Written Representation

for the

Royal Society for the Protection of Birds

Annex C

Derogation case: predator eradication

Submitted for Deadline 2

29 March 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. This submission sets out the RSPB's comments based, in particular, on the following documents submitted by the Applicant as part of its original application documents:

- APP-193: B2.8 FFC SPA: Gannet Guillemot and Razorbill Compensation Plan
- APP-196: B2.8.3 Compensation measures for FFC SPA: Predator Eradication: Ecological Evidence
- APP-197: B2.8.4 Compensation measures for FFC SPA: Predator Eradication: Roadmap

1.2. We note here that at Deadline 1 the Applicant made further submissions in relation to its predator eradication compensation proposals. We will respond to the following documents at Deadline 3 once we have had the opportunity to review the new information provided:

- REP1-061: G1.33 - Predator Eradication Island Suitability Assessment: Bailiwick of Guernsey
- REP1-022/REP1-023: Predator Eradication Roadmap (clean and tracked versions).

2. Island restoration in the UK to date and the main seabird species targeted

Overview of island restoration in the UK

2.1. Island restoration has become a mainstream conservation measure to restore locally extinct or declining populations of many species, including seabirds. It comprises the eradication of invasive non-native species (INNS), the subsequent management for ecosystem recovery and scrupulous attention to biosecurity.[1] In the UK, the greatest impacts are likely to come from the removal of a range of invasive predatory mammals: these include black rat, brown rat, feral ferret, feral cat, American mink and (where outside their native range) stoat and hedgehog.

RSPB experience and expertise on island restoration

2.2. The RSPB has a long history of involvement in island restoration. This began with the first, unsuccessful efforts to remove rats from Ailsa Craig, Scotland in the 1920s, one of the earliest rodent eradication attempts anywhere in the world. With the advent of second-generation anticoagulant rodenticides in the 1980s and the development of aerial application techniques in New Zealand in the 1990s, island restoration become an established field of conservation. The RSPB was an early adopter of this conservation tool, supporting the successful eradication of rats from Ailsa Craig in 1991-4, then leading eradication projects on Ramsey Island, Wales (1999) and Ascension Island (2002)**.** Since then, the RSPB has been involved in numerous island restoration initiatives, working on eradication, installing and improving biosecurity, facilitating species recovery and building local capacity in this work, predominantly in the UK and UK Overseas Territories. Most recently, work has been guided by prioritisation exercises with which the RSPB has been involved at global[2], UK Overseas Territories[3] (RSPB-led) and UK[4] (RSPB-led) levels. The RSPB has found that island restoration work has been most successful when we have had early and consistent input from experts and engaged early with island residents and other stakeholders.

Biosecurity for LIFE project

2.3. Biosecurity for LIFE is a 4-year, EU LIFE funded, project aimed at putting in place robust and sustainable biosecurity measures to protect 42 island Special Protection Areas in the UK that are designated for their breeding seabirds. It is a partnership project[5] designed to work with island communities and stakeholders to develop and put in place long-term biosecurity

[1] Thomas, S., Brown, A., Bullock, D., Lock, L., Luxmoore, R., Roy, S., Stanbury, A. and Varnham, K. (2017) *Island restoration in the UK -past, present and future*. British Wildlife (April 2017): 231-242.
[2] Holmes ND, Spatz DR, Oppel S, Tershy B, Croll DA, Keitt B, et al. (2019) *Globally important islands where eradicating invasive mammals will benefit highly threatened vertebrates.* PLoS ONE 14(3): e0212128.
[3] Dawson, J., Oppel, S., Cuthbert, R.J., Holmes, N., Bird, J.P., Butchart, S.H.M., Spatz, D.R. & Tershy, B. (2015) Prioritizing islands for the eradication of invasive vertebrates in the United Kingdom overseas territories. *Conservation Biology* No 29, (1) 143-153.
[4] Stanbury, A., Thomas, S., Aegerter, J., Brown, A., Bullock, D., Eaton, M., Lock, L., Luxmoore, R., Roy, S., Whitaker, S. & Oppel, S. (2017) Prioritising islands in the United Kingdom and Crown Dependencies for the eradication of invasive alien vertebrates and rodent biosecurity. *European Journal of Wildlife Research.* 63:31.
[5] The partnership comprises the RSPB, National Trust and the National Trust for Scotland. In addition to EU LIFE, funding has also been provided by NatureScot, Natural England, Department of Agriculture, Environment and Rural Affairs (Northern Ireland), Natural Resources Wales and the Department for Environment, Food and Rural Affairs (England).

measures to avoid the risk of an INNS incursion on any of these island SPAs. Its main biosecurity measures are:

- **Biosecurity plans**: working with island land managers and communities to develop and implement biosecurity plans;
- **Biosecurity surveillance**: supporting biosecurity surveillance for invasive predators by training personnel, deploying surveillance equipment and training a specialised biosecurity dog;
- **Rapid response hubs**: developing a network of regional hubs equipped to rapidly respond in the event of an incursion on any of the 42 island SPAs; and
- **Industry training**: providing training to marine industries and businesses on how to undertake an implement effective biosecurity when operating in areas of risk.

Key considerations in developing a successful IR scheme

2.4. To succeed, IR needs the effective targeting of 100% of the INNS to achieve eradication, supported by comprehensive measures to keep the risk of reinvasion low and ongoing capacity to respond effectively to any biosecurity breach. The complete support of the affected island communities is critical to avoid weak links in the eradication and biosecurity chains.

2.5. Therefore, it requires the feasibility of removing the INNS from each island to be restored to be firmly established, rather than assumed, combined with ongoing commitment among key stakeholders. This is to ensure successful eradication is sustained through implementation of biosecurity and (48-hour) emergency response plans and securing the resources necessary to implement these measures in perpetuity.

2.6. The level of detailed information and assessment described below is critical to bottom out before deciding whether an IR scheme is feasible to proceed to implementation. In the context of determining whether a compensation measure is feasible and therefore DCO consent should be granted, this is particularly important. For the reasons set out below, it cannot be assumed it will sort itself out and that all the key detail can be worked out later.

2.7. To have confidence IR will succeed in restoring the seabird species it is intended to benefit requires:

- A good understanding of the vulnerability of the beneficiary seabird species to the INNS to be targeted for removal i.e. to be confident that INNS removal will support an increase in the seabird's population;
- An understanding of the risk of reinvasion by the target INNS (assuming they have been successfully eradicated). It is essential to determine all the pathways by which INNS may return to an island – e.g. by ferry, cargo ship, recreational vessels, or by swimming. Each species has a varying capacity to swim between islands. Published maximum potential swimming distances for a selection of INNS are:
    - 2.0 km brown rat
    - 0.75 km black rat
    - 0.5 km house mouse

- 6.5km American mink.

- A detailed assessment of the selected island(s) that in addition to the above:
  - Establishes the presence/absence of the beneficiary seabird species and its historic and current population status. For many species, restoring an existing colony is easier than seeking to reinstate a species that is locally extinct;
  - Habitat suitability survey to determine the extent of unoccupied but suitable habitat available to the beneficiary seabird species;
  - Up to date survey to establish the presence of INNS of concern, on both target islands and areas where they could reinvade from;
  - A full-scale Feasibility Study carried out by a suitable eradication expert contractor to international best practice standards (see section 3 below).

2.8. Successful IR requires meticulous and detailed preparation and planning to ensure that it is feasible at the selected location. This is why detailed feasibility studies and preparation are required. These take account of factors such as interactions between different predators, the risk of anthropogenic reinvasion, views of residents (social feasibility) and costs.[6]

Prioritising island restoration in the UK – a short summary of Stanbury et al 2017

2.9. A paper by Stanbury et al 2017 has been used by the Applicant (and other offshore wind farm developers) as part of their work to try and identify possible island locations that could be suited to IR. To assist the Examining Authority we thought it would be helpful to provide a brief summary of what the Stanbury et al 2017 seeks to do and what it does not seek to do.

- Stanbury et al 2017 aimed to assist the effective targeting of IR in the UK to maximise conservation gain given limited resources.
- It drew on existing IR prioritisation methods and compiled data for all 9,688 islands in the UK (including crown dependencies) on the presence of almost 100 vertebrate species (seabirds, mammals, reptiles) and subspecies of conservation interest for which islands are important habitats.
- 955 of these islands were identified as having both species of conservation interest and invasive invertebrates.
- They assessed the ecological importance of the native vertebrates and the anticipated impact of the INNS present to estimate the benefit of restoration. This was based on the feasibility and sustainability of INNS eradications using global benchmarks in relation to island size, human population and risk of unassisted INNS reinvasion by swimming. They explored different levels of risk to assess priorities for IR.
- They ranked the 955 islands according to the anticipated conservation benefits that would be accrued following the eradication of invasive non-native mammals. Rankings were performed based on potential conservation benefit should all INNS be removed

[6] Stanbury, A., Thomas, S., Aegerter, J., Brown, A., Bullock, D., Eaton, M., Lock, L., Luxmoore, R., Roy, S., Whitaker, S. and Oppel, S. (2017) *Prioritising islands in the United Kingdom and crown dependencies for the eradication of invasive alien vertebrates and rodent biosecurity*. European Journal of Wildlife Research 63: 31.

and likely conservation benefit based on the removal only of those INNS thought currently feasible. Feasibility considered the best methods deployed globally, rather than the constraints under which restoration in the UK operates.

- Importantly, they made clear that this was an initial guide only and that further, detailed feasibility studies would be needed before planning any eradication scheme, as well as (in some cases) verification of the presence of invasive species at an individual site.

2.10. Drawing on earlier work, Stanbury et al 2017[7] considered the breeding ecology of each species of conservation interest in the study, including seabirds. They assessed the likely severity of impact of each INNS on the beneficiary species as follows:

- 0 = no apparent negative impact on the species;
- 1 = small to moderate impact that would reduce population size but allow the species to persist;
- 2 = severe impact that would eventually lead to local extinction of the species.

2.11. They considered the level of risk from natural reinvasion based on the swimming distances of the different INNS. The closer an island is to a source of INNS, the higher the risk of natural reinvasion events and hence, in the absence of effective biosecurity measures and emergency response plans, the higher the risk of the INNS reestablishing. Some islands are too close to ineradicable sources of INNS to achieve sustainable eradication.

2.12. Their "medium risk" approach was based on an assumption that natural reinvasion by the INNS would occur at up to half its maximum swimming distance. Their risk averse approach assumed natural reinvasion could occur up to an INNS maximum swimming distance.

2.13. This enabled Stanbury et al 2017 to produce different priority listings of islands for IR schemes depending on the level of risk accepted. Table 3 of Stanbury et al 2017 lists the top 25 islands based on the benefit of feasible and sustainable eradications and the medium risk approach to natural reinvasion described above.

2.14. We have partially reproduced Table 3 below, showing the ranked list of islands and the INNS confirmed or thought to be present on each island.

Table 1: simplified version of Table 3 (Stanbury et al 2017): Top 25 islands prioritised for invasive alien invertebrate eradication in the UK based on the eradication benefit of feasible and sustainable eradications and a medium-risk approach from natural reinvasion.

Note: only Rank position, island name and INNS presence shown

Rank position	**Island name**	**INNS presence** (confirmed or *probable*) Species in **bold** are considered ineradicable on that island
1	Foula, Shetland	Feral cat, House mouse, European rabbit, Wood mouse, European hedgehog
2	Fair Isle	Feral cat, House mouse, Wood mouse, European rabbit
3	Westray, Orkney	Feral cat, House mouse, **European rabbit, European hedgehog**

[7] Ibid

Rank position	Island name	INNS presence (confirmed or *probable*) Species in **bold** are considered ineradicable on that island
4a	Garbh Eilean and Eilean an Taighe, Shiant Islands	Black rat[8]
4b	Rousay, Orkney	Brown rat, Feral cat, House Mouse, **European rabbit**
4c	Rathlin Island, Northern Ireland	Brown rat, Feral cat, Feral ferret, Feral goat, House mouse, Wood mouse, European rabbit
7a	Colonsay & Oronsay, Inner Hebrides	Brown rat, Feral cat, Feral goat, House mouse, Wood mouse, **European rabbit**
7b	Unst, Shetland	Brown rat, Feral cat, House mouse, **European rabbit, European hedgehog**
9	Yell, Shetland	Feral cat, **House mouse, European hedgehog, European rabbit**
10	Rum, Small Isles	Brown rat, Feral goat, House mouse, Wood mouse
11	Papa Westray, Orkney	House mouse, European rabbit, *Feral cat*
12a	Fetlar, Shetland	Feral cat, House mouse, Wood mouse, European rabbit, **European hedgehog**
12b	Inchkeith, Forth Estuary	Brown rat[9], House mouse, European rabbit
14	Hoy, Orkney	Feral cat, **European rabbit, Brown rat, European hedgehog, House mouse, Wood mouse**
15	Flotta, Orkney	Brown rat, Feral cat, House mouse, European hedgehog, European rabbit
16a	Tiree, Inner Hebrides	*Brown rat, Feral cat,* Wood mouse, *House mouse*, **European hedgehog**
16b	Inchmarnock, Clyde Islands	*Brown rat, House mouse, American mink, European rabbit*
18a	Stronsay, Orkney	Brown rat, Feral cat, House mouse, Wood mouse, European rabbit, **European hedgehog**
18b	Eilean Mhuire, Shiant Islands	Black rat[10]
20a	Gairsay, Orkney	Feral cat, Brown rat, European rabbit
20b	North Ronaldsay, Orkney	Feral cat, House mouse, Wood mouse, European hedgehog, European rabbit
22	Muck, Small Isles	Brown rat, Wood mouse, *Feral cat, House mouse*
23	Housay, Outer Skerries	Brown rat, *Feral cat, House mouse, European rabbit*
24	South Havra, Shetland	*Feral cat*
25	Herm, Channel Islands	Black rat[11], Brown rat, Wood mouse, *Feral cat, House mouse, European rabbit*

2.15. It is important to note that most islands have multiple INNS that would need to be removed in order to accrue maximum conservation benefit i.e. not just rats. Removing only one INNS from an island system may worsen conservation outcomes. As we note below, some of the islands listed have already been subject to IR schemes e.g. Shiant Islands (4a, 18b) and others are in preparation e.g. Rathlin Island (4c).

2.16. At all times, Stanbury et al 2017 emphasise this was an initial prioritisation exercise for which **"more detailed assessments can be undertaken before planning an eradication**". The

[8] These have since been eradicated.
[9] More recent information suggests brown rat is not present.
[10] These have since been eradicated.
[11] A survey since 2017 suggests black rats are not currently present on the island.

RSPB considers those detailed assessments are essential. Stanbury et al 2017 further note that "**closer inspection of some islands may reveal that the eradication of one or several [INNS] currently considered feasible and likely to deliver ecological benefit may still not be possible."**

2.17. This underlines the need for the detailed studies outlined above before deciding whether a particular IR scheme is both feasible and capable of delivering the desired ecological benefit.

Island restoration in the UK to date and the main bird species targeted

2.18. As Thomas et al (2017)[12] set out, the importance of UK islands for seabirds has meant that IR in the UK has focused almost exclusively on removing predatory mammals. The focus to date has been on brown rats, reflecting the widespread nature of this INNS, but on Lundy and the Shiant Islands, black rats were also present and targeted (see section 5 below for more on these species). A small population of feral cats was removed from Ramsey Island, complementing its rat eradication scheme.[13]

2.19. Burrow nesting seabirds have been the top priority for IR schemes in the UK due to their known vulnerability to predatory mammals and the strong likelihood of a positive response to removal of INNS i.e.:

- Manx shearwaters
- Storm petrels; and
- Puffins.

2.20. Thomas et al (2017)[14] set out the 12 formal IR schemes that have taken place in the UK to date, starting in 1968 on Cardigan Island (Ceredigion) and most recently, the Shiant Islands (Hebrides).

2.21. Some of these have been spectacularly successful notably Lundy and Ramsey (see below) but others less so because the eradication failed, the island was reinvaded or the eradication did not produce the expected response from the key species. Some have only been completed in recent years and so the impacts of the eradication project are not yet fully known (St Agnes and Gugh (Isles of Scilly), Shiant Isles).

- For seabird species where productivity is driven by food availability and the state of the marine ecosystem, the removal of land-based predators may only benefit where food is not limited. This underlines the need to understand whether there is a good food supply available to the beneficiary seabird species which are the focus of the IR proposal.
- For some sites, lack of monitoring data before and after eradication limits the understanding of the impacts of the eradication.

2.22. For long lived seabirds, the benefits of an IR scheme may not be clear until a decade after eradication i.e. the benefits for some of the IR schemes may not yet be clear. However, the

[12] Thomas, S., Brown, A., Bullock, D., Lock, L., Luxmoore, R., Roy, S., Stanbury, A. and Varnham, K. (2017) *Island restoration in the UK -past, present and future*. British Wildlife (April 2017): 231-242.
[13] Ibid
[14] Ibid

recovery on Lundy and Ramsey islands has been very strong, particularly for the burrow nesting species like Manx shearwater.

3. Summary of pre-requisites to assess an island restoration proposal

Introduction

3.1. The RSPB recognises that predator eradication or island restoration (IR) offers some potential to benefit guillemots and razorbills. However, we consider it premature to describe IR as a primary compensation measure for these two auk species. Below we set out why, and summarise the pre-requisites we consider necessary to assess an island restoration proposal.

3.2. Broome et al. (2014)[15] state:

'Eradication is not control 'intensified', it must remove the last individual which means taking individual behaviour into account from the very beginning and the level of resourcing is 'whatever it takes'...To under-achieve eradication... means failure. The approach must be to over-achieve it.'

3.3. Attempting a rodent eradication on an island is very different to undertaking rodent control. Although similar techniques are used in rodent control and eradication, there are important differences and the goal and therefore the mindset required are also different. Cromarty et al. (2002)[16] encapsulate it as follows:

"Assume that if something can go wrong it will and plan for it."

3.4. Therefore, eradication programmes tend to require considerably more planning, logistical and contingency arrangements than control operations. Insufficient planning and under-resourcing are understood to be key reasons for eradication attempts to fail.

3.5. All organisations and individuals involved in the operation need to understand that eradication is different from control. Every single individual of the target species must be killed for eradication to succeed. It requires commitment from the whole team to achieve this. Eradicating the last 1% of the invasive population can cost more and take longer than the other 99%. The need to invest more per area will increase relatively as the population density of the target species goes down.

3.6. In other words, IR is a complex and highly specialised conservation measure. Below, we have outlined the critical matters that need to be addressed in evaluating whether an IR scheme can be assessed as feasible, planned in sufficient detail and is capable of being implemented successfully over the long term.

Pre-requisites to assess an island restoration proposal

3.7. The RSPB considers the following elements are essential before a proposal to deploy IR as a compensation measure for specific seabird species can be properly assessed to determine if

[15] Broome, K.G., Cox, A., Golding, C., Cromarty, P., Bell, P. & McClelland, P. 2014: *Rat eradication using aerial baiting: Current agreed best practice used in New Zealand (Version 3.0).* New Zealand Department of Conservation internal document, Wellington, New Zealand.

[16] Cromarty, P.L., Broome, K.G., Cox, A., Empson, R.A., Hutchinson, W.M. and McFadden, I. 2002. Eradication planning for invasive alien animal species on islands – the approach developed by the New Zealand Department of Conservation. Pp 85-91 in: Veitch, C.R. & Clout, M.N. (eds) *Turning the tide: the eradication of invasive species.* IUCN SSS Invasive Species Specialist Group, Gland, Switzerland.

it will have a "reasonable guarantee of success" in line with Defra and EC guidance on compensation. The following evidence should be available for public examination before any decision to grant consent for an offshore wind farm scheme relying on IR as a compensation measure:

- A full-scale Feasibility Study carried out by a suitable eradication expert contractor to international best practice standards in order to firmly establish that the removal of Invasive Non-Native Species (INNS) for each island to be restored is feasible. They would need expertise relevant to the chosen approach to bait laying: ground-based versus aerial. This must be assessed against the 7 feasibility criteria set out in Table 1 on page 18 of the Manual of the UK Rodent Eradication Best Practice Toolkit (2018)[17] i.e.:
    - Technically feasible
    - Sustainable
    - Socially acceptable (see below)
    - Politically and legally acceptable
    - Environmentally acceptable
    - Capacity
    - Affordable
- The above will include but is not limited to detailed assessments of the selected islands regarding:
    - the presence/absence of the beneficiary seabird species and its historic and current population status;
    - Habitat suitability survey to determine the extent of unoccupied but suitable habitat available to the beneficiary seabird species;
    - Up to date survey to establish the presence of INNS of concern, on both target islands and areas from where they could reinvade;
    - A good understanding of the vulnerability of the beneficiary seabird species to the INNS to be targeted for removal on the selected islands and evidence to show how they will benefit from the IR proposal i.e. to be confident that INNS removal on the specified islands will support any claimed increase in the seabird's population.
- It must also include:
    - Detailed biosecurity and emergency response plans, based on a proper understanding of the risk of reinvasion by the target INNS and to be funded in perpetuity. This applies for the entire lifetime of the IR scheme (from implementation onwards, normally in perpetuity) and to both inhabited and uninhabited islands;
    - Evidence that full community support for the IR scheme (eradication, biosecurity and emergency response) has been obtained;
    - Evidence that relevant landowner/occupier consents have been obtained;
    - Evidence that relevant legal consents to carry out IR have been obtained where required e.g. ASSI/SSSI consents from the relevant statutory nature conservation

[17] See [redacted] Accessed 29 March 2022

body; information for any accompanying Habitats Regulations Assessment if an SPA/SAC/Ramsar site is likely to be affected; and Health and Safety Executive/Defra consent (depending on bait type and delivery method used).

3.8. We have provided the following extracts from the Manual of the UK Rodent Eradication Best Practice Toolkit at Annex 1 to this Appendix:

- Manual – UK Best Practice for Rodent Eradications, including:
  - Annex 1: Eradication techniques in the UK
  - Annex 4: Biosecurity Planning and incursion response

Critical importance of securing community support to ensure successful island restoration

3.9. A critical factor in the success of an IR scheme is securing the support of the affected human communities. Without this, IR schemes are at considerable risk of failure as it can result in weakness in key elements of an IR scheme, especially the eradication itself and then the ongoing biosecurity measures. Securing such support is a highly skilled job requiring both community engagement skills and species eradication knowledge.

3.10. In island communities, this will involve not just the main landowners, but all property owners or occupiers, boat launch and flight locations (both on relevant islands and any mainland access points) etc.

3.11. Stanbury et al 2017[18] point out that this key element of IR schemes has often been underestimated. They give the example of the (successful) IR scheme for St. Agnes and Gugh in the Isles of Scilly which took more than 10 years of preparatory work with the island communities involved. They considered 10 years a reasonable timescale for similar projects.

3.12. The RSPB considers this is a key consideration in assessing any IR compensation proposal. It is directly relevant to the aim to have compensation in place and effective before damage occurs. Any suggestion that securing community support is straightforward, or that it could either be short-circuited or completed within a couple of years, risks undermining the proposal and could result in failure and/or hostility to the IR scheme.

[18] Stanbury, A., Thomas, S., Aegerter, J., Brown, A., Bullock, D., Eaton, M., Lock, L., Luxmoore, R., Roy, S., Whitaker, S. and Oppel, S. (2017) *Prioritising islands in the United Kingdom and crown dependencies for the eradication of invasive alien vertebrates and rodent biosecurity*. European Journal of Wildlife Research 63: 31.

4. What evidence is there that island restoration benefits guillemot and/or razorbill?

How vulnerable are guillemots and razorbills to predation by INNS?

4.1. Understanding the vulnerability of a seabird species to predation by INNS requires a knowledge of the species' breeding habitat requirements and the potential for an INNS to access that habitat and predate the species.

4.2. In Table 2 below, we set out a summary description of the breeding habitat of each species: guillemot and razorbill. Using the scoring system from Stanbury et al 2017 (see paragraph 2.10 above), we have also indicated the RSPB's assessment of the likely severity of impact from (i) black rat and (ii) brown rat for each auk species.

Table 2: summary description of the breeding habitat of guillemot and razorbill and the RSPB's general assessment of the likely severity of impact of black rat and brown rat on that species (based on scoring system in Stanbury et al 2017)

Species	Breeding habitat (from JNCC)	Likely severity of impact from black rat	Likely severity of impact from brown rat
Guillemot	Breeding areas are situated where the birds are safe from mammalian predators. This means that on the mainland, they are confined to sheer cliffs or in among boulders at the bases of cliffs where access is difficult even from the sea. On islands, cliffs and the tops of large stacks are preferred but where such habitat is absent they breed among rocks or even on flat open ground.[19]	Score = 1 Small to moderate impact that would reduce population size but allow the seabird species to persist	Score = 1 Small to moderate impact that would reduce population size but allow the seabird species to persist
Razorbill	Breed mainly on small ledges or in cracks of rocky cliffs and in associated scree, and on boulder-fields.[20]	Score = 2 Severe impact that would eventually lead to local extinction of the seabird species	Score = 2 Severe impact that would eventually lead to local extinction of the seabird species

4.3. The RSPB's general assessment is that guillemots are less vulnerable to rat predation than razorbills due to their general preference for sheer cliffs to nest. This should make them less accessible to both rat species.

[19] See: https://jncc.gov.uk/our-work/guillemot-uria-aalge/ Accessed 29 March 2022
[20] See: https://jncc.gov.uk/our-work/razorbill-alca-torda/ Accessed 29 March 2022

4.4. In addition, based on practical knowledge of the two rat species, it is considered black rat is a higher risk to both species due to its greater agility and ability to access difficult nesting locations. This does not impact the classification used in Stanbury et al 2017 but should be considered carefully on any specific island of interest.

4.5. Therefore, in summary (and in general terms):

- Razorbills are thought to be more vulnerable than guillemots to predation by black and/or brown rat and risk of local extinction due to the accessibility of their nesting habitat;
- Black rat is likely to be a greater threat than brown rat to either guillemot or razorbill due to its greater agility and potential ability to access their nesting habitat.

4.6. Black rat has a highly restricted distribution in the UK and crown dependencies. Following its successful eradication from Lundy and the Shiant Islands it is the RSPB's understanding that it is now restricted to the following islands:

- Inchcolm (Firth of Forth);
- Channel Islands: black rats confirmed on Sark only and no black rats have been reported from Guernsey in recent years (J. Henney, States of Guernsey pers.comm.).

4.7. Since publication of the Stanbury et al 2017 article, small mammal trapping work has been carried out on Herm which found only brown rats present.

4.8. As set out above, a detailed feasibility study of potential IR locations would be required before it could be determined what level of risk black rat, brown rat or other INNS pose to either guillemot or razorbill. This would include an assessment of the availability of suitable but unoccupied breeding habitat for each species to determine if there could be a benefit to either auk species from an eradication scheme.

5. Assessment of Hornsea 4 predator eradication proposals

Introduction

5.1. This section sets out the RSPB's initial assessment based on the material provided by the Applicants for its proposed compensation measure, predator eradication, in respect of guillemots and razorbill. We have assessed it against the criteria set out in the EC guidance Managing Natura 2000[21] (summarised in Table 4 in our main Written Representation document) and the pre-requisites set out in section 4 above.

Table 3: RSPB review of Hornsea Four predator eradication compensation proposals

EC criteria/additional consideration	RSPB comments
Targeted	As set out in section 5 above, there is limited evidence that predator eradication is of benefit to either guillemot or razorbill as neither species has been the primary beneficiary of previous island restoration schemes. The RSPB is aware that the Applicant has carried out a basic comparison of Lundy with two nearby seabird colonies: Castlemartin Coast and Skomer (see pages 17-19, section 6.2, Volume B2 Annex 8.3: Compensation measures for FFC SPA: Predator Eradication: Ecological Evidence, APP-196). However, this is not a statistical analysis. Before it is possible to draw sound conclusions, it would be necessary to carry out a statistical comparison to understand the wider influences on population dynamics of Lundy and other suitable comparator sites. In the absence of a detailed feasibility study for a specified location (see section 4 above), the RSPB cannot have confidence that the measure would benefit either species. To determine whether an IR scheme will, rather than might, benefit either species in a selected location requires detailed scrutiny of a feasibility study and associated work as part of the examination process. This is why leaving site selection and related issues to the post-consent phase is not acceptable. In addition, based on the potential locations identified by the Applicant, it is not clear which populations of guillemot and/or razorbill would benefit, or whether any such benefit would accrue to the UK SPA network. It is likely that any potential benefits would be to the wider biogeographic population, not the Flamborough and Filey Coast SPA. The implications of this in terms of meeting the legal requirement to protect the coherence of the National Site Network for guillemots and razorbills need to be properly understood.
Effective	We do not have sufficient information to be able to make a valid assessment of whether an IR scheme would be effective for either

[21] EC (2018) *Managing Natura 2000 sites – The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (21/11/18) C(2018) 7621 final.

