposed of at a suitable waste collection point (or preferably removed from Farnuff and Dull). Where possible, supplies should be packed and stored in rodent-proof containers.

Advertisements or articles could be provided for sailing magazines or talks given to the appropriate groups regarding the islands' rat- and mouse-free status.

4.1.4 Project personnel

The project personnel have ongoing responsibility to maintain the biosecurity programme on Farnuff and Dull and to raise awareness about the project and requirements to keep the islands rat- and mouse-free. The maintenance of permanent bait stations, storage and transport of equipment in rodent-proof containers, on-going consultation with the community, provision of visitor interpretation material on the rat- and mouse-free status of Farnuff and Dull, management of sightings (including data entry and analysis), training of volunteers in biosecurity methods and rapid response in the event of an incursion will be their responsibility.

4.1.5 The Clipper family

As the landowner, the Clipper family should assist with the on-going biosecurity of Farnuff and Dull by providing adequate signage and publicity material, advising visitors and visiting yachts on the rat- and mouse-free status of Farnuff and Dull, maintaining bait stations on each of the other islands' quays and providing waste management options for visiting yachts.

4.1.6 Other conservation agencies

As research and conservation agencies with an interest in Farnuff and Dull, the Seabird Conservation Trust and the Wildlife Conservation Agency can contribute to the on-going biosecurity of Farnuff and Dull by assisting with the maintenance of the permanent monitoring stations, transporting and storing equipment and food in rodent-proof containers, advising visitors on the rat- and mouse-free status of Farnuff and Dull, recording and reporting sightings, training volunteers in biosecurity methods and rapid response in the event of an incursion. All equipment should be checked before taking to Farnuff and Dull.

It is important that all these agencies have excellent preventative measures to avoid accidental introductions of rodents and should lead by example (e.g. all gear and food should be in rodent-proof containers). Staff members that visit Farnuff and Dull often should have regular training in biosecurity (particularly in surveillance and response). One staff member on each trip should be responsible for ensuring all biosecurity measures have been implemented and followed by the rest of the team; an island biosecurity information sheet outlining the quarantine procedures should be used to ensure everything is covered (Appendix 2).

4.1.7 Visitors

Tourists visiting Farnuff and Dull pose a serious risk to biosecurity primarily due to the number of trips per year. Generally they do not carry large amounts of gear or food, but all visitors to Farnuff and Dull should be given an information brochure when they receive their information pack and tickets to the islands. This brochure should detail the rat- and mouse-free status of the islands and outline simple biosecurity procedures and what they can do to help. The best way for people to reduce the risk of a rodent stowing away in their gear is to pack on the day of travel, even if this involves re-packing if the

journey time is longer than one day. It is important that visitors are told how to report any sightings of non-native rodents and are informed of any ongoing events and updates from the project.

It is also important to encourage visitors to remove all rubbish and leftover food from Farnuff and Dull as this will make surveillance difficult in any event of an incursion by providing another food source.

4.2 Prevention measures

Measures to prevent risk species getting onto Farnuff and Dull should be practiced by all stakeholders. Prevention measures need to be implemented before reaching Farnuff and Dull, on boats servicing or visiting the islands, on Farnuff and Dull themselves and on arrival back on Lewis. Details of prevention measures for Farnuff and Dull are listed in Table 8.

Preventative measures before departure focus on quarantining bags and equipment (i.e. checking for rodents). On service or visitor boats and on the islands, prevention focuses on vigilance, detection and removal of risk species. Back on the mainland (or neighbouring islands), on-going prevention measures target the relevant communities, boats, quays and storage areas to reduce their attractiveness to risk species. Local residents from Farnuff and Dull and local staff from the UKSCT and SWCA and other stakeholders will be trained by the Project Manager in biosecurity protocols to assist with the on-going biosecurity requirements (including prevention, surveillance and incursion response). This is particularly important for the long-term biosecurity of Farnuff and Dull as on-going checks will be undertaken by the community and these agencies; **vigilance is key**.

Data collection and management is important (particularly if incursions are detected and subsequently removed); all sightings and other rodent-related observations should be recorded and investigated.

Periodic audits and training exercises and on-going monitoring of these biosecurity (and quarantine & contingency) measures should be completed as it is common for people and agencies to become complacent and let standards drop. It is important that all involved (i.e. Farnuff community, project personnel, SWCA staff, commercial operators and relevant agencies) realise that biosecurity is a long-term ongoing commitment.

4.2.1 Quarantine kit for contingency response on Farnuff

The SWCA will maintain a quarantine store for equipment required to manage an incursion response. This will include bait stations, monitoring stations, monitoring tools (chocolate wax, coconut wax, peanut wax, soap and tracking tunnels). Full details can be found in Section 7. Currently the bulk of the equipment will be stored in the Clipper family shed at Dairy Farm. Boxes should be clearly labelled with the content details. Regular checks of the equipment should be completed by the relevant research group or agency.

Table 8: The prevention measures that can be implemented prior to departure for, en route to and following arrival at Farnuff and Dull.

Implementation time	Prevention measure
Prior to departure from the mainland (and/or neighbouring islands)	• Empty, check and repack items into storage containers (especially important when items have been packed and stored for extended periods) • Purchase food and store in clean, sealed rodent-proof containers (or purchase on Farnuff) • Wherever possible, transport food and equipment in sealed, rodent-proof containers • Ensure all personnel, including transport providers, are aware that Farnuff and Dull are rat- and mouse-free

On Lewis	• Maintain bait stations on the quay on Lewis • Maintain bait stations in any storage areas on the quays
On the boat	• Check the boat for rodent sign (if a rodent is found, return to port of origin, do not continue to Farnuff and Dull, attempt to catch and kill the rodent and then thoroughly search the vessel before proceeding to Farnuff and Dull; report the incident) • Ensure a bait station is on-board • Ensure information pamphlets are available to all people on the vessel
On Farnuff and Dull	• Be vigilant • Ensure incursion kit is up-to-date and easily available • Ensure bait is in the container at the Farnuff quay (and product is in-date and registered for use in open areas) • Ensure a quarantine space is available for checking damaged or suspicious goods • Keep the quay as clean as possible • Maintain the permanent monitoring stations • Do not leave any food (even biodegradable items) outside on the islands • Dispose of all waste in correct bins or remove from the islands • Ensure all residents know who to report rodent sightings to and what to ask if a visitor reports seeing a rat. see Appendix 5 • Report any rodent sightings to the relevant person (provide contact details and information sheet) • Do not deliberately release any non-native rodents on the islands
On return to mainland (and/or neighbouring islands)	• Do not leave any food or waste near the quay or storage area • Maintain bait stations at the quay or equipment storage area
Training	• Provide regular training sessions for all personnel and local residents in prevention and incursion response protocols • Ensure all personnel know the location of the quarantine contingency kit • Ensure all personnel are aware of interview and site inspection protocols

4.2.2 Storage room for bulk biosecurity and research equipment

In addition to biosecurity work and on-going rodent removal projects on the uninhabited islands, stakeholders such as UKSCT and SWCA undertake a range of research projects on Farnuff and Dull. As such, different items of equipment are used throughout the year. A store room for biosecurity and research should be established on Lewis; the most suitable location is at the UKSCT office in Lewis.

