

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

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

Acknowledgements:

This document draws on both the worked examples devised by the Pacific Invasives Initiative as part of their Resource Kit for Rodent and Cat Eradication (<http://pacificinvasivesinitiative.org/rce/>) and on the project documents produced by Wildlife Management International Ltd. during their extensive work on UK islands. We are very grateful to both organisations.

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

Report produced by: T.Burke¹, P. Smith² and M. Burns³

¹Biosecurity expert

²UK Seabird Conservation Trust: *A local non-governmental organisation based in Lewis*

³Scottish Wildlife and Conservation Agency: *A local government agency based in Lewis*

Funded by the Seabird Conservation Foundation

Reviewer(s): M. Byrne (UK Island Eradication Specialist, m.byrne123@ratmail.co.uk), P. Hunter (NZ Rat Eradication Specialist p.hunter123@ratmail.co.nz)

Version History:

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

Citation:

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 Unpublished report for Stewart Islands Restoration Project Partnership.

Executive Summary

1. Invasive non-native rodents, (i.e. rats and mice) have led to the extinction or extirpation of many native species of birds from islands around the world, including in the United Kingdom. Preventing them from becoming established on new islands is one of the most effective things we can do to prevent further extinctions. 'Biosecurity' refers to actions preventing the arrival and establishment of new invasive species.
2. Following the eradication of brown rats from Farnuff and Dull islands, although not officially confirmed until 2019, both islands currently appear to be free of invasive rodents, which will greatly benefit the island's seabirds as well as other native animals and plants. However, with the current increase in development on the island, the risks of pest species arriving are increasing and it is important to put biosecurity measures in place to a) minimise the chances of new arrivals reaching the island, b) quickly detect any which do arrive and c) respond quickly and effectively to remove any new arrivals.
3. Installing effective biosecurity measures will require investment in, among other things, training staff, buying monitoring equipment and improving the island's waste management system. Any investment in this area will, however, be a very small fraction of the costs of eradicating or of long-term control of invasive species if they become established across the island.
4. The most common routes ('pathways') by which invasive mammals reach new islands are by stowing away on boats, especially when transporting food supplies and building materials or swimming (e.g. rats and mice).
5. This plan focuses on preventing non-native rodent species (rats and mice) from reaching and becoming established on Farnuff and Dull following the eradication operation in 2017/18. Farnuff and Dull are too far away from other islands for rats and mice to swim there, but they could arrive either on the Caledonian MacBrayne ferry, on the inter-island freight vessel *MV Alastair* or on private boats. Currently the ferry and the *MV Alastair* are the most likely pathways but measures should be taken to deal with all potential routes by which rodents could reach the island.
6. Routine surveillance monitoring should take place in order to actively search for any invasive rodents which may arrive. This will involve a network of monitoring stations set out in areas where rodents are most likely to arrive (e.g. the Farnuff quay), and where there are likely to become established (e.g. in areas around human habitation). These stations should be checked monthly by trained staff and the results recorded. A variety of non-toxic methods should be used including wax blocks in a range of flavours, and ink tracking tunnels.
7. All island residents and visitors should be informed about the threat invasive species pose to the island's natural heritage and encouraged to report any sightings or suspected sign of invasive species to project and SWCA staff with a designated responsibility for the islands. Keeping the island free of invasives is to the benefit of everyone living and working on the island, as well as to the island's native species.
8. If possible (but not probable/ definite) signs of rats or mice are found the intensive monitoring actions described in section 6.2.1 should be immediately implemented, ideally within 48hrs.