EC criteria/additional consideration	RSPB comments
	guillemot or razorbill. As set out in section 5 above, a detailed feasibility study of potential IR locations is required before it could be determined what level of risk black rat, brown rat or other INNS pose to either guillemot or razorbill. This would include an assessment of the availability of suitable but unoccupied breeding habitat for each species to determine if there could be a benefit to either auk species from an eradication scheme. Therefore we agree with Natural England that while an IR scheme is theoretically possible, we cannot have certainty that the measure would be deliverable (page 8, Appendix C, RR-029). The need for a comprehensive and agreed long-term monitoring plan to assess the effectiveness of any IR scheme is required as part of the examination process. Issues it should cover include: • Type, nature and timescale of monitoring to assess whether eradication has worked; • Type, nature, frequency etc of monitoring to detect reinvasion; • how best to monitor and assess colonisation and breeding success (e.g. productivity) and how to relate this to agreed compensation objectives.
Technical feasibility	Island Restoration is a complex and highly specialised conservation measure. Proven techniques exist to successfully eradicate black and brown rat from islands provided those techniques are implemented to a high standard and by experienced professionals, complemented by rigorous biosecurity and emergency response plans to deal with reinvasion risks. As noted by Natural England (Appendix C, page 8), eradication programmes are "challenging and can be prone to delays and other issues arising from unforeseen circumstances". Hence is it critical that a full feasibility study for a selected location is presented for scrutiny to determine whether it (i) meets the seven feasibility criteria and (ii) will benefit guillemot and/or razorbill. A detailed Implementation Plan must accompany this so that it can be tested as part of the examination process. It is not acceptable to leave such critical detail to the post-consent phase as is proposed. This includes demonstrating in full the level of community support which is a critical element in determining whether an IR proposal will be technically feasible. As we set out in section 4, it is vital that there is full community support to ensure the long-term success of the implementation and associated biosecurity and emergency response plans.
Extent	Due to concerns with the baseline characterisation of the impacts of Hornsea Project Four on the Flamborough and Filey Coast SPA (see section 4 of main Written Representation) it is not currently possible to agree impact levels and therefore compensation levels.

EC criteria/additional consideration	RSPB comments
	Further work would then be needed to agree how any detailed compensation objectives should be set, in part based on the location selected. Given the lack of key information, this is not currently possible.
Location	No specific location has been proposed. Therefore, it is not possible to evaluate the Applicant's proposals at this stage, pending provision of a full Feasibility Study (see section 4 above). We note here the Deadline 1 submissions from the Applicant which indicate that its sole focus is now on predator eradication located somewhere in the Bailiwick of Guernsey, with all other suggested locations now dropped i.e. Rathlin Island, Isles of Scilly and islands off the Devon coast, along with any suggestion of the use of predator control (see above). The RSPB welcomes the removal of Rathlin Island, which we had informed the Applicant in early September 2021 is already the site of a fully funded island restoration project. We will respond in full to the following documents at Deadline 3 once we have had the opportunity to review the new information provided: • REP1-061: G1.33 - Predator Eradication Island Suitability Assessment: Bailiwick of Guernsey • REP1-022/REP1-023: Predator Eradication Roadmap (clean and tracked versions) We simply note here is that it is our understanding that several of the possible islands in the proposed area would be vulnerable to reinvasion. A Feasibility Study will be required to assess the risk of reincursion in detail, on both inhabited and uninhabited islands, and outline the measures that would be required to prevent (or respond to) reinvasion. In addition, the choice of Guernsey, located outside UK jurisdiction, as a preferred location raises legitimate questions in respect of long-term implementation, with particular regard to how the UK Government could ensure that any measures could be enforced outside of its legal jurisdiction. We have set out these concerns in detail in section 6 of our Written Representations and in summary we would expect the Applicant to provide details during the examination on the relevant legal mechanisms and agreements that would need to be put in place (and provide evidence to show it is confident of securing) so that they can be properly examined to determine whether or not the proposed measures can be properly secured. In addition, we believe that any enforcement measures can only relate to the Application since within UK jurisdiction and therefore some

EC criteria/additional consideration	RSPB comments
	form of "stopping" the operation of the Application would be the only choice.
Timing	We note that the Applicant has allocated 2 years to carry out the eradication phase. In the absence of a detailed Feasibility Study for the final location(s), it is not possible to say with any certainty at this stage how long the eradication phase of an island restoration project would take. In addition, is the need for ongoing biosecurity and emergency response plans. As set out in section 4 above, this includes time to secure local community and stakeholder support for the eradication, pre- and post eradication biosecurity, and emergency response plans. The need for such community supports applies to both inhabited and uninhabited islands to ensure they are part of the long-term solution. Undue haste on this critical aspect risks alienating local communities. **We consider this a critical element of successful island restoration which must not be underestimated.** We agree with Natural England's comments on timing (Appendix C, p9) that implementation before impact is not the same as delivering of the functional compensation before impact. Determining what comprises functional compensation is related to agreement on detailed compensation objectives and how success should be measured, which in turn will be related to relevant breeding ecology metrics.
Long-term implementation	**Length of time over which the compensation measure should be in place** We refer the Examining Authority to our generic comments on this issue at paragraphs 5.28-5.30 in our main Written Representation document. For the reasons set out there, we consider it unacceptable to limit the lifetime of the compensation to that of the offshore wind farm itself. To be successful it will need to be delivered to best practice standards. At present, we have no detail on the Applicant's (long-term) implementation proposals and therefore are unable to comment on whether or not they meet the requirements for a successful IR scheme. In general terms, we are not persuaded the suggested implementation timetable (over winter 2023/24) will be workable and require more detailed information. For example: • availability of suitable experts -most such experts are booked up several seasons in advance;

EC criteria/additional consideration	RSPB comments
	• securing full community and stakeholder support (see section 4 as well as comments under Technical Feasibility and Timing above). **Biosecurity and monitoring for reinvasion** Biosecurity and emergency response plans must be in place for the lifetime of the compensation measure. Monitoring for reincursion should be monthly using appropriate best practice monitoring methods. This is to enable a swift response to any incursion by an INNS i.e. before breeding occurs and a population becomes established (i.e. the island is reinvaded). Therefore a detailed biosecurity and monitoring plan needs to be submitted to the examination as part of the feasibility study.
Additionality	The RSPB agrees with Natural England that, as with artificial nesting structures for kittiwakes, it will be very difficult to ascertain whether any breeding birds are additional or have simply redistributed (page 9, Appendix C, RR-029).

6. Overall Conclusions

6.1. To succeed, IR needs the effective targeting of 100% of the INNS to achieve eradication, supported by comprehensive measures to keep the risk of reinvasion low and ongoing capacity to respond effectively to any biosecurity breach. Therefore, it requires the feasibility of removing the INNS from each island to be restored to be firmly established, rather than assumed, combined with ongoing commitment among key stakeholders. This is to ensure successful eradication is sustained through implementation of biosecurity and (48-hour) emergency response plans and securing the resources necessary to implement these measures in perpetuity.

6.2. The level of detailed information and assessment described below is critical to bottom out before deciding whether an IR scheme is feasible to proceed to implementation. In the context of determining whether a compensation measure is feasible and therefore whether DCO consent should be granted, this is particularly important.

6.3. To have confidence IR will succeed in restoring the seabird species it is intended to benefit requires a good understanding of the vulnerability of the beneficiary seabird species to the INNS to be targeted for removal, and an understanding of the risk of reinvasion by the target INNS (assuming they have been successfully eradicated).

6.4. The RSPB recognises that predator eradication or island restoration (IR) offers some potential to benefit guillemots and razorbills. However, we consider it premature to describe IR as a primary compensation measure for these two auk species.

6.5. IR is a complex and highly specialised conservation measure. The RSPB considers the following elements are essential before a proposal to deploy IR as a compensation measure for specific seabird species can be properly assessed to determine if it will have a "reasonable guarantee of success" in line with Defra and EC guidance on compensation.

6.6. A full-scale Feasibility Study carried out by a suitable eradication expert contractor to international best practice standards in order to firmly establish that the removal of Invasive Non-Native Species (INNS) for each island to be restored is feasible. This must be assessed against the 7 feasibility criteria set out in Table 1 on page 18 of the Manual of the UK Rodent Eradication Best Practice Toolkit (2018).[22] This will include but is not limited to detailed assessments of the selected islands regarding:

- The presence/absence of the beneficiary seabird species and its historic and current population status;
- Habitat suitability survey to determine the extent of unoccupied but suitable habitat available to the beneficiary seabird species;
- Up to date survey to establish the presence of INNS of concern, on both target islands and areas from where they could reinvade;
- A good understanding of the vulnerability of the beneficiary seabird species to the INNS to be targeted for removal on the selected islands and evidence to show how they will benefit from the IR proposal;

[22] See [redacted] Accessed 29 March 2022

- Detailed biosecurity and emergency response plans, based on a proper understanding of the risk of reinvasion by the target INNS and to be funded in perpetuity;
- Evidence that full community support for the IR scheme (eradication, biosecurity and emergency response) has been obtained;
- Evidence that relevant landowner/occupier consents have been obtained;
- Evidence that relevant legal consents to carry out IR have been obtained where required.

6.7. In general terms:

- Razorbills are thought to be more vulnerable than guillemots to predation by black and/or brown rat and risk of local extinction due to the accessibility of their nesting habitat;
- Black rat is likely to be a greater threat than brown rat to either guillemot or razorbill due to its greater agility and potential ability to access their nesting habitat.

6.8. At present, the Applicant has not provided any information on the precise location it intends to carry out any IR scheme. Nor is there a detailed feasibility study and associated implementation and biosecurity plans which can be used to assess whether or not any selected location is both suited to IR and which provides evidence that either guillemot and/or razorbill will benefit.

6.9. Therefore, we agree with Natural England (page 8, Appendix C, RR-029) that is not possible to:

"have certainty that the measure will be deliverable or make any assessment of the scale of the measure that might be achievable."

6.10. At present, the RSPB does not have confidence that the measure would benefit either guillemot or razorbill. To determine whether an IR scheme will, rather than might, benefit either species in a selected location requires detailed scrutiny of a feasibility study and associated plans, as part of the examination process.

6.11. Therefore, the results of any detailed feasibility study and associated implementation plans must be presented to the examination for scrutiny by the Examining Authority and interested parties as soon as practicable. Should Guernsey be the chosen location, located outside UK jurisdiction, we would expect the Applicant to provide details during the examination on the relevant legal mechanisms and agreements that would need to be put in place (and provide evidence to show it is confident of securing) so that they can be properly examined to determine whether or not the proposed measures can be properly secured. In addition, we believe that any enforcement measures can only relate to the Application since within UK jurisdiction and therefore some form of "stopping" the operation of the Application would be the only choice.

Appendix 1: Extracts from the Manual – UK Best Practice for Rodent Eradications

- Manual – UK Best Practice for Rodent Eradications
- Annex 1: Eradication techniques in the UK
- Annex 4: Biosecurity Planning and incursion response

CURRENT RECOMMENDED PROCEDURES FOR UK (BAIT STATION) RODENT ERADICATION PROJECTS

Contents

This document can be cited in references as:

Thomas, S., Varnham, K. & Havery, S. 2017: *Current Recommended Procedures for UK (bait station) rodent eradication projects.* (Version 4.0) Royal Society for the Protection of Birds, Sandy, Bedfordshire.

1 Introduction

The Recommended Procedures manual (this manual and the associated Annexes) is an advisory toolkit for planning rodent eradications on islands in the UK using bait stations and anticoagulant rodenticide baits. It provides technical advice on specific methods to be used in the UK, as well as an eradication project management framework which is applicable to projects everywhere.

The objective of this toolkit is to provide a single port of call for people interested in carrying out, or simply learning more about, ground-based rodent control, eradication and biosecurity projects in the UK. It is envisaged that the toolkit will mainly be used by conservation managers and practitioners planning or considering carrying out rodent control, eradication or biosecurity work. Use of the Best Practice Toolkit aims to give UK agencies the ability to embark on invasive rodent management projects with greater confidence of achieving the desired island restoration goals.

The manual is based on the New Zealand Department of Conservation's *Best Practice for rat eradication – bait station* (Broome *et al.* 2011) and the Pacific Invasive Initiative's (PII) Resource Kit for Rodent & Cat Eradication, and has been adapted for use in the UK. This Best Practice Toolkit has been compiled, and contributed to, by several UK governmental and non-governmental organisations involved in island restoration, these being: **Royal Society for the Protection of Birds (RSPB), Animal and Plant Health Agency (APHA), Department for Environment, Food and Rural Affairs (Defra), GB Non-Native Species Secretariat (GB NNSS), Joint Nature Conservation Committee (JNCC), National Trust, National Trust for Scotland, Natural England, Natural Resources Wales (NRW), Scottish Natural Heritage (SNH), Scottish Wildlife Trust (SWT) and the Isles of Scilly Wildlife Trust.** The toolkit has also received input from **Wildlife Management International Ltd (WMIL)**, and draws heavily from the documentation produced by WMIL for various rat eradication projects undertaken in the UK. We are extremely grateful to these organisations for allowing us to adapt their resources to the UK experience. Please pass new information and suggested improvements for this resource to Sophie Thomas [redacted]

While many of the rodent control methods used were originally developed in Europe, eradication techniques for successfully removing rodents from islands were pioneered by conservationists in New Zealand and have been honed over the past 50 years, resulting in the publication of internationally-acclaimed best practice protocols underpinned by empirical evidence. The UK Rodent Eradication Best Practice Toolkit is focussed on eradication (though may be of interest to those involved in rodent control) and is based on that best practice guidance from the New Zealand Department of Conservation (NZ DOC), and the Pacific Invasive Initiative's (PII) Rodent & Cat Eradication Toolkit (itself based on the New Zealand model and expanded to tropical islands).

It is necessary to create a bespoke toolkit for use in the UK as certain procedures advocated by international best practice cannot be applied here. Where specific guidance has been written for the UK and is not applicable to work internationally (including in the UK Overseas Territories), follow the guidance provided in the relevant sections of the PII Resource Kit or New Zealand protocols.

The objective of this manual is to provide a single port of call for people interested in carrying out, or simply learning more about, ground based rodent control, eradication and biosecurity projects in the UK. This has been produced by collating existing best practice, adapted to the legal, environmental and social conditions in the UK. Rodent eradication projects have become a mainstream conservation tool in recent years but high quality information on how to maximise their chances of success can be hard to come by, especially within the UK context. We envisage that the manual will mainly be used by conservation managers and practitioners planning or considering carrying out rodent control, eradication or biosecurity work.

The invasive non-native rodent species present in the UK are brown (or Norway) rat *Rattus norvegicus*, black (or ship or roof or bush) rat *Rattus rattus* and house mouse *Mus musculus*. Experience with bait station operations targeting house mouse is more limited and additional expert advice should be sought if mice are your target species.

1.1 Island restoration

Island restoration describes a set of conservation actions undertaken in order to protect the wildlife – particularly colonial breeding grounds or endemic ecosystems – that occur on many islands. Island restoration projects tend to have three core actions:

1. **Eradicating invasive non-native species from the island(s)**;
2. **Implementing strict biosecurity measures *ad infinitum*** to prevent subsequent reinvasion or arrival and establishment of new non-native species; and, as necessary,
3. **Assisting recovery of species/ecosystems**, e.g. further habitat management / translocation of extirpated species.

These Recommended Procedures cover eradication (1) and biosecurity (2), but not actions to further promote wider island restoration/ecosystem recovery (3). Planning for all three, however, is recommended from the outset as they are interdependent i.e. biosecurity is a fundamental requirement for eradications and island restoration plans provide the context and potentially goals and success measures for eradication projects.

The spread of invasive non-native species presents one of the greatest threats to biodiversity globally: invasive species are the primary driver of biodiversity loss on islands and the second largest everywhere else. More than 70 species of bird have been driven to global extinction by invasive species since 1500, with rodents implicated in the extinction of at least 40 of them (BirdLife International 2008a). The impacts of invasive species are continuing, with population declines in 625 threatened bird species attributed to this cause (BirdLife International 2008b).

Many of the UK's island ecosystems have been devastated by the arrival and establishment of invasive non-native species, although often the extent of damage is masked by a dearth of historic records, especially quantitative ones. Introduced predators such as rats, hedgehogs, feral cats and mink have caused particularly catastrophic damage to waders and seabird colonies, undoubtedly causing numerous extirpations as well as contributing to ongoing declines.

The UK has various international commitments which the eradication of invasive non-native species on islands can help to meet, including:

- **Convention on Biological Diversity** (Article 8(h)) and the Aichi Targets;
- Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (The **Habitats Directive**);
- Directive 2009/147/EC on the Conservation of Wild Birds (The **Birds Directive);**
- **EU Marine Strategy Framework Directive** (2008/56/EC);
- **EU Regulation on the prevention and management of the introduction and spread of invasive alien species** (1143/2014).

UK-based conservation organisations have a relatively long and successful track record in the removal of target non-native species as part of island restoration projects, with 16 successful eradications of four invasive species over 15 islands, of which 10 were successful rodent eradications using rodenticides from nine islands (DIISE, 2015). These successful rodent eradications were:

- Ailsa Craig, a 99 ha island in the Outer Firth of Clyde, Scotland, was the first successful brown rat eradication in the UK in 1992. Since then seabird species such as Atlantic puffin, and black guillemot have re-colonised;
- In 1997 brown rats were successfully eradicated from Handa, a 309 ha island off the west coast of Sutherland, Scotland (which has since been reinvaded);

- In 1998 brown rats were successfully eradicated from Puffin Island, off the coast of Anglesea, Wales;
- In 2000 brown rats (and feral cats) were eradicated from Ramsay Island, a 260 ha island in Pembrokeshire, Wales. Following the eradications, Manx shearwater numbers almost quadrupled and European storm-petrel were recorded breeding for the first time in 2008;
- In 2004 black and brown rats were eradicated from Lundy Island (i.e. eradication of two rodent species), a 445 ha island in the Bristol Channel, England. Total seabird numbers recorded have doubled in the ten years since the eradications, with the breeding population of Manx shearwaters increasing more than tenfold, and European storm-petrel were recorded breeding for the first time in 2014;
- Brown rats were successfully eradicated in 2008 from Isle of Canna and Sanday (i.e. eradication from two islands), in the Inner Hebrides, Scotland, which is the largest rat eradication project in UK so far at a combined total size of 1,317 ha (Canna is 1,126 ha; Sanday is 191 ha); and
- St Agnes (105 ha) and Gugh (37 ha), in the Isles of Scilly, England, is currently one of the largest successful community-lead eradication projects, with a successful brown rat eradication in 2016 (i.e. eradication from two islands). Manx shearwater chicks had fledged successfully and breeding European storm petrel returned within a year of the eradication.

UK-based conservation organisations have also been involved with the successful removal of target non-native species as part of island restoration projects in the UK Overseas Territories, which have different ecological and legal considerations to domestic UK. For example, a ground-based eradication of black rats from Dog Island, a 207 ha island within the UK Overseas Territory of Anguilla, West Indies, was successful in 2014 and has benefitted Critically Endangered species of marine turtle and many internationally important seabird species.

Whilst the potential benefits of eradicating invasive rodents from islands are obvious, they are not always successful. About 5% of brown rat, 8% of black rat, and 19% of house mouse eradication attempts worldwide have failed and a higher rate of failure for rats is reported from the tropics (around 17%) compared with temperate islands (Howald *et al.* 2007, figures for aerial and ground-based projects combined). As failed attempts may be less well documented than successful eradications, all these figures are likely underestimates.

Furthermore, in some cases where projects have succeeded in removing invasive predators, the recovery of native species has been slower than anticipated or, in the case of recolonisation, is yet to be realised. For example, neither European storm-petrel nor Manx shearwater has returned to Ailsa Craig which has been rat-free for over 15 years. The possible reasons for this are not understood. Recent research suggests that the distance from suitable source populations is the most important factor influencing the natural recolonisation of islands by seabirds (Buxton *et al.* 2014), although geographical or climatic factors may also play an important role in the suitability of an island for a particular species (Lambert *et al. submitted*). Historical reports of a particular species on an island may not be a reliable indicator of habitat suitability as circumstances/conditions may have changed since the species was first present.

Sometimes, island restoration attempts have had significant unanticipated and unintended consequences. For example, over 400 poisoned birds were found on Rat Island in the Aleutians, USA after the rat eradication project carried out there (Buckelew *et al.* 2011). Deaths of non-target species as a result of poisoning have also occurred in some UK rat eradication projects. Often, some level of mortality amongst non-target species is anticipated and accepted – it may be unavoidable.

A refinement of eradication techniques has helped reduce known non-target deaths in more recent years, but risks remain in every project. Indeed, as some top predators show signs of recovery in the UK, the risks of non-target mortality may be increasing. However, the long-term conservation benefits are likely to outweigh any temporary losses.

Other damaging consequences may arise when interactions between species are overlooked or not understood, leading to issues such as mesopredator release[1] and hyperpredation[2], potentially leading to *increased* predation of vulnerable species after the removal of rodents/other invasive species. Removing rodents may also result in an increase in invasive plants and other undesirable species as they are released from rodent predation. Detailed scrutiny of likely ecosystem interactions in the aftermath of target species removal is imperative.

Attempts at eradicating invasive species from islands come at high reputational risk to conservation bodies and carry risks to animal welfare. Island restoration projects are expensive and so present a resource risk to organisations, too. Ensuring all projects are undertaken to a common operational standard, as outlined in these Recommended Procedures, will reduce each of these risks whilst also improving the chances of success.

[1] a process whereby mid-sized carnivorous mammals became far more abundant after being "released" from the control of a larger carnivore.

[2] an enhanced predation pressure on a secondary prey due to either an increase in the abundance of a predator population or a sudden drop in the abundance of the main prey.

1.2 The Recommended Procedures

Whilst no wildlife response can be guaranteed, careful project selection and planning, and a commitment to undertake all phases of island restoration to best practice standards offers the greatest chances for achieving and sustaining the benefits of eradication.

This manual comprises two major components:

1. guidelines on project management processes – applicable to all eradication projects (covered mainly in this document); and
2. guidelines on eradication and biosecurity methods - tailored for UK rodent eradication projects (covered mainly in the Annexes).

The UK Rodent Eradication Best Practice Toolkit does not currently cover removal of other invasive species aside from rodents, or best practice for restoring extirpated species to islands.

The Process diagram in Fig. 1 (modified from the PII Resource Kit) shows the typical stages in the life cycle of an eradication project and how stakeholder engagement, transparent documentation, monitoring and evaluation, biosecurity and independent expert review are ongoing activities throughout all or most of the project phases.

Figure 1 – The Process diagram showing the typical stages in the life cycle of an eradication project (modified from the PII Resource Kit).

Each of the six major stages of rodent eradication projects depicted in the Process diagram require the production of project documents which should be reviewed by an Independent Technical Expert (**NB** - project documents with templates available are coloured in **purple**). The importance of good documentation cannot be overstated: thorough, accurate and timely project documentation is fundamental to understanding success and failure.

Transferring learning from one project to another is extremely important and these documents are essential planning and communication tools. Having all project details well documented will facilitate project communication and save a lot of time as the project progresses. Moreover, eradication projects span many years during which time there are likely to be changes in personnel – it is vital new staff can get up to speed quickly and that knowledge does not disappear along with departing staff. Good documentation from the field is also needed.

For each of the **major documents** (listed within toolkit homepage) that require technical, eradication-specific knowledge in order to be completed, these Recommended Procedures provide:

- Technical guidance and planning advice;
- A document template and checklist to assist with completion; and
- A list of sources of additional information.

For other, equally important but less subject-specific documents, this manual provides brief guidance only or no guidance. Examples include the Health and Safety Plan, Communications Strategy and Fundraising Strategy. The recommended procedures stipulate that independent technical input is sought in the production of many of these documents also, to ensure they are fit for purpose for a rodent eradication project.

INDEPENDENT REVIEWS & INDEPENDENT TECHNICAL ADVISORS

Independent review of all key project documents is integral to project success and helps build local capacity. Independent Technical Advisors should be approached to provide timely advice and mentoring as well as undertake independent checks of key project documentation (e.g. Feasibility Study, Operational Plan, Eradication Readiness Checks, Project Plan, Communications Plan, Health & Safety Plan).

An independent review is when a knowledgeable expert who has no relationship with or involvement in the project reads a document (if possible this could also include a site visit) and, using their experience and expertise, provides feedback to the project management team. They should be able to speak their mind and not come with "baggage" associated with their organisation or yours. Independent reviews give the project team the opportunity to check that they are doing everything they need to do, that they have made the correct decisions and are considering everything relevant to the project. For more information on how to find potential Independent Technical Advisors contact Sophie Thomas (Sophie.Thomas@rspb.org.uk).

DO NOT leave the first review of a document until you have nearly completed it as you may have spent a lot of time writing only to learn that you have made some serious mistakes or omissions – **review often and early.**

It is usual to have more than one reviewer review a document. Using the same advisors throughout the whole project will allow them to build up an in-depth knowledge of the project and make their advice and reviews more useful. Independent reviewers often help problem solve and become more invested in the project as time goes on.

1.3 How to use this manual

Read the whole of Sections 1 and 2 and the relevant Stage Section in this document, as well as all relevant parts of the associated Annexes before commencing work on a particular stage.

Paragraph numbering such as this:

1.3.1 Numbering denotes actions you must take to adhere to the Recommended Procedures.

Paragraphs within this overview document with no numbering contain useful information which should help you plan and execute the project. In the Annexes (1-6), all paragraphs are numbered for ease of reference.

You do not have to use the document templates, but if you choose not to, the contents of your document should still cover all of the points and checklists provided within the templates.

1.4 At the outset – what it takes for eradication to succeed

Eradication is not control 'intensified', it must remove the last individual which means taking individual behaviour into account from the very beginning and the level of resourcing is 'whatever it takes'...To under-achieve eradication... means failure. The approach must be to over-achieve it.'

Broome *et al.* 2014.

Attempting a **rodent eradication** on an island is very different to undertaking **rodent control**. Although *similar* techniques are used in rodent control and eradication, there are important differences and the goal and therefore the mindset required are also different. The paper by [redacted]) is **highly recommended reading** at the outset for everyone who wishes to be involved in an eradication project.

Eradication programmes tend to require considerably more planning, logistical and contingency arrangements than control operations. Insufficient planning and under-resourcing are understood to be key reasons for eradication attempts to fail.

All organisations and individuals involved in the operation need to understand that eradication is different from control. Every single individual of the target species must be killed for eradication to succeed. It requires commitment from the whole team to achieve this. Eradicating the last 1% of the invasive population can cost more and take longer than the other 99%. The need to invest more per area will increase relatively as the population density of the target species goes down.

STAKEHOLDER SUPPORT

Stakeholders will be many and varied, but no project will succeed without the full backing of the people who live on the island and those who own or manage land there. Respectful and carefully planned communication is vital. You **should involve an expert in community liaison/ consultation from the outset**. Island residents, land owners and land managers must want the project to succeed, and must be willing to take on their (significant) share of the biosecurity arrangements if the benefits of eradication are to be realised and sustained.

Ten years is not an unreasonable timescale for initial community engagement to eradication implementation, depending upon your starting point, the value placed upon seabirds/other benefit species by the islanders/community, and the strength of your partnership. Producing a local conservation strategy with key partners and embedding it as an action within a local community-based strategy may help lay some of the groundwork for restoration projects.

If you cannot secure community backing, you should be prepared to walk away from the project until such time as islanders, land owners and land managers wish to proceed with an eradication attempt.

Even when you have secured stakeholder support, it will need to be maintained throughout the entire project. The larger the community the longer you are likely to need to ensure that people are all at the same position of understanding at each of the various stages of the project. This will require significant, on-going liaison and the establishment of effective two-way lines of communication. Do not underestimate the time implications of securing and maintaining the support of stakeholders.

1.5 When eradication is not appropriate

Quite often, and for a variety of reasons, rodent eradication on an island may not be possible. It may be impractical due to the size of the island and its resident human population, or considered unsustainable if the island is a tidal island or is so close to the mainland or other islands with rats that rodents are likely to reinvade regularly.

The conservation imperative for reducing the impact of invasive species on species of conservation interest on these islands, however, is likely to remain high. In such cases, **rodent control** techniques may be appropriate.

You should be very clear from the outset whether you are attempting to eradicate or control rodents. This will be linked to the conservation outcomes you want to achieve – some outcomes will only be possible with rodent eradication, for example if bird species very sensitive to the presence of rats are found there.

These guidelines specifically address the recommended procedures for eradication. However, much of the detail contained in the Annexes will provide useful information for a control programme as well (for example on trapping techniques, bait station design, mitigation of risks of rodenticide use, rodent behaviour, surveillance). There is a rodenticide Stewardship scheme in place which offers **best practice guidance for rodent control** (CRRU 2015). That **best practice must be followed**.

2 Overview of the major stages in rodent eradication for island restoration projects

This section provides an overview of the process and tasks involved in managing an eradication project. Further detail on stages 2-6 outlined below can be found in Sections 3 to 7.