This store room should be well lit, have adequate storage (preferably on shelves with little or no equipment on the floor), preferably be rodent-proof and have regular control checks. This office is an excellent space to store the biosecurity and research equipment, and to check, prepare and pack for island visits. A full list of all equipment stored in this space should be generated and regular checks of the equipment should be completed. No rubbish or food should be stored in or near this storage room. Rodent control should be maintained within and around the store.

4.2.3 Permanent stations and rodent motels on Farnuff and Dull

A series of permanent stations have been established around the coastline of both Farnuff and Dull and other high risk areas (e.g. selected farm buildings, seabird colonies, etc.); stations are approximately 100 metres apart, but closer in high risk areas *(Figure 5 – would be an annotated aerial map)*.

These permanent stations are lockable Protecta™ stations secured to the ground by three tent pegs and in certain locations, also wired to trees or fence posts (Figure 6).

Figure 6: The design of permanent stations on Farnuff and Dull (Photo credit: WMIL©)

Each station has a rock on the top to hold it securely in place. Different monitoring tools (chocolate, coconut or peanut wax or soap) are wired inside these stations to detect any rodent incursion. These stations will be checked every four weeks. Three additional permanent stations have been established at the Farnuff quay (two at the waste management site) and will be maintained weekly by a local resident as part of the waste management programme.

Rodent motels have been placed at four sites: the waste management site at the top of the quay, near the beach on the south coast of Furnuff and south west coast of Dull both and the shop on Farnuff. A rodent motel is a wooden station that is used to provide an alternative habitat for a rodent if it reaches the island (Figure 7). Each rodent motel has been placed on a level spot and a rock has been placed on top to hold the lid securely.

Figure 7: A rodent motel on Farnuff (Photo credit: WMIL©).

4.2.4 Permanent bait stations on Lewis

Permanent bait stations will be established in the cargo storage shed on the quay on Lewis. These will be checked every week by the Harbour Master, who has now completed the necessary one-day course in safe rodenticide handing required to use products sold for professional use. These will be the same design as those established on Farnuff and Dull.

4.2.5 Checks of high risk freight items and bulk equipment or food

High-risk items such as stock feed and bedding should be inspected on the day of shipping either on the mainland or on arrival on Farnuff; rodent sign/damage is highly visible and, with care, can be easily detected. If sign is detected; these items should be very thoroughly checked to ensure rodents are not accidentally transported to Farnuff and Dull.

Nothing suspected of containing rodents should be transported to the islands. Heavy equipment and bulk building supplies are shipped occasionally to Farnuff and Dull. Any movement of these items increases the risk of rodents gaining access to the islands. Splitting or breaking down bulk supplies when delivered to Lewis for shipping across to Farnuff on the MV *Alastair* would greatly reduce this risk as any rodent hiding amongst the goods would be discovered, and transferring bulk supplies and goods transferred on the day they arrive also reduces the chance of rodents stowing away. The delivery of freight by the MV *Alastair* enables effective quarantine measures to be put in place as the residents manage the incoming goods. Local residents should check freight for rodent damage on arrival at the Farnuff Quay; any damaged boxes should be opened and checked to ensure they don't harbour rodents before transporting further onto the island.

Transportation of stock feed and hay to Farnuff increases the risk of an accidental introduction of rodents; it must be checked for sign as soon as it arrives at the quay. All stock feed and hay suppliers should be informed of the rat- and mouse-free status of Farnuff and Dull and asked to be vigilant in regards to the products being sent to Farnuff and Dull and if possible, maintaining rodent control at their location on the mainland (to reduce the risk of rodents burrowing into the hay and being transported). Alternative rodent-proof packaging should be used whenever possible.

Shipments of hay and bulk stock feed should be checked on Farnuff quay; they should be unloaded at the bottom of the quay while one person stands higher up the quay to check for and, if possible, intercept any rodent. If any rodent escapes onto the island, traps and bait stations should be

established at the quay and surrounding area to target the rodent. Long-term storage of stock feed and other grain on the farms on Farnuff should continue to be in rodent-proof containers. This will help restrict access by rodents to any alternative food if an incursion occurs. Permanent monitoring stations should be maintained in or very close to high-risk areas (such as where stock feed is being stored) on the farms. These should contain non-toxic wax monitoring blocks as standard, but they should be switched immediately to rodenticide blocks if any known or suspected incursion of non-native rodents occurs (see sections

Any equipment (for personal use such as camping equipment, or for research) that has been stored long-term on Lewis, or on the mainland that is to be transported to Farnuff and Dull should be opened and checked for the presence of rodents before being taken the islands. Any food stored overnight or longer should be inspected before transit to Farnuff and Dull.

4.2.6 Medium/small service vessels

The CalMac ferry *Lady Campbell* and the local authority-operated MV *Alastair* should have permanent bait and monitoring stations maintained on-board and these should be serviced regularly (weekly). A designated crew member should be responsible for the maintenance of these bait and monitoring stations. This crew member should receive appropriate training in the safe use of rodenticides and identification of rodents prior to commencing this role and have regular refresher training opportunities.

4.2.7 Waste management

It is important that high standards of waste management are maintained on Farnuff and Dull. Currently the local community store all household waste in rodent-proof rubbish bins (or wheelie bins) before transportation to the waste collection site at the quay. Waste is only taken to the quay on the weekend. On Monday, this waste is then transported by the MV *Alastair* to Lewis for disposal. This system works very well and means all waste on the islands is unavailable to rodents.

It is important to inform people to dispose of waste in the correct locations or take their rubbish with them.

4.2.8 Communication and education

Educating the public about the threat of non-native rodent incursion onto Farnuff and Dull is a high priority. Education includes the priority messages to communicate, the media with which to communicate them, and assessing the impact of those messages on the target audiences.

It is important to focus on the priority messages such as impacts of non-native rodents, pathways for rodent incursions, measures people can implement to reduce the risk of rodent incursions and the importance of vigilance and reporting sightings of non-native rodents (or anything unusual on Farnuff and Dull).