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

EXAMPLE

Contents

Executive Summary	2
1 INTRODUCTION.....	5
2 RISK SPECIES	7
3 PATHWAYS	12
4 PREVENTION	16
5 SURVEILLANCE (INCURSION DETECTION)	25
6 INCURSION RESPONSE	31
7 EQUIPMENT LIST	37
8 REFERENCES.....	39
Appendix 1: Biosecurity Log.....	41
Appendix 2: Biosecurity checklist for quarantine procedures	42
Appendix 3: Notes on trap and bait station placement	44
Appendix 4: Instructions for making wax monitoring blocks	45
Appendix 5: Interview recording sheet for reported sightings.....	47

1 INTRODUCTION

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

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

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

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

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

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

1.1 The Site

1.1.1 Farnuff Island

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

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

1.1.2 Dull Island

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

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

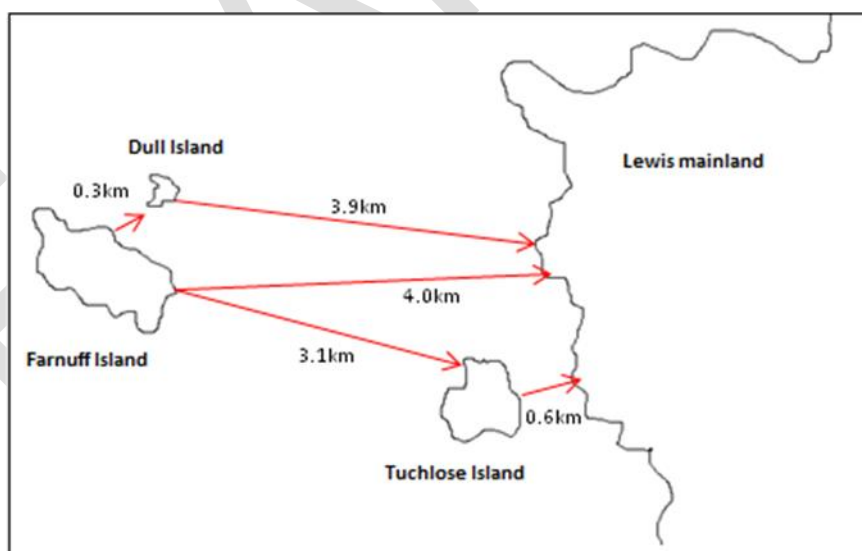


Figure 1: Map showing position of islands within the Stewart Islands group and their distances from each other and the Isle of Lewis, which are beyond the known swimming distances for brown rat.

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

2 RISK SPECIES

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

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

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

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

Invasive species	Incursion risk	Incursion speed	Impact severity	Description of possible impacts
Brown rat	High	Rapid	Critical	<ul style="list-style-type: none"> Decline and loss of native vertebrates, invertebrates and plants through predation and competition Potential transmitter of disease to community and visitors leading to a loss in tourism and recreation value
Black rat	Low (due to limited range in the UK)	Rapid	Critical	<ul style="list-style-type: none"> Decline and loss of native vertebrates, invertebrates and plants through predation and competition Potential transmitter of disease to community and visitors leading to a loss in tourism and recreation value
House mouse	High	Rapid	Moderate	<ul style="list-style-type: none"> Decline and loss of native invertebrates through predation and competition Competition for food and nesting sites with endemic Stewart Island vole and native shrew

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

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

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

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

2.1 Brown rats *Rattus norvegicus*

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

2.2 Black rats *Rattus rattus*

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

2.3 House mouse *Mus domesticus*

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

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

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

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

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

3 PATHWAYS

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

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

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

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

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

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

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

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

Would include an aerial map here

3.1 Small/medium service vessels

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

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

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

3.3 Bulk food supplies

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

3.4 Shipwrecks

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

3.5 Bulk equipment and building supplies

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

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

3.6 Private yachts

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

3.7 Residents private boats

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

3.8 Overnight visitors

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

3.9 Residents' private supplies

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

3.10 Day visitors

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

3.11 Cruise ships

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

3.12 Swimming from nearby islands

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

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

3.13 Storm enhanced dispersal (rafting/floating on debris)

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

3.14 Deliberate release by public

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

4 PREVENTION

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

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

4.1 Stakeholders

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

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

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

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

4.1.1 Farnuff community

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

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

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

4.1.2 Local boating company

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

4.1.3 Private yachts and other vessels

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

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

4.1.4 Project personnel

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

4.1.5 The Clipper family

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

4.1.6 Other conservation agencies

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

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

4.1.7 Visitors

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

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

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

4.2 Prevention measures

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

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

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

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

4.2.1 Quarantine kit for contingency response on Farnuff

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

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

Implementation time	Prevention measure
Prior to departure from the mainland (and/or neighbouring islands)	<ul style="list-style-type: none"> • Empty, check and repack items into storage containers (especially important when items have been packed and stored for extended periods) • Purchase food and store in clean, sealed rodent-proof containers (or purchase on Farnuff) • Wherever possible, transport food and equipment in sealed, rodent-proof containers • Ensure all personnel, including transport providers, are aware that Farnuff and Dull are rat- and mouse-free

