Rodent Eradication on South Georgia – Preparation and Evaluation: a summary report of activities during the 2011/2012 field season

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

In conjunction with the South Georgia Heritage Trust's habitat restoration project, the Government of South Georgia and the South Sandwich Islands (GSGSSI) is conducting a programme of pre-eradication research and post-eradication monitoring. Broadly, the purpose of the pre-eradication programme is to monitor the outcome of the trial phase of the rodent eradication and provide key data to underpin a subsequent island wide eradication. It assesses the effects on target, non-target and putative beneficiary species following the trial phase, establishes base-line data on key beneficiary and non-target species around the island and, using genetics, investigates the efficacy of (rapidly retreating) glaciers as barriers to rodent movements, which is fundamental to the success of an island-wide eradication. This report covers the first season of Overseas Territories Environment Programme (OTEP) funded pre-eradication research, which focuses on the collection of rat tissue samples for genetic analysis and establishing baseline data on beneficiary and non-target species.

To obtain tissue samples from putatively isolated rat populations around South Georgia, three teams of field workers were deployed around the island from 14th November 2011 to 25th January 2012. Fieldwork took place over six baiting Zones (REF SGHT) known to contain rats. Surveys were conducted for mice, as they are considered to be a factor in the success of the rat eradication and may also be affecting the ecology of the island. Surveys were also conducted to identify the distribution of key beneficiary and non-target species.

Key findings of this work were:

- In early summer, fresh rat sign was limited and rat catch rates were low, but increased as the summer progressed. The first recently weaned rat was caught in early December, suggesting that breeding commences in mid October.
- Rat distribution was patchy, even at the height of summer. Rats were most frequently caught in stands of dense tussock, often bordering king penguin colonies. However, rat sign indicated that rats dispersed away from the coast as the summer progressed.
- Trap covers reduced the ability to effectively capture rats. When uncovered traps were used, four pintail ducks were caught in over 7,200 trap nights, suggesting that the risk to non-target species was minimal.
- No mouse sign was detected or mice caught in the Zones visited.
- The breeding skua population within the surveyed Zones is approximately 750–950 pairs. Observations of skua pellets and prey remains suggested that prions are major prey, along with rat, diving petrel, fur seal and penguin remains.
- The distribution of pintails, skuas, giant petrels, pipits and sheathbills throughout the Zones was documented for post-eradication monitoring.
- Of the Zones visited, colonies of small burrowing petrels were found predominantly in the Stromness and Barff Zones, areas occupied by reindeer and rats.

Analysis of rat tissue samples to obtain population genetic data is pending, and may allow assessment of the effectiveness of glacial barriers to rat dispersal and help to determine the provenance of any rats found post-eradication.

Based on these findings we conclude that:

- Rat populations appeared to have suffered a high mortality rate in the previous winter, with survivors restricted to coastal areas. Rat breeding also appears to be seasonal on South Georgia, ceasing during winter. Eradications undertaken early in the summer would benefit from the winter rat diebacks.
- The prevalence of rats in coastal tussac and associations of rats with king penguin colonies emphasises the importance of double-baiting coastal areas and the fringes of penguin colonies during the eradication.
- Reindeer may limit rat populations by impacting on habitat that rats require for winter survival.
- Reindeer-associated rat suppression may have helped colonies of small burrowing-petrel species persist in rat-infested areas. Rat eradication should follow promptly after reindeer removal to limit the potential for increases in rat abundance and consequent effects on burrowing petrel colonies. Once the reindeer are removed, petrel populations will be at risk if rat numbers increase.
- Trap covers are not necessary on South Georgia for short-term use. The risk to non-target species is minimal and covers reduced the effectiveness of rat trapping.
- Mouse sign was not detected in the baiting Zones visited, although this does not guarantee that these areas are free of mice.
- Pintails, skuas, giant petrels and sheathbills were present patchily throughout the baiting Zones surveyed. Where practicable, post-eradication monitoring should revisit sites that support large numbers of these species.