2.1 Stage 1 - Project Selection

2.1.1 Many islands are in need of restoration, and resources are limited. A strategic approach to project identification and selection is crucial. Stakeholders, funders and potential project partners will all need to be convinced that the project is worthwhile and, moreover, that it should be given priority over work on other islands/other areas of conservation need. The 'need' for the project need is also required in order to justify the outdoor use of rodenticides.

2.1.2 Restoration projects have often been embarked upon opportunistically. In some cases this has worked, but it can lead to under-resourced projects which are not thought through or planned properly, are therefore more likely to fail and which are of dubious benefit. Such an approach can be unhelpful to future projects because they divert resources and can lead to a poorer track record of restoration making it harder to secure investment from funders.

2.1.3 A transparent record of decision-making which demonstrates the reasons for a project's selection should be kept. Ensure selection criteria and weightings are clearly defined and scored. It should be recognised however that if opportunities arise (particularly funding) for lower priority islands, the project should not be discounted solely on the basis of its priority position.

2.1.4 Project selection criteria should be aligned with relevant conservation strategies/targets, especially ones to which UK government/partners are committed (e.g. Marine Strategy Framework Directive, Birds and Habitats Directives, Convention on Biological Diversity).

2.1.5 An initial, independently-reviewed stakeholder Communication Strategy should be written. This will require regular review at key stages of the project. Once this is written, inform stakeholders of the outcomes of project selection. A useful communications plan template can be accessed from the New Zealand DOC Standard Operating Procedures webpage.

Project selection is not considered further in this toolkit. However, a useful document 'Guidelines on Project Selection', which includes a template for comparing weighted criteria is available from PII. We advise reference to the UK, Isle of Man and Channel Islands prioritisation database 2015 (Stanbury et al. 2017), which can be used to create lists of priority sites for a number of species of conservation concern or geographical areas. Contact Sophie Thomas sophie.thomas@rspb.org.uk or Karen Varnham karen.varnham@rspb.org.uk regarding access to the database.

2.2 Stage 2 - Feasibility Study

2.2.1 Island restoration projects usually take many years to develop, plan and implement.

2.2.2 Projects should not be developed until a comprehensive, expert-led and independently reviewed **Feasibility Study** is completed which concludes that eradication of the target species is both feasible *and* sustainable.

2.2.3 All eradication projects have a risk of failure, and all islands are at some risk of subsequent reinvasion(s) by the eradicated species or being invaded by species new to the island. The Feasibility Study establishes just how high the risks are for a particular island.

2.2.4 The Feasibility Study is used to:

- Articulate the goals of the project and the rationale behind them;
- Define the scope and identify the size of the project (which invasive species will be eradicated and which islands need to be included for eradication to be effective);
- Decide whether or not the target species can be successfully eradicated from all areas of the project site and whether measures to manage their risk of return can be resourced; and
- Identify key issues that will need to be addressed before the eradication operation is undertaken, if the project is to have a high chance of success.

2.2.5 Ultimately, it determines whether or not the project is feasible *at the current time*. If eradication is deemed infeasible, a control programme *may* be appropriate. It may also recommend a timeframe for assessing the island in the future as technology develops or community attitudes change.

2.2.6 Conducting a Feasibility Study contributes to clear thinking about whether or not to proceed with an eradication project. It helps inform decision-making throughout the remainder of the project and can ensure resources are not invested in projects that are likely to fail either in the short- or long-term. It can also be used to support funding applications for the project.

2.2.7 No Feasibility Study can be undertaken without a site visit by experts capable of assessing (between them) all seven of the feasibility criteria (technically feasible, sustainable/ biosecure, sufficient capacity, financially-, socially-, legally-, and environmentally-viable).

2.2.8 Feasibility should be reassessed if critical factors change or new issues emerge before the eradication attempt gets underway (Stage 5 - Implementation). For example, a change in stakeholder support may render the project untenable or the necessary ongoing biosecurity unsustainable. If considerable time has elapsed since the initial Feasibility Study was undertaken, a new study should be conducted if critical factors have changed, e.g. island ownership or land use. Even a couple of years can result in different factors that could impact on a eradication. It is always valuable to have a pre-assessment/pre-eradication planning visit to the site at least 6 months prior to the eradication to assess any changes.

2.2.9 Annexes 1-6 will be helpful for completing Stage 2.

2.3 Stage 3 - Project Design

2.3.1 During this stage, details about how the project will be managed and governed are decided, and a **Project Plan** is written. Such planning and assignment of responsibility and decision-making powers are fundamental to the success of eradication projects.

2.3.2 During the Project Design stage:

- A governance, management and decision-making framework is defined;
- Measurable targets and objectives are set;
- Accurate costs for all phases of the project are established and a Fundraising Strategy produced;
- Realistic timeframes are established for project milestones;
- Dependencies of project actions are established and conditional 'proceed/stop' points identified – e.g. 'if full funding is not in place by [date], implementation of the eradication operation will be postponed by at least 12 months;
- A Risk Register is created to allow for risk management within the project;
- The stakeholder Communication Strategy is updated.

2.3.3 The **Project Plan** and Communication Strategy must be reviewed by an independent expert before being implemented.

2.3.4 Annexes 1, 5 and 6 will be particularly helpful for completing Stage 3.

2.4 Stage 4 - Operational Planning

2.4.1 Three related plans must be completed during this stage:

1**. Operational Plan**, to minimise the risk of eradication failure and enable meaningful external review of the operation, covering:

- Eradication design,
- Logistical planning,
- Health and Safety planning;

2. **Biosecurity Plan,** to maximise the chances that the benefits of eradication will be sustained;

3. **Monitoring and Evaluation Plan,** to ensure that the impacts of the project can be determined – information that will be required by funders, permit/consent givers and stakeholders both for this project and future projects.

2.4.2 The Operational Plan, Biosecurity Plan, and Monitoring and Evaluation Plan should each be independently reviewed by island eradication experts before being implemented. For some projects, experts with specialist knowledge, e.g. of a particular native species, will be required.

2.4.3 Testing rodents for rodenticide resistance should be carried out during the feasibility stage since this will help determine whether eradication is feasible (a high level of resistant rats would make eradication difficult) and will help determine the choice of rodenticide used. Early decision in rodenticide will allow for time to obtain derogations of use certificates (a requirement for specific bait types), if needed.

Annexes 1-6 will be helpful for completing Stage 4.

2.5 Stage 5 - Implementation

2.5.1 As well as the actual eradication operation, the Implementation Stage also covers tasks that need to be undertaken before and after the operation.

2.5.2 Pre-Operational tasks include:

- Adequately addressing all of the issues raised during (and since) the **Feasibility Study,** including field testing any unproven equipment/techniques;
- Selecting and training personnel/contractors;
- Sourcing all equipment and transporting it to the island;
- Obtaining all necessary permits;
- Undertaking baseline monitoring (part of the **Monitoring & Evaluation Plan);**
- Ensuring the initial **Biosecurity Plan** is implemented; and
- Completing an independently-assessed **Eradication Readiness Check**.

2.5.3 The eradication operation must not be initiated until an **Eradication Readiness Check** is completed by independent experts, who conclude the project is ready to proceed.

2.5.4 Eradication Operation tasks include:

- Daily documentation of the implementation of the operational plan, for example through a journal/log book;
- Leading and motivating the project team, housing them, feeding them and keeping them warm;
- Setting up a bait station grid across the entire project site;
- Supplying bait across the grid on a sufficiently high rate and duration so as to kill 100% of the target species;
- Accurately logging all bait taken from each station;
- Establishing an intensive monitoring grid to detect any remaining target species individuals;
- Swiftly dealing with any remaining individuals – deploying novel tactics and techniques if necessary;
- Initiating the implementation of the revised/long-term **Biosecurity Plan** e.g. installing permanent surveillance stations and sourcing equipment for the Rodent Incursion Kit; and
- Clearing away all equipment.

2.5.5 Unwarranted departure from the **Operational Plan** during the Implementation stage may increase the risk of eradication failure or negative non-target impacts. However, changes can sometimes be necessary – if, for example, non-target species are found to be interfering with bait stations in a way not anticipated during the risk mitigation planning. Novel tactics and techniques, where the results of monitoring feed back to influence operational decisions, will therefore be needed if unexpected rodent behaviour is observed or situations occur that were not foreseen during the feasibility study. The **Project Plan** should have identified how any necessary changes can be decided upon and implemented in the field in a timely and appropriate manner.

2.5.6 Post-Operational tasks include:

- Debrief with the project team;
- Managing the safe disposal of rodenticides (both used and unused);
- Reporting back to permit/consent issuers and other stakeholders;
- Writing an **Operational Review**;
- After an appropriate interval, declaring whether the project is a success; and
- Dissemination of the results to the scientific community through peer-reviewed journals and at conferences.

2.5.7 The **Biosecurity Plan** protocols should be active well before the eradication team leave the island.

2.5.8 The **Operational Review** should be written soon after the eradication phase is completed following a debrief, whilst the experience is still fresh in the minds of project personnel. It should be a candid report detailing all aspects of the project, including those that were unexpected, ran less smoothly than anticipated, or could in any other way have compromised the success of the eradication. It should also describe aspects that went well and should be done again in future projects, especially if novel techniques were used. The review may form a subsection of a wider Technical Report from the project.

2.5.9 Annexes 1-6 will be helpful for completing Stage 5.

2.6 Stage 6 - Sustaining the project benefit: Biosecurity and documenting ecological recovery

2.6.1 This stage is often neglected due to long-term funding running out or momentum being lost once eradication is achieved. However, **it is as important as all other stages**.

2.6.2 Without it, the benefits of the project will remain undocumented (making it harder to secure support for future projects) and at high risk of being compromised.

2.6.3 The ultimate risk is that important populations recover on islands only to be heavily predated in future years following a biosecurity breach that remained undetected or was mishandled.

2.6.4 As well as risk of conservation damage, under-resourcing this stage comes with high reputational risk.

2.6.5 The main tasks involve:

- Ensuring regular review and ongoing implementation of the **Biosecurity Plan** and the **Monitoring and Evaluation Plan.**
- Continuing to refresh training in biosecurity for all stakeholders and biosecurity personnel.

2.6.6 Implementation of the Biosecurity Plan – and resources for this – will be required in perpetuity.

2.6.7 Annexes 3 and 4 will be particularly helpful for completing Stage 6.

2.6.8 The following sections cover Stages 2-6 in more detail.

3 Feasibility Study stage

3.1 Introduction

A decision on the feasibility of the project is based on three overarching questions:

Q1 **Can it be done?** Based on an assessment of seven feasibility criteria (see Table 1 below).

Q2 **What will it take?** An assessment of the issues that have been raised through the study and how they can be resolved.

Q3 **Is it worth it?** Considering all aspects of costs and benefits (e.g. environmental, financial, social) - do the benefits of the project justify the costs?

3.1.1 In order to answer these questions, first consider the goals, objectives and outcomes for the project (these will be finalised in the project design stage, section 4):

Goal: A long-term, desired result. E.g. 'Maintain a viable self-sustaining Manx shearwater breeding colony on Lundy Island'

Objective: A specific achievement that will help reach the goal. E.g. 'Eradication of invasive predators from Lundy Island' and 'Maintenance of a rat-free Lundy Island'

Outcome: A change resulting from the achievement of an objective. E.g. 'An increase in productivity of the Manx shearwater breeding colony on Lundy Island'

3.1.2 Ensure you have people sufficiently experienced in each of the seven feasibility criteria to gather the required information and make a comprehensive assessment (see below).

3.1.3 Plan the site visit well, and in consultation with island residents and landowners. Understand what you need to do during it and how the information gathered will be recorded. Keep a log of what was done during the visit. Note that this can require significant time investment. The number of residents/landowners/stakeholders will determine the amount of time required for the site visit.

3.1.4 Ensure that an expert practitioner in rodent eradication (able to answer questions about eradication) is involved in the initial communication with key stakeholders. This communication should focus on the goal as well as the means. Make the conversation about the vision (more seabirds etc.), as well as the work required to achieve this (killing rats with poison).

3.1.5 Biosecurity measures should be taken before *all* visits to the island, to ensure no invasive species are taken to or from the island – create and complete a **Biosecurity checklist** prior to the site visit (see Annex 4).

3.1.6 Identify all necessary trials and research required to eliminate knowledge gaps in the biological and logistical aspects of the project.

3.1.7 Some of these information needs may be driven by what stakeholders want to know. Knowing about these requirements during the feasibility stage allows time and resources to be built into the project design and informs the decision over whether to invest further in the project.

INVOLVING STAKEHOLDERS WITH THE FEASIBILITY STUDY

It may be useful to give some stakeholders (e.g. residents and landowners) the opportunity to read and comment on later draft versions of the Feasibility Study. This may help provide further information for the team and ensure the stakeholders are not surprised by the final version of the report. It also allows the project team to start discussions with relevant stakeholders on any contentious issues which may affect the project's feasibility. Be careful to manage expectations of stakeholders. Things identified in a feasibility study may not translate into the project design. Avoid the common mistake of making changes without technical advice. Changes that compromise eradication may well get community support but if the end result is failure this is pointless. Technical advice can often provide solutions that both work and meet stakeholder concern.

3.2 Feasibility study: Can it be done?

Table 1 – The criteria for a feasibility study

Criteria	What 'feasible' looks like:
3.3. Technically feasible	For each target species, bait and bait stations can be distributed across the entirety of the project site so as to remove every last individual of the population at a rate that is faster than their ability to breed (even if their breeding rate increases to a maximum). All logistical challenges due to remoteness, access in winter, terrain or vegetation must be solvable.
3.4. Sustainable	The likelihood of reinvasion by the target species is low, or the risks of reinvasion leading to population re-establishment can be reduced through realistic and affordable biosecurity measures. ***N.B.*** *The sustainability of rodent eradication on islands which could be easily reinvaded by rodents swimming to them must be seriously questioned. ' DNA connectivity studies may be useful in these circumstances but these can be expensive and are not definitive since existing rodent populations can inhibit survival and breeding of newly arriving immigrants*.
3.5. Socially acceptable	The project has full support from the community, landowners and key island users, all of whom understand and accept the implications of the project. Access will be granted to every property and all privately-owned land. The risks to people (e.g. of laying rodenticides on islands with resident children) can be managed effectively.
3.6. Politically & Legally acceptable	All required permits and consents can be/expect to be obtained, e.g. for use of second generation anticoagulant rodenticides in open areas (requires strict adherence to *Best Practice Protocols for anticoagulant rodenticide use in Island Restoration,* Annex 5, Section 5), disturbance on SPAs/SSSIs, disturbance on archaeological sites/Scheduled Ancient Monuments, disturbance of protected species. The techniques, equipment and materials required are all legal to import/use in the UK.
3.7. Environmentally acceptable	The impact on the environment (e.g. risks of disturbance, poisoning of non-target species, rodenticide residues in soil/water) can be reduced to an acceptably low level. Removal of the target species has been assessed as unl kely to lead to permanent negative changes in the ecosystem, e.g. through mesopredator release or prey-switching to vulnerable species. The possibility of shorter term negative impacts should not be shied away from, however, and stakeholders and the public should not be encouraged to expect that these projects can be 'all gain and no pain' if you're serious about avoiding further extinctions of species vulnerable to the presence of rodents. Some primary or secondary poisoning of non-target species may be unavoidable: the focus for managing risks to non-target species may be on safeguarding the population rather than individual animals, and is likely to vary depending on the habitats present. You may conclude that the short-term impact is outweighed by the benefits of a successful eradication, but you will need to convince others too. ***N.B.*** *Deaths of individual animals of some species may not be socially acceptable or may compromise the chances of obtaining legal consents.*
3.8. Capacity	All the required resources, skilled people, and equipment are available, or can be sourced in a timely manner for the duration of the project – including Stage 6 – Sustaining the project benefits.
3.9. Affordable	The *total cost* of the project and ongoing biosecurity can be funded before the project commences, including an additional contingency (c. 20%) for unforeseen complications. You can demonstrate to funders that the benefits of the project outweigh the costs. ***N.B.*** *Doing it "on the cheap" is false economy and leads to a high risk of failure.*

3.3 CRITERION 1 - TECHNICALLY FEASIBLE?

3.3.1 Eradication of rodents on UK islands should be attempted only via the laying of poisoned baits (rodenticide) in bait stations. Trapping may be deployed as a *supplementary* technique, particularly to target individuals which may be avoiding bait (although future developments in trap design or efficiency may increase the role of traps in eradication projects). Traps also have an important role in biosecurity and incursion response.

3.3.2 The fundamental requirement is to establish bait stations within the territory of every individual of the target species and maintain enough palatable bait in each station for as long as it takes for every individual to find a station and eat a lethal dose. It is important that stations are spaced such that no individual could remain without encountering at least one station.

3.3.3 For brown rats, this is usually a 50m x 50m grid (max 100m x 100m in poor habitat and up to 25m x 25m in preferred habitats and areas of human habitation, including stations inside all buildings). For black rats it is usually 30m x 30m or 40m x 40m (max 50m x 50m). For mice, it may be as little as 10m x 10m (25m x 25m is the maximum currently considered, although common view now is that that maximum for mice should be 20m x 20m).

3.3.4 A monitoring grid is also required at *at least* the same density of the poison grid (if not smaller), in order to detect individuals who have survived the initial baiting effort.

3.3.5 At least two types of rodenticide should be available in *every* eradication attempt. If using a first generation anticoagulant rodenticide as your primary bait, your second bait ('back up bait', to be targeted at rodents known to be or suspected of avoiding the primary bait) must be a second generation anticoagulant rodenticide.

- Assess whether or not access to lay and service bait stations and monitoring stations on the correct grid and frequency for the entirety of the project area is physically feasible. Can people be landed safely on all the islets and off-shore stacks as well as the main island?
- Can the required number of people needed to implement the project live on the island or otherwise get to it every day? Remember, the operation is most likely to take place over winter when boat access may be difficult and daylight hours reduced.
- Assess the pros and cons of the different rodenticides available and make recommendations for the rodenticide to be used, both for the initial eradication and ongoing biosecurity.
- If natural alternative food is abundantly available to rats all year round, even if only at specific sites on the island, undertake bait palatability/acceptance trials during the feasibility study to determine whether bait uptake is reduced and whether all rats will eat the bait. Use non-toxic versions of the bait for these trials.

3.3.6 If trap use is also proposed, recommend specific trap types based on an assessment of the options available and the pros and cons of each.

3.4 CRITERION 2 - SUSTAINABLE?

3.4.1 The Feasibility Study should identify and assess all biosecurity risks for the project including the risks of quarantine failure, sabotage and target animals reinvading through swimming/ drifting to the island.

3.4.2 The distance rodents can swim to reinvade islands may vary from site to site and is largely unknown in any more than a general sense. We only know the current recorded longest swim for each species, which has proven an unreliable predictor of future swimming abilities. There are multiple factors which may influence the probability of rodents successfully swimming to an island (e.g. water temperature, current, coastal cliffs, predators in water and on land, prevalence of floating debris). As a ballpark indicator of risk:

- Brown rats can swim better than black rats which can swim better than house mice. All three rodents are high risk stowaway invaders.
- At 50 metres all rodents can easily get to the island by swimming, and will do so frequently.
- At 500 metres black rats will invade but the frequency of incursions may be low. Brown rats could, in many circumstances, be expected to reach the island every year.
- If the distance is near the currently known record for the species (brown rat c.2km; black rat c.750m, house mouse c.500m) they can be expected to invade but may not.
- If the distance is twice the currently known record, reinvasion by swimming may not occur *but we do not consider it impossible*.
- It is only islands several kilometres off-shore where we can categorically say that rodents will not be capable of swimming there, but the risk of quarantine failure is ever present no matter how far it is.

3.4.3 Although some of the longest distances have been recorded in warmer waters, as currents also play a part in facilitating swimming events these distances should be considered appropriate for use in the UK until further research / evidence determines otherwise.

3.4.4 A genetic comparison should be made between the animals on the target island with those of likely/possible source populations on the mainland or neighbouring islands, particularly those within twice the known swimming distance of the target species. This involves taking representative DNA samples from each population. Results are used to estimate the frequency of animals invading the island (or the 'connectivity' of the island's rodent populations with potential source populations) which will support a decision on whether eradication is the best course of action or if other options should be investigated (e.g. sustained control). However, see Fraser *et al.* (2015), which presents evidence that newly arriving individuals may be prevented from establishing on islands where existing populations of the same species are found. Genetic analyses may therefore overestimate the true likelihood of rats from other sources reaching an island being considered for rodent eradication.

3.4.5 While the financial cost of DNA analyses can be significant for larger islands or those with multiple possible source locations (where more sampling is required), it is far lower than the financial and social costs of having rodents quickly reinvade an island - e.g. loss of public support or the costs of multiple eradication attempts.

3.5 CRITERION 3 – LEGAL?

3.5.1 You may need legal approvals, for example, a permit from the [redacted]) rodenticides which are not currently registered for use in open areas or consent to cause disturbance in a [redacted]. The regulations surrounding anticoagulant rodenticide use have recently been reviewed. *The HSE's guidelines on rodenticide use can be found here – check you are accessing the most up-to-date information:* http://www.hse.gov.uk/biocides/eu-bpr/rodenticides.htm.

3.5.2 Check the legal conditions of the registration of the bait products recommended for use in the operation. This is usually detailed on the product label. Use must be in compliance with label instructions. If use in 'open areas' (the category required for island rodent eradication work) is not permitted on the label, you will need the bait manufacturer to apply on your behalf to the HSE for an 'extension of use' certificate. However, products containing two of the SGAR rodenticides most widely used in eradication projects (difenacoum and bromadiolone) have been registered for use in open areas, including a number of the wax block formulations typically used in eradication projects. A database detailing products registered for use under the new regulations can be found here:

http://webcommunities.hse.gov.uk/connect.ti/pesticides/viewdatastore?dsid=10116

3.5.3 Check the legal conditions surrounding the use of proposed traps (live or kill) in the UK. See Table 2. Best practice on occasion exceeds the requirements of the law. Generally:

- Live traps should be checked at least twice a day, according to [redacted]. The Animal Welfare Act (2006) makes it an offence to cause unnecessary suffering to animals caught in traps. Live traps must be placed so that any captured animal is protected from weather, temperature extremes or flooding.
- Kill traps should be checked at least once per day according to best practice (though this is not a legal requirement), as a clean kill cannot be guaranteed by any trap approved for use in the UK. Only traps designed to kill rats humanely and listed by the relevant Spring Traps Approval Orders (STAOs) may be used. This is a devolved issue so check you have the correct Order. Spring traps must be set in a natural or artificial tunnel. Break-back traps may also be used and are not subject to the STAOs.
- Consider all permits/consents you may need, e.g. licensing disturbance on designated sites (ASSI/SSSI/Scheduled Ancient Monument) or of protected species/breeding sites, collection of specimens from a SSSI, obstruction to public rights of way, planning permission for temporary structures (e.g. accommodation or landing sites), how will disposal of used rodenticide meet the Environmental Protection Act (1990)? Identify permit-holders (e.g. government departments/statutory agencies).
- Seek advice as the precise suite of legal approvals required will vary from project to project.
- Start applying for approvals as soon as possible - as soon as feasibility is confirmed and funding secured. Some approvals can take a long time - months, and possibly years.

Table 2 – Examples of permits and consent that may be required.

Issue requiring permit/consent	Permit/consent holder
Import of rodenticides/traps	HSE / Defra
Use of unregistered rodenticides in open areas	HSE
Export/disposal of unused bait (after the operation)	HSE/ Environment Agency/ SEPA
Damage to SSSI, e.g. track cutting	NE/NRW/NIEA/SNH
Approval to temporarily remove at risk non-target species	Defra/NRW/NIEA/SNH
Scheduled Ancient Monument (disturbance of)	Secretary of State for Culture, Media & Sport; Historic Environment Scotland

3.6 CRITERION 4 – SOCIALLY ACCEPTABLE?

3.6.1 Identify all possible stakeholders during the feasibility study and assess the likely level of interest, support, opposition and social issues requiring resolution. Have community liaison experts assist with the planning and execution of this.

3.6.2 Ensure that an expert practitioner in island restoration who is able to answer questions about island restoration/the proposed project is able to meet residents at the earliest stage of project development (e.g. preferably before the Feasibility Study).

3.6.3 Ensure you have a team member respected in the local community. Seek to have this person involved with as much of the work as possible, so long as a positive relationship with islanders is maintained.

3.6.4 Remember you will need to be able to lay and regularly service a grid of bait stations and monitoring stations across the entire project area, including in all buildings and on private property.

3.6.5 Gaining support from the necessary stakeholders may take a long time (e.g. several years).

3.6.6 A conditional feasibility status may be given to a project if not all necessary support is immediately forthcoming. However, no rodent eradication should commence until island resident and land owner support is gained. You must be prepared to walk away from a project if the required support is not achieved.

3.6.7 If people (particularly children) live on or visit the island, the project team must be capable of reducing to near-zero the risk of bait consumption or injury from tampering with traps via education/awareness-raising and bait station design.

3.6.8 People may object to the project based on concerns over **animal welfare or animal rights**. You should be prepared for these concerns at the outset and be respectful of the range of opinion. The rationale for the project, as outlined in the project selection process, will be crucial to any attempt to convince stakeholders that the work is necessary.

3.6.9 Animal welfare should be a high priority in all planning and decision-making for eradication projects as far as possible – e.g. ensuring regular checking of traps. The use of anticoagulant rodenticides carries welfare concerns which are less easily addressed. Ensuring the project has the highest chances of success and does not need to be repeated in future years minimises the number of animals that will be killed by poisoning.

3.6.10 Animal rights – e.g. the entitlement of animals to possess their own lives – are not compatible with eradication operations. Capture and release of invasive non-native species is prohibited in some cases and is also unviable as trapping alone will not achieve rodent eradication.

3.6.11 Projects may attract the attention of individuals or organisations who are not associated with the project area, and who may or may not be considered stakeholders. As such, you may determine that a project is socially acceptable even if such individuals/groups are opposed to it. However, your communications strategy should still consider the impacts of such concerns on the project's profile and key stakeholder groups. A water-tight project rationale (documented in Stage 1 – project selection) will be key to arguing the case for action.

3.6.12 The New Zealand Department of Conservation has useful templates for stakeholder communication planning.

3.6.13 Additional considerations for projects on inhabited islands:

- It is important that islanders consider themselves to be amongst the beneficiaries of the project and want it to succeed as much as you do (even if for different reasons). Ideally, they will consider it to be 'their project'.
- Seek to include islanders/the local community within the decision-making process and management of the project, as well as its implementation.
- Recruit local community representatives e.g. local councillors to act as community liaison ambassadors, disseminate information, introduce you to residents, and so on. Be mindful of community dynamics and ensure you are talking with all groups.
- Be clear, consistent and open with your communication – all team members and contractors must present the same messages and information throughout. Plan this carefully – have answers already to hand for all anticipated queries. If some details can only be confirmed later, communicate a worst case scenario – e.g. bait stations will be needed every 25m. It will be easier to relax this to 50m than go back to residents and state that the work will be more intrusive than you initially said.
- Discuss the possibility of seeking to eradicate rats from the island with individual households, where possible via a face-to face discussion. Try to get to the bottom of any concerns as early as possible. An expert capable of answering questions immediately should be part of the process so that false fears/incorrect information cannot take hold. Avoid discussing a % of community support that is required in order for a project to proceed.
- Consult and educate the island's children about the proposals.
- Consider holding community meetings. These might be best held *after* you have ascertained likely levels of support via household consultations and you have developed a greater appreciation of community dynamics. You will need a skilful chair and personable experts capable of answering technical eradication questions clearly for a lay audience.
- Seek the views of people who will be indirectly affected by the project (such as visitors to the island, residents on neighbouring islands), e.g. via drop in sessions and questionnaires.

3.6.14 Secure agreement to proceed with a Feasibility Study. Scope the nature of the Feasibility Study using a local workshop hosted by a local community organisation inviting all key stakeholder representatives. Groups of islands bring additional stakeholders that should be approached.

- The Feasibility Study should answer all the islander/community's questions highlighted in the workshop, interviews and questionnaires.
- Secure agreement with the community to proceed with funding bids for the project, and secure written consent from all people directly affected.
- Secure access and interpretation agreements with land owners/managers as part of the funding application agreements.

3.7 CRITERION 5 – ENVIRONMENTALLY ACCEPTABLE?

3.7.1 Determining whether a project is environmentally acceptable is a complex and specialised area and it is highly recommended that appropriate expertise is brought into the project to ensure this is done properly. The notes given in this section illustrate the issues involved but are no substitute for relevant professional experience.

3.7.2 Anticoagulant rodenticides are not thought to affect invertebrates but they can, and do, kill other animals including fish birds, mammals, amphibians and reptiles. This can be by primary poisoning (consuming bait directly) or secondary poisoning (indirect consumption, e.g. scavenging poisoned carcasses or predating upon moribund rats). Risks of unintended poisoning differ depending on the type of rodenticide used and its presentation.

3.7.3 Evaluate the actual or potential effects your proposed eradication operation may have on the environment and the ways in which any adverse effects may be reduced or eliminated by conducting an environmental impact assessment (EIA) for the project.