On Lewis	<ul style="list-style-type: none"> • Maintain bait stations on the quay on Lewis • Maintain bait stations in any storage areas on the quays
On the boat	<ul style="list-style-type: none"> • Check the boat for rodent sign (if a rodent is found, return to port of origin, do not continue to Farnuff and Dull, attempt to catch and kill the rodent and then thoroughly search the vessel before proceeding to Farnuff and Dull; report the incident) • Ensure a bait station is on-board • Ensure information pamphlets are available to all people on the vessel
On Farnuff and Dull	<ul style="list-style-type: none"> • Be vigilant • Ensure incursion kit is up-to-date and easily available • Ensure bait is in the container at the Farnuff quay (and product is in-date and registered for use in open areas) • Ensure a quarantine space is available for checking damaged or suspicious goods • Keep the quay as clean as possible • Maintain the permanent monitoring stations • Do not leave any food (even biodegradable items) outside on the islands • Dispose of all waste in correct bins or remove from the islands • Ensure all residents know who to report rodent sightings to and what to ask if a visitor reports seeing a rat. see Appendix 5 • Report any rodent sightings to the relevant person (provide contact details and information sheet) • Do not deliberately release any non-native rodents on the islands
On return to mainland (and/or neighbouring islands)	<ul style="list-style-type: none"> • Do not leave any food or waste near the quay or storage area • Maintain bait stations at the quay or equipment storage area
Training	<ul style="list-style-type: none"> • Provide regular training sessions for all personnel and local residents in prevention and incursion response protocols • Ensure all personnel know the location of the quarantine contingency kit • Ensure all personnel are aware of interview and site inspection protocols

4.2.2 Storage room for bulk biosecurity and research equipment

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

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

4.2.3 Permanent stations and rodent motels on Farnuff and Dull

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

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

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



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

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

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



4.2.4 Permanent bait stations on Lewis

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

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

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

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

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

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

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

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

4.2.6 Medium/small service vessels

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

4.2.7 Waste management

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

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

4.2.8 Communication and education

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

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

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

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

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

4.2.9 Information leaflets

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

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

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

5 SURVEILLANCE (INCURSION DETECTION)

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

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

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

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

Many rodents are secretive or nocturnal, making them difficult to see. Identification of tracks, droppings, burrows and feeding sign is therefore an important aspect of detection monitoring. To gain an accurate picture of whether a species is present on an island, it is important that the sign they leave can be correctly identified; Annex 3 of the UK Rodent Eradication Best Practice Toolkit (Thomas *et al.* 2017; <http://www.nonnativespecies.org/index.cfm?pageid=613>) can be used as a guide to assist with the identification of sign left by rodents (including a brief description and ecological information with images of the animals and their droppings, tracks and teeth-marks).

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

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

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

5.1 Surveillance timetable

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

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

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

5.2 Monitoring tools, methods and identification of sign

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

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

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

Method	Notes on surveillance use
Permanent station	<ul style="list-style-type: none"> • 1 visit per month • Can be used to house monitoring tools such as chocolate wax • Can target rodent incursion directly (i.e. by adding bait or traps) • Possible non-target consumption of monitoring tools or bait between checks
Rodent motel	<ul style="list-style-type: none"> • 1 visit per month • Can be used to house monitoring tools such as chocolate wax • Can target rodent incursion directly (i.e. by adding bait or traps) • Possible non-target consumption of monitoring tools or bait between checks
Visual searches	<ul style="list-style-type: none"> • Whenever trained personnel are visiting the islands • Rodent tracks, droppings, runs, burrows and chews can all be recognised • Identification of rodent species (depending on size and clarity of prints, droppings and burrows)
Tracking tunnel	<ul style="list-style-type: none"> • 1 to 3 nights per month • Tunnels can be placed out permanently, but plates only added when necessary • Tracking cards can be baited with peanut butter • Identification of rodent species (depending on size and clarity of prints)
Wax	<ul style="list-style-type: none"> • 1 visit per month • Ranges of wax flavours such as chocolate, peanut or coconut can be used