Various media can be used to disseminate these biosecurity messages including signage at boat departure points, on-site arrival points, on the *Lady Campbell* and MV *Alastair*; information pamphlets for tourists and tour operators; presentations to stakeholders and other interest groups and the use of television, newspaper and radio to reach the wider public. Questionnaires could be used to assess changes in public attitudes and behaviour.

It is important that regular contact with project personnel and Farnuff and Dull residents is maintained. This should be the responsibility of the Project Manager.

Project personnel and stakeholders should continue to promote the ecological value of Farnuff and Dull and the species present on these islands in all media sources (local and international) and reinforce the message that biosecurity is vital to protect and maintain those values.

4.2.9 Information leaflets

Many islands around the world are rodent-free and, in many cases, visitors are provided with information sheets and checklists to help prevent the accidental introduction of non-native rodents and other pests. Similar information leaflets could be included when ferry tickets are purchased. These leaflets would outline the rodent-free status of Farnuff and Dull, best practices for preventing rodent introductions and detail how members of the public can assist.

An information pamphlet that outlines the rat- and mouse-free status of Farnuff and Dull is very important; this should be available to all residents, visitors, service and private vessels, research expeditions, agencies that regularly visit the islands, boat and dive clubs and any other parties that may visit Farnuff and Dull.

The information pamphlet should contain the following information: Farnuff and Dull's rat- and mouse-free status, the reasons for the rat removal project and its benefits, the importance of remaining free of non-native rodents, an explanation of the permanent monitoring stations, quarantine measures, the importance of vigilance and the procedures for reporting rat or mouse sightings or sign. This information should be added to the project signage on Farnuff and Dull, the tourist information office on Lewis, the quay waiting room on Lewis, the *Lady Campbell* and MV *Alastair*.

5 SURVEILLANCE (INCURSION DETECTION)

An important part of the long-term biosecurity of these islands is surveillance (or incursion detection). It is important to monitor for the possible accidental introduction of rodents on Farnuff and Dull. There are a number of different surveillance methods available and these are covered separately below.

Vigilance is the key to detecting rodents quickly and ensuring key management actions can be implemented effectively to prevent adverse effects on the biodiversity of the islands.

Rats and mice can be notoriously difficult to detect in low numbers and could easily escape detection until they are well established across Farnuff and Dull. It is important to use a range of monitoring (detection) methods over the islands, including (but not limited to) permanent monitoring stations, rodent motels, tracking tunnels, chocolate wax, peanut wax, coconut wax and soap.

Accurate data collection and management is important (particularly if incursions are detected and subsequently removed); it is important to use a surveillance log or database. This should be used to record each monitoring visit and any suspicious activity on Farnuff and Dull. All suspicious sign, whether it results in action or not, should be recorded; a single event may not cause concern or raise warning signals, but a number of records particularly at the same location over a long period could change the response. Monthly check data should be collected in waterproof notebooks in the field (and any relevant photographs taken on a digital camera). All data (monitoring checks and any suspicious events) should be entered into the project database. Maps of reported sightings should be generated every three months to determine if there have been any multiple events.

Many rodents are secretive or nocturnal, making them difficult to see. Identification of tracks, droppings, burrows and feeding sign is therefore an important aspect of detection monitoring. To gain an accurate picture of whether a species is present on an island, it is important that the sign they leave can be correctly identified; Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al*. 2017 [redacted]) can be used as a guide to assist with the identification of sign left by rodents (including a brief description and ecological information with images of the animals and their droppings, tracks and teeth-marks).

It is important to record any suspicious sign and photograph (preferably with a scale) any evidence *in situ* whenever possible before disturbing it. Close-up shots of any sign and wider shots showing placement and general location are valuable. Evidence should be collected in sample bags or pots and labelled clearly with the location (GPS position if possible, or location marked on a field map), notes from the observer, date and observer's name.

Additional time should be spent looking around the location for other evidence (this may or may not confirm the incursion – it is important to look for all possible explanations). If any sign or evidence cannot be identified or is unclear, it should be sent to experienced personnel for their opinions.

One of the most important ways to detect particular animals in the field is "*to think like that animal*" and look where those animals are most likely to be active. For example, brown rats are extensive burrowers, make clear runs and tracks in long vegetation and leave large droppings in latrines (on runs or rocks), whereas black rats live and nest in trees meaning sign will be in and amongst trees, including droppings which can be found along branches.

5.1 Surveillance timetable

A surveillance check of the permanent stations on Farnuff and Dull should be completed every four weeks. *A map of the location of all permanent stations would be provided in the Appendices*. If an experienced and trained research team is visiting the islands for another project, additional checks could be undertaken. Four weeks is less than the generation time of a brown rat (the highest risk and

highest impact species threatening Farnuff and Dull) and so effective surveillance during this interval should allow a rapid response before an incursion becomes an invasion.

One trip per year should be used for training and public awareness to refresh team members and local residents on incursion response and biosecurity requirements. Project personnel and other agencies should be ready to respond to incursions as rapidly as possible if they occur. Incursion response is covered in Section 6.

5.2 Monitoring tools, methods and identification of sign

A variety of monitoring tools and equipment can be used to detect rodents on Farnuff and Dull including tracking tunnels and sand (or mud) traps to detect footprints; chocolate, coconut or peanut wax, chocolate resin blocks, candles or soap, commercially produced waxtags™, commercially produced detector blocks and chewsticks (or cheSWCArds) for detecting teeth-marks. Most methods can be used on daytime visits, although some need an overnight visit, or visits on consecutive days or within a week. Many could be left in position permanently and checked as part of the monthly biosecurity check. A summary of methods is given in Table 9 and each monitoring tool covered separately in Sections 5.2.1 to 5.2.10.

All personnel should be able to identify and record evidence of rodents on the monitoring tools in the event of an incursion as well as identifying those native species present on Farnuff and Dull. Chews and teeth-marks on monitoring blocks should be identified and recorded (or collected as evidence if the sign is suspicious). All droppings should be identified, recorded and removed (or collected as evidence if suspicious). Hairs should be identified or, if suspicious, collected for expert advice. Footprints should also be checked and photographed if suspicious.

Table 9: Monitoring methods for detecting rodents on Farnuff and Dull and information on their use.