3.7.4 N.B. While the ecological consequences of using anticoagulant rodenticides must be considered very seriously, any mitigation of those consequences cannot be allowed to affect the chances of eradication success. In these situations the eradication should not go ahead. However, wherever possible seek to make the case that some non-target effects are small in comparison to the benefits of removing rodents and the dire consequences of rodents remaining in the ecosystem.

3.7.5 Consider all of the proposed eradication techniques and project phases, and the logistical and support systems required to undertake the operation and review the effects of these on the environment. E.g. use of each type of rodenticide, use of each type of trap, the need to cut tracks, daily trampling along the same paths (disturbance and destruction of plants and animals), installation of temporary accommodation or rope anchor points, biosecurity.

3.7.6 All risks to non-target species should be assessed and the assessment used in a cost-benefit analysis to determine whether or not a project deemed feasible should proceed:

- What native and non-native species (including livestock and domestic animals) are potentially at risk?
- Are there other species (including other invasive species) which may compete for bait?
- Are there any people potentially at risk (e.g. children)?
- Which techniques pose the highest risk and why?
- What are the direct effects of placing toxic bait in the environment?
- What are the secondary effects?
- Can the effects be accepted, or if not, eliminated or reduced?
- Are the adverse effects outweighed by the gains?

3.7.7 Wider ecosystem impacts of removing the target species from the island must be analysed. The paper by Bull and Courchamp (2009) is a helpful reference point.

3.7.8 Well-documented impacts include hyperpredation[3], mesopredator release[4], competitor release and herbivore release. It is important to know which species are present on your island in order to anticipate potential responses – this should include invasive plant species.

3.7.9 **Mice** can sometimes be present but difficult to detect on islands where there are rats. Because mice can survive a bait station technique targeting rats (due to their home ranges being smaller than the grid spacing of stations used), this could lead to an increased mouse population following successful rat eradication. The presence of mice is therefore an important consideration in choosing the eradication method and/or predicting the outcomes of the eradication project. Efforts to detect mice in the Feasibility Study phase may be important. This can be done by creating a large rat-proof area, trapping out rats from within the area, and waiting long enough to see if a mouse population rebounds and can be detected, though this is resource and time intensive.

3.7.10 Rodents can have a profound impact on entire ecosystems. It is common for **rabbit** populations to increase in the absence of rats, often with profound impacts on vegetation structure and soil stability. On islands without rabbits, vegetation may increase in the absence of invasive rodents.

[3] an enhanced predation pressure on a secondary prey due to either an increase in the abundance of a predator population or a sudden drop in the abundance of the main prey.

[4] a process whereby mid-sized carnivorous mammals became far more abundant after being "released" from the control of a larger carnivore.

3.8 CRITERION 6 – CAPACITY?

3.8.1 Project managers must have a very high level of skill in leadership, project management and organising logistics (see Table 3).

3.8.2 All projects need a well-briefed understudy to the Project Manager, who can take over from the Project Manager if necessary, in times of illness, injury, change of jobs, etc.

3.8.3 If appropriately skilled people are not directly available to the project team, assistance from external contractors will be needed.

3.8.4 At least one Independent Technical Advisor will also be required to advise the Project Manager and to review key project documents

3.8.5 The agency or agencies implementing the project will also need the capacity to support the team in terms of human resources, administration and financial management

Table 3 – Capacities required by project management team for rodent eradication.

Is the Project Manager/Management team capable of taking responsibility, either directly or via the management of contractors, for:	**Are the required skills available?**
• The overall success of the project • Managing the project through all Project Stages to completion • Finding the people and equipment needed • Ensuring the health and safety of the team/stakeholders • Regulatory compliance • Setting appropriate and measurable goals, objectives and outcomes to enable project evaluation • Managing the project team, giving it direction and keeping it focused, motivated and determined to succeed • Delegating tasks • External communication and stakeholder engagement • Making operational decisions and changes as necessary in the field • Deciding on priorities • Budgeting • Evaluating and reporting on the project	• An 'eradication mind-set': a 'can-do' attitude, motivated and dedicated to achieve the project's goals and objectives, and an understanding that nothing less than 100% kill rate is acceptable for eradication purposes • Broad experience in the conservation field, and specific experience in leading ground-based eradication operations using bait stations • Ecological knowledge of the target species and its prey species • Appropriate boat handling /helicopter flying /rock climbing skills to enable access to the entirety of the project area • Good people skills, able to build and maintain positive and productive working relationships with key stakeholders and staff • Good verbal and written communication • Problem identification and resolution skills • Good negotiation skills, ability to prepare cases thoroughly and also listen, consult and accept negative or alternative viewpoints constructively • Ability to plan, prioritise, delegate appropriately, set timelines and work to deadlines • Understanding of local environmental regulations • Sensitive to, and appreciative of, local cultural perspectives • Knowledge of the project and its intended outcomes

3.9 CRITERION 7 – FINANCIALLY VIABLE?

3.9.1 When **costing** projects take care to cost all aspects adequately and allow for contingencies. Money shortages affect morale and raise operational risks which, if they lead to failure, will be more expensive in the long run. It is important to note that the cost/ha and/or cost/individual rodent removed may well increase as the rodent density goes down, meaning that phasing of budgets can quite easily be the other way round from normal projects.

- A contingency of 20% should be added to the project's anticipated cost. Initial costing will never be completely accurate as the exact design and mitigation actions are yet to be fully identified. Also aspects subject to competitive tender will not be known until contracts are in place. Also consider the effects of inflation on your pricing – it may be several years between the initial costing of a project in the Feasibility Study and the sourcing of the materials and labour.
- Some funders and implementing agencies may have organisationally-mandated contingency amounts and some funders do not allow the use of contingency amounts. Regardless, you still require a 20% contingency to be found for the project.
- Consider how you will fund the biosecurity measures long-term, after the eradication project is completed and the operation team has moved onto other projects. The Sustaining the Project Stage (Stage 6) may run for many years. Biosecurity costs will continue indefinitely.
- Ongoing costs include annual salaries of biosecurity personnel, costs of replacing lures, bait, traps, information signs, renewing rodenticide permissions, and providing biosecurity refresher training. Cost of responding to incursions or reinvasions will be significant.
- Consider how you will raise the funds. Is it a project worth investing in?

3.10 What will it take?

3.10.1 As you assess the seven feasibility criteria you will identify issues that, while not necessarily making the project unfeasible, will need to be addressed before the eradication operation can begin. For example, funding may still be required, mitigation measures for non-target species may need to be designed and trialled, permits for rodenticide use may need to be obtained, full stakeholder support will need to be obtained and maintained.

3.10.2 Issues must be clearly identified in the 'What will it take?' section of the Feasibility Study and the additional work that is required to resolve the issue must be outlined.

3.10.3 Failure to clearly record the issues can lead to them getting lost or not being resolved early enough, which will endanger the success of the eradication operation.

3.10.4 Incorporate risks to the environment or to non-target species that are identified in the Feasibility Study into the project objectives and outcomes – and determine if the project is still feasible.

3.10.5 For example, the Feasibility Study identifies that a native shrew may be at risk from the proposed rodenticide to be used (via primary or secondary poisoning). A significant decrease in the shrew population would not be acceptable. For the project team to manage this risk a further project objective: 'The long term viability of the native shrew population will be safeguarded' can be added. An associated outcome would also be required, for example: 'The post-eradication native shrew population returns to pre-eradication levels within two years'.

3.11 Is it worth it?

3.11.1 The anticipated benefits of eradication need to be clear from the outset and should have been recorded (although perhaps only in broad terms) in the transparent record of decision-making arising from Project Selection (Stage 1). These now need to be fleshed-out and should be defined as measurable targets so that they can be assessed against environmental and financial costs.

3.11.2 Even if the project is considered feasible, the effort required to achieve and sustain eradication may be considered too great for it to be worthwhile.

4 Project Design stage

4.1 Project Plan

4.1.1 The Project Plan enables a project manager to keep the right focus for the project, manage it to a successful conclusion and provide adequate information about the project and its progress to stakeholders. It provides details on the scope of the project so that it is clear to all parties involved what the project aims to do and areas of work it does not cover.

4.1.2 It also provides a detailed and realistic timeline for the project and its important milestones and outlines how progress will be reported and to whom. Accurate costs for all phases of the project are detailed and if funding for all these aspects is not yet secured, then a Fundraising Strategy should also be produced.

4.1.3 Importantly, the Project Plan should detail a number of 'stop' points, where a project is reassessed and continued only if all conditions are met. For example, if full funding is not in place, the eradication operation would not proceed.

4.1.4 It must be clearly agreed and documented who is authorised to make key project decisions.

4.1.5 A Responsible/Accountable/Consulted/Informed (RACI) model (or similar) for the project team and all stakeholders should be developed – who is responsible for an action, who is accountable, who needs to be consulted over it and who should be informed? The 'consulted' and 'informed' lists should inform the development of your stakeholder Communication Strategy.

4.1.6 Project indicators (targets and performance measures) which represent the health of the project must be identified so that it is possible to measure and report on progress to partners, residents, funders and other stakeholders. Monitoring of the project outcomes is also undertaken as part of the implementation of the Monitoring and Evaluation Plan, but do not rely on these outcomes – early indicators of progress (prior to the eradication operation) are also required.

4.1.7 A Risk Register should be kept and regularly assessed and reviewed in order to manage both risks to the project and risks emanating from the project.

4.1.8 The **Project Plan** and Communication Strategy must be reviewed by an independent expert before being implemented.

5 Operational Planning stage

5.1 Operational Plan

5.1.1 The fundamental aim of poison baiting using bait stations to eradicate rodents is to establish bait stations within the territory of every individual of the target species and maintain enough fresh bait in each station for as long as it takes for every individual to find a station and eat a lethal dose.

5.1.2 The **Operational Plan** details exactly how the work will be carried out, covering all logistical and practical aspects. It should cover the work needed before, during and after the operation and create a task schedule for the operation.

5.1.3 The **Operational Plan** must detail how all problems identified in the Feasibility Study will be overcome and how the risks to non-target species and the environment will be managed.

5.1.4 The **Operational Plan** is a living document and should be reviewed regularly and updated as necessary. As the plan changes, you must be mindful of the fact that the original assumptions underpinning the Feasibility Study may no longer be valid. Whenever the plan needs to be changed, establish whether or not:

- The project is still feasible;
- The outcomes remain sustainable;
- The benefits still outweigh the costs.

5.1.5 If a change makes the project no longer feasible, the goal no longer sustainable or the benefits no longer outweigh the costs, the project must either be **STOPPED** or the issues must be addressed by further changes to the plan.

5.1.6 Following any substantial changes to the **Operational Plan**, it should be reviewed again by the project's independent technical advisors.

5.2 Health and Safety

5.2.1 Health and safety is paramount and must be considered for all people associated with the project, i.e. island residents as well as the field team and those involved with the logistics of the transport of personnel, bait and equipment.

5.2.2 The details of the Health and Safety Plan will depend to a large extent on the particulars of the project. No generic template is provided as Health and Safety should be carefully considered on a case-by-case basis. However, Table 4 details some of the key areas you will need to consider.

5.2.3 When recruiting staff, having an agreement form in advance to the team establishing will allow for time to mitigate for individual limitations and the health and safety implications as a result. E.g. Can they swim? Are they afraid of heights? Etc.

Table 4 – Health and safety considerations for island restoration projects.

Area of work	Risks	Examples of safety measures
Use of toxic bait	Inhalation of dust, consumption of bait leading to internal hemorrhaging/death	- Stocks of antidote (Vitamin K1) available on island and trained personnel competent to administer the antidote - Follow all manufacturer's instructions for rodenticide use - Train personnel in safe handling and use (N.B. this is now a legal requirement for anyone handling bait sold for professional use) - Provision and use of personal protective equipment e.g. gloves, dust masks - Wash hands after use/before eating/cooking - Raise community awareness of risks - Warning labels on bait stations - Lockable stations in residences
Use of traps	Injury from trapping fingers or handling captured animals. Disease contracted from handling captured animals and from being in contact with rodent urine (i.e. Weil's disease)	- Train users in safe handling of traps and captured animals - Ensure personnel's tetanus vaccinations are up to date - Maintain traps to a high standard - Provision and use of personal protective equipment - Wash hands after use/before eating/cooking
Use of boats	Drowning/hypothermia / injury from loading/unloading, especially if access is difficult or sea conditions rough	- Use only experienced boat handlers who are accustomed to local conditions - Use of life jackets - Personnel employed should be strong swimmers - Coastguard should be aware of project and risks - Establish cut offs for sea and weather conditions after which boats will not be used - Do not overload boats and evenly distribute loads
Terrain & Weather conditions	Steep cliffs/ravines/ gullies, especially in conjunction with wet, slippery vegetation. Dark, cold, wet, windy winter conditions	- Provision and use of suitable clothing and footwear - Work in teams - Use of radios for communication whilst in the field - System for knowing where personnel are and what time they are expected back at base (could consider using SPOT satellite-tracking system) - Establish cut offs for weather conditions after which work will be called off - Plan work realistically so people are back at base well before dusk
Encountering wildlife	Injury/illness from contact with poisonous plants or dangerous animals – e.g. ticks and Lyme disease.	- Define areas of risk - Ensure personnel can identify risk species - Check daily for ticks - Provide and use appropriate clothing/footwear
Heavy lifting	Injury/strains - bait and other equipment is heavy and may need to be carried for long periods	- Redistribute loads into more manageable weights - Select personnel capable of carrying equipment - Do not expect/pressure people to carry loads heavier than they can handle safely
Use of tools – e.g. for track cutting	Injury or death from sharp or mechanised tools	- Ensure users are certified to use specific tools - Maintain safe working distances - Maintain tools in optimum working condition - Provision and use of personal protective equipment - Take regular breaks - Cover sharp edges when in storage/transit
Living in small, remote community	Personnel may not cope well with isolated conditions (mental health compromised)	- Ensure a manager as well as operations manager is responsible for the emotional wellbeing of staff – identify an approachable contact point both on and off island for all personnel. Having an alternative person for people to communicate with is very important in case they are for some reason not comfortable ta king to the operations manager.

5.2.4 *At least* one member of the team must be trained in first aid with valid in-date certification, specifically for outdoor/remote working conditions. Preferably, all project team members should be trained.

5.2.5 Appropriately-stocked first aid kits must be available – preferably each team member should carry one at all times whilst in the field.

5.2.6 Health issues within the project team (e.g. allergies, asthma, medication requirements) must be identified prior to travelling to the island and appropriate measures must be in place to deal with potential emergencies.

5.2.7 A procedure for dealing with serious and life-threatening accidents and an Evacuation Plan must be in place. All team members should know the procedure. This should involve effective lines of communication with the mainland and with emergency services.

5.3 Biosecurity Plan: minimising risk of rodent (re)invasion

5.3.1 Biosecurity procedures are implemented so as to **reduce the risks of invasive species spreading to new areas or reinvading areas from which they have been cleared**. This means preventing the export of species *from* islands as well as preventing their arrival on islands.

5.3.2 Biosecurity is relevant to all stages of an island restoration programme, even before eradication has taken place, as you do not wish to transport any species between sites, and it will be needed in perpetuity.

5.3.3 The eradication operation itself represents a significant biosecurity risk as considerable amounts of cargo are landed on the island.

5.3.4 Well before the eradication operation begins, review the biosecurity procedures that are in place to prevent the reinvasion of the target species or invasion of other pest species, particularly those which would have a higher chance of successful establishment in the absence of the target species (e.g. mice in the absence of rats). It may be that no biosecurity provisions are in place on the island, in which case, install basic procedures in the interim (see **Biosecurity checklist**, Annex 4). Allow enough time to implement and test any required improvements before the eradication begins.

5.3.5 A full-scale plan will be developed and implemented by the time the project team leaves the island. Often biosecurity planning will benefit from the extended stay of project personnel on the island during the eradication, as risks will be better understood.

5.3.6 The purpose of biosecurity planning is to identify risk species and 'pathways' (routes to the island) and identify multiple barriers and interventions that can be placed along those pathways.

5.3.7 There are then three components to biosecurity implementation – **quarantine, surveillance, and incursion response**:

1) Quarantine or prevention measures are devised, installed and continuously applied in order to reduce the chance of invasive species moving from one area to another;
2) Surveillance procedures are put in place to search for any sign that an invasive species has slipped through the preventative measures, and to raise the alarm quickly if quarantine has been breached;
3) Incursion response plans are developed so that people are ready and able to respond quickly and efficiently to any incursion (breach of quarantine) by an invasive non-native species, saving the island from a full-blown reinvasion.

5.3.8 In order to complete a **Biosecurity Plan**, you must:

1) Identify and describe characteristics of the island that will affect biosecurity measures;
2) Identify and prioritise risk species and pathways;
3) Identify multiple barriers and interventions you can place along the pathways to mitigate the risks posed;
4) Design an appropriate Surveillance Strategy;
5) Develop an Incursion Response Plan; and
6) Have the plans reviewed by an independent expert, and amend them as necessary.

5.3.9 Biosecurity planning and execution will incur considerable costs – these should be adequately planned for within the Project Plan.

5.3.10 A Biosecurity Plan should be considered a living document and should be reviewed regularly. This should be done at least every five years, and sooner if there are any major changes in island use or if there is a breach of quarantine.

5.4 Monitoring and Evaluation Plan

5.4.1 The Monitoring and Evaluation Plan is designed to monitor the results and *outcomes of the project*. It includes:

- Monitoring for the presence/absence of the target invasive species;
- Monitoring of the outcomes that result from the removal of the target invasive species – e.g. the effects on native species (both positive and negative); and
- Monitoring of indicators (performance measures against key targets) for each project objective.

5.4.2 Monitoring for the presence/absence of the target species is usually undertaken as an ongoing part of the biosecurity plan (the surveillance measures) and via a bespoke, intensive search (usually) two years after the eradication operation is completed (see Annex 4, and Section 3.7, Annex 1).

5.4.3 Each project objective must have at least one indicator which can be used to measure success/ to determine whether or not the project outcomes have been met.

5.4.4 You must establish a baseline measurement for each indicator. For ecological indicators in particular, this is best done via baseline monitoring over several years prior to the eradication.

5.4.5 Executing the Monitoring and Evaluation Plan can incur considerable costs including to transport, sustain and remunerate a monitoring team who may need to undertake lengthy, seasonal stays on the island over several years. These costs must be accounted for in the **Project Plan**.

5.4.6 One year of monitoring is better than none, but is less likely to produce a reliable baseline as it will be subject to annual fluctuations in target species numbers, weather conditions and other variables. A wide suite of species expected to be influenced by the removal of the target species should be monitored, e.g. vegetation, invertebrates, herptiles, mammals, land birds and seabirds. Measure what is appropriate for the specific outcome – e.g. presence/absence, diversity/species richness, population size, or productivity – each of which is likely to require different monitoring techniques and effort.

5.4.7 Control sites are extremely useful to help ascertain whether or not observed ecological changes are likely to be the result of the eradication or can be explained by other factors such as climate. These should resemble the project site (prior to eradication) as closely as possible.

5.4.8 The baseline monitoring should be repeated consistently in the post-eradication monitoring, in terms of seasonal timing, techniques used and survey effort, which will allow greater confidence to be placed in any observed changes at the project site. The plan should clearly describe all methods used and provide GPS locations of permanent monitoring plots to facilitate this.

6 Implementation Stage

6.1 Eradication Readiness Check

6.1.1 You should not embark on the implementation of the eradication operation until an independent expert has performed an Eradication Readiness Check and concluded that the project is ready to proceed. Do this in time to allow any changes or improvements identified to be implemented.

6.1.2 This check gives an independent audit of the state of planning, training and logistical organisation of the project to ensure you can deliver on the implementation as it is described in the (peer reviewed and subsequently revised) Operational Plan.

6.2 Eradication Operation Delivery

6.2.1 Details of the requirements for eradication operation delivery are contained in Annexes 1-6.

6.3 Operational Review

6.3.1 The **Operational Review** records the outcomes from the post-operation debriefing.

6.3.2 Organise the review as soon as possible after the end of the eradication operation, so that the knowledge, ideas and experiences are still fresh in the minds of the project team.

6.3.3 Include everyone involved in the project, including key stakeholders, contractors (e.g. the captain of the boat used for transporting people/supplies), the wider project team (i.e. those planning as well as executing it) and the independent experts.

6.3.4 Provide an agenda and give people time to plan what they want to say at the review.

6.3.5 Ask someone who is an expert in group-based project evaluation to arrange and facilitate the review. The review will be meaningless if people are reluctant or uneasy about talking in the setting provided, or feel intimidated talking in front of other attendees. You may need to hold more than one review if a single space in which all people feel comfortable is not achievable. This could even involve interviewing select individuals privately.

6.3.6 Consider any problems that the project encountered and discuss how they might be avoided in subsequent projects. Focus on how to make things better, rather than apportioning blame.

6.3.7 Ideally, the review document (Operational Review or wider Technical Report) should be made publically available – this will ensure maximum benefit to subsequent projects.

7 Sustaining the project benefits: Biosecurity and documentation of ecosystem recovery

7.1.1 Ensure regular review and ongoing implementation of the **Biosecurity Plan** and the **Monitoring and Evaluation Plan**. The biosecurity plan should be updated at least every five years and as soon as possible if there are quarantine breaches or an incursion response is required.

7.1.2 Refresher training in biosecurity for all stakeholders and biosecurity personnel should be provided at least annually, or before if there are changes in key personnel.

7.1.3 Stakeholders must be kept engaged and informed during this stage using an updated Communications Strategy.

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ANNEX 1: ERADICATION TECHNIQUES IN THE UK

Planning and implementing a ground-based bait station operation

Contents

This document can be cited in references as:

Thomas, S., Varnham, K. & Havery, S. 2017: *Current Recommended Procedures for UK (bait station) rodent eradication projects: Annex 1: Eradication techniques in the UK: Planning and implementing a ground-based bait station operation* (Version 4.0). Royal Society for the Protection of Birds, Sandy, Bedfordshire.

1 Background information

1.1.1 Currently the best proven method for eradicating rodents from islands is via the distribution of cereal-based baits laced with an anticoagulant rodenticide. Distribution needs to be achieved across the entire island in a methodical and comprehensive manner. Eradication methods have been developed and refined over many years: do not consider or attempt any other method unless there is a very clear and justifiable reason why anticoagulant rodenticides cannot be used.

1.1.2 Trapping may be used *in conjunction* with poisoning, but eradication should not be attempted using trapping alone. Although trapping *may* be successful on very small islands (e.g. <5 hectares), the use of rodenticides is still the preferred technique as, almost invariably, some rodents will escape from / become wary of traps, thereby leading to eradication failure.

1.1.3 There are a number of different types of rodenticides, but those most commonly used in island restoration are anticoagulants which interrupt the Vitamin K cycle. After consumption of a lethal dose, death occurs through internal haemorrhaging. Many rodenticides have a delayed onset, so symptoms of poisoning are not associated with the bait until a lethal dose is likely to have already been consumed. This helps avoid bait shyness. Depending on the potency of the rodenticide used, consumption of a lethal dose may well require multiple feeds over several days. Death is likely to occur within ten days (generally 5-7 days) after ingestion of a lethal dose, but may well be longer.

1.1.4 Fast-acting acute rodenticides (e.g. brodifacoum) have been used successfully to achieve the eradication of some invasive mammals from islands, but their use carries a substantial risk of failure and they have not proven to be reliably effective for rodent eradication. The onset of poisoning symptoms from acute rodenticides is quite rapid – any animal which ingests only enough bait to receive a sub-lethal dose is likely to associate their sickness with eating bait. Such animals, when they recover, are more cautious about novel foods (bait shy/neophobic) and may avoid taking any further baits, thereby leading to eradication failure.

1.1.5 Circumstances (legal and social) in the UK mean that aerial baiting by helicopter is currently not a feasible option; therefore the deployment of rodenticides is restricted to ground-based (hand) placement in covered bait stations. This method involves:

- Rodenticide bait contained in custom made bait stations.
- Bait stations placed island-wide on a grid with a species-specific density such that every individual of the target species will encounter bait.
- Stations are checked and bait replenished frequently (ideally every 1-3 days, in order to ensure that attractive bait is always available) such that every individual of the target species will be exposed to a lethal dose.

1.1.6 Ground-based operations can reduce the risks of unintended primary poisoning of non-target species compared to other operation types, but the risks must still be properly assessed and mitigated before baiting commences.

1.1.7 There is an added element of risk to bait station operations (over aerial baiting by helicopter) as some individuals of the target species may be wary of entering a bait station or may be excluded from doing so by inter- or intra-specific competition.

Table A1.1: The advantages and disadvantages of ground-based rodent eradication operations using bait stations.

Advantages	Disadvantages
○ Bait contained in stations reduces non-target effects (but does not eliminate them). ○ Generally uses less rodenticide per hectare than other methods. ○ Generally the safest option if livestock is present. ○ Generally less resistance from community to use of rodenticides by this method. ○ Allows detailed record keeping of both rodent and non-target species activity.	○ Very labour-intensive, requires intensive grid & multiple refills to achieve eradication. ○ Time-consuming operation – can take at least six months (depending on the island). ○ Coverage of island can be hampered by large areas of cliff (therefore may require rope access which is time consuming and has additional costs to consider), thick vegetation or bog, increasing risk of incomplete coverage (and subsequent failure). ○ Non target predatory or scavenging species such as raptors are potentially at risk by consumption of dead or dying rodents. Even with mitigation measures, still some risk of poisoning of non-target species.

2 Planning and knowledge required for the Feasibility Study

2.1 Defining the grid layout

2.1.1 **Clearly define the area to be treated.** The treatment area must include all dry land accessible to the target species including neighbouring islands, islets and rocks, as well as those in inland waters (e.g. lakes) etc. Bait stations will be required on rock stacks above high water around an island, especially those with vegetation on them, even if it seems unlikely that there are any rodents on them. **Use the known or suspected swimming ranges for the target species very conservatively when deciding which rock stacks do not need treatment. It is critical that all potential rodent habitat is baited**.

2.1.2 **Assess how treatment of all areas is to be achieved** – including on steep cliffs, offshore rock stacks, islets on inland waters (e.g. lakes) etc. If some areas cannot be accessed (e.g. by climbers), other options must be considered and trialled (e.g. lowering stations on to ledges) or the operation cannot proceed.

2.1.3 The **required density of rodenticide distribution** will depend on local circumstances (e.g. human habitation, habitat types) and the species of rodent to be eradicated. The required density should have been considered and identified during the Feasibility Study (i.e. in order to determine that baiting at that density was feasible).

2.1.4 For brown rats, the required density is usually a grid of 50m x 50m (max 100m x 100m in poor habitat, such as upland bogs, and up to 25m x 25m in preferred habitats and areas of human habitation), although some environments such as around farm buildings may require an even higher density of bait points. For black rats this is usually 30m x 30m (max 50m x 50m). For mice, this may be as little as 10m x 10m. Additional bait points will need to be set in all buildings.

2.1.5 **A monitoring grid is also required at the same density or smaller than the rodenticide grid**, in order to detect individuals that have survived the baiting operation or are reluctant to enter bait stations. It is desirable to place monitoring devices near to bait stations and also roughly half way between bait stations (in case any individuals will not enter or approach bait stations). In practice this means a 50m poison grid will form the basis of a 50m x 25m monitoring grid.

2.1.6 Ground-based operations may involve the **cutting of tracks** (with associated costs and environmental damage/disturbance) and the use **of specialist rope-workers** to ensure that all parts of the island can be baited and monitored. Feasibility of these must be properly assessed and costed during the Feasibility Study (e.g. will consent be granted to cut tracks on a ASSI/SSSI/SPA/SAC? From which relevant authority is consent required for operations within protected areas?).

2.1.7 Ground-based operations have a far longer implementation phase than aerial operations, and similarly lengthy planning requirements. **Plan for up to six months of work on the ground. For islands with permanent inhabitants, *at least* six months will be required to perform the eradication:**

- Depending on island area and team size, around one month will be required at the outset for final on-island preparations (e.g. clearing harbourage from buildings) and to establish a grid of bait stations (two months were required to establish the grid over the total of 1,317 ha of the islands of Canna & Sanday).
- At least 6-8 weeks will be needed to poison the rodent population. You should continue to lay rodenticide bait for at least one month after the last sign or suspected sign of rats.
- You should plan for several weeks of intensive monitoring as part of the operation to check for (and deal with) any surviving rodents after the initial baiting phase.

- Time is needed at the end to install permanent biosecurity measures (i.e. long-term monitoring), pack away the grid and all other equipment, and safely dispose of waste (i.e. used) bait. Remaining unused bait, which is still within the shelf-life timeframe, can be used for long term biosecurity responses or donated to other projects meeting the best practice requirements. Any bait left over past shelf-life will need to be safely disposed.

2.2 Rodenticide requirements

2.2.1 **At least two types of rodenticide, with different active ingredients must be available (on island) for every eradication attempt.** Although rats are opportunistic omnivores, they are also fussy eaters and some individuals may avoid the first bait you use.

