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

Contents

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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 Sophie.Thomas@rspb.org.uk.

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 Cromarty *et al.* (2002) 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 unlikely 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 Health and Safety Executive (HSE) for the outside use of any certain Second Generation Anticoagulant Rodenticides (SGAR) rodenticides which are not currently registered for use in open areas or consent to cause disturbance in a ASSI/SSSI/SPA/SAC. 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 best practice. 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 talking 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.

8 References and sources of additional information

BirdLife International (2008a): Invasive alien species have been implicated in nearly half of recent bird extinctions. Presented as part of the BirdLife State of the world's birds website. Available from: http://www.birdlife.org/datazone/sowb/casestudy/127. Accessed: 26/06/2015.

BirdLife International (2008b): A range of threats drives declines in bird populations. Presented as part of the BirdLife State of the world's birds website. Available from: http://www.birdlife.org/datazone/sowb/casestudy/120. Accessed: 26/06/2015.

Broome, K.G., Brown, D, Cox, A., Cromarty, P., McClelland, P., Golding, C., Griffiths, R. & Bell, P. 2011: *Current Agreed Best Practice for Rat Eradication – poison bait in bait stations (Version 1.3).* New Zealand Department of Conservation internal document DOCDM-839096. Department of Conservation, Wellington, New Zealand.

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.

Brown, D. & Tershy, B.R. 2013: *A Review of the Desecheo Island Rat Eradication Project*. US Fish and Wildlife Service, Cabo Rojo, Puerto Rico.

Buckelew, S., Byrd, V., Howald, G., MacLean, S. & Sheppard, J. 2011: Preliminary ecosystem response following invasive Norway rat eradication on Rat Island, Aleutian Islands, Alaska. pp 275-279 In: Veitch, C. R.; Clout, M. N. and Towns, D. R. (eds.). 2011. Island invasives: eradication and management. IUCN, Gland, Switzerland.

Bull L. & Courchamp F. 2009: Management of interacting invasives: ecosystem approaches In, Invasive Species Management*, A Handbook of Principles and Techniques*. M. Clout & Williams, P.A. (eds). Oxford University Press. pp. 232-247.

Buxton, R.T., Jones, C., Moller, H. & Towns, D.R. 2014: Drivers of Seabird Population Recovery on New Zealand Islands after Predator Eradication *Conservation Biology* 28:333–344.

Cash, B. & Gaze. P. 2000: Restoration of Motuara Island – Queen Charlotte Sound. *Ecological Management* 8:31-36. Threatened Species Occasional Publication, Department of Conservation, Wellington.

Courchamp, F., Caut, S., Bonnaud, E., Bourgeois, K., Angulo, E. & Watari, Y. 2011: Eradication of alien invasive species: surprise effects and conservation successes. In Veitch, C.R., Clout, M.N., and Towns, D.R. (eds.). *Island invasives: eradication and management. Proceedings of the international conference on island invasives.* Gland Switzerland: IUCN and Auckland, New Zealand: Pp 285-289.

Cromarty, P.L., Broome, K.G., Cox, A., Empson, R.A., Hutchinson, W.M. & McFadden, I. 2002: Eradication planning for invasive alien animal species on islands – the approach developed by the New Zealand Department of Conservation. In Veitch, C.R. & Clout, M.N. (eds.) *Turning the Tide: the eradication of invasive species*. IUCN SSC Invasive Species Specialist Group. Pp 85-91. http://www.issg.org/database/species/reference_files/TURTID/Cromarty.pdf

Campaign for Responsible Rodenticide Use. 2015: CRRU UK Code of Best Practice: Best practice and guidance for rodent control and the safe use of rodenticides. www.thinkwildlife.org.uk

DIISE, 2015: The Database of Island Invasive Species Eradications, developed by Island Conservation, Coastal Conservation Action Laboratory UCSC, IUCN SSC Invasive Species Specialist Group, University of Auckland and Landcare Research New Zealand. http://diise.islandconservation.org.

Fraser, C.I., Banks, S.C. & Waters, J.M. 2015: Priority effects can lead to underestimation of dispersal and invasion potential. *Biological Invasions* 17:1-8.

Fukami, T., Wardle, D.A., . Bellingham, P.J., Mulder, C. P. H., Towns, D.R., Yeates, G.W., Bonner, K.I., Durrett, M.S., Grant-Hoffman, M.N., & Williamson, W.M. 2006: Above- and below-ground impacts of introduced predators in seabird-dominated island ecosystems, *Ecology Letters* 9:1299–1307.

Genovesi, P. 2005: Eradications of invasive alien species in Europe: a review *Biological Invasions* 7:127–133.