Method	Notes on surveillance use
Permanent station	• 1 visit per month • Can be used to house monitoring tools such as chocolate wax • Can target rodent incursion directly (i.e. by adding bait or traps) • Possible non-target consumption of monitoring tools or bait between checks
Rodent motel	• 1 visit per month • Can be used to house monitoring tools such as chocolate wax • Can target rodent incursion directly (i.e. by adding bait or traps) • Possible non-target consumption of monitoring tools or bait between checks
Visual searches	• Whenever trained personnel are visiting the islands • Rodent tracks, droppings, runs, burrows and chews can all be recognised • Identification of rodent species (depending on size and clarity of prints, droppings and burrows)
Tracking tunnel	• 1 to 3 nights per month • Tunnels can be placed out permanently, but plates only added when necessary • Tracking cards can be baited with peanut butter • Identification of rodent species (depending on size and clarity of prints)
Wax	• 1 visit per month • Ranges of wax flavours such as chocolate, peanut or coconut can be used

	• Identification of rodent species (depending on size and clarity of teeth-marks)
Trail cameras	• 1+ nights per month • Video and still images available • Can be put in place and set to record over multiple nights • Can be used in all locations • Identification of rodent species (depending on clarity of images) • Identification of non-target species (depending on clarity of images)
Kill traps	• 3 to 5 nights per month • Traps must be checked daily when set • Traps must be set in either natural tunnels, wooden trap boxes, tracking tunnels or permanent stations to exclude non-target species • Can target rodent incursion directly • Traps must be maintained regularly to ensure they are functioning correctly
Live traps	• 3 to 5 nights per month • Traps must be checked twice a day when set • Can target rodent incursion directly • Non-target species can be released unharmed
Hair traps	• 2 visits per month • Identification of rodent species
UV light	• 1 visit per month • Difficult to use if other mammal species are present

5.2.1 Permanent stations

Permanent stations have been established approximately every 100 metres around the coastline of Farnuff and Dull, as well as in the farm sheds where animal feed and bedding are stored. These can be used for both long-term monitoring (using chocolate wax or soap) or as bait stations (using rodenticides) in the event of any rodent incursion. Protecta™ boxes are designed to restrict access to non-target species while maintaining easy access for rodents. Elevating the stations can also restrict access by smaller non-target species (such as Stewart Island vole), but this may also restrict access by mice.

Personnel should take note of any leaf litter, grass or other vegetation dragged into bait stations, as rodents (particularly rats) may do this for nesting. Rats may also chew the edges of the inside of the station.

These Protecta™ boxes are lockable and have been secured to the ground. It should be noted that wooden bait stations are more attractive to rats than plastic stations, and different designs of plastic stations have different attractiveness ratings (Spurr *et al.* 2005, Spurr *et al.* 2007). It would be worth considering using a different design of bait station after a while, or trying them in different locations, just in case it is the design of the bait station that is preventing detection. It is important to cover both islands, and have enough monitoring stations (c. 100 points) to have the best chance of detecting any incursion.

5.2.2 Rodent motels

Rodent motels are wooden boxes that contain a monitoring tool (usually chocolate wax) and bedding material giving rodents a safe habitat to nest. Rats in low densities may be more interested in optimum habitat rather than food as there would be less competition for food following an incursion. These motels are usually placed in high risk locations (i.e. quays, seabird colonies, farm, etc.) for rapid detection of any incursion event. These boxes can also hold traps or bait to target a rodent in the event of an incursion.

Personnel should take note of any leaf litter, grass or other vegetation dragged into the rodent motels, as rodents (particularly rats) may do this for nesting.

5.2.3 Visual searches

Whenever on Farnuff and Dull, personnel should be constantly on the look for any sign of rodents, whether that be sightings of any animals themselves, alive or dead, droppings, footprints, signs of chewing (particularly on plastic debris on beaches), food caches (including seed damage and predated animals, particularly seabird eggs or chicks) and burrows or runs in vegetation. Search efforts should focus on the likely incursion points, but personnel should remain vigilant wherever they are on the islands.

Rodents may be seen on the island following an incursion and could be noticed when walking along the roads and pathways or along the coastline, particularly at night. The animal may be viewed for a very short time and it could be difficult to be sure of the sighting and identity of the species, especially in the presence of the Stewart Island vole. The use of trail cameras may be useful to determine if such sightings were actually of rats or mice. Additional monitoring should be placed at such locations to clarify the sighting.

Individual droppings can be variable for each rodent, but there are generally distinctive traits for each species. The distinction between black and brown rat droppings may not always be clear, but they should be obvious as rat droppings. Size, shape and even smell can be distinctive. It is important to note that Stewart Island vole droppings could be easily confused with those of mice or young rats.

There are several publications and guides for the identification of the droppings of a number of mammal species. Refer to Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017). Many of these guides are available for download as PDF files.

Footprints or tracks are useful for recording the presence of, and identifying, different species of rodents. When on Farnuff and Dull, personnel should check sandy beaches and any muddy areas for rodent footprints as well as using tracking tunnels and plates. It is important to note that tracks on sand and mud can be hard to interpret compared to those on tracking plates or ink cards. Adults and juveniles, or even male and female animals, can leave tracks of different sizes and shapes.

Rodent sign on natural food can be obvious, although this depends on the species. Rodent teeth marks can be visible on bone, seeds and trees. Large fruit or seeds (particularly if found in caches) should be checked for rodent damage and rats can also ring-bark trees for the nutritious cambium layer. Rodents also chew plastic, wood and other materials leaving distinctive teeth marks. Plastic rubbish on the beach can often be found with gnaw marks.

Many animals have a particular preference for burrow, nest or refuge locations; many of which can be used throughout the year. The size, shape and location of these vary between species and can be on the ground (particularly brown rats which have extensive burrow systems and clear runs to the entrances), in trees (particularly black rats), in cavities or caves or buildings (particularly mice). Other sign such as droppings can also be very obvious in and around these burrow or nest sites; brown rats also can leave oil marks (caused by oil and dirt in their coats rubbing off) along walls or trees on

regular routes. These burrow or nest sites can be on the ground (particularly for brown rats), in trees, cavities or caves.

5.2.4 Tracking tunnels

Tracking tunnels, with cardboard pre-inked tracking cards, are available commercially [redacted]). Alternatively tracking ink can be made using nontoxic poster paint and vegetable oil (equal measures of each) which is painted onto cardboard (and used in the tunnels) or onto corrugated plastic and set in the open. An alternative method using sponges soaked in food colouring is described on page 5-7 of Gillies & Williams 2013.

Tracking tunnels should be left permanently in place, ensuring they are stable and do not move if an animal steps on them. When they are ready to be used, ink plates (or tracking cards) need to be put inside them, baited with peanut butter and then checked within the next three days.