	<ul style="list-style-type: none"> • Identification of rodent species (depending on size and clarity of teeth-marks)
Trail cameras	<ul style="list-style-type: none"> • 1+ nights per month • Video and still images available • Can be put in place and set to record over multiple nights • Can be used in all locations • Identification of rodent species (depending on clarity of images) • Identification of non-target species (depending on clarity of images)
Kill traps	<ul style="list-style-type: none"> • 3 to 5 nights per month • Traps must be checked daily when set • Traps must be set in either natural tunnels, wooden trap boxes, tracking tunnels or permanent stations to exclude non-target species • Can target rodent incursion directly • Traps must be maintained regularly to ensure they are functioning correctly
Live traps	<ul style="list-style-type: none"> • 3 to 5 nights per month • Traps must be checked twice a day when set • Can target rodent incursion directly • Non-target species can be released unharmed
Hair traps	<ul style="list-style-type: none"> • 2 visits per month • Identification of rodent species
UV light	<ul style="list-style-type: none"> • 1 visit per month • Difficult to use if other mammal species are present

5.2.1 Permanent stations

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

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

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

5.2.2 Rodent motels

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

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

5.2.3 Visual searches

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

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

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

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

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

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

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

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

5.2.4 Tracking tunnels

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

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

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

5.2.5 Wax blocks

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

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

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

5.2.6 Trail cameras

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

5.2.7 Kill traps

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

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

5.2.8 Live traps

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

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

5.2.9 Hair traps

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

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

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

5.2.10 UV lights

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

6 INCURSION RESPONSE

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

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

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

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

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

6.1 Response decision making

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

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

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

6.1.2 Definitions

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

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

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

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

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

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

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

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

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

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

Activity	Stakeholder	Responsibility
Report by public	Project staff Farnuff community	<ul style="list-style-type: none"> Interview member of public who reported sighting or suspicious sign Site assessment of location of sighting Determine whether incursion possible or probable (see Section 6.4) and respond accordingly
Confirmed incursion report by project staff or residents	Project staff Farnuff community External expert	<ul style="list-style-type: none"> Confirmed presence of non-native rodent (either directly or inferred from sign during routine checks) (see Section 6.1) Alert stakeholders Alert Response Team Confirm species of rodent (if possible) Identify resources (including personnel)
Mobilise response team	Project steering group	<ul style="list-style-type: none"> Implement incursion response plan (see Section 6.2.2) Use local personnel (and external help if required) Assess and obtain other resources necessary for response Consult with residents and stakeholders on action (via Progress Reports)
Monitor incursion response	Project staff; SWCA; UKSCT; external expert (as required)	<ul style="list-style-type: none"> Determine whether incursion is limited to single animal or island-wide If possible, collect sample (by trapping) for DNA analysis Predict the loss of threatened or important species and possible economic and social impacts on Farnuff Assess outcome of incursion response and determine whether the incursion has been removed Consult with residents on action and outcomes Audit the biosecurity measures and training standards
Reporting to stakeholders and interested parties	Project team	<ul style="list-style-type: none"> Progress reports and Technical Report provided to stakeholders Incursion technical report (covering response, detection, outcomes, etc.) Decide further action needed (surveillance, awareness raising, training, etc.)