2.2.2 If using a first generation anticoagulant rodenticide (FGAR) as your primary bait**, your secondary bait ('back-up bait') must contain a second generation anticoagulant rodenticide (SGAR) as the active ingredient**. Any local restrictions on the use of such baits outdoors must be checked in advance and, if necessary, appropriate approval sought from the regulatory authority e.g. the Health and Safety Executive (HSE). Since rodents developed resistance to warfarin-based poisons, SGARs were developed and rodent eradication practices have adapted appropriately. Since that time, most likely as a result of several contributing factors, no eradication has been successful which has solely relied upon a FGAR (e.g. warfarin or coumatetralyl). See Annex 5, Section 2.1.6 for more details on rodenticide choice.

2.2.3 The most widely used rodenticide in island restoration worldwide is brodifacoum. Brodifacoum is a potent SGAR which can deliver a lethal dose to rodents in a single feed, as can some other SGARs. FGARs require multiple feeds over several days in order to be effective. The use of brodifacoum outdoors in the UK is heavily restricted. Permissions for extremely limited outdoor use may be granted where resistance to other rodenticides can be demonstrated, but it is highly unlikely brodifacoum will be permitted as an eradication's primary bait. There are also restrictions on other rodenticides in the UK, both FGARs and SGARs - their use is managed through a [redacted]. The HSE website has a searchable database of rodenticide products which can be used in different situations. Products registered for use outdoors 'in open areas' can be used in eradication projects. Special permission from HSE would be needed to use products not listed in this category.

2.2.4 People seeking to use anticoagulant rodenticides must be sufficiently and appropriately trained in rodenticide use and adhere strictly to Best Practice guidelines. From March 31st 2017 it will be compulsory to have undergone an appropriate training course in order to buy anticoagulant rodenticide baits for anything other than household use. **For all rodenticide baits, use must be in compliance with their label instructions**. See Annex 5 for more detailed information on rodenticide use in the UK.

2.2.5 The logistical implications of UK rodenticide use restrictions are, most notably, that regular and repeated access will be required to all bait stations in all parts of the island(s) - preferably every 1-3 days for several months.

2.2.6 **Winter to early spring** is the **preferred time** in the UK to apply rodenticide bait. This timing has been successful in the past and tends to coincide with times of natural food scarcity and no young rodents in the nest. (Although rodents *can* breed all year round in the UK, in many cases they are unlikely to be breeding in winter.) It can also coincide with times of low non-target species activity, though this may not hold true in all circumstances. The risk of eradication failure is likely to increase substantially if a winter operation is not possible.

2.2.7 **Bait must be available and sufficiently attractive to every individual** of the target species in order for eradication to be successful. Palatability is highest when bait is fresh and dry. Winter weather in the UK can adversely affect bait, even inside a bait station. Slug damage may also reduce palatability. Wet bait may crumble and go mouldy quickly, making it less palatable and harder to recognise species-specific signs on the bait. Therefore, **bait must be changed regularly, even when it has not been eaten**.

2.2.8 Stations must be serviced frequently throughout the eradication programme. Checking bait every two weeks is the longest time interval that should be contemplated, although such infrequent checking carries a higher risk of failure. Checks every two weeks should only be contemplated after an intensive (checks every 1-3 days) operation in the first 6-8 weeks. Checking every 1-3 days throughout is preferable on many levels (ensuring bait palatability, checking for/responding to surviving rodents, checking for/responding to non-target interference). It is very important that palatable bait is present in every bait station for the duration of the eradication – if bait take by rats is very high, more frequent checks may be needed to ensure a continuous supply. This is particularly critical for FGARs, where multiple feeds are needed to provide a lethal dose.

2.2.9 Anticoagulant rodenticides come in many different formulations including waxy blocks, grains and pastes. Those which are wrapped (e.g. paste forms) should be avoided as they may not be sufficiently attractive for every individual. Higher wax content in bait may help it last longer in the field, but it may also make it slightly less attractive to the target species.

2.2.10 For **all rodenticide baits**, there must be careful **evaluation** of the available evidence for:

- **Acceptability to target species;**
- **Risks to non-target species;**
- **Other environmental effects (e.g. possible impacts on soil and water);** and
- **Storage and handling properties** (see Annex 6).

2.2.11 For reasons of practicality, cost effectiveness and proven acceptability to rodents, the majority of bait stations are made out of corrugated plastic tubing/drainage pipe of 100 mm diameter, see Figure A1.1. Bait stations should be made before the start of the operation by cutting 750 mm lengths from a large coil of piping. Small access lids need to be cut from one side in the middle of each length (large enough to fit a hand in), and holes pierced for threading wires through. Wires are used to secure the stations to the ground and to help prevent bait from blowing out of the station. Smaller numbers of purpose-built lockable commercial stations and DIY wooden stations will also be needed for on-going biosecurity (see Annex 3). *The use of lockable bait boxes may be preferable in some situations, e.g. around buildings, where a high bait capacity is needed, or if grain-based baits are used. Wooden bait stations are well-accepted by brown rats (Figure A1.2) and can be made cheaply from easily-obtained materials, though labour costs may prohibit their use in large numbers.*

2.2.12 Use only those types of **bait stations** proven in prior eradication projects targeting the same species and in similar habitat. Extensive field testing would be required to ensure all individuals of the target species will willingly enter a new design. Wooden tunnel designs are most favoured by rats but plastic tunnels are most often used because of their lower cost, weight and durability. Consider whether some wooden tunnels may be an advantage to use if they will continue to play a part in the ongoing biosecurity of the island. **Use a bait station with appropriate-sized entrance for the species being targeted** - 90mm minimum for brown rats, 60mm for black rats (this can be reduced to 45mm if non-target species are an issue).

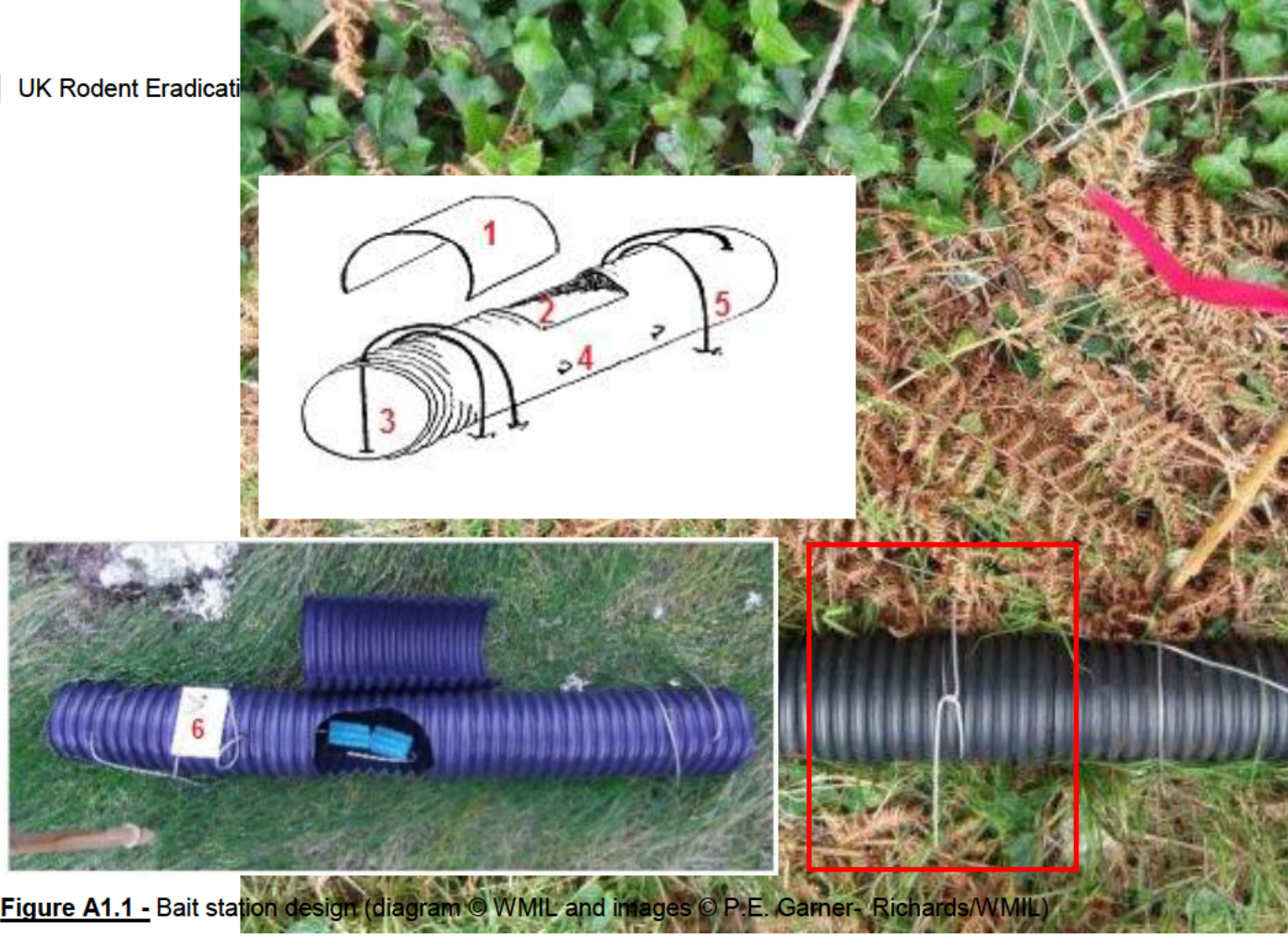

Figure A1.1 - Bait station design (diagram © WMIL and images © P.E. Garner- Richards/WMIL)

1 = removable inspection lid, 2 = access hole, 3= wire peg to halve entrance diameter,

4 = wire to hold bait in centre of station and 5 = wire pegs to hold station securely to the ground

6 = tag for numbering bait station/poison label. Left photo: Example in the field; Right photo: crow clip in place to secure lid.

Figure A1.2 - Wooden bait station (dimensions 35cm long x 25cm wide x 13cm high) with a galvanised metal lid and internal baffle; such stations offer a higher bait capacity for use in areas of particularly high rat density, e.g. around farm buildings, and are well accepted by brown rats. Photo © National Wildlife Management Centre (Animal and Plant Health Agency).

2.3 Reducing the risk to non-target species

2.3.1 Risks to non-target species can be reduced by, for example, placing additional wire through the entrance hole to halve the entrance size or securing the lids with a 'crow clip' (an additional wire bent around the tube and lid). There will be a slight curve to the piping which should be used so that the ends are raised slightly off the ground, making it harder for invertebrates to enter (N.B. this can lead to water pooling inside – if this occurs make small drainage holes in the bottom of the tube at its lowest point). Do not assume these provisions will make the rodenticide unavailable to non-target species. Consider and, if in doubt, test the possibility of exposure with non-rodenticide bait.

2.3.2 Risks to non-target species can also be reduced by the choice of rodenticide, as some rodenticides have a higher risk of secondary poisoning. See Annex 5 for more details.

2.3.3 Non-target species present both direct and indirect risks to project success.

2.3.4 **DIRECT / PRIMARY:** where animals (e.g. livestock, voles/native mice, slugs) **eat bait intended for the target species**, thereby **dying as a result of direct bait consumption** and **limiting the amount of bait available to the target species,** thereby reducing the chances of eradication success.

2.3.5 Such non-target species may have to be removed before the eradication project begins or the design of the bait station modified to reduce access and interference with the bait.

2.3.6 In the UK, bait competition is most likely to occur from non-target rodents, although a full assessment should be conducted for all non-target species. Rats are *likely* to be the dominant rodent species on UK islands where they are present; suppressing the populations of other rodent species, but this should be confirmed via population density assessments during the feasibility stage (see Annex 2).

2.3.7 As such, the risk of non-target species directly compromising eradication success should be low, but should still be assessed to ensure such assumptions are valid for your island: corvids and livestock have interfered with stations in a number of UK projects (which can be mitigated for by using crow-clips (see Figure A1.1) and re-positioning stations), whilst invertebrates may also consume bait. Regular replenishment of bait is crucial in these situations, and daily servicing of bait stations may be necessary in cases of regular and sustained interference from non-target species. It may be necessary to increase baiting rates in order to take account of competition. (N.B. this may address the availability issue for target species, but could exacerbate the issue of non-target species poisoning). Livestock eating bait is also a potential problem for human health if those animals are due to enter the food chain and, if it cannot be prevented, their owners need to know what has happened. Good record-keeping means it should be possible to tell fairly accurately how much bait has been eaten by non-target species.

2.3.8 **INDIRECT / SECONDARY**: where animals who have eaten bait (e.g. the target rodent species, or non-target invertebrates etc.) are the **poisoned prey for other non-target species** (such as raptors) **resulting in the unintended death** of individuals or even entire island populations.

2.3.9 The death of non-target species may not lead to project failure *per se* (i.e. the eradication itself may be successful), but could compromise support for future projects and/or lead to unacceptable deaths in non-target species.

2.3.10 The grid size for laying bait stations should be determined as a result of considering the risks from both direct and indirect non-target impacts, e.g. if brown rats (target species) and wood mice (non-target species) are both present, you may wish to opt for a maximum of a 50m grid in the densest areas (rather than 25m), to maximise the chances of at least some mice surviving the baiting operation, whilst not moving to 100m which may compromise the success of the rat eradication.

2.3.11 If non-target issues are significant, you may wish to review the timing of the operation to see if these risks can be reduced, but this may also increase the chances of project failure.

2.3.12 **To manage non-target risks**:

- Identify the non-target species present on the island;
- Assess whether the project poses any risks to them;
- Assess whether non-target species will interfere with the project; and
- Implement management plans to deal with each of the risks you have identified.

2.3.13 Basic information on non-target risks can be collected from other UK eradication operations but each non-target species should be assessed for each specific island as their behaviour and ecology may differ between islands.

2.3.14 A **peer reviewed** Environmental Impact Assessment (EIA) is the best means of achieving this so that any necessary mitigation measures can be built into project planning from the outset e.g. mitigation actions are used as evaluation indicators/objectives/outcomes for the project. Furthermore, for Natura 2000 sites in the UK a Habitats Regulations Appraisal (and Appropriate Assessment) may be needed.

2.3.15 Consider all of the proposed eradication techniques and phases and the logistical and support systems required to undertake the operation and review the effects of these on the environment e.g. use of *each* type of rodenticide, use of *each* type of trap, the need to cut tracks, daily trampling along the same paths, installation of temporary accommodation/sanitation for the team, biosecurity requirements.

2.3.16 N.B. If **rodenticides** are already being used to control rodents on the island, **their use must cease about 6 months before the start of the eradication operation**. Residents may wish to use traps in the interim to control rodents, which will incur different risks for animal welfare and non-target issues. All such use of traps must be in accordance with the stipulations outlined in Annex 2.

2.3.17 If any non-target species are found to be at an unacceptably high level of risk, either through direct or indirect poisoning during the feasibility stage, plans should be made to remove *at least* one genetically viable captive population for reintroduction post rodenticide administration (consider the risks of holding just one captive population were they to succumb to disease or other catastrophe). Although this option may be scientifically acceptable, you must consider whether or not this will still be socially and legally acceptable, or whether this impacts on project feasibility. Experts would be required to catch, translocate, house and care for the animals while in captivity and this will add significant cost to the project. It also comes with additional animal welfare considerations. Seek advice from veterinarians and captive breeding centres/zoos. Laws and Codes of Practice will be dependent on the species to be held in captivity, but all that are applicable must be adhered to.

3 Operational planning and execution

3.1 Peer review

3.1.1 **Have operational planning peer reviewed as it is being developed**, to ensure the eradication design matches the terrain and ecology of the island and you've thought the details of the logistics through completely.

3.1.2 Before the operation commences, you need an independent expert to conduct an **Eradication Readiness Check** and conclude that the project is ready to proceed. **If the project is not ready, DO NOT PROCEED. The chances of failure will be high and you may only have one shot at eradication**. Do not jeopardise the probability of success when there are unnecessary risks. It can be challenging to make the decision to postpone implementation, but ultimately it will waste less money, time and resources than continuing and failing the eradication.

3.2 Personnel/team considerations

3.2.1 **Health and safety of the team is always paramount** and an independently-reviewed Health and Safety Plan must be in place. All team members should have a copy of the plan and should declare that they have read it and commit to working in accordance with its stipulations.

3.2.2 Those involved in the operation need to understand eradication is different from control as *all* individuals of the target species must be targeted. Unlike typical conservation projects, expect the resources and commitment for eradication projects to **increase** rather than decrease throughout the project life. Killing the last rat (which is essential) may require orders of magnitude more operant time than the first few hundred. It requires commitment from the whole team to achieve this. In ground-based rat eradications, **every team member must be fully committed to the operation** – a mistake, careless action, or failure to carry out work in accordance with operational requirements by any one person could easily result in failure of the entire project.

3.2.3 There is a **trade-off in team size**. More people may allow the project to be completed faster but also mean greater logistics and costs for transport and living on the island. More people increase the chance of someone doing substandard work but too few people leads to fatigue and subsequent mistakes. With ground-based operations, every single field assistant has the potential to cause the project to fail. The **plan needs to be simple** so that it becomes very difficult to get it wrong.

3.2.4 **Considerable fitness is required** for ground-based rat baiting operations. Often large distances are walked with heavy loads of bait. A high level of fitness in each team member will reduce the likelihood of mistakes being made through fatigue.

3.2.5 For those projects involving **extended stays on remote islands**, all people involved on the island need the **ability to live and work harmoniously** in such an environment. Poor group dynamics can lead to mistakes which can affect the success of the project.

3.2.6 Inexperienced people should be provided with adequate training and deployed on non-critical tasks to allow the more experienced people to focus on servicing bait stations correctly. Alternatively, pair inexperienced people with an experienced 'mentor' or supervisor. Select the team very carefully, with employment of experienced Team Leader(s) and **at least 50% of all field staff having prior eradication experience**, if at all possible, so each 'novice' can be assigned an experienced on-site mentor or supervisor.

3.2.7 **Create task specifications** for team members to use and **provide adequate training** from experienced Team Leader(s), for example for positioning or servicing bait stations, see Figure A1.3 for an example specification. This approach can also be used to specify other complex or important tasks in the project.

3.2.8 The Project Manager (or Operations Manager if different) should **provide an operational briefing** to all personnel just before the start of the operation. Provide information to the entire team at the same time to be sure everyone has the same information. Describe the tasks ahead, assign responsibility for each task and remind people of the hazards associated with the project, health and safety provisions and emergency procedures. Identify the Project Manager and Team Leader(s) and ensure that the entire team is familiar with each other. Before commencing any work ensure those taking part understand the why, what, who, when and how of the work.

3.2.9 **Gather the team at the end of each day for a debrief**. This allows issues to be identified and rectified early. Ensure the whole team are present so everyone gets the same information. Brief the team about the following day's tasks then or hold a morning meeting before teams disperse. All team members must report observations of target and non-target species, whatever the probable cause of death.

3.2.10 **Stick to the plan**. Any changes once the work is underway should be taken only after careful consideration of the impacts and with input from the Independent Technical Advisor(s). Communicate any changes to the plan to the entire team, e.g. at the morning or evening team briefing.

Task Specification:	**Filling bait stations and re-baiting them**
Delegated to:	**Jim Harris** – Volunteer Eradication Operator **Supervised by Jane Taylor**, who holds ultimate responsibility to see task is performed as specified
Project:	Isles of Scilly Seabird Recovery Project
Target Species:	Brown rat

Background to task

The task specification provides guidance and standards for those involved in using rodenticide rodenticide baits in bait stations on the islands of St Agnes and Gugh in the Isles of Scilly. In order to achieve the eradication of rats on the island every single individual rat must have access to bait. Therefore it is **vital** that **every bait station** on the island **has a steady supply of palatable bait.**

Included in scope of task specification

- Distributing rodenticide baits via bait stations established on the island
- Measuring and recording the amount of bait taken from each bait station
- Maintaining the level of bait available in each bait station

Outside Scope

- Establishing the grid of bait stations (see separate Task Specification)
- Establishing or checking the grid of monitoring stations (see separate Task Specifications)

Standards

- All bait stations are filled with 3 blocks of bait which are placed loose in the middle of the station.
- Every bait station is checked every day and bait take is recorded on the attached form.
- Each bait block is closely inspected for signs of rodent nibbling and the results recorded at each station before moving on to the next.
- Records are made of the amount of bait taken at each station as well as any other information (e.g. station lost/dislodged/tampered with, other signs of rodent/non-target activity), before moving on to the next station.
- Any spoiled, wet or mouldy bait is removed and returned to base using the bucket provided.
- Every checked bait station is left with a total of 3 entire and palatable blocks of bait in it.
- A GPS is carried and a track log is collected for the entire day.
- Each transect in each section is assigned to one person to complete the bait application task.
- *Bait will be wired in to the station when decided by the supervisor. At this point, each station will be left with 2 blocks of bait at each check.*

Equipment

Buckets with rodenticide/poison label attached – one for fresh/replacement bait and one for used bait
Personal Protective Equipment (gloves, hand sanitizer, waterproof clothing, sturdy boots)
Rodenticide Safe Handling sheet
Material Safety Data Sheet (MSDS) for the rodenticide being used & COSHH assessment
This task specification
Recording forms (in waterproof notebooks where appropriate) and pencils
Colour coded map of transects with names of each person assigned to each transect
GPS and instructions

Figure A1.3 - An example of a task specification document for servicing bait stations (RSPB).

Date:	12/11/14	**Staff:**	Jim Harris	**Bait check round:**	7	**Transects:**	A-G incl.
Station	**Bait taken:** blocks / species	**Notes**					
A1	2 / presumed rat	Blue rat droppings outside station (bagged and removed).					
A2	½ / rat	Rodent chew marks. Part-eaten bait replaced, untouched block left.					
A3	0 / n/a	Station loose: secured with extra wire. Bait replaced as was damp.					
B1	¼ / invertebrate	Suspected slugs, none present in station during check.					

Figure A1.4 - An example of a completed recording form (RSPB). Note: in the field it is easier to collect data in a waterproof notebook to keep everything together, but small laminated crib cards could be made so that personnel are aware of what information must be recorded and how.

3.2.11 It is the roles of Project Manager, Operations Manager and Team Leader(s) who are *responsible* to do everything possible to maintain positive morale, though it is likely that it is the Project Manager who is *accountable*. This should be clearly identified in the **project plan** and made clear how the responsibility will be allocated. This includes ensuring working conditions are as comfortable and achievable as possible, and set the work schedule according to the abilities of the slowest team members. Keep the team informed of progress. Keeping the team's morale high increases the chances of project success. Projects can involve long hours working in difficult and demanding conditions, so pay particular attention to this.

3.3 Laying out the grid

3.3.1 **Establish the grid of bait stations** at least one week and **preferably two weeks or more prior to baiting**, to reduce potential neophobic reactions from rats. Mice are inquisitive and this time is less crucial if mice are your sole target species. Spacing will vary depending on the target species. For multiple target species use the smallest grid recommended. For operations targeting both *R. norvegicus* and *R. rattus* a 50m x 50m grid should be sufficient. If robust island-specific home range information exists for the target species, use the minimum home range size to inform grid size.

3.3.2 **Concentrate on one task at a time** – get the grid marked out before returning to lay the bait stations, Fig. A1.5. Number the stations only after they have all been laid out, reducing the chances of mis-numbering. This also gives *all* stations 'bedding in' time so that neophobic rodents are ready to enter them island-wide when bait is laid.

3.3.3 Create a computer shape file of the project area and required grid. Load the grid points from your shape file onto **GPS devices for establishing grid points in the field**. Practice this before going to the island if unfamiliar with the equipment. Accuracy of GPS fixes should be < ±8m for a reliable (rat) grid to be established using GPS. This will not be sufficiently accurate if you are establishing a mouse grid. At each point, place a highly visible marker flag (e.g. bamboo cane and/or high visibility tape).

3.3.4 Start the **transect lines** at a logical point, ideally, the centre of the island, so a straight 'backbone' or reference line can be established at correct spacing between transects, Fig A1.5. This reduces potential for error in establishing transects, as transects from centre to coast are shorter than coast-to-coast lines. Establish 'cross-island' transects at right angles to this central line. Where dense vegetation makes a central line impractical, transect lines should start from the coast and, where possible, head parallel to the coast. Transect lines must be individually numbered and the number of grid points along that transect should also be established and mapped.

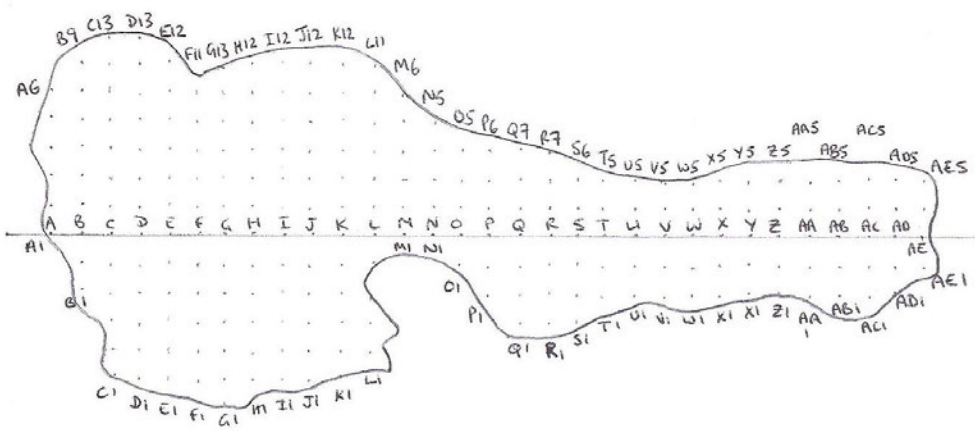

Figure A1.5 - A backbone transect grid

3.3.5 **Keep the grid/transect system as simple as possible**, preferably parallel lines across the whole island. However, natural features or settlements/stone walls may preclude this, and the island may need to be divided into sub-sections, Fig. A1.6. Sometimes ridgelines or other natural features may be easier to follow, and subsections created from those. Ensure end/start points are very clearly identified for each sub-section and that there are no gaps between the end of one sub-section and start of another.

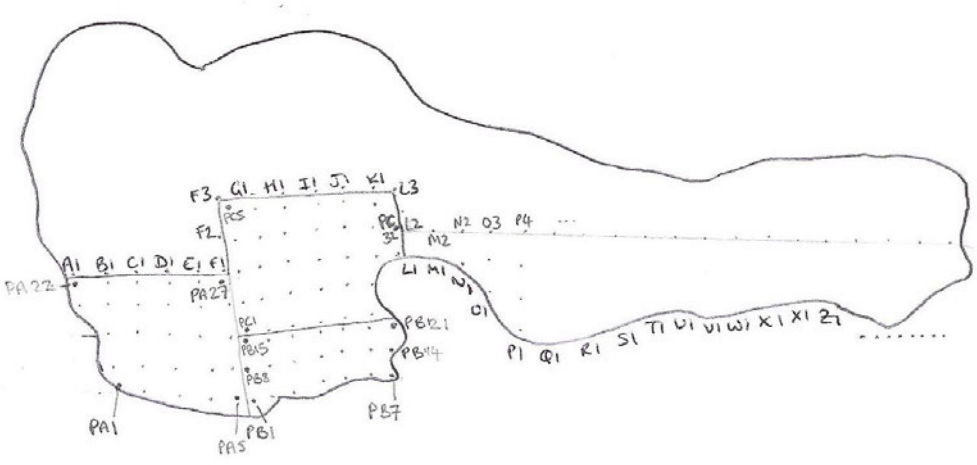

Figure A1.6- Grid based backbone system, with subdivisions to take account of three paddocks bounded by stone walls.

3.3.6 **Cut tracks** where necessary or desirable – clear tracks will greatly aid the efficiency of regular servicing, and will minimize the potential for wasted time attempting to find 'lost' bait stations and the associated risk of some stations being left unserviced. Such tracks must be subject to consent/agreement on protected areas.

3.3.7 Particularly on larger islands, create bait station equipment depots at strategic locations to reduce the amount of times teams have to return to base and the distance they have to carry bulky equipment.

3.3.8 Establish a bait station at each **grid point** and ensure it is **clearly marked** (e.g. with flagging tape on a bamboo cane). Once all bait stations are established, label each one with the transect identifier and sequential number (A1, A2, A3 etc). Visibility of grid points is very important – where practical, ensure the subsequent grid point is clearly visible from the previous one. Where this is not feasible (e.g. very dense forest), mark the route to it using a cut track and/or a different coloured tape.

3.3.9 All bait station locations should be recorded on GPS and this information safely stored and mapped. This should be checked by someone trained in GPS mapping systems to identify if any gaps in coverage are apparent. This should be done prior to the commencement of baiting.

3.3.10 Once these sites are established and marked, use the information to check prior calculations on amount of bait/bait stations required – does the actuality on the island match the prior planning? Check carefully for potential gaps both on the map and in the field before commencement of baiting. Ensure you have enough bait on hand to cover all baiting stations, with extra allowed for contingency.