Rodent prints are clearly identifiable to species and there are several publications and guides for footprint identification available, please refer to Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017). A reference collection of footprints of species present on Farnuff and Dull and the relevant tracking cards is stored in the shed on Farnuff Farm.

5.2.5 Wax blocks

Non-toxic wax blocks can be used to detect rodents by identifying teeth-marks and other damage caused by rodents and other species. Monitoring tools such as chocolate, coconut or peanut wax, chew cards and Waxtags™ can be used to distinguish between different rodents and other species. Size, shape and form are different between most species and foraging behaviour can also be used to identify the species (i.e. mice are 'neat' eaters whereas rats are 'messy').

There are several publications and guides for the identification of chews and teeth marks from rodents, some of which can be downloaded as PDFs, please refer to Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017). A reference collection of the marks left by different species on wax monitoring blocks is stored in the shed on Farnuff Farm.

The recipes for chocolate, peanut and coconut wax are given in Appendix 4. Wax blocks can be placed in permanent monitoring stations, or in the open (wired to the ground or attached to vegetation). Minor non-target species damage on edges can be sliced off with a pocket knife leaving a new flat edge to pick up fresh sign. Heavily marked or old wax blocks can be recycled by melting them down (adding an extra heaped tablespoon of cocoa powder to freshen the scent) and re-moulding them in silicon trays.

5.2.6 Trail cameras

Rodents can be detected by identifying them in either still images or video from night vision trail cameras. There are a number of trail cameras available in the UK and Bushnell® Trophy Cams were used during the rat-removal phase. These cameras can be set to record still images or short videos at specific times or when the motion sensor detects movement on day or night settings. Cameras can be very useful to identify animals (either non-native rodents or non-target animals) when unconfirmed sightings have been reported on Farnuff and Dull. Cameras can be set in place and left to record over multiple days.

5.2.7 Kill traps

There are a number of kill traps available for trapping rodents that are registered in the UK under the Spring Traps Approval Order 1995, such as Doc 150 and Goodnature A24 traps (the latter should be approved for use in Scotland by the end of 2018 but check for updates to the Spring Traps Approval Order before using).. Snap traps, which are not subject to the Spring Traps Approval Order are also

available, including TRex ™, Victor™ and Snap-E™. Kill traps should be set inside covers (natural, man-made or commercial) and should be checked at least once a day. The traps should be set overnight, but left sprung during the day to minimise the risk of non-target captures. Kill traps can be set in the permanent stations as an option for detecting rats, but as this is so time consuming, this is usually employed when an incursion has been detected or a rat sighting has been reported rather than during routine surveillance.

5.2.8 Live traps

There are a number of live traps available for trapping rodents, including models by Tomahawk and Sherman, Havahart™ Rat Cage Traps, Big Cheese Rat Cage Traps™ and Rentokil® Rat Cage Traps. Live traps can be used at specific locations (high-risk sites) or following a rat incursion or reported rat sightings. This is a labour intensive method as these traps must be checked at dawn and dusk to ensure non-target captures can be released as quickly as possible. Any captured rat must be killed humanely.

This method is usually employed when an incursion has been detected or a rat sighting has been reported rather than during routine surveillance. It should be noted that under Section 14 of the Wildlife and Countryside Act 1981 it is an offence to release any non-native animal into the wild and certain native mammals (such as shrews and dormice) require a licence from Natural England to trap, such as the Stewart Island vole. As such, advice should be sought prior to setting live traps to ensure what species are present in the area.

5.2.9 Hair traps

Sticky traps (glue boards or tape traps) can be used to help identify some animals by their hairs, fur or skin. This can be a useful tool, however for the case of Farnuff and Dull with the presence of the Stewart Island vole is likely to limit the potential of rat identification. Therefore it is important to use these in locations that will not affect non target species such as smaller mammals or lizards which may not be able to extract themselves from the glue or tape.

Glue traps should only be used if registered and appropriate to use in the site; glue traps should be used to collect fur and not to trap the animal (i.e. set tape or glue on the side or top of a tunnel rather than on the base, so fur is pulled out as the animal passes, but does not cause the animal to stick to the trap).

Alternatively Velcro™ hair traps can be made using 100 mm diameter drainage pipe (or an old bait station) with a piece of adhesive Velcro™ attached to the top or side of the pipe; this allows rodents to pass through and rub their fur again the Velcro™. Although these hair tubes may detect rodents, individual species identification may be difficult

5.2.10 UV lights

Mammalian urine fluoresces under ultraviolet light (UV) and this can be a method of detecting runs and rodent activity at high risk locations on Farnuff and Dull. These searches have to be undertaken at night (and as such will require an overnight stay on Farnuff and Dull. However, it is only suitable when there are few other mammal species (such as dogs, cats, rabbits and livestock) as all mammalian urine will fluoresce in the way, which may confuse observers.

6 INCURSION RESPONSE

Even with the best biosecurity systems in place, there is still always a chance of the accidental introduction of rodents. The appearance of non-native rodents or other key invasive species on an island previously free of them is referred to as an incursion. At this stage it is likely that there is only one or a small number of animals present. Detecting and responding to even one animal will involve a considerable outlay of time and resources. However, it is important to bear in mind that an incursion response will always be much cheaper than a full eradication project covering the entire island.

If probable or definite signs of rodents are detected (see section 6.1.1 for definitions) then the basic incursion response consists of setting up a 50m grid of rodenticide-containing bait stations for a distance of 250m in all directions from the site where the sign was found. These stations should be checked regularly and bait replenished as needed, until all signs of rodent activity have ceased (full details are given in section 6.2.2). Additional methods should also be used to target and monitor for rodents, including snap traps, wax monitoring blocks, tracking tunnels and trail cameras.

Incursion response procedures outline specific actions to be taken in the event of a reported rodent sighting or a shipwreck: action should be taken immediately. The Project Manager should be responsible for this rapid response, but should be able to call on volunteers and assistance from other agencies. It is important to have a response plan and equipment ready for deployment in case of an incursion.

There are a number of activities required in response to any incursion of a non-native rodent; as such it is important that those responsible for deciding who responds and when these activities occur are identified. These activities and agencies responsible are shown in Table 10.

Incursion response also depends on who reports the sighting and how confident they are. If a sighting of a rodent or suspicious sign is reported by the public, a series of protocols should be followed to determine the likelihood of the report and to confirm any incursion event. These protocols are covered in Sections 6.1 to 6.3.

6.1 Response decision making

If possible sign of rodents is found, then additional monitoring should be carried out to determine as soon as possible whether rodents are actually present – see section 6.2.1 below. An incursion response should be triggered as soon as a probable or definite sign of rodents is found – see section 6.2.2 below.