6.2 Incursion response plan: Responding to signs of rodents

6.2.1 Responding to possible signs of rodents: INTENSIVE MONITORING

1. Replace or refresh existing wax block monitoring stations (c.100) to ensure the smell of the attractant (chocolate, coconut, peanut butter etc) is fresh and strong. Set 15-20 additional wax monitoring points (wax blocks not inside monitoring stations) close to the suspected sign in sites of likely rat or mouse activity
2. Set 25-30 snap traps in suitable locations, where there are no risks to non-target species. See appendix 2 for notes on trap placement and setting. This could include inside buildings, or outside in commercially available bait boxes such as 'Protecta' stations. Make sure that you use appropriate sized snap traps for the species believed to be present. Mice are not heavy enough to set off rat-sized trap and rats are very unlikely to be killed in mouse-sized traps. If you are not sure which species are present use some of each size. Bait with an attractive lure such as peanut butter
3. Snap traps should be checked twice daily, once in the dusk to bait and set the trap and once in the morning to disarm it. This should minimise the risk to diurnal non-target species and limit suffering should any animal not be killed outright.
4. Set 25-30 tracking tunnels in likely sites of rat or mouse activity close to the suspected sign and bait with an attractive lure such as peanut butter.
5. Carry out regular visual searches for rat or mouse sign, such as droppings, feeding sign, footprints etc.
6. Use trail cameras to look for evidence of INNS moving at night
7. Check wax blocks, tracking tunnels and trail cameras twice a week for **four weeks**
8. If no additional sign is found during this time, return to the routine monitoring described in section 5. If probable or definite sign is found, immediately implement the full incursion response plan in section 6.2.2. Log all actions taken in the biosecurity log (see appendix 1).

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

6.2.2 Responding to probable or definite rat sign: INCURSION RESPONSE

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

3. Stations should be checked daily for five days and then twice weekly for **six weeks**. Replenish bait as necessary to ensure a fresh supply is always available – we want the bait to be the most attractive food available to rats on the island and mouldy or damp bait is far less appealing.
4. Also set snap traps in suitable locations, where there are minimal risks to non-target species. See appendix 2 for notes on trap placement and setting. They should only ever be set inside bait stations (the only exception to this is if they are set inside buildings). Make sure that you use appropriate sized snap traps for the species believed to be present. Mice are not heavy enough to set off rat-sized trap and rats are very unlikely to be killed in mouse-sized traps. If you are not sure which species are present use some of each size.
5. Snap traps should be checked twice daily, once at dusk to bait and set the trap and once in the morning to disarm it. This should minimise the risk to non-target species which are only active in the daytime and limit suffering should any animal not be killed outright.
6. After the first week of poison baiting, set up monitoring points halfway between each bait station and place flavoured wax and/ or tracking tunnels at each. Check with the same regularity as bait stations.
7. Use trail cameras in any areas with active sign to confirm the presence of rodents. If confirmed place traps at the site (in addition to the bait stations) and run for five nights.
8. Enter bait take, trap and monitoring check data into a suitable database (an Excel file is fine) on the day it is gathered. See example in Table 11 below:

Table 11: Example data collection table.