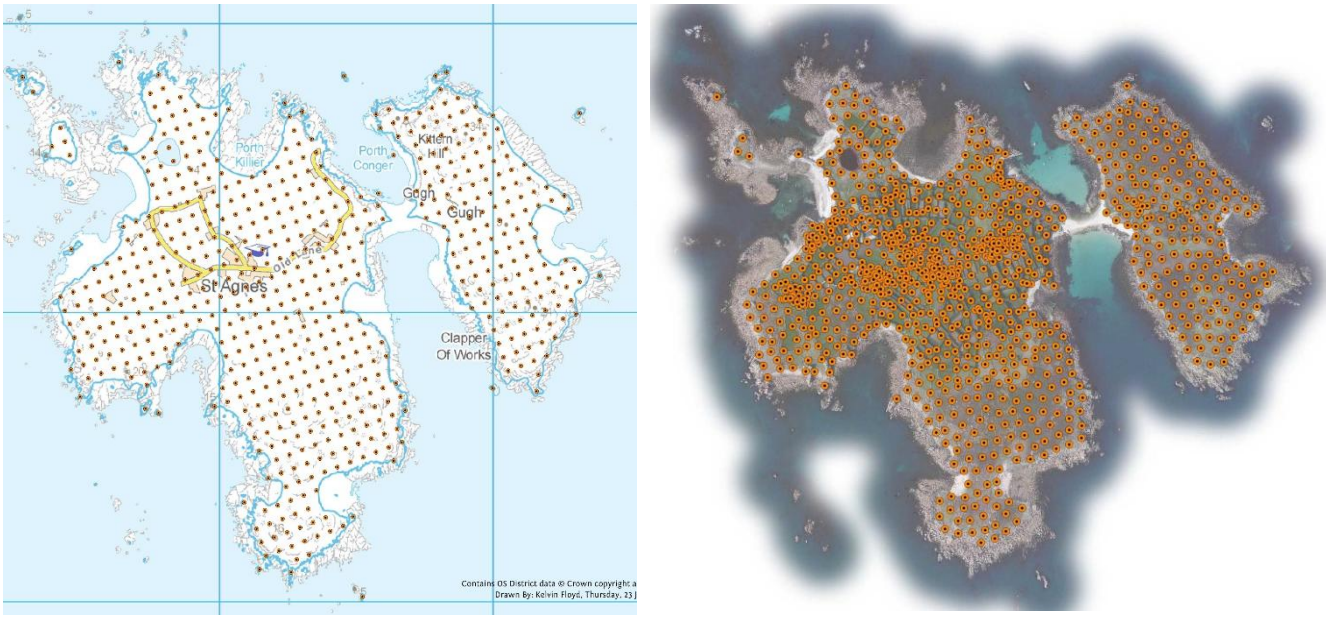

Figure A1.7- Schematic grid overlay compared with actual grid, once special areas (mainly buildings and stone walls) were accounted for. Isles of Scilly Seabird Recovery Project, © WMIL and Ordnance Survey.

3.3.11 Ensure **other** 'special' **areas** are **treated** by specifically targeted actions. Bait should be applied in, around and, where practical, under all buildings (all portions, including cellars, attics, etc.), in large caves, on offshore rock stacks that are still exposed at high tides, on islets within inland lakes, steep cliffs etc. See figure A1.8 for example.

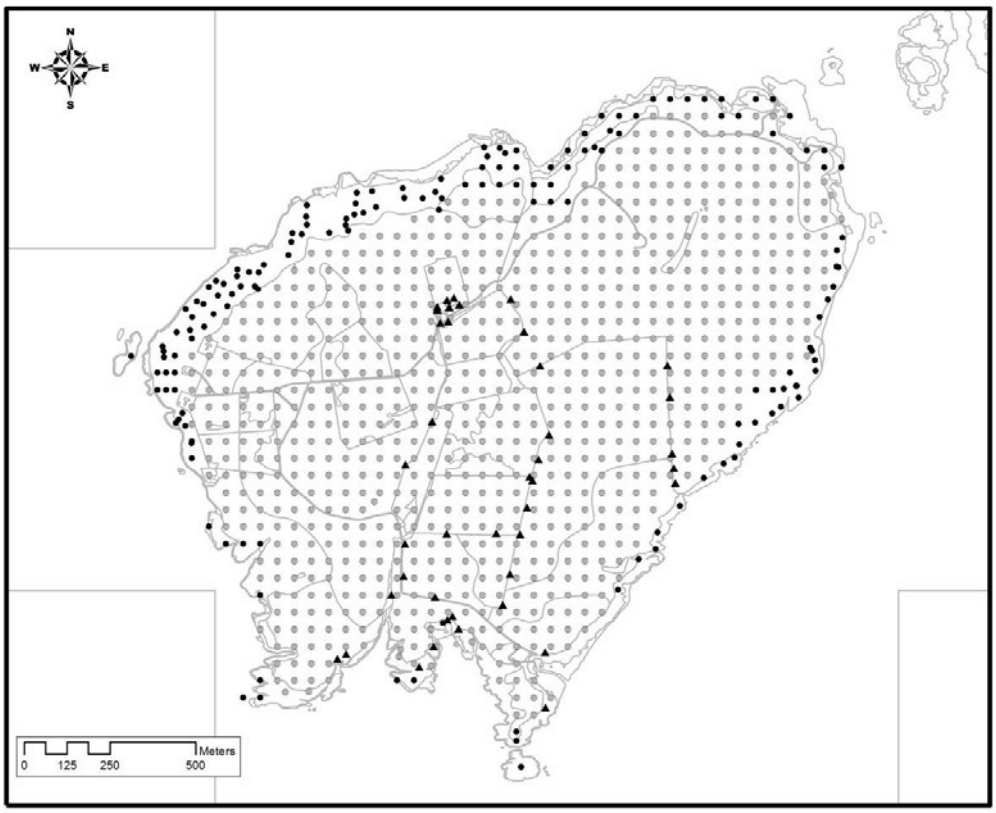

Figure A1.8 - the bespoke grid for the Calf of Man operation, illustrating greater density of stations around the coast, buildings and stone walls (APHA).

3.3.12 Very steep areas (i.e. slopes exceeding 50^{o}) that are over 25m in vertical height need to have additional or specialized treatment. Consider how bait can be placed in adequate density on steep cliffs, and trial methods by which to position bait as far as possible up, down or across cliff areas. Where possible, choose routes that can be safely accessed by foot. For larger cliff areas (where all other options may leave gaps of more than 50m x 50m for rats) abseiling may be an option. If cliffs have no vegetated areas, ledges or seabird nesting sites, then there is less chance that rats will be living permanently in these areas. In these cases fewer stations can be used (i.e. equating to a 100 x 100m grid or 1 per hectare) but it is advisable to put out as many monitoring devices as possible to assess rat activity.

3.3.13 If rat sign is found, then the cliff area will need to be baited as intensively as the rest of the island. For cliffs with ledges and vegetated areas bait stations should be set at the higher density of 50 x 50m. Space the stations regularly wherever possible, but it is better to put a station on a vegetated ledge a few metres out, rather than exactly 50m from the previous station but in an inhospitable location unlikely to be used by rats.

3.4 Other preparations prior to baiting

3.4.1 As far as possible, **eliminate or reduce all other potential sources of food for rodents before baiting** (e.g. all food scraps from the field team or island residents should be stored inside sealed, rodent-proof containers, seal all emptied food containers and tins inside rodent-proof containers, etc). Clearing up the island before poisoning begins can be a major, time-consuming task on inhabited islands. Good waste management is important both for the success of the eradication operation and for the success of any future responses to biosecurity breaches. The project should assist island residents to improve their waste management by providing and installing rodent-proof bins, for example.

3.4.2 **Harbourage must also be reduced before the baiting begins.** On inhabited islands, this will mean ensuring that all outbuildings, sheds etc. are tidy and easily accessible around wall edges, with large bulky items stored on pallets. As well as reducing hiding places for rodents, this will also ensure such spaces can be accessed easily to lay bait. Again, assistance should be provided to residents to achieve this. All island residents should be consulted before this work begins to ensure they are happy with this aspect of the eradication.

3.4.3 In accordance with local regulations, prior to the operation, **remove any wildlife carcasses found** to minimize the risk of rats utilizing alternative foods in preference to the rodenticide baits. During the operation, ensure carcasses of wildlife and of the target species are collected; see section 3.4.6.

3.4.4 **Warning signs must be in place prior to the commencement of baiting** to alert visitors and residents to the presence and danger of the rodenticides being used. See Fig. A1.9 for an example.

3.4.5 Warning signs must include:

- Details of the specific rodenticides being used, their active ingredient and brand name;
- How to recognise the bait (a photo is recommended);
- Instructions for what visitors/ residents should and should not do;
- Emergency contact details; and
- Consider providing information in different languages, as well as the local language(s), if the island is frequented by tourists.

Figure A1.9- Warning sign example. Consult the product label for any further instructions on information to include in warning signs.

3.5 Bait application

3.5.1 Attempt to **start baiting all stations on the same day**, or within as close a time period as possible. Apply a known quantity of bait to each station by counting out individual baits (or using a standard scoop). This will allow the amount of bait taken between checks to be calculated. It is particularly important *toward the end of the baiting operation* to be able to distinguish any possible rodent take from individual stations (and so to effectively target remaining individuals), so bait is *wired in to the stations* at this point. Until then, bait is not wired in – this allows shyer individuals to remove bait and eat it at their own leisure, rather than in a bait station. It also means bait can be taken back to any nesting females who may not otherwise encounter bait.

3.5.2 **Each member** of the baiting team should be personally **allocated transects** to complete, and this information should be recorded. If issues arise later it may be possible to determine if a single individual is responsible – if so, other lines completed by that person should also be inspected. Staff can be moved around between sections of the island on different days. This is particularly useful if different parts of the island vary in terms of ease of working, e.g. rugged versus flat terrain, thus enabling all staff members to see all parts of the island and to share out the more challenging transects. In all cases the Operations Manager, Project Manager, Team Leader(s) or other experienced staff (whoever is identified as being responsible for the field operation) should check all transects as often as possible, e.g. checking those in section 1 on day 1, section 2 on day 2 etc.

3.5.3 Create a comprehensive list of stations per transect and tick them off in field notepads when baiting of each has occurred.

3.5.4 **Record bait take** from each individually numbered station whenever bait stations are checked, on a daily basis if possible. **Data should be inputted immediately (same day) into a project database** to allow for adaptive management (e.g. via identification of rodent hotspots or areas of ongoing activity).

3.5.5 Any **interference with the stations or the bait by non-target species should also be recorded**. If this is observed, it will require immediate adaptive management to be deployed, e.g. removal of livestock, making the stations more secure, further refinement of the bait station design.

3.5.6 **Searches for carcasses** should be carried out. Any dead target species should be removed and disposed of in accordance with rodenticide label instructions. Any dead non-target species should be necropsied by a trained individual. If there is **any evidence that poisoning played a part in death, this should be reported to the Chemicals Regulation Directorate** (see Annex 5).

3.5.7 **Stations** should be **checked** (and bait replenished if necessary) on a **daily** basis if possible. Regularity of checking can be reduced where logistic constraints are in place, but only when wholly confident that palatable bait will remain available in all stations over the entire time between checks.

3.5.8 **Replace** any bait that has become **mouldy** or **damaged** with fresh **bait whenever necessary**. Dispose of old bait away from possible rodent access until it can be correctly disposed of (see Section 3.6.6). If bait has gone mouldy between checks, the frequency of checks must be increased to ensure all available bait remains attractive.

3.5.9 **Leave** bait **stations** in place (**baited**) for **at least 1 month after the last evidence of rat bait-take or suspected take**. There are usually two peaks in bait take – the first usually occurs in the first few weeks after bait is laid. As initial bait take subsides, it can be tempting to think the poisoning has been successful and that baiting can cease. However, this first wave may have only knocked back the dominant individuals. Once these animals have been killed, subdominant individuals are able to start accessing bait. Bait consumption is then usually seen to rise again before tailing off to zero.

3.5.10 An **alternative type of bait/rodenticide should be used** once bait consumption has dropped off in case any surviving rats have an aversion to the original bait type. Wire bait in to the stations so that any take can be more easily attributed to a specific species.

3.5.11 It is prudent to continue baiting of buildings long after the application of bait elsewhere. Islands with permanently occupied human habitation should be baited for six months or longer.

3.6 Monitoring operation

3.6.1 **Intensive monitoring should not start until bait take has diminished**, to enable identification of fussy individuals and focus areas. It is important to ensure alternative food sources are not being provided (such as with baiting tracking tunnels with peanut butter). Rodenticide bait should still be laid during the monitoring operation. It can be useful however to put out some monitoring at the beginning of the operation to obtain a reference sample of teeth marks and footprints on all types of monitoring equipment. This will enable the team have comparison samples for later in the project (as many may not be very experienced in identifying sign).

3.6.2 Establishment of the monitoring grid should be comparatively easy: **place a monitoring device** (such as flavoured wax, soap or chew sticks) **at each bait station and another as you walk from one station to the next, approximately halfway between the two**. Placing the device outside the bait station will help identify if a target individual has survived as it is not willing to enter stations. Mark the 'in between' monitoring point with flagging tape (e.g. on nearby vegetation). Use **as many different types of detection device as possible**. Refer to Annex 3.

3.6.3 Monitoring points should be checked as regularly as the poison grid and data should be entered on to the database immediately after each check. **Any suspicious sign will require a prompt response**. Placing a trail camera out (see Annex 3) will help confirm whether a target individual has indeed survived, whether or not they are avoiding entering a station or just not taking the bait. Alternative methods are likely to be required at this point, such as placing traps out in the vicinity, reducing the size of the bait station grid, offering an alternative bait.

THE IMPORTANCE OF GOOD FIELD DOCUMENTATION

A lot happens during the eradication operation and intensive monitoring. It is easy to think that a specific detail can be remembered and recorded later/when you are back at base, but in practice this rarely happens – something else occurs which distracts you and then the information is lost. Station numbers are easy to confuse (was it B6 or B7?) and it is easy to forget if you meant the bait that was taken or the bait that was left in a station (Was it a ¼ block gone or a ¼ remaining?)

Good record-keeping can mean the difference between success and failure.

Correct identification of any sign of a target species during the operation is crucial to making the right decision on how to respond. In many cases the evidence will be open to interpretation, therefore it is important that evidence collection techniques maximise the information available and minimise the chance of wrong conclusions being drawn from it. Ask open-ended questions, gather all evidence (e.g. all droppings in the pile, not just one or two), label samples thoroughly (location, date, observer), take photos (including *in situ* with a size comparator), take time to search for other evidence, make notes of discussions, conclusions and resulting action.

Good records allow you to refer back to specific events or look for patterns that might require stitching together observations from different people (e.g. people working on adjacent transects) or different days. Evidence dismissed as unlikely one day might suddenly be crucial if other sign is spotted nearby a week or two later.

Document more rather than less – you will have many opportunities to delete superfluous data later, but only one opportunity to record it in the first place. Consider providing recording sheets/templates to ensure consistency in record-keeping across the team.

The Operations Manager should keep a daily log of activities. This should record general observations such as the weather conditions, and what work was planned for and actually achieved during the day. It should note who was responsible for specific tasks, detail any issues that arose and document any deviation from the Operational Plan.

<u>This is one of the best ways of learning and building capacity for future projects.</u>

3.7 Post-operation activities

3.7.1 The field team should make preparations so that the detailed **Biosecurity Plan is operational when they leave the island**. More details are provided in Annex 4. This is likely to involve a range of activities including:

- Identifying an appropriate storage area for biosecurity equipment;
- Stocking the storage area with all equipment required to carry out both the ongoing surveillance operation and incursion response operations (the Incursion Response Kit), including making supplies of detection devices such as flavoured wax;
- Installing and mapping the location of permanent surveillance devices;
- Providing training to those who will be responsible for implementing the Biosecurity Plan;
- Ensuring there is a clear chain of decision-making and emergency contact numbers in the event of a suspected incursion/reinvasion.

3.7.2 It is important to be familiar with the Biosecurity Plan – depending on the island, it may be considered prudent to leave out the grid of bait stations so that any incursion response can be executed rapidly (e.g. on an island deemed at higher risk of reinvasion which has no residents/visitors).

3.7.3 If all **equipment** is being brought in, **take time to store it well**. If a grid is required in future, the ability to lay it quickly and efficiently is crucial. E.g. create an inventory of what is in the storage area and label boxes clearly so people can quickly access the specific equipment they need; straighten wires and re-bundle them in sizes that are easy to transport and are helpful for re-laying a grid (e.g. in bundles sufficient to establish 10 stations); bag consistent numbers of bait stations in large dumpy bags so they are kept contained and can simply be carried straight out into the field.

3.7.4 **Rodenticide** bait should be **kept in a locked container** which is **able to withstand fire** for 45 minutes. Bait containers must be labelled with the label from the manufacturer. The Material Safety Data Sheet (MSDS) should also be attached. It is important to have a record sheet to quantify the amount of bait used during any incursion response, in order to keep an accurate record of the amount of bait remaining (i.e. 15 x 10 kg buckets in depot on 1 May 2015, 1 bucket used for incursion response on 12 May 2015, total 14 buckets remaining).

3.7.5 Additional equipment which would not be needed in the event of a reinvasion, and **all rubbish generated by the project should be removed from the island**.

All used **rodenticide bait** should be removed from the environment and stored in labelled containers until it is disposed of. **Plans for its disposal should be in place before the operation commences**. The MSDS should provide details on safe disposal and arrangements should be made with the local authority in advance. Not many landfills in the UK are registered to take waste bait for deep burial. The most common option at present is incineration at a registered hazardous waste plants. This can be expensive and movement of bait to the incinerator requires a hazardous waste transportation certificate as well as a registered waste transporter. It is advised to seek advice from the Environment Agency/SEPA/NRW.

3.7.6 It is important to **debrief the team before it is disbanded**. Arrangements should also be made for the Operational Review (see Overview document) if this is to happen off-island. If not all of the team will be able to attend the review workshop, it is important to capture their ideas before they leave the island or provide an opportunity to feedback/contribute to the Technical Report.

3.8 Declaring the eradication to be successful

This section is taken largely from New Zealand's extremely useful Department of Conservation (DOC) rodent eradication best practice guidelines (Broome *et al*. 2011), as referenced in Section 4.

3.8.1 It is often much harder to be confident that a species is absent from an island than to be confident it is present. To get the same confidence level that nil sign is confirmation of a successful eradication you need to deploy more effort early, less effort later. Too early and huge effort will still give you little confidence, very late and minimal effort will give you good confidence, provided eradication failure can be distinguished from biosecurity failure through DNA samples. Make these judgements on the facts available at the time (i.e. what has actually been done/what is the situation).

3.8.2 The variables to be considered when declaring an eradication successful are**:**

a) *The length of time with no detections*. Longer timeframes in theory will allow survivors to build up to detectable numbers so species productivity and timing of breeding must be considered. As a rule of thumb in the UK this final intensive search should be undertaken **two years** after the last rodent sign was detected, as this gives sufficient time for a population to rebuild to more easily detectable levels due to rodent breeding capacity and life span. Ensure you have managed stakeholder expectations and that they are aware of the delay between the end of the poisoning operation and the declaration of eradication success.

b) *How hard have you looked?* This should incorporate a judgement on the quality of detection effort as well as the quantity (e.g. a diverse array of detection devices is better than relying solely on chocolate wax).

c) *What are the species involved?* Think about: vulnerable species present in low numbers or previously present that may (re)establish if eradication is successful; species proposed to be translocated; and the species targeted for eradication (some are easier to detect than others). Highly vulnerable native species might actually be good detection devices, e.g. the natural return of vulnerable seabirds on some islands with no sign of predation can be a good indication that the predators have gone, though of course is not conclusive evidence in itself.

d) *What is the urgency for confirmation?* Perhaps better expressed as what management action requires this information and how urgent is it? If you have a critical species that needs the island sooner rather than later or if confirmation allows you to wind down or defer another project, then confirmation is more urgent. If it's just so you know the eradication was successful with no urgent management action either way (recognising that for eradication planning elsewhere the confidence of transferring lessons from a confirmed eradication is preferable) what's the rush?

e) *What are the consequences of wrongly declaring eradication success?* If the translocation proposal is to release a relatively robust or common species then the biological consequences of being wrong about the eradication outcome are not that serious and perhaps you could afford to take a greater risk. Reputational consequences may be more damaging, however.

f) *How effective is biosecurity?* If it is not up to standard (or reinvasion risk is high) then a successful eradication might only be temporary. See Annex 4.

g) *What is the cost?* Extremely remote islands can be very costly to visit so monitoring visits may be more cost effective if combined with other reasons for making the journey.

3.8.3 Use a range of indicators to detect the presence of rodents following an eradication. Detection devices include snap traps, live capture traps, flavoured wax blocks/tags, inked footprint tracking tunnels, candles, lard, chocolate, flavoured resin blocks, fur traps, wooden boxes providing shelter and wood shavings as nesting material (rodent motels), trail cameras and, potentially, rodenticide baits a (waxy type) secured in bait stations.

3.8.4 Deploy detection devices in the most likely places. It does not have to be on a transect or grid, just try to sample different habitats and choose places most likely to have rodents.

3.8.5 Look for rodent sign wherever you go but especially around burrowing seabirds, sandy beaches or soft mud. Beware of signs that pre-date the eradication which may be still present – faeces (rat droppings) can often last for years in sheltered sites.

3.8.6 Consider some night searches if you have a likely area which you can search safely.

3.8.7 If the use of kill traps results in a capture and death of a non-target species, leave the carcass secured in the trap for a few days to see if it gets scavenged by a rat.

3.8.8 All work should be recorded on GPS and mapped to show the amount of island coverage achieved. Any tangible sign or indication of non-native rodent presence should be photographed and if possible retrieved as a labelled sample for expert opinions on identification and for DNA analysis.

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ANNEX 4: BIOSECURITY PLANNING AND INCURSION RESPONSE FOR RODENTS

Contents

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1 Introduction

1.1 Overview of biosecurity and incursion response

1.1.1 Biosecurity procedures are implemented so as to reduce the risks of invasive species spreading to new areas or reinvading areas from which they have been cleared. This means preventing the export of species *from* islands as well as preventing their arrival on islands.

1.1.2 *(Re)incursion* is when an invasive animal arrives on an island that was previously free of that species. If an incursion/reinvasion is not handled effectively, it can soon become a *(re)invasion*, whereby a breeding population of the invasive animal is established. Response to a reinvasion will require a(nother) full-blown eradication operation to be developed and implemented. It is far preferable, therefore, for conservation, financial and social reasons, to prevent (re)incursions from becoming reinvasions, and ultimately, to prevent (re)incursion in the first place. This is the purpose of biosecurity.

1.1.3 Biosecurity is relevant to all stages of an island restoration programme, even before eradication has taken place - you do not wish to transport *any* species between sites.

1.1.4 Biosecurity is also important for sites where no invasive species have been recorded. It should not be assumed that failure of an invasive species to arrive and establish in the past in any way indicates that an island is safe from future invasion. The rate of rodent invasion on islands has hardly slowed in the past century. It may be luck, as much as anything else, which has kept some islands 'invasive-free' so far.

1.1.5 Biosecurity planning involves the identification of risk species and 'pathways' (routes to the island) and multiple barriers that can be placed along those pathways to obstruct the movement of invasive species.

1.2 Implementation

1.2.1 There are then three areas of biosecurity implementation – quarantine (prevention), surveillance, and incursion response:

1.2.2 **Quarantine or prevention measures** are devised, installed and continuously applied to in order to reduce the chance of invasive species moving from one area to another;

1.2.3 **Surveillance procedures** are put in place to search for any sign that an invasive species has slipped through the preventative measures, and to raise the alarm quickly if quarantine has been breached;

1.2.4 **Incursion response plans** are required so that people are ready and able to respond quickly and efficiently to any incursion (breach of quarantine) by an invasive non-native species.

1.2.5 Quarantine measures aim to prevent (re)incursion events, surveillance and incursion response aim to identify and respond quickly enough to incursion events to prevent (re)invasion.

1.2.6 In order to prevent incursions becoming invasions, the biosecurity implementation team must be ready to respond immediately – preferably, a team will be on the island implementing the incursion response plan within 48 hours of detecting an incursion. Such response requires a high level of planning and preparedness, just like for initial eradication programmes: who will go, which boat/helicopter will be used, where does it leave from, where will all the necessary gear (including rodenticide) be stored?

1.3 Planning

1.3.1 Detailed planning and preparation are integral to biosecurity. Someone with no knowledge of the island should be able to pick up a biosecurity plan and implement it, if necessary.

1.3.2 Detailed biosecurity planning benefits from an in-depth knowledge of the island and the ways in which is it used. The quality of a plan is likely to develop during the course of a restoration programme. As such, it is recommended that an initial, brief biosecurity plan and biosecurity checklist (for use before embarking on trips to/from the island) are in place from the outset of the project and that a more comprehensive plan is developed towards the end of the eradication operation. This comprehensive plan should be in place before the eradication team leave the islands.

1.3.3 A **Biosecurity Plan** should be considered a living document and should be reviewed regularly. The responsible organisations/stakeholders should be outlined in the project governance section of the Project Plan. If there are any significant changes in island use/incursion risk or external factors such as regulations surrounding permitted rodenticide use then it should be reviewed immediately. Similarly, if there is an incursion event, plans should be reviewed as soon as the incursion has been dealt with.

1.3.4 These guidelines specifically cover biosecurity planning and incursion response for invasive non-native *rodents*, but you should consider including in your plan measures to mitigate risks from all unwanted species, e.g. pathogens, invertebrates, plants and vertebrates. These guidelines are written as part of the *Current Recommended Procedures for UK (bait station) rodent eradication projects*, but can be applied to all islands requiring a biosecurity plan, even when no eradication has taken place. Other documents are available on more general biosecurity planning e.g. from the GB Non-Native Species Secretariat ([redacted]

1.3.5 In order to complete a Biosecurity Plan, you must:

- Identify and describe characteristics of the island that will affect biosecurity measures;
- Identify and prioritize risk species and pathways;
- Identify multiple barriers you can place in the pathways to mitigate the risks posed (Quarantine/ prevention measures);
- Design an appropriate Surveillance Strategy;
- Develop an **Incursion Response Plan**; and
- Have the plans reviewed by an independent expert, and amend them as necessary.

1.3.6 There are few hard and fast rules with biosecurity as so much depends on the island's unique characteristics, however, as general guidance:

- Place multiple barriers along pathways;
- Deploy multiple types of detection devices;
- Check the devices as often as possible;
- Be prepared to act immediately;
- Maintain constant vigilance.

1.3.7 Once the Biosecurity Plan is approved, you should immediately:

- Put the quarantine measures in place;
- Initiate the Surveillance Strategy; and
- Source equipment needed for the Incursion Response Kit (part of the Incursion Response Plan).

1.3.8 It is imperative that responsibilities for each element of the Biosecurity Plan are clearly assigned to individual staff members/stakeholders. These responsibilities should be built in to formal job descriptions and, where necessary, other responsibilities should be delegated so that sufficient time is available to deliver the Biosecurity Plan. *Do not underestimate how much time biosecurity tasks/responsibilities can take.* In the event of a confirmed quarantine breach, responsible staff should expect to be required to devote a significant amount of their time in the following weeks (most likely all of it) to implementing the incursion response plan. **At least six weeks are likely to be needed**. Managers must be prepared for, and supportive of, this.

1.3.9 It is important that the Biosecurity Plan is able to minimise the risk of invasive species being transported, whilst still allowing the site to function as a home, place of work, conservation area or site of tourist interest. Compliance from all island users is required for biosecurity to be successful. Expectations need to be sensitively managed and it's important not give the impression that it's going to be all gain and no pain. The key message should be that "it's worth it".

1.3.10 In order to complete the Biosecurity Plan, consult with other island users, for example, fishermen, graziers, and boat/ferry operators, as well as with island residents and landowners. You will get a better understanding of the risks, real and perceived, and produce a better plan as a result as these stakeholders may think of risks and pathways that do not occur to outsiders.

1.3.11 You will also need to talk with harbour operators on the mainland. If tourists visit the island, you will need to find a way to disseminate information about simple steps they should take to adhere to the biosecurity requirements.

1.3.12 Some elements of international best practice for biosecurity cannot be deployed in the UK at present. Other elements, such as the building of quarantine rooms for storing and checking all island-bound goods/equipment, may be considered impractical, but should still be installed wherever possible. Proposed biosecurity plans should be appropriate to the island and the level of risk, but Plan Managers should be aware of the increased risks where best practice is not implemented. In general, it is likely to be **cheaper to plan and implement thorough biosecurity measures than it is to respond to incursions.** The cost of good biosecurity is the insurance premium paid to protect the conservation value of the island.

1.3.13 N.B. Whilst these guidelines have been tailored for UK use, they remain generic guidelines and the lists of risk species, pathways and surveillance options are not exhaustive. In each case you should consider the unique circumstances and characteristics of your island.