Triggering either the intensive monitoring or full incursion response plan should occur within 48 hours, preferably less.

6.1.1 The decision to trigger either of these two courses of action is the responsibility of Nancy McEwen, the Project Manager

6.1.2 Definitions

Possible signs include finding one or more dead birds or other native species showing possible signs of predation, unclear or degraded rodent footprints or droppings, burrows, sightings made by people unfamiliar with rodents or unclear sightings made by people who are familiar with rodents.

Probable signs of rats and mice include clear teeth marks on monitoring tools or other items, clear footprints on tracking tunnels, droppings, footprints, predated birds or other clear feeding sign, shipwrecks, or partial, brief or unclear sightings.

Definite signs include non-native rodent corpses and clear sightings made by people with experience of rats or mice (in person or images on trial cameras).

If a rodent is detected on any of the monitoring tools by the project team, a rapid response will be necessary. **A rapid response is within 48 hours of the first detection**; the earlier the response means the quicker the rodent(s) can be removed from the islands. The rapid response protocols are covered in Section 6.2.

If the regular monthly monitoring checks confirm an incursion has occurred, then a rapid response is required. It is likely that up to six people will be needed to implement a rapid response; this team should be led by project personnel who have been trained in the incursion response practices (and have experience in surveillance and rat removal procedures) with support from local residents and personnel from other local agencies. Additional people could be called in from project partners.

Following an incursion, any rodent caught in a trap should be sent for DNA sampling to try and determine provenance (i.e. whether the rat-removal programme failed or there has been an incursion from a neighbouring island or the UK mainland). Samples from Farnuff and Dull have been collected, analysed and are held at a local University for comparison.

Detailed reporting of any sighting is vital and it is also important to record any action following these sightings. Data from routine monitoring or any response in the event of an incursion should also be recorded in detail. All records and reports must be widely disseminated to all residents, stakeholders and interested parties.

Regular audits of the biosecurity programme should be undertaken to ensure continued compliance and support; it is also important to refresh the training of personnel covering identification of sign and rodents. Annual refresher training for personnel and residents should be undertaken by the Project Manager.

In addition to this, a biosecurity and island restoration expert should audit the project and personnel and complete a training workshop on biosecurity methods and technology every five years.

Table 10: Activities and stakeholder responsibilities following a rodent incursion on Farnuff and Dull.

Activity	Stakeholder	Responsibility
Report by public	Project staff Farnuff community	• Interview member of public who reported sighting or suspicious sign • Site assessment of location of sighting • Determine whether incursion possible or probable (see Section 6.4) and • respond accordingly
Confirmed incursion report by project staff or residents	Project staff Farnuff community External expert	• Confirmed presence of non-native rodent (either directly or inferred from sign during routine checks) (see Section 6.1) • Alert stakeholders • Alert Response Team • Confirm species of rodent (if possible) • Identify resources (including personnel)
Mobilise response team	Project steering group	• Implement incursion response plan (see Section 6.2.2) • Use local personnel (and external help if required) • Assess and obtain other resources necessary for response • Consult with residents and stakeholders on action (via Progress Reports)
Monitor incursion response	Project staff; SWCA; UKSCT; external expert (as required)	• Determine whether incursion is limited to single animal or island-wide • If possible, collect sample (by trapping) for DNA analysis • Predict the loss of threatened or important species and possible economic and social impacts on Farnuff • Assess outcome of incursion response and determine whether the incursion has been removed • Consult with residents on action and outcomes • Audit the biosecurity measures and training standards
Reporting to stakeholders and interested parties	Project team	• Progress reports and Technical Report provided to stakeholders • Incursion technical report (covering response, detection, outcomes, etc.) • Decide further action needed (surveillance, awareness raising, training, etc.)

6.2 Incursion response plan: Responding to signs of rodents

6.2.1 Responding to possible signs of rodents: INTENSIVE MONITORING

1. Replace or refresh existing wax block monitoring stations (c.100) to ensure the smell of the attractant (chocolate, coconut, peanut butter etc) is fresh and strong. Set 15-20 additional wax monitoring points (wax blocks not inside monitoring stations) close to the suspected sign in sites of likely rat or mouse activity

2. Set 25-30 snap traps in suitable locations, where there are no risks to non-target species. See appendix 2 for notes on trap placement and setting. This could include inside buildings, or outside in commercially available bait boxes such as 'Protecta' stations. Make sure that you use appropriate sized snap traps for the species believed to be present. Mice are not heavy enough to set off rat-sized trap and rats are very unlikely to be killed in mouse-sized traps. If you are not sure which species are present use some of each size. Bait with an attractive lure such as peanut butter

3. Snap traps should be checked twice daily, once in the dusk to bait and set the trap and once in the morning to disarm it. This should minimise the risk to diurnal non-target species and limit suffering should any animal not be killed outright.

4. Set 25-30 tracking tunnels in likely sites of rat or mouse activity close to the suspected sign and bait with an attractive lure such as peanut butter.

5. Carry out regular visual searches for rat or mouse sign, such as droppings, feeding sign, footprints etc.

6. Use trail cameras to look for evidence of INNS moving at night

7. Check wax blocks, tracking tunnels and trail cameras twice a week for **four weeks**

8. If no additional sign is found during this time, return to the routine monitoring described in section 5. If probable or definite sign is found, immediately implement the full incursion response plan in section 6.2.2. Log all actions taken in the biosecurity log (see appendix 1).

All monitoring tools should be placed in sites likely to appeal to rats and mice, such as the shoreline and along linear landscape features such as walls. See appendix 2 for notes on trap and bait station placement. Contact project staff at UKUKSCT or SSWCA at any time for advice on using monitoring tools or for interpreting any suspect sign.

6.2.2 Responding to probable or definite rat sign: INCURSION RESPONSE

1. Set out bait stations on a 50 x 50m grid around the site where rodent sign was detected, for 250m in all directions using a GPS. This will create a grid of 11 x 11 (=121) bait stations, plus extra for any buildings in the area). These can be commercially available plastic bait boxes or custom made 75cm waste pipe stations used in many rat eradication projects worldwide.

2. Wire three blocks of rodenticide into each bait station. Also place rodenticide in all of the stations which are used for routine surveillance.

3. Stations should be checked daily for five days and then twice weekly for **six weeks**. Replenish bait as necessary to ensure a fresh supply is always available – we want the bait to be the most attractive food available to rats on the island and mouldy or damp bait is far less appealing.