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

6.3 Response readiness

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

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

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

7 EQUIPMENT LIST

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

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

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

EXAMPLE

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

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

8 REFERENCES

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

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

- Atkinson, I.A.E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on island avifaunas. Pages 35-81 in Moors, P.J. (Ed.). *Conservation of island birds*. ICBP Technical Publication 3.
- Boursot, P.; Din, W.; Anand, R.; Darviche, D.; Dod, B.; Von Deimling, F.; Talwar, G.P.; Bonhomme, F. 1996. Origin and radiation of the house mouse: mitochondrial DNA phylogeny. *Journal of Evolutionary Biology* 9: 391–415.
- Cunningham, D.M.; Moors, P.J. 1996. *Guide to the identification and collection of New Zealand rodents (3rd Ed.)*. Department of Conservation. Wellington, New Zealand. [Available for download from: <http://www.doc.govt.nz/documents/science-andtechnical/rodent-identification.pdf>]
- Gillies, C.A. & Williams, D. 2013. *DOC tracking tunnel guide v2.5.2: Using tracking tunnels to monitor rodents and mustelids*. Department of Conservation, Science & Capability Group, Hamilton, New Zealand. [available for download from: <http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-animal-pests-using-tracking-tunnels-to-monitor-rodents-and-mustelids.pdf>]
- Harris, S.; Yalden, D. (Eds.) 2008. *Mammals of the British Isles: Handbook, 4th Revised Edition*. Mammal Society, Southampton, UK.
- Howald, G.; Donlan, C.J.; Galvan, J.P.; Russell, J.C.; Parkes, J.; Samaniego, A.; Wang, Y.; Veitch, D.; Genovesi, P.; Pascal, M.; Saunders, A. and Tershey, B. 2007. Invasive rodent eradication on islands. *Conservation Biology* 21: 1258-1268.
- Jones, H.P.; Tershy, B.R.; Zavaleta, E.S.; Croll, D.A.; Keitt, B.S.; Finkelstein, M.E.; Howald, G.R. 2008. Review of the global severity of the effects of invasive rats on seabirds. *Conservation Biology* 22: 16-26.
- King, C.M. (Ed.). 1990. *The handbook of New Zealand Mammals*. Oxford University Press. Auckland, New Zealand.
- Moors, P.J.; Atkinson, I.A.E.; Sherley, G.H. 1992. Reducing the rat threat to island birds. *Bird Conservation International* 2: 93-114.
- Morton, M.N.; Cole, N. 2013. *A biosecurity plan and protocols for Saint Lucia's offshore islands*. Unpublished report to Saint Lucia National Trust, Saint Lucia Forestry Department, Durrell Wildlife Conservation Trust and Fauna & Flora International.
- Moors, P.J.; Atkinson, I.A.E. 1984. Predation on seabirds by introduced animals and factors affecting its severity. Pages 667-690 in Croxall, J.P, Evans, P.G.H. and
- Nowak, R.M. 1999. *Walker's Mammals of the World: Volume II*. The Johns Hopkin University Press, London, United Kingdom.
- Perry J.S. 1945. The reproduction of the wild brown rat (*Rattus norvegicus* Erxleben). *Proceedings of the Zoological Society of London* 115: 19-46.
- PII – Pacific Invasives Initiative. 2011. Resource Kit for Rodent and Cat Eradications: Biosecurity Plan Template. Available for download from www.pacificinvasivesinitiative.org
- Pocock, M.J.O.; Hauffe, H.C.; Searle, J. 2005. Dispersal in house mice. *Biological Journal of the Linnean Society* 84: 565–583.

- Russell, J.C.; Towns, D.R.; Anderson, S.H.; Clout, M.N. 2005. Intercepting the first rat ashore. *Nature* 437: 1107.
- 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.
- Schreiber, R.W. (Eds.). *Status and conservation of the world's seabirds*. ICBP. Technical Publication 2.
- Smith, P. & Burns, M. (2017) Operational plan for the eradication of brown rats from Farnuff and Dull Islands, Outer Hebrides, UK. Unpublished report for Stewart Islands Restoration Project Partnership.
- Thomas, S., Varnham, K. & Havery, S. 2017: *UK Rodent Eradication Best Practice Toolkit* (Version 4.0). <http://www.nonnativespecies.org/index.cfm?pageid=613> Royal Society for the Protection of Birds, Sandy, Bedfordshire
- Towns, D. R., Atkinson, I. A. E. and Daugherty, C. H. 2006. Have the harmful effects of introduced rats on islands been exaggerated? *Biological Invasions* 8, 863-891.
- Towns, D. R. and Broome, K. G. 2003. From small Maria to massive Campbell: forty years of rat eradications from New Zealand islands. *New Zealand Journal of Zoology* 30, 377-398.

Appendix 1: Biosecurity Log

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

Appendix 2: Biosecurity checklist for quarantine procedures

BIOSECURITY CHECKLIST

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

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

Appendix 3: Notes on trap and bait station placement

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

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

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

Appendix 4: Instructions for making wax monitoring blocks

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

Makes approximately 60 small blocks

Equipment:

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

Different flavour blocks are made as follows:

Chocolate wax:

Ingredients:

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

Instructions:

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

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

Coconut wax:

Ingredients:

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

Instructions:

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

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

Peanut wax:

Ingredients:

12 standard white wax candles
½ jar of smooth peanut butter

Instructions:

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

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

EXAMPLE

Appendix 5: Interview recording sheet for reported sightings

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