2 Identifying the risks

2.1 Site description

2.1.1 Here you need to identify and describe characteristics of the island that will affect biosecurity measures. This can be achieved by describing the island, its wildlife interest and its uses, and by creating annotated maps of the island.

2.1.2 Do not underestimate the importance of annotated maps and detailed site descriptions: keeping an island rodent-free may depend on the advice and actions of people who have never visited it.

2.1.3 Some key considerations are:

- Where is the island?
    - Distances and orientation to neighbouring islands/mainland
    - Directions and strengths of currents/prevailing wind
    - Proximity to a river mouth/estuary
    - Jurisdiction
- How large is the island?
- How easy is it to get to the island/how often can it be visited?

  Are parts of the island inaccessible / have restricted access? (e.g. sheer or unstable cliffs, private property, important archaeological features, protected species or sites, impossible to land in winter/ during seal pup nursing/ sea eagle breeding locations)
- What is on the island? (infrastructure (particularly boat landings or quays), buildings, land use, habitats)
- Who owns, manages and accesses the island?
- Who lives on the island? e.g.:
    - People (how many, are they residents or employees)
    - Livestock and pets (which species)
    - Protected species and habitats
    - Species at risk from rodenticide poison or small mammal traps (e.g. raptors, voles)
    - Species at risk from the arrival of invasive species
- What happens on the island? e.g.:
    - Permanent/seasonal residence
    - Farming (provide details e.g. livestock / arable / organic)
    - Tourism (is it seasonal?)
    - Research (is it seasonal?)
- What is brought to the island, from where and how?
    - People (how many, how often, residents or visitors)
    - Goods & equipment (food, agricultural feed/seeds, fleece bags)
    - Boat (describe types) / air / road causeway
- What and where are the natural and manmade access points?

2.1.4 Consult widely with local communities – they will be a valuable source of information on species present on the island/surrounding islands, and on the vessels that visit the island.

2.1.5 They can also advise on potential effects on biosecurity risks that may not be apparent to experts who are only on the islands over winter during rodent eradication (e.g. seasonal ferries, increased visitors, migrating species).

2.1.6 It is also an effective way to find out what the local community perceives as the high risk species and pathways and gain commitment to comply with the plan. *Remember, you need all residents and other island users to comply with biosecurity in order for it to be effective.*

2.2 Risk species

2.2.1 Identify what is at risk on the island from the arrival/spread of invasive species, and which invasive species would be most damaging, were they to arrive.

2.2.2 You will need to know about the ecology of risk species. Their behaviour, feeding habits, and reproductive traits will all define the impacts they are likely to have on the island, as well as how quickly the impacts will be felt and how likely they are to arrive in the first place. See Annex 3 for a summary of relevant rodent ecology.

2.2.3 Particularly problematic invasive mammals in the UK include:

- Brown (Norway) rats *Rattus norvegicus*
- Black (ship/roof) rats *R. rattus* (these are rare in the UK but, as their name suggests, are often found on ships and in ports and so the level of risk may be higher than assumed)
- Feral cat *Felis catus*
- American mink *Neovison vison*
- Hedgehog *Erinaceus europaeus* (where not native)
- Feral ferret *Mustela furo*
- Stoat *M. erminea* / weasel *M. nivalis* / *polecat M. putorius* (where not native)
- House mice *Mus musculus/domesticus*
- Grey squirrel *Sciurus carolinensis*
- Deer (all species where not native)
- Goat *Capra spp.*
- Rabbit *Oryctolagus cuniculus*[1]

[1] The impacts of rabbits on UK islands are not fully understood, aside from destabilising archaeological sites, and have been considered important for vegetation control on some seabird islands.

2.2.4 You should establish which invasive species are resident on nearby islands/mainland/and the ports from which the island's service vessels embark.

2.2.5 Rodents are more likely to arrive on an island and remain undetected than many of the larger invasive mammals and so are likely to be high risk species for all islands. If you identify species other than rodents as your island's highest risk, seek further advice – but bear in mind the principles of these guidelines will be equally applicable for many invasive animals.

2.2.6 Consider damage beyond the island's conservation interest, e.g. to island culture, economic activities or archaeological interests. These may be more important to stakeholders (whose compliance you require for biosecurity measures to be successful) than conservation concerns.

2.2.7 You can either use the species and features identified through your site description in order to assess which might be susceptible to harm by invasive species, or you can list invasive species that might arrive on your island and identify the damage they could do. See Table A4.1, A4.2 and A4.3.

Table A4.1 - Risks identified by important species/island features (illustrative only)

Important species/feature	Risks posed by invasive species	Impact speed	Impact severity
Manx shearwater	Predation or disturbance by brown rat, black rat, stoat, cat Possible competition with rabbits for burrows	Rapid Slow	Critical Moderate
Storm petrel	Predation or disturbance by brown or black rat Possible predation by house mouse	Rapid Rapid	Critical High-critical
Breeding waders	Predation by rats, fox, mink, cat, hedgehog	Rapid	Critical
Endemic subspecies of vole and wood mouse	Competition/possible predation by brown or black rat Possible competition with house mouse	Moderate Moderate	Moderate Moderate
Scheduled ancient monuments	Rabbit warrens / burrowing under structures causing destabilisation	Moderate	High

Table A4.2 - Risks identified to the site by the invasive species present (illustrative only)

Invasive species	Description of impacts	Impact speed	Impact severity
Brown rat	Decline and loss of native plants, invertebrates and vertebrates through predation and competition, including species for which UK has international importance.	Rapid (rapid rate of reproduction)	Critical
Feral cat	Decline and loss of vertebrates, including species for which UK has international importance.	Moderate-rapid (slower rate of reproduction)	Critical
Rhododendron	Decline in populations of native plants and invertebrates and vertebrates through habitat alteration.	Slow (woody shrub)	Moderate

Table A4.3 - Example classification of impact severity of risk species on the various biodiversity, economic and cultural interests of an island. From Bell *et al.* 2014, adapted from Pacific Invasives Initiative, 2010.

Impact area / **Impact Severity**	Biodiversity	Economy	Culture
Critical	Loss of a threatened native species / species occurring in internationally important numbers	Significant reduction in income from tourism Significant costs of controlling rodents or of replacing rodent-damaged goods	Permanent damage to archaeological features
High	Loss or significant decline of at least one native species	Reduction in income from tourism High costs of controlling rodents or replacing rodent-damaged goods	Major damage to archaeological features
Moderate	Decline in population of several native species Decline in a species of significance	Decrease in tourism Continued costs in managing rodents	Degradation in an area or historic site
Low	Decline in population of at least one species	Small decrease in tourism	Small changes in protected archaeological sites Small changes to quality of an area of importance

3 Pathways

Once you know which species would cause damage were they to arrive, next you need to identify which 'pathways' an invasive species could use to reach the island and how likely is it that the pathway would be used. Once you have done this, create an annotated map of the island which identifies all possible incursion points.

Pathways are categorised into two types: natural and human-assisted.

3.1 Natural pathways

3.1.1 For rodents, mustelids and other mammals, natural pathways essentially comprise swimming or floating on driftwood/storm debris. Birds and some invertebrates may be able to fly or may be carried by the wind. Plants, fungi and pathogens may also be dispersed by wind. Other extreme and less predictable weather events may also assist arrival: climate change may exacerbate these risks. For tidal islands regular invasion should be anticipated as rodents and other mammals can simply walk across to them.

3.1.2 At the outset of a restoration project (i.e. at the feasibility stage) (or, if no eradication is required then as part of the biosecurity plan,) you should confirm the invasive non-native species present on surrounding islands and other islands/mainland from which island-bound services embark. DNA sampling may provide a useful guide to previous invasion sources and hence possible reinvasion risks, and can confirm the source(s) of any future invasion(s). See Annex 2 for information on DNA sampling.

3.1.3 Different species have different swimming strengths and this is important information in determining the risk from potential sources based on their proximity to the island. Water temperature, currents, and wave conditions have an un-quantified impact – do not assume that apparently adverse conditions will prevent arrival over distances shorter than those described below. Strong currents, for example, may slacken when the tide turns.

3.1.4 As a guide, see Table A4.4:

- Brown rats can swim better than black rats which can swim better than house mice. Mice, however, are high-risk stowaway invaders.
- At 50m all rodents can easily swim to an island, and will do so frequently.
- At 500m black rat will invade but the frequency of incursions may be low.
- At 500m brown rat could, in many circumstances, be expected to reach the island every year.
- If the distance is near the currently known record for the species, they can be expected to invade but may not.
- If the distance is twice the currently known record, reinvasion by swimming may not occur but we do not consider it impossible.
- It is only islands several kilometres off-shore where we can categorically say that rodents will not be capable of swimming there. This may be reduced for islands surrounded by strong currents, but this must be considered on a case-by-case basis. However, the risk of quarantine failure on human-assisted pathways is ever present no matter how far it is.

Table A4.4 - Guidance on rodent swimming distances

Species	Known swimming capability
House mouse	500m
Black rat	750m
Brown rat	1000m ('easy') 2000m (less frequently) 4000m (possible)

3.1.5 Longest distances achieved in cooler (UK) waters may be less than stated, but for the purposes of biosecurity planning these distances should all be considered swimmable in a UK context.

3.1.6 N.B. As research continues in this area, swimming capabilities are often revised upwards.

3.2 Human-assisted pathways

3.2.1 The main pathways are (see Table A4.5):

- vessels used for transport to the island (for people, goods or services);
- leisure activities in waters surrounding the island (even if vessels do not make land), and
- shipwrecks (includes vessels that pass near but do not make scheduled stops at the island).

3.2.2 These usually result in unintentional introduction of species, but intentional release may also be an important pathway, particularly if the initial eradication is contentious. Bear in mind that other illegal or unregulated activity may also represent a significant pathway.

3.2.3 Human-assisted climate change is also likely to increase the movement of invasive species, but is not considered further here, beyond highlighting that increased storm events may increase the risk of arrival by floating on storm debris. Managers of islands close to estuaries should take particular note.

Table A4.5 - Examples of human-assisted pathways

Pathway	Activity
Small boats	Fishing/harvesting of local resources Transport between islands Boat trips for tourists Research trips – government/conservation bodies Private/residents transport/leisure
Larger/Commercial boats	Yachts Waste removal Transport of cargo/supplies Ferries Fishing fleets Tourism, incl. cruise ships Fisheries inspection, military, customs, police
Any boat	Shipwreck
Aircraft	Cargo Passenger/tourism Private
People	Intentional release

3.2.4 Boats are likely to vary considerably in the risk level they pose and should not be lumped together when assessing risk levels. e.g.:

- Small boats with no concealed areas which do not moor close to the island or stay overnight are likely to be lower risk than larger boats with a closed bilge/places for a rodent to hide which moor up to the island and stay overnight (rodents being more active at night).
- Boats carrying items such as waste/animal fodder/human food supplies, especially if cargo has been left in storage for any length of time, are likely to be higher risk than day-tripper tour boats.

3.2.5 Once you have established the pathways a species may take to get to your island, assess their likelihood of arrival. If resources are insufficient to cover all invasive species, you should prioritize those which are considered most likely to arrive and cause damage. See Table A4.6.

Table A4.6 - Risk matrix combining impacts and likelihood of arrival of invasive species to the site (illustrative only)

Invasive species	Impact speed	Impact severity	Likelihood of arrival
Brown rat	Rapid	Critical	High – likely stowaways and good, willing swimmers
Feral cat	Moderate	Critical	Low-Moderate - unlikely stowaways and don't like to swim. But are sometimes present as pets on boats and may reach islands this way
Rhododendron	Slow	Moderate	Medium - not present in nearby habitats/landscape, but seeds can be dispersed long distances.

4 Creating a quarantine (prevention) plan

4.1 Aims and objectives

4.1.1 The main aim of the quarantine plan is to prevent (re)incursion events by identifying barriers you can place along pathways to obstruct the movement of invasive species. If resources are insufficient to cover all invasive species or pathways, you should identify and prioritize those which pose the greatest risks to your particular island (e.g. species which are most likely to go undetected, boats that visit most often, that carry higher risk goods/people, that stay near the island overnight, or that come from highest risk places).

4.1.2 The principle of prevention is to place as many barriers and checks along pathways of introduction as possible. Barriers should be placed and checks made so as to:

- prevent species getting on to vessels, either directly (e.g. climbing up mooring ropes) or indirectly (e.g. as a stowaway in cargo);
- prevent species dispersing from land within swimming distance of the island;
- identify the presence of species on vessels in transit;
- prevent species getting off vessels; and
- prevent species getting out of quarantine areas on the island.

4.1.3 The exact measures deployed will depend on the species and pathways identified for your island. Carefully consider each pathway that you have identified and ensure there are multiple barriers in every one that is recognised as a biosecurity risk.

4.1.4 As many stakeholders as possible need to be aware of these preventative measures and content to implement them. This should include:

- island residents;
- dock/wharf/marina operators;
- vessel operators and owners;
- aircraft operators (those responsible for loading aircraft and running airports);
- tour operators and tourists;
- researchers; and
- any other visitors (e.g. fishermen, graziers, civil servants/inspectors).

4.1.5 Try to make the quarantine/preventative measures as simple as possible – the harder they are the less likely people are to undertake them.

4.1.6 Stakeholder engagement may be made easier if you are able to identify and communicate the benefits *to them*, as well as to wildlife, of the island being free of the invasive species in question.

4.1.7 If there are access approvers (e.g. landowners, government departments) you should ask them to make implementation of biosecurity (quarantine/prevention) measures a condition of access to the island. As far as possible, government agencies should assist with ensuring compliance on biosecurity measures.

4.1.8 Those responsible for implementing the biosecurity plan should **inform, motivate** and **equip** relevant stakeholders to implement biosecurity measures. 'Equip' means to provide, free of charge, both the physical equipment needed to implement biosecurity as well as technical training. Training should be offered following any changes in staff (e.g. amongst vessel operators) and periodically as a refresher. Annual training is recommended. Adequate funding should be secured for this.

4.1.9 Biosecurity is required in perpetuity and project funding will most likely be time-bound. As such, adequate plans should be made to fund the biosecurity requirements in the longer-term.

4.1.10 Sections 4.2 to 4.5 are not exhaustive, but give some ideas for barriers you can put in place.

4.2 Barrier 1: Actions at points of origin

4.2.1 Have in place baited stations and/or traps on quays of servicing harbours. Such use needs to be in accordance with best practice outlined in Annexes 2 and 5.

4.2.2 Install good waste management and reduce harbourage at quays/along adjacent 'swimmable' mainland. You may wish to undertake lethal control measures in high risk habitats along adjacent coastlines to reduce the likelihood of dispersal events (see Annexes 2 and 5).

4.2.3 As far as possible, place island-bound goods and supplies in rodent-proof containers. At the very least, all items (including visitor day packs) should be placed in a sealed container so that they can be inspected for signs of tampering/entry by rodents.

4.2.4 Before loading onto vessels, check goods and supplies that are island-bound for signs of rodent interference, especially items which cannot be placed inside rodent-proof containers or which have been stored overnight or longer. Look for chew marks and signs of entry/holes.

4.2.5 As far as possible, ensure goods are packed on the day of delivery. For items which will be stored long-term or overnight before being transported, store off the ground (e.g. on a pallet) and place traps/rodenticide underneath/around the goods. This is particularly important for high risk goods such as fodder.

4.2.6 As a preference, store all island-bound cargo in a quarantine store after it has been checked. Check cargo again before loading onto the vessel. More detailed information is available if installing a quarantine store is an option for your biosecurity plan (contact sophie.thomas@rspb.org.uk).

4.2.7 For boats moored on buoys or anchor:

- If possible, position the mooring so that the boat remains in the water at low tide;
- fix mooring hoods to mooring lines (where possible use a fixed mooring instead of an anchor);
- ensure nothing is suspended over the side of the boat;

- moor boats in areas free from shore-based rubbish and other food sources or concentrated rodent habitat.

4.2.8 Do not run mooring lines ashore unless you absolutely need to.

4.2.9 Larger ships should use line guards on ship-to-shore lines to stop rodents using mooring lines to get on and off the ship.

4.2.10 Do not land at night unless you absolutely need to.

4.2.11 Consider if any risks can be avoided altogether by a change in practice – e.g. using island sources rather than importing items (invasive-rodent-free Ramsey Island now produces hay itself rather than importing it, for example).

4.2.12 Raise awareness of the invasive-rodent-free nature of the island and inform visitors of biosecurity actions they need to undertake (such as sealing and checking all their bags). Consider:

- placing signs at key departure and arrival points about the risks of reincursion and the measures you would like people to take to reduce risks;
- providing information leaflets at these points;
- placing information on vessels (visual or audio – e.g. over ferry tannoy announcements);
- designing visitor/ferry tickets so that they provide biosecurity information (e.g. using the reverse side for this purpose);
- placing awareness-raising notices in local papers or radio.

4.2.13 Publicise a contact number so people can report if they think they see an invasive rodent/rodent sign.

4.2.14 For people planning to visit a number of islands (e.g. researchers, tour guides, rubbish collection vessels), visit those that are invasive-free (or have less chance of invasive species escaping onto your vessel) before visiting those with invasive species. Visiting islands in order of least risk decreases the chances of you transporting invasives from invaded to invasive-free islands.

4.2.15 Encourage all relevant stakeholders to maintain vigilance at all points of origin.

4.3 Barrier 2: Actions *en route* to the island

4.3.1 Rodenticide poison and/or kill traps should be in place on all vessels which pose a significant risk of transporting rodents to the island. Second generation anticoagulant rodenticides are best for biosecurity purposes on vessels, but check the legality of using them in this way.

4.3.2 All rodenticides and kill traps should be placed in covered and lockable containers and significant effort should be undertaken to reduce risk of harm to all non-target species.

4.3.3 Traps should be checked at least once a day. If they cannot be checked with this frequency, they should not be used. Refer to **Annex 2**.

4.3.4 Rodenticides should be checked at least weekly for any sign of consumption or tampering, and bait refreshed regularly (at least once per month or sooner if weekly checks show it to be damaged by weather/less attractive to rodents for any other reason). Refer to **Annex 5**.

4.3.5 Train boat operators and encourage visitors to maintain vigilance whilst in transit.

4.3.6 If a rodent (or any other invasive species) is found on a boat which is island-bound, the boat should not land. The boat should return to its point of origin until it is clear all rodents present have been removed. Never allow a live rodent to be thrown overboard.

4.4 Barrier 3: Actions on arrival at the island

4.4.1 Do not run mooring lines ashore unless you absolutely need to.

4.4.2 Do not land at night unless you absolutely need to.

4.4.3 Before unloading anything at the island, all packed gear should be thoroughly inspected for sign of rodent exposure (chews marks, gnawed holes, etc.).

4.4.4 Only unload what must be unloaded.

4.4.5 Unpack containers, luggage and cargo in enclosed, rodent-proof, well lit, and tidy areas. Preferably this would be in a quarantine room. This will allow easier detection and capture of any invasive species that do escape. The more secure the area, the easier it will be to stop the invasive species escaping onto the island.

4.4.6 If there are no appropriate buildings on the island and a quarantine room cannot be built, goods should be unloaded and checked close to shore in an area which can be surrounded by people who are poised to take action should a rodent/other invasive species escape. N.B. there are significant additional risks to this approach.

4.4.7 Consider installing lethal control measures at the main incursion points identified earlier in your biosecurity plan (an EIA and measures to limit risks to non-target species will be required).

4.5 Barrier 4: Actions on departure from the island

4.5.1 Apply the ‘Actions at points of origin’ measures to ensure you do not export invasive species from the island.

4.5.2 Do not remove anything from the island that could contain invasive species.

4.5.3 Remove all your rubbish, including fruit and vegetables, from the island. Rubbish provides a great food source to many invasive species and can hinder both surveillance efforts and incursion responses. Discarded species may also prove invasive themselves (e.g. fruit from vines/climbers).

4.6 Basic biosecurity checklist to be completed by team leaders for all island visits:

Task	Completed?
1. Have I given clear biosecurity instructions to all trip members?	Yes/No
2. Have I checked they have understood these instructions?	Yes/No
3. Have all stores and supplies (which are small enough) been packed in approved rodent-proof containers?	Yes/No
4. Itemise gear too bulky/awkward to fit into rodent-proof containers: • • Items checked immediately prior to departure -	Yes/No
5. Has everything been stored in a rodent-proof room in sealed containers or re-checked immediately prior to departure?	Yes/No
6. Have I checked with every member of trip: - packs kept in rodent-free areas or checked and re-packed since? - no food held in any unsealed bags? - boots and other footwear clean and free of soil/seeds? - packs, pockets, Velcro fasteners, socks, etc clean of weed or grass seed? - no-one in party has worked in area of known invasive plant/invertebrate infestation recently without changing/ washing gear (including shoes/bags)?	 Yes/No Yes/No Yes/No Yes/No Yes/No
ANSWERS 1-6 MUST BE 'YES' BEFORE TRIP CAN PROCEED	
7. Identify any added risks of the trip: - are we leaving/ travelling at night? - are there planned stops *en route* where pests could enter or exit? - are we travelling on a boat with no poison rat baits or effective rodent control measures? - are any items being stored on deck or in non-rodent proof holds?	 Yes/No Yes/No Yes/No Yes/No
8. Have I addressed these concerns by identifying and implementing bespoke solutions to minimise potential risk to the islands?	Yes/No
YOUR ANSWER TO TASK 8. MUST BE 'YES' BEFORE TRIP CAN PROCEED	
In Transit to Islands: If any sign of rodent or other invasive species is detected on the boat whilst *en route* to your destination, DO NOT land at the destination island or any other island until the problem has been identified and remedial actions implemented in consultation with experts.	
On Arrival: - Have I re-inspected all containers for rodent entry or damage which could allow entry? - Has everything been unpacked or opened up and carefully inspected in an open area or quarantine room? - Have I instructed everyone on rules for disposal of organic rubbish? - If planning to go to other islands from here, have I considered and established how to apply quarantine procedures before we leave? - If on a daytrip, have I ensured only day-bags are taken, and that they have been checked as clean and been packed only on the day of departure?	Yes/No Yes/No Yes/No Yes/No Yes/No

5 Designing an appropriate surveillance strategy

If your quarantine/prevention measures fail, your surveillance strategy is all that stands between species of conservation interest or concern and a full blown reinvasion of the island that would take you back to square one. Getting surveillance right requires significant on-going time commitments and carries with it an annual running cost. By preventing invasions, however, it will save a lot of time and money in the long run.

Annex 3 details surveillance methods for rodents applicable to various stages in island restoration projects, including for biosecurity purposes.

However, there are additional, **important considerations when planning a surveillance strategy as part of biosecurity:**

(a) Behaviour of rats in very low densities is less predictable than when an established population is in place, for example:

They are likely to wander widely to explore the island and search for other rodents to mate with. The rat may be nowhere near the point at which it left sign by the time of your next surveillance check. If incursion is detected, you should immediately search across the island to check for further sign.

Following arrival, a new rat is unlikely to be food-stressed and might be most **attracted by good habitat**. Rodent motels are deployed with this in mind - as a particularly sheltered and safe environment they can make ideal habitat and be very attractive to rats.

(b) You need to **plan for the quirks of an individual rat's behaviour** – the rat that has made it to the island might be wary of traps or be uninterested in chocolate flavoured wax. **Deploy as many different types of detection devices as possible.**

5.1 Detection techniques

Detection techniques include:

- Flavoured wax blocks – e.g. chocolate, coconut, peanut butter, meat gravy, fish. Plain wax is considered less reliable for use in surveillance (see Annex 3, Section 2):
- Tracking tunnels/plates or natural mud/sand traps;
- Cameras;
- Traps;
- Visual searches for runs/droppings/chew marks on naturally occurring foods;
- Hair traps; and
- UV light.

5.1.1 See Table A4.7 for the appropriate surveillance strategies for generic island types.

5.1.2 In the UK surveillance cannot usually involve 'passive' killing of invasive species as permanent laying of poison or traps is not likely to be permitted. It is even more important, therefore, that surveillance devices are checked as frequently as possible so as to catch any incursion before it becomes an invasion.

5.1.3 It is worth noting that even international best practice still states that it is better to detect an incursion and launch a calculated response than to rely on permanent baiting.

5.1.4 The location of all permanent monitoring devices should be recorded using GPS and mapped for ease of reference when doing routine surveillance or if incursion response is required.

5.1.5 Carefully archive all devices that display some form of interaction with a species (e.g. tracking cards, chewed wax block) noting exact locations, dates and who interpreted them. This information may be useful to refer to when dealing with future invasion/incursion responses.

5.1.6 Create a biosecurity log (see Table A4.8) **to** detail all suspicious sign or sightings, **including false alarms,** near-misses or other events occurring as part of the quarantine actions.

Table A4.7 - Appropriate surveillance strategies for generic island types.

Scenario	Recommended surveillance for rodents
1. The island can be easily or regularly visited and is **small** enough to cover with a grid of detection devices – e.g. up to ca. 250 ha. (Includes inhabited islands)	Deploy a **broad array of detection devices over the whole island** at about one or two per hectare and check each of them on every visit. Use, primarily, **tracking tunnels** and **flavoured wax blocks**. Put fresh tracking cards and wax out each time you visit, or freshen wax blocks by shaving off outer layers – the smell of the flavour (chocolate etc.) should be easily detectable. Wax blocks should be checked within around 7 days of being set. Ideally, tracking tunnels would be run for 7-10 days each time and checked at the end of this period. Add a lure, e.g. peanut butter. Supplement this with looking for feeding sign and footprints on sand or mud. Place wax/tracking cards inside permanent wooden boxes in preference to plastic stations. These can double up for use housing traps or poison if an incursion is detected. **Monthly checking is advised**. As an absolute minimum do four checks per year (about every three months). If you only do four checks a year and a pregnant female arrives, you can expect a breeding population to be establishing by your next check.
2. The island can be easily or regularly visited but is too **large** to cover with a grid of detection devices – e.g. larger than ca. 250 ha. (Includes inhabited islands)	Deploy a **broad array of detection devices in a range of likely habitats** which are easy to access, **and at possible incursion points** (e.g. around the coastline). Supplement this with looking for feeding sign/footprints on sand or mud. Use, primarily, **tracking tunnels** and **flavoured wax blocks**. Put fresh tracking cards and wax out each time you visit, or freshen wax blocks by shaving off outer layers – the smell of the flavour (chocolate etc.) should be easily detectable. Wax blocks should be checked within around 7 days of being set. Ideally, tracking tunnels would be run for 7-10 days each time and checked at the end of this period. Bait them, e.g. with peanut butter. Place wax/tracking cards inside permanent wooden boxes in preference to plastic stations. These can double up for use housing traps or poison if an incursion is detected. **Monthly checking is advised**. As an absolute minimum do four checks per year (about every three months). If you only do four checks a year and a pregnant female arrives, you can expect a breeding population to be establishing by your next check.

3. The island has a known history of regular rodent incursions, or you **expect the likelihood of** future **incursions to be high** (Includes inhabited islands)	Given permanent trap use in the UK will be impractical, and permanent rodenticide baiting considered poor practice, there must be exceptionally high conservation interest on the island for eradication to have been undertaken. **Consider installing rodent-proof fences** to create exclusion zones around sites of high conservation value. See Xcluder® (http://xcluder.co.nz/xcluder-fences/fences-designs.html) for more information. N.B. if exclusion zones extend to the coast, they cannot be considered complete barriers. Surveillance must continue inside the fenced area, regardless of the fencing. Lay **poison bait in all buildings on the island** – concentrate on baiting during the winter months if permanent baiting is not possible. First generation anticoagulant rodenticides can be used for this if necessary. **A network of (empty) wooden trap tunnels should be in place across the entire island** which can be used for trapping, baiting or placing tracking cards. Place them on most likely sites if a one to two per hectare grid (or greater if mice are highest risk invader) is not possible. Run tracking tunnels for 5- 10 days and check at the end of this period. Wax blocks should also be checked within around 7 days of being set. Supplement this with searches for sign/footprints on sand/mud and at likely incursion points. Weigh up the costs of fewer, longer visits over shorter more frequent ones. How early do you need to detect and deal with an incursion in order to prevent catastrophic damage to the conservation interest? Where possible, fewer, longer visits are advised.
4. **Remote** and uninhabited islands which are seldom visited.	Ensure visits, when they do happen, **give the team as long as possible on the island.** Also ensure that the highest biosecurity standards are adhered to in order to prevent accidental introductions to the island. **A network of (empty) wooden trap tunnels should be in place across the entire island** which can be used for trapping, baiting or placing tracking cards. Place them in most likely sites if a one to two per hectare grid is not possible. When visiting run tracking tunnels for 5 nights or longer, focusing on likely areas if necessary. Check the tunnels at the end of this period. Supplement searches by using flavoured wax (these should be checked within c. 7 days of being set) and look for feeding sign/footprints on sand/mud and at incursion points.
5. At least one **native rodent** exists on the island and you want to detect new species arriving.	Carefully select detection devices to **maximise the chances of distinguishing between native species and invading species** – e.g. tracking tunnels, Bovril wax. **Do not use rodenticides pre-emptively.** Operate appropriate traps when visiting (e.g. set for rats if resident mice/voles are present) and look for feeding sign.