4. Also set snap traps in suitable locations, where there are minimal risks to non-target species. See appendix 2 for notes on trap placement and setting. They should only ever be set inside bait stations (the only exception to this is if they are set inside buildings). Make sure that you use appropriate sized snap traps for the species believed to be present. Mice are not heavy enough to set off rat-sized trap and rats are very unlikely to be killed in mouse-sized traps. If you are not sure which species are present use some of each size.

5. Snap traps should be checked twice daily, once at dusk to bait and set the trap and once in the morning to disarm it. This should minimise the risk to non-target species which are only active in the daytime and limit suffering should any animal not be killed outright.

6. After the first week of poison baiting, set up monitoring points halfway between each bait station and place flavoured wax and/ or tracking tunnels at each. Check with the same regularity as bait stations.

7. Use trail cameras in any areas with active sign to confirm the presence of rodents. If confirmed place traps at the site (in addition to the bait stations) and run for five nights.

8. Enter bait take, trap and monitoring check data into a suitable database (an Excel file is fine) on the day it is gathered. See example in Table 11 below:

Table 11: Example data collection table.

Bait station	**Check 1 (6/10/17)**			**Check 2 (7/10/17)**		
	Rat sign?	Type of sign (T = teethmarks, D = droppings)	No. blocks added	Rat sign?	Type of sign (T = teethmarks, D = droppings)	No. blocks added
A1	1	D	1	1	T/D	3
A2	0		0	0		0
A3	1	T/ D	2	1	T/ D	3
B1	0		0	1	T	2

6.3 Response readiness

In order to be ready to respond in a timely way to any possible, probable or definite incursion in a timely way the actions in Table 12 should be completed.

Table 12: Biosecurity actions. These are all the responsibility of the SWCA representative for Farnuff and Dull.

Action
Routine surveillance
1. Establish biosecurity and incursion response kit – buy and securely store equipment listed in section 7 **AS SOON AS POSSIBLE**
2. Ensure regular checks are undertaken and the data are recorded electronically **MONTHLY**
3. Ensure all the equipment listed in section 7 is present, in good condition and within its use-by date **SIX MONTHLY**
In event of any known or suspected incursion
1. Inform independent expert of possible/ probable/ definite incursion
2. In agreement with independent expert/Technical Advice group, initiate intensive monitoring and/ or incursion response actions
3. Ensure agreed actions are carried out and results collected and recorded electronically
4. End intensive monitoring or incursion response actions in agreement with Technical Advice Group
5. Replace any equipment used during the response
After intensive monitoring/ incursion response is concluded
1. Replace any equipment used during the response
2. Review the response, in discussion with Technical Advice Group

7 EQUIPMENT LIST

A list of equipment needed to implement a rapid incursion response is given in Table 11; this is a guide only and additional equipment may be required. A detailed list of current items in storage should be kept. This equipment is currently stored in the project shed on Farnuff Farm. Bait is stored in the secure container on Farnuff quay.

The biosecurity, surveillance and incursion response equipment kit should be maintained on Farnuff and Dull (Table 11); it should be stored together in a place where it will be easily accessed. At this stage it is securely stored in the project shed (on Farnuff Farm). The bait is stored in the container in the waste management site at the top of the Farnuff quay.

It is the responsibility of the SWCA staff member whose role covers Farnuff and Dull, to ensure the equipment is regularly checked, is in good order and to replace the bait once out of date.

Table 13: Biosecurity, surveillance and incursion response equipment kit for Farnuff and Dull.

Item	Number/amount	Explanation	Location	Included in kit? (Y/N)
Protecta™ lockable bait stations	50	Replacement for permanent monitoring stations	Incursion response shed	Y
Protecta™ bait station keys	25	Opening locks on Protecta™ bait stations	Incursion response shed	Y
Buckets (8 L) and lids	15	For moving bait and monitoring equipment around island	Incursion response shed	Y
Rat trap (T-Rex™)	100	For trapping rats (incursion response)	Incursion response shed	Y
Bait stations (tubes)	500	10 bulk bags, containing 50 stations in each bag	Incursion response shed	Y
Long wires	3000	Enough to secure 500 tube bait stations	Incursion response shed	Y
Short wires	1000	Enough for 1000 monitoring points	Incursion response shed	Y
Poison labels	500	Warning signs for bait stations	Incursion response shed	Y
Tags	500	For numbering bait stations	Incursion response shed	Y
Marker pen	5	For numbering bait stations	Incursion response shed	Y
Flagging tape	10	For marking baiting and monitoring grid	Incursion response shed	Y
Bamboo canes	1500	For marking bait stations (4', 20 canes/bundle)	Incursion response shed	Y
Chocolate wax	10000	For monitoring (10 x bins, 10000 pieces of wax)	Incursion response shed	Y
Peanut wax	2000	For monitoring (2 x bins, 2000 pieces of wax)	Incursion response shed	Y
Soap	1000	For monitoring (2 x bins, 1000 pieces of soap)	Incursion response shed	Y
Trail cameras	3	For confirming species	Incursion response shed	Y
Plastic bags	2500	For samples and specimens	Incursion response shed	Y
Waterproof notebooks	5	For data recording	Incursion response shed	Y
Pencils	5	For data recording	Incursion response shed	Y
First aid kits	10	For field team	Incursion response shed	Y
Pocket knife	10	For field team	Incursion response shed	Y
Hand sanitiser	10	For field team, after handling bait	Incursion response shed	Y
Nitrile gloves	3	For handling bait (1x box of each: large, medium, small)	Incursion response shed	Y
Dissection kit	1	For collecting rodent samples	Incursion response shed	Y
Bait	75 (8 kg buckets)	Incursion response	Project container	Y

8 REFERENCES

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Would also include reference to Feasibility Study, Project Plan and Operational Plan

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Appendix 1: Biosecurity Log

Date	Recorder : name/ contact details	Incident description	Response/Action taken	Outcome