Griffiths, R., Buchanan, F., Broome, K.G., Butland, B. 2012: Rangitoto and Motutapu- a starting point for future vertebrate pest eradications on inhabited islands. *Proceedings of the 25th Vertebrate Pest Conference*, Monterey, California.

Griffiths, R., Broome, K., Brown, P. & Buchanan, F. 2013*: Multispecies invasive mammal eradication on Rangitoto and Motutapu Islands, Hauraki Gulf New Zealand*. Department of Conservation internal report DOCDM-898404.

Howald, G.C., Donlan, C.J., Galvan, J.P., Russell, J.C., Parkes, J. Samaniego, A., Wang, Y., Veitch,C.R., Genovesi, P., Pascal, M., Saunders, A. & Tershey, B. 2007: Invasive rodent eradication on islands. *Conservation Biology* 21:1258–1268.

Jones, H.P. 2010: Prognosis for ecosystem recovery following rodent eradication and seabird restoration in an island archipelago *Ecological Applications* 20:1204–1216.

Kappes, P.J., & Jones, H.P. 2014: Integrating seabird restoration and mammal eradication programs on islands to maximize conservation gains *Biodiversity Conservation* 23:503–509.

Keitt, B., Griffiths, R., Boudjelas, S., Broome, K., Cranwell, S., Millet, J., Pitt, W. & Samaniego-Herrera, A. 2015: Best practice guidelines for rat eradications on tropical islands. *Biological Conservation* 185: 17-26 Special issue on Tropical island conservation: rat eradication for species recovery.

Morgan, D.R., Innes, J., Ryan, C., & Meikle, L. 1996: *Baits and baiting strategies for multi-species pest control and feral cats,* Science For Conservation: 40, Department of Conservation: Wellington, New Zealand.

Mulder, C. P. H., Anderson, W.B., David R. Towns, D.R. & Bellingham, P.J. (eds.) 2011: *Seabird Islands Ecology, Invasion, and Restoration* Oxford University Press: New York. ISBN 978-0-19-973569-3.

Ogden, J. & Gilbert J. 2011: Running the gauntlet: advocating rat and feral cat eradication on an inhabited island – Great Barrier Island, New Zealand. In Veitch, C.R., Clout, M.N., and Towns, D.R. (eds.). *Island invasives: eradication and management. Proceedings of the international conference on island invasives*. Gland Switzerland: IUCN and Auckland, New Zealand: 467-471.

Oppel, S., Beavan, B.M., Bolton, M., Vickery, J. & Bodey, T.W. 2010: Eradication of invasive mammals on islands inhabited by humans and domestic animals. *Conservation Biology* 25:232-240.

Orueta, J.F., Aranda, Y., Gomez, T., Tapia, G.G., & Sanchez-Marmol, L. 2005: Successful eradication of invasive rodents from a small island through pulsed baiting inside covered stations *Biological Invasions* 7:141-147.

Pacific Invasives Initiative *Resource kit for rodent and cat eradication.* http://rce.pacificinvasives initiative.org/

Parkes, J, Fisher, P. & Forrester, G. 2011: Diagnosing the cause of failure to eradicate introduced rodents on islands: brodifacoum versus diphacinone and method of bait delivery *Conservation Evidence* 8:100-106.

Russell, J. C., Towns, D.R. & Clout, M. N. 2008: *Review of rat invasion biology. Implications for island biosecurity.* Science for Conservation 286. Department of Conservation, Wellington New Zealand. http://www.doc.govt.nz/upload/documents/science-andtechnical/sfc286entire.pdf

Stanbury, A., Thomas, S., Aegerter, J., Brown, A., Bullock, D., Eaton, M., ... & 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.

The Ornithological Council 2010: *The Rat Island rat eradication project: A critical evaluation of non-target mortality.* Report prepared for Island Conservation, The Nature Conservancy, US Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge. http://www.seabirdrestoration.org/pdf/RatIslandReview.pdf

Thomas, B.W. & Taylor, R.H. 2002: A history of ground based rodent eradication techniques developed in New Zealand 1959 - 1993. In: Veitch & Clout *Turning the Tide: the eradication of invasive species*. IUCN SSC Invasive Species Specialist Group.

http://www.issg.org/database/species/reference_files/TURTID/Thomas.pdf

Wilkinson I.S. & Priddel, D. 2011: Rodent eradication on Lord Howe Island: challenges posed by people, livestock, and threatened endemics, pp 508–514 In: Veitch C.R., Clout M.N. and Towns D.R. (eds.) (2011). *Island invasives: eradication and management*. IUCN, Gland, Switzerland.