Table A4.8 – Example Biosecurity Incident Log

Date	Recorder: name/contact details	Incident description	Response/Action taken	Outcome	Additional information
12/3/14	*Insert name & number*	Rat droppings found on 'Brenda' boat by visitor *en route* to island	Boat did not land on island – returned to port. Full search conducted of vessel and cargo. Baited and covered traps placed on board. *name* discussed tighter quarantine measures for the boat with owner and provided refresher info on rat sign. Boat had recently come out of winter storage.	**NEAR MISS** No rat found. Assumed it left boat after being disturbed. Boat to obtain rodent-free certification next spring before being launched. Owner committed to checking for sign.	Contact details for 'Brenda' owner, *Insert name & number*
1/5/14	*Insert name & number*	Member of public *Insert name* reported rat sighting at grid reference xxxxx	*name* interviewed *name* on same day and together visited location of sighting. Considered reliability of report to be poor (middle of day, middle of field), but instigated daily monitoring of surveillance grid 250m in each direction from sighting for four weeks, without further sign. Instigated one island wide check of all permanent surveillance stations	No confirmed rat sign. Regular surveillance checking resumed. **Assumed False alarm**	(Add hyperlink to completed interview form for this incident)
3/6/14	*Insert name & number*	Member of public *Insert name* reported rat sighting at grid reference xxxxx	*name* interviewed *name* following day and visited location of sighting alone following detailed description. Considered reliability of report to be poor, but instigated daily monitoring of surveillance grid 250m in each direction from sighting for four weeks, without further sign. Instigated one island wide check of all permanent surveillance stations	No confirmed rat sign. Regular surveillance checking resumed. **Assumed False alarm**	(Add hyperlink to completed interview form for this incident)
9/8/14	*Insert name & number*	Member of public *Insert name* reported rat sighting at grid reference xxxx	*name* interviewed *name* same day and together visited location of sighting. Considered reliability of report to be poor, but noted almost identical location to that of 1.5.14 so instigated daily monitoring of surveillance grid 250m in each direction from sighting for four weeks and brought in additional detection methods (cameras and tracking tunnels baited with peanut butter). Instigated island wide check of all permanent surveillance stations. No sign of rats found.	No confirmed rat sign. Regular surveillance checking resumed. **Assumed False alarm**, but extra surveillance (camera) left in place around sighting	(Add hyperlink to completed interview form for this incident)

6 Confirming and responding to incursion

6.1 Collecting evidence

6.1.1 Correct identification of any sign of rodent incursion is crucial to making the right decision on how to respond. In some situations the evidence of an incursion will be indisputable, e.g. a dead body in a trap on the island/footage captured on a trail camera. However in many cases the evidence will be open to interpretation – e.g. sightings by third parties. It is important, therefore, that evidence collection techniques maximise the information available and minimise the chance of wrong conclusions being drawn from it. Table A4.9 provides advice on collecting and caring for different types of evidence indicating a rodent incursion.

Table A4.9 - Collecting and archiving surveillance evidence

Sightings	Interview the person who made the sighting as soon as possible – preferably on the same day. Take account of their experience but do not judge a sighting on experience alone. The most important factors are how well they saw it, i.e. how close, how long, what visibility. *What made them think it was a rat/mouse?* Ask open questions e.g. "tell me what you saw? how long did you observe it? What did it look like?" DO NOT ask leading questions e.g. "was it brown and about this big?" Record or write everything down, including when the sighting took place, when the interview took place and who conducted the interview. Ensure the exact location of the sighting is recorded, if necessary take the person back to the location where they saw the animal. Always record the incident in the biosecurity log and check it against previous incident records. One vague sighting on its own may be dismissed but if you get a number of similar sightings in a similar area over time you may form a different conclusion. New techniques for identification may present themselves in the future which could allow the archived evidence to be reviewed. Try to establish other evidence that supports or challenges the sighting (could it have been a vole or a shrew, or even a wren?). Use a standard recording form to gather similar information from each sighting.
Droppings or feeding sign	Photograph the evidence *in situ* where possible before disturbing it. If taking digital photographs, use high definition settings for at least some photos and provide a size comparator (e.g. coin, pen lid). When retrieving evidence to take back, physically mark the spot and collect everything i.e. if there are 24 suspected rat droppings there pick up all 24 and take them back, not just one or two. Take time to look around carefully for other sign such as tracks, hair, scratch marks etc. Remember you are not only looking for evidence of the suspected species, you're also looking for evidence which may support an alternative explanation. Label the evidence, including photos with detail on when /where /who. If sending evidence to an expert for identification, think about the security of transporting it e.g. this evidence may be the crucial factor in a decision to spend thousands of pounds in a contingency response, so don't save £5 by sending it in the post instead of by courier or other traceable/more secure transport system. If the evidence is going to be difficult to identify, have more than one expert look at it independently to give their opinion. Ask each of them why they came to the conclusion they did and what other opportunities there may be to further verify this. Always archive the evidence and record the incident in the biosecurity log. Reference it

	against previous incident records (see above).
Carcasses	Photograph *in situ*. Preserve in alcohol or triple bag and freeze. Label the evidence with details on location, state, and who found it and when. If species cannot be determined (e.g. due to decomposition), follow instructions on gathering DNA evidence in Annex 2.

6.1.2 If there is any uncertainty over the sign, **ask at least two experts to help interpret the evidence**. Experts prepared to offer advice should be identified in advance and their names and contact details should form part of the Incursion Response Kit (see below). As experts may be uncontactable in the field when you need their advice, ensure you gather details of several experts who are prepared to help.

6.1.3 In New Zealand, the first line of action if incursion is suspected is to use rodent detection dogs to help locate any individuals that are present. In the UK there is no trained dog resource at present for island restoration, although training dogs for conservation purposes does take place (e.g. dogs trained to find dead bats around wind turbines) and the potential for bespoke training and application to island restoration purposes is being explored. **At present, dogs MAY NOT be used in UK projects**. The risk of falling foul of the Hunting Act (2004) or Protection of Wild Mammals (Scotland) Act 2002 is too high in the absence of dogs that have gone through a vigorous, bespoke, certified training scheme for island restoration. **Do not deploy dogs in the UK, no matter how obedient/well-trained they appear or their owner insists they are.**

6.1.4 As a possible alternative, caged rats may prove an effective lure for wild brown rats. This has **not been extensively field tested**, but is a promising field of research. **Seek further advice**: the risks of the rat escaping must be managed effectively and there will be animal welfare considerations regarding the use of caged animals, therefore local legislation will need to be consulted. There is evidence to suggest this method doesn't work for black rats, so only consider using if you know only brown rats are present.

6.2 Planning and management for (re)incursions

6.2.1 The following decision tree procedures are designed to help you manage potential incursions promptly and effectively, however they can be guides only as so much depends on island circumstances. This is why independent review is so important. The general course of action is:

a) A sighting is reported;
b) The person who sighted the rodent is interviewed as soon as possible;
c) The location of the sighting is visited (preferably with the observer) and assessed;
d) Any further evidence is collected and, if necessary, sent to experts;
e) The sighting is considered either **uncertain/possible** or **probable/confirmed;**
f) Uncertain sightings trigger a monitoring response;
g) Probable & confirmed sightings trigger incursion response involving traps and rodenticide; and
h) All sightings and follow up actions are recorded in the biosecurity log.

6.2.2 If there is a **shipwreck**, the area is immediately **considered as a probable/confirmed incursion and triggers an incursion response.** Consider working with maritime authorities who get involved in the shipwreck response to get more information about the level of risk e.g. if salvage experts are going on board the vessel they could be trained to look for rodent sign in the galley. Knowing the cargo and the prospects for the ship breaking up could also forewarn your response.

6.2.3 The speed of a response is crucial. For a probable or confirmed incursion, you want a team on the island ready to deploy bait/set traps/bolster the grid **within 48 hours**. For this to be possible, the mechanisms for responding to a reported sighting/sign find must be slick and lines of responsibility need to be clear. Transport arrangements should be in place and all equipment ready for loading, if not stored on the island. As UK surveillance strategies are limited to detecting incursion events (by themselves they cannot deal with an incursion), it is even more imperative that plans for incursion response are in place and people are ready to respond immediately.

6.2.4 Where there is already a network of stations in place on the island, use it as the basis for the response. It may need to be bolstered – e.g. if rodent sign is discovered on a large island in an area where there is no grid or only a sparse grid. Speed is of the essence. A sparse but extensive network covering as much of the island as possible is probably better if a grid has to be established than a dense grid in a small area. 1 to 2 devices per ha targeting preferred habitat is sufficient – it doesn't need to be an exact grid because invading rodents are likely to travel. Cover all major habitat types, but focus on preferred sites and known invasion sites. If a grid is already established, you may have time to reduce the grid size around the area of the sighting/evidence.

6.2.5 Place traps around the area of the sighting/evidence where there is plenty of natural cover and where rodents are likely to be active (e.g. alongside large rocks or walls, around the base of trees, under logs, overhanging vegetation, and under buildings). Traps can be baited with a mixture of peanut butter and rolled oats for an easy, durable bait which can be stored as part of the Incursion Response Kit. Tracks are used by invading brown rats and mice. Brown rats tend to be coastal foragers while black rats might prefer interior forest and may avoid tracks. Additionally, refer to Section 6.6 for setting up rodenticide grid from point of rodent sighting.

6.2.6 Having a Rodent Incursion Kit stocked and stored in a suitable place is crucial to preparedness. Some items in the Incursion Response Kit will need to be replaced periodically even if not used (*****). An annual inspection of the kit is highly recommended. The contents of the kit will depend on the characteristics of your island, but a starter list is provided in Table A4.10.

6.2.7 Table A4.11 shows an example form for recording bait take during an incursion response.

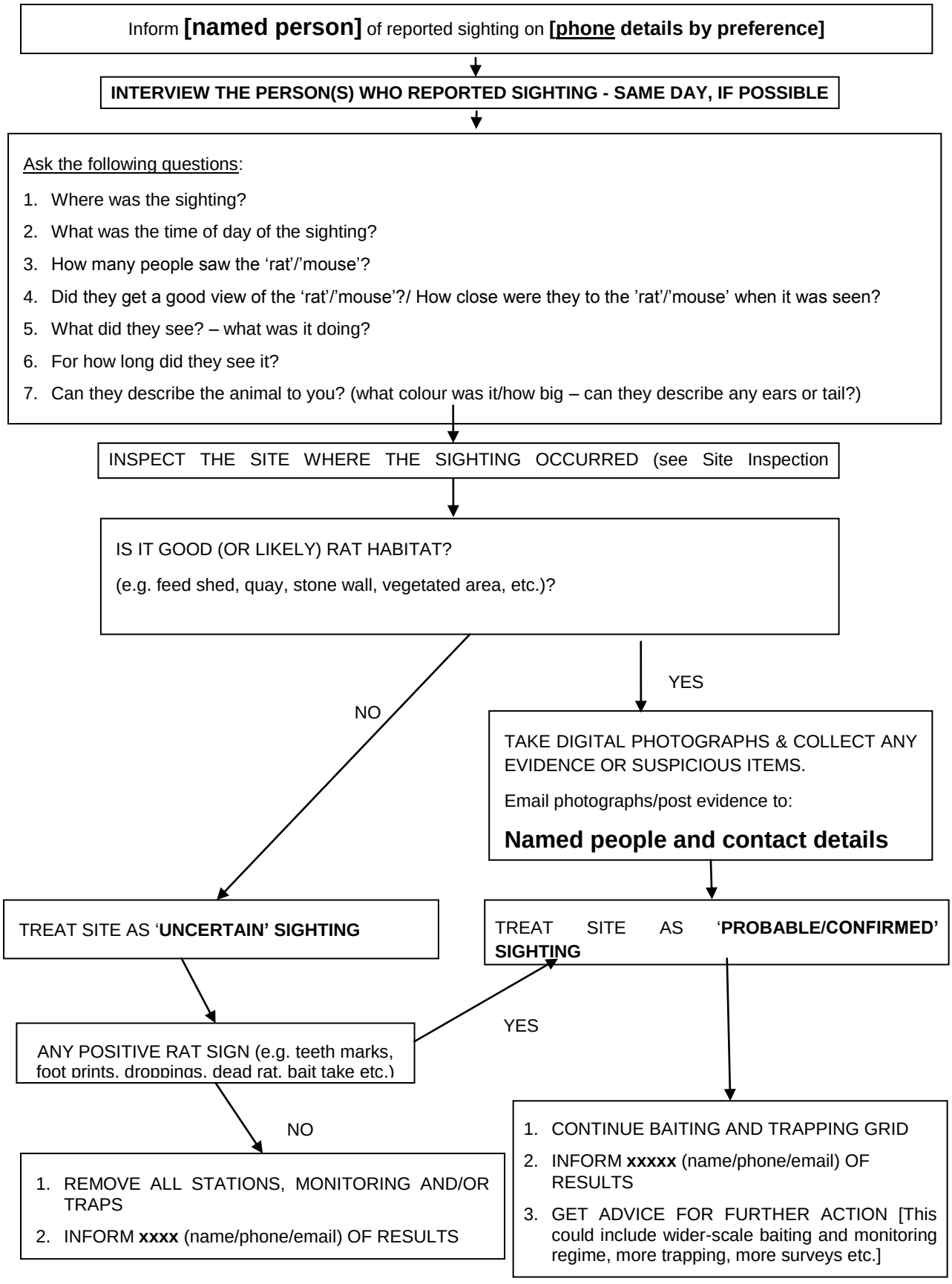
Table A4.10 - Rodent Incursion Kit contents

Item
Reference information - consider having laminated copies
Biosecurity plan *
Map of island
Map and description of GPS locations of permanent monitoring devices / grid
Species identification material
Operating instructions (e.g. CPS, trail camera, traps, installing bait stations)
Contact details for experts *
Record keeping
Waterproof notebooks
Copies of maps for note-making (incl. some laminated)
Pens/pencils
Vivid marker pens
GPS (loaded with locations of stations) and spare batteries*
Compass
Data sheets for recording activity at traps/tracking tunnels/monitoring stations
Flagging tape (at least two colours)
Specimen containers (jars, zip lock bags) & labels
1 litre of 70% ethanol
Sharp knife or dissecting tools (e.g. scalpel, tweezers)
Digital camera and spare batteries*
50m tape measure
Detection
Tracking cards*, ink* & tunnels
Bait for tracking tunnels - peanut butter/oats, pieces of coconut, etc *
Indicator baits - chocolate/peanut butter/coconut wax, soap, coconut, eggs, chocolate *
Trail camera(s) and spare batteries*
Headlamps/torches & spare batteries*
Eradication
Snap traps and covers with length of wire for each trap to attach to anchor-point. Mouse and rat-sized if both species a risk.
Bait for traps – eg peanut butter* and rolled oats*
Wire and bait stations – sufficient to create correct grid size across island, if required
Second generation rodenticide*- replace every couple of years: has limited shelf-life
Self-sealing bags
Disposable gloves* for handling baits, traps or dead animals
Tools e.g. hammers, spades, pliers, nails, thin wire, thicker wire
1st Aid kit including blankets*
Boat & safety gear*
Rope access gear*
Two means of long-distance communications – two-way radio and/or satellite phone and/or emergency locator beacons, and spare batteries* or means to charge these.
Personal protective equipment
Tent and sleeping equipment (if no accommodation available on island)
Water* and cooking implements (take fresh supplies of food and water as well)
Generator and fuel (if no electricity on island)
Rodent-proof and waterproof containers for all equipment to be packed in

Table 4.11 – Example incursion response bait take form

	Date	1/1/14			**Date**	2/1/14
	Surveyor	Sophie Thomas			**Surveyor**	Sophie Thomas
Station	**Bait taken**	**Notes**		**Station**	**Bait taken**	**Notes**
A1	2 blocks	Rat droppings found (all removed)		A1	0 blocks	Bait in good condition
A2	0.5 block	Suspected crow interference. Block replaced		A2	0.25 block	Block collected for tooth mark identification
A3	0 blocks	-		A3	0 blocks	bait replaced as damp around edges
A4				A4		
A5				A5		
A6				A6		
A7				A7		
A8				A8		
A9				A9		
A10				A10		
A11				A11		
A12				A12		
A13				A13		
B1				B1		
B2				B2		
B3				B3		
B4				B4		
B5				B5		
B6				B6		
B7				B7		
B8				B8		
C1				C1		

6.3 Interview guidelines for sightings:



6.3.1 Interview Recording Sheet for reported sightings:

<table>
<tr><td colspan="2">Name of person reporting sighting:</td><td colspan="2">Name of person who made sighting (if different)</td></tr>
<tr><td colspan="2">Contact details of person reporting sighting
Email:
Telephone:</td><td colspan="2">Contact for person who made sighting (if different)</td></tr>
<tr><td>Date of sighting:</td><td>Date of interview:</td><td colspan="2">Interviewer:</td></tr>
<tr><td colspan="4">Overview of action taken:</td></tr>
<tr><td colspan="4">Circumstances (circle as appropriate): Live animal Dead animal Footprints Droppings Damage Other</td></tr>
<tr><td colspan="4">Time / conditions of sighting:</td></tr>
<tr><td colspan="4">Location of sighting - as much detail as possible:</td></tr>
<tr><td colspan="4">Any other observers? Names and contact details if known:</td></tr>
<tr><td colspan="4"><u>Description of the sighting</u>
What did you see?

Can you describe the animal?

What was it doing?

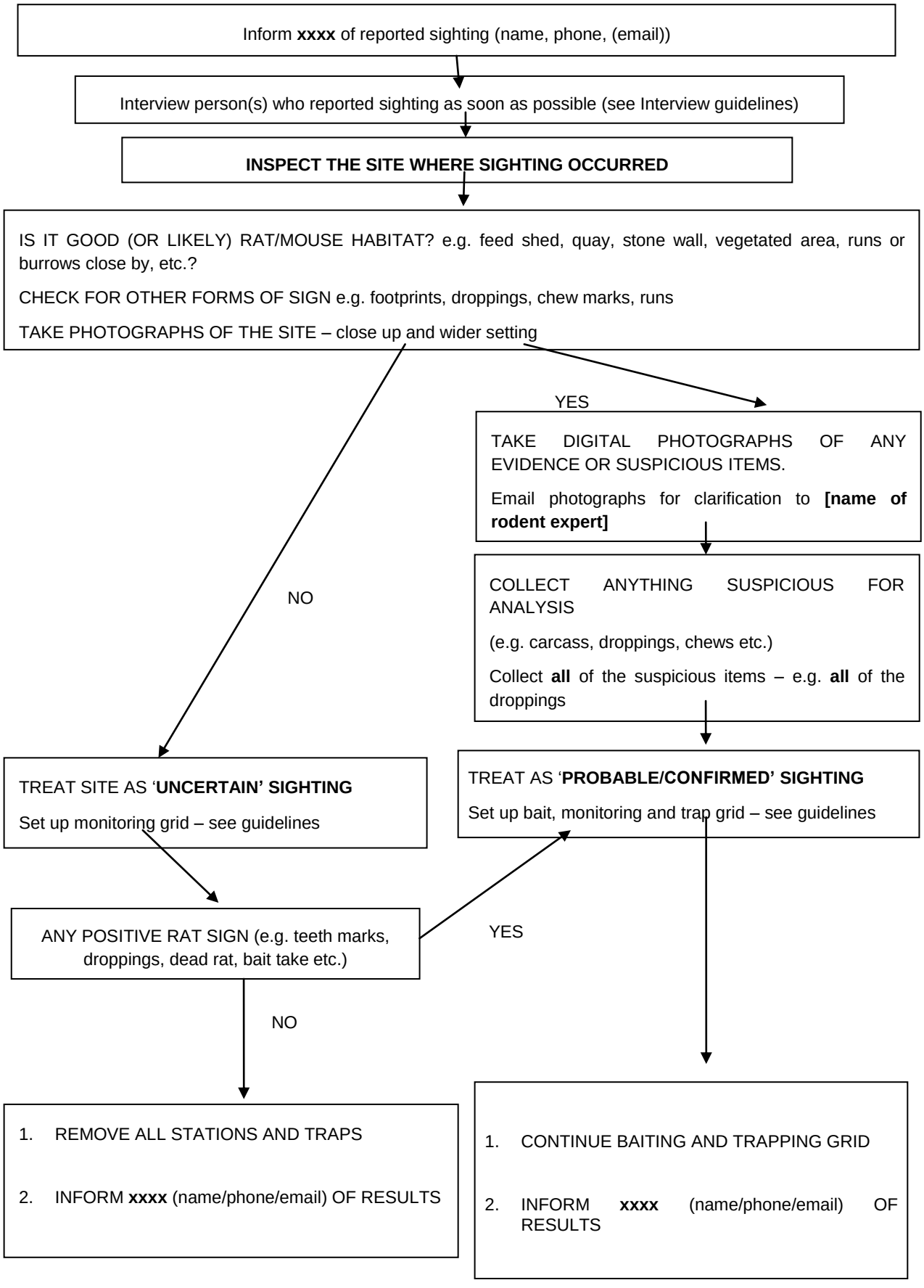
How long did you observe it for?

How close were you to it?</td></tr>
</table>

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]

Image of brown rat compared to house mouse and Scilly shrew (Scaled, but not life size, from Bell *et al.* 2014)

6.4 Site inspection guidelines for reported sightings:

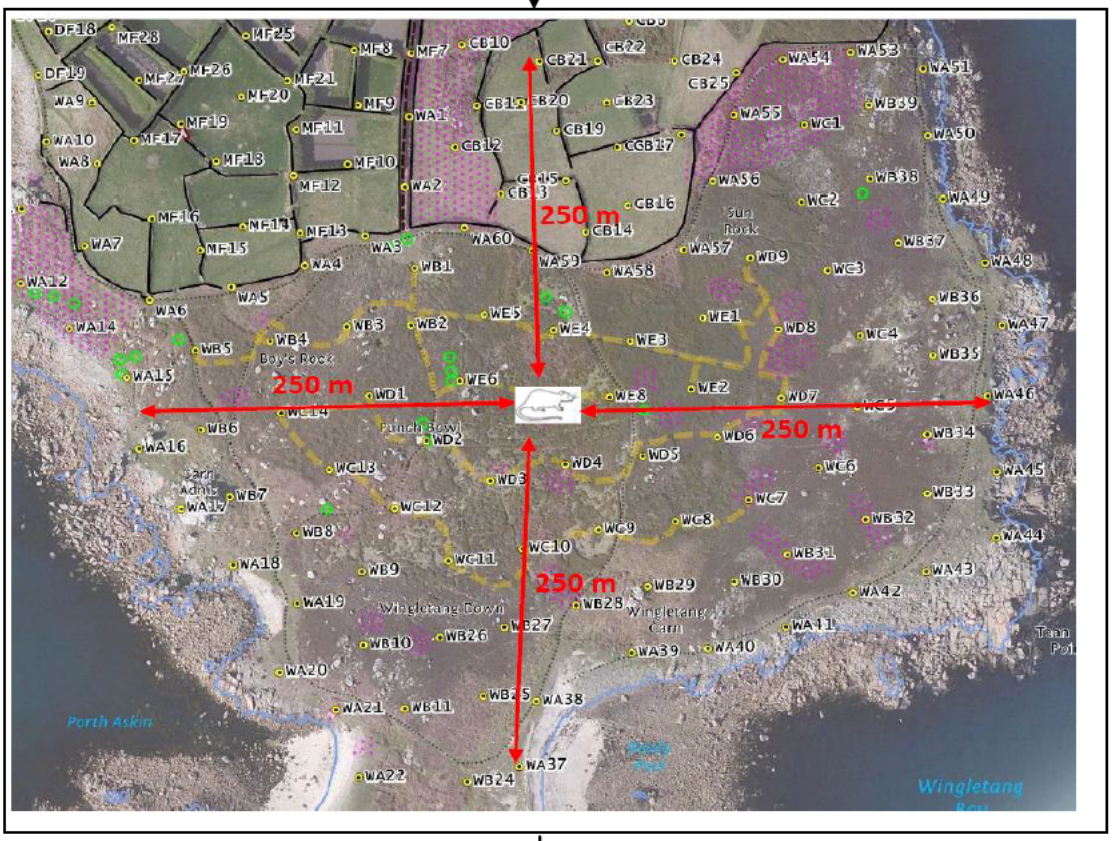


Guidelines for "uncertain/possible" sightings/ evidence:

Inform **xxxxx** of outcome of interview/site inspection (name/phone/email)

SET UP MONITORING GRID:

- Establish/bolster monitoring grid with stations 50 metres apart (closer if it is a mouse sighting) around the area of the reported sighting (use old bait station locations as mapped during the eradication operation for speed and ease of response)
- Spread monitoring stations to out up to 250 metres in all directions from sighting (terrain dependant).
- Put flavoured wax and/or tracking tunnels at each monitoring point. If you have more detection devices available, use them as well.
- **Check all points daily for three days, then once a week for four weeks**



ANY POSITIVE RAT SIGN? e.g. teeth marks, droppings, dead rat, monitoring take, etc.

NO

1. REVIEW THE SITUATION AFTER ONE MONTH, WITH EXPERT INPUT
2. REMOVE NON-PERMANENT MONITORING STATIONS
3. INFORM **xxxx** (name/phone/email) OF RESULTS
4. REMAIN VIGILANT

YES

1. IMPLEMENT BAITING, MONITORING AND TRAPPING GRID (see guidelines for "**probable/confirmed" sighting**)
2. INFORM **xxxx** (name/phone/email) OF RESULTS
3. GET EXPERT ADVICE FOR FURTHER ACTION [This could include wider-scale poisoning and monitoring regime, more trapping, more surveys etc.]

6.5 Guidelines for "probable/confirmed" sightings/evidence and shipwrecks:

Inform **xxxxx** of outcome of interview/site inspection (name/phone/email)

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UPDATE COMMUNITY/STAKEHOLDERS AND PUT RODENTCIDE WARNING SIGNS IN PLACE

↓

INCURSION RESPONSE TEAM (4 people minimum) ARRIVE ON ISLAND (preferably within 48 hours)

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SET UP BAIT, MONITORING AND TRAPPING GRID:

- Check permanent detection devices across the whole island for any further sign of rodent.
- Set bait stations 50 metres apart (or closer if establishing a mouse grid, e.g. 20 or 25m) using the locations from the original eradication operation (if applicable) spread out for 500 m in all directions from the sighting/evidence and any other sign picked up from island-wide check, dependant on terrain.
- Wire 3 20g blocks of rodenticide into each bait station in the permanent and incursion response/bolstered grid.
- Add a line of baited stations around the coast if one is not already in place.
- Place and set baited traps (or pairs of traps) (**T**) every 50 metres in all directions from the sighting/sign (i.e. N, NE, E, SE, S, SW, W, NW, total 8 or 16 traps).
- **Check all stations daily for five days, then once a week for six weeks, replenishing bait as required to keep it fresh**.
- **Check all traps twice daily**: set at night and disarm in the morning.
- After the first week of poison baiting, place monitoring stations halfway between each bait station and place

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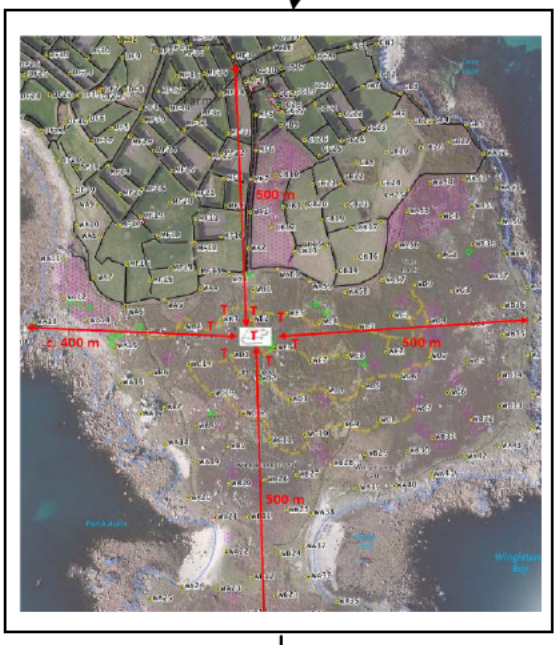

↓

AFTER SIX WEEKS: ANY POSITIVE RAT SIGN (e.g. teeth marks, droppings, dead rat, bait

NO

1. REVIEW THE SITUATION, WITH EXPERT INPUT
2. REMOVE NON-PERMANENT STATIONS & ALL TRAPS
3. INFORM (**name/phone/email**) OF RESULTS

YES

1. CONTINUE BAIT, MONITORING AND TRAP GRID for **at least** two weeks after the last rodent sign
2. INFORM **xxxx** (name/phone/email) OF RESULTS
3. GET EXPERT ADVICE FOR FURTHER ACTION [This could include wider-scale baiting and monitoring regime, more trapping, more surveys etc.]

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