Appendix 2: Biosecurity checklist for quarantine procedures

BIOSECURITY CHECKLIST

Task	Completed?
Have I given clear verbal biosecurity instructions to all trip members?	Yes/No
Have I checked they have understood these instructions?	Yes/No
Have all stores and supplies been packed in rodent- proof containers?	Yes/No
Itemise gear too bulky/awkward to fit into rodent-proof containers here: Check these immediately prior to departure -	Yes/No
Has everything been stored in equipment room in sealed containers or re-checked immediately prior to departure? (Remember the 'extras' like boats, radios, day-bags, last-minute items etc).	Yes/No
Check with every member of trip: - packs kept in rodent-free areas or checked and re-packed since? - no food held in any unsealed bags? - no-one in party has worked in area of known invasive plant infestation recently?	Yes/No
IF THE ANSWER TO ANY OF THE ABOVE IS 'NO', THEN FURTHER ACTION IS REQUIRED	
What are the added risks on this trip? - are we leaving/ travelling at night? - are there planned stops en route where rodents could enter or exit? - what bulky or non-rodent proof packages do we have? - are we travelling on a boat/from a quay with no poison rat bait or effective rodent control measures? - are any items being stored on deck or in non-rodent proof holds?	Yes/No
IF THE ANSWER IS 'YES' TO ANY OF THESE QUESTIONS YOUR TRIP HAS EXTRA RISKS	
Have I addressed these concerns by identifying 'tailor-made' solutions? (How do I deal with the added risk to minimise potential risk to the islands?).	Yes/No

If your answer to this is no, then your trip should not proceed until you have addressed these issues.	
<u>In Transit to Islands:</u> If any sign of rodent presence is detected on the boat whilst en route to your destination, **<u>STOP</u>** Do not land at the destination island or any other island until the problem has been identified and remedial actions taken.	
<u>On Arrival at Destination Island:</u> - Have I inspected all containers for rodent entry or damage which could allow such? - Has everything been unpacked or opened up and carefully inspected in an open area? - Have I instructed everyone on rules for disposal of organic rubbish? - If planning to go to the other island from here, have I considered and established how to apply quarantine procedures before we leave? - If on a daytrip only, have I ensured only day-bags are being taken, and that they have been checked as clean and been packed only on the day of departure?	Yes/No

Appendix 3: Notes on trap and bait station placement

Traps, bait stations and other monitoring tools should be set in places likely to be attractive to rodents, e.g. in narrow runways through undergrowth or along linear features such as walls and big rocks. When siting monitoring tools, think for a moment about where rodents would be likely to run in a particular area. Like many small mammals they are more likely to run along the edges of landscape features than across the middle of open areas.

Bait stations and snap traps need to be carefully positioned to increase the chances that rodents will go into them. They should always be set be on a flat surface (or as flat as possible) so that they don't wobble when something steps onto them. Bait stations should always be secured in place using rocks, bricks, wires, metal pegs or any other means, in order to stop them being blown away by the wind or dragged away by animals. The black plastic Trapper T-rex snap traps are very sensitive, easy to arm and much more consistent than older-style metal or wooden traps. To protect non-target species, traps should be set as close to nightfall and checked as soon after sunrise as possible. Any traps that are still set when they are checked in the morning need to be disarmed. This is best done by tapping a thin stick on the corner of the plate around the bait compartment. Traps can be baited with any strong smelling and palatable bait, such as peanut butter or mashed sardines. Take care to squash the bait right down inside the round bait compartment – this prevents rodents from simply flicking it off the top of the trap without having to step on the plate. Rebait daily to keep the scent of the bait fresh and appealing.

Snap traps should ideally be set inside commercially available plastic bait boxes, or home-made wooden boxes with entrance holes too small for the traps to be dragged out through (injured rats will try to do this). The boxes should be positioned so that the entrance holes are next to the linear feature against which the box is placed. If boxes are not available, traps should always be tied to something solid to prevent injured rodents dragging the traps away, or scavengers from dragging away the dead rodent and the trap. Lengths of string or twine about 50cm long are ideal for this purpose. Make sure they are not tied to the mechanism of the trap as this might interfere with their ability to catch rodents. If boxes are unavailable, traps should be baited and armed, then carefully placed on the ground in pairs back to back, with the baited ends outermost. **Using snap traps without proper boxes is only suitable for use inside buildings as the risk of non-target captures will be significantly higher.** The traps should always be covered over, e.g. with a length of wood propped against a wall.

Appendix 4: Instructions for making wax monitoring blocks

Flavoured wax blocks are simple and effective monitoring tools that can be used to detect rodents (and other species). This is the recipe provided by Wildlife Management International Ltd, the NZ-based contractors who have run many of the successful rat eradication projects in the UK in recent years.

Makes approximately 60 small blocks

Equipment:

Standard 25 cm saucepan
Gas ring and gas bottle
Silicon muffin tray (24 cup mini muffin tray)
Wooden spoon for mixing
Heatproof glass jug for pouring

Different flavour blocks are made as follows:

Chocolate wax:

Ingredients:

12 standard white wax candles
5 heaped tablespoons of pure cocoa powder
Instructions:

Melt candles in pot, remove wicks, add cocoa powder, stir thoroughly to mix, pour into silicon tray. Just before wax sets, put hole through centre of the block (alternatively put bent paperclip for hanging in tree/vegetation)

[Note: do not use drinking chocolate as this contains milk powder and the mixture will split and burn.]

Coconut wax:

Ingredients:

12 standard white wax candles
5 teaspoons of coconut essence (or ½ block of creamed coconut)
1 heaped tablespoon of pure cocoa powder
Instructions:

Melt candles in pot, remove wicks, add cocoa powder, stir thoroughly to mix, take off the heat and add coconut essence one spoonful at a time (taking care as the mixture will bubble and fizz). Pour into silicon tray, just before wax sets, put hole through centre of the block (alternatively put bent paperclip for hanging in tree/vegetation).

[Note: the cocoa is added to make teethmarks easier to see on the wax block]

Peanut wax:

Ingredients:

12 standard white wax candles
½ jar of smooth peanut butter

Instructions:

Melt candles in pot, remove wicks, add peanut butter, stir thoroughly to mix (do not leave on the high heat too long as the peanut butter can burn), pour into silicon tray, just before wax sets, put hole through centre of the block (alternatively put bent paperclip for hanging in tree/vegetation).

[Note: this wax does not last or store as long as the other types as it can spoil due to the peanut butter content]

Appendix 5: Interview recording sheet for reported sightings

Name of person reporting sighting:		Name of person who made sighting (if different)
Contact details of person reporting sighting Email: Telephone:		Contact for person who made sighting (if different)
Date of sighting:	Date of interview:	Interviewer:
Overview of action taken:		
Circumstances (circle as appropriate): Live animal Dead animal Footprints Droppings Damage Other		
Time / conditions of sighting:		
Location of sighting - as much detail as possible:		
Any other observers? Names and contact details if known:		
Description of the sighting What did you see? Can you describe the animal? What was it doing? How long did you observe it for? How close were you to it? Have you seen mice/rats in the wild before / Do you have any experience with mice/rats? What makes you think it was a rat/mouse? How sure are you that it was a rat/mouse?		
Does the observer wish to be notified of outcome of the monitoring? [Inform them that will take at least six weeks]		