Other work conducted during the summer found:

- Giant petrel surveys counted a total of 80 northern giant petrel and 186 southern giant petrel chicks across 14 separate sites
- Grass Island was visited to confirm that the island is still rat-free after eradication in 2000. No rat sign was found, and four pipits displaying breeding behaviour were observed on the island.
- Prion Island was visited in January to conduct the annual wandering albatross breeding survey, 28 breeding pairs were counted on the island. The distribution of giant petrel and skua nests were also recorded.
- Post-eradication rat survey was conducted on the Greene Peninsula. No rat sign was detected and 46 rodent-monitoring wax tags were deployed along the coast and inland.
- Gentoo and king penguin feather, egg shell and blood samples were collected as part of ongoing work to determine genetic and stable isotope signatures for these species.

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1. INTRODUCTION

1.1 Background

South Georgia is home to globally significant populations of seabirds (Clarke *et al.* 2012) and marine mammals, many of which are in decline. Although considered relatively pristine, the environment of South Georgia has been seriously affected by human influence, notably through sealing and whaling operations from the mid-18th century until the cessation of whaling in the 1960's (Moore *et al.* 1999). These activities not only seriously depleted populations of whales and seals, but also led to profound changes in the terrestrial ecology of the island as a consequence of the inadvertent introduction of invasive species such as brown rats (*Rattus norvegicus*) and house mice (*Mus musculus*) to the island.

Rats and mice probably arrived with the first sealing vessels and the former now occupy many locations on the north coast. Rats now occupy approximately 66% of the coastline of the island, which comprises 75% of the total vegetated area of mainland South Georgia (Poncet 2006). The spread of rats is checked to some extent by glaciers but dispersal is likely to be on-going, as illustrated by the arrival of rats on Saddle Island between 1987 and 2007 (pers. obs.). Mice are established in the Cape Rosa and Nuñez Peninsula areas, which are free of rats.

Rats are known to depredate the eggs and young of many small ground-nesting birds, with devastating consequences (Towns *et al.* 2006, Hilton and Cuthbert 2010). The endemic South Georgia pipit (*Anthus antarcticus*) is very unlikely to breed successfully in the presence of rats. The vast majority of its former range is currently rat infested, with its only remaining refuge being the unaffected south coast and small offshore islands (Clarke *et al.* 2012). Only a small number of burrowing seabird species, such as white-chinned petrel (*Procellaria aequinoctialis*), can breed in rat infested areas albeit in reduced numbers, while the majority cannot breed at all in the presence of rats (Poncet 2006). Both rats and mice are almost certainly impacting on invertebrate and plant communities (see Smith *et al.* 2002 for an example from Marion Island), which may also be affecting ground-nesting birds.

To address the rodent problem, and as part of a wider initiative to restore South Georgia habitats, the South Georgia Heritage Trust (SGHT, a registered UK charity) is in the midst of an island-wide rodent eradication project, targeting rats and mice. The first (trial) phase of the Habitat Restoration project started in March 2011 and involved the aerial spreading of poison (brodifacoum) bait on the Thatcher, Greene and Mercer Peninsulas (SGHT 2010). Two subsequent seasons of baiting (Phase 2 of the project) will be required to treat the remainder of the island, between 2013 and 2015. The trial Phase 1 area alone represents the largest ever attempted rat eradication. The island-wide clearance of South Georgia will be by far the most ambitious rodent eradication ever attempted, and success is expected to have enormous benefits for the island, especially with regard to recovery of bird populations, especially the endemic South Georgia pipit. It is crucial to measure the impacts and successes of each season's fieldwork in order to inform plans for subsequent seasons on South Georgia. It is also important for the Government of South Georgia and the South Sandwich Islands (GSGSSI), in its oversight capacity, to be assured that the use of poison bait is not having any unforeseen adverse effects on non-target animals.

Ordinarily it would not be conceivable to attempt rat or mouse eradications on an island the size of South Georgia. However the presence of glaciers effectively subdivide the mainland into numerous smaller “islands” (Figure 1, referred to as ‘Zones’ hereafter), making an island wide eradication a realistic proposition (Cook *et al.* 2010). The trial Phase 1 of the rodent eradication targeted the Thatcher, Greene and Mercer Peninsulas (not thought to contain mice), which are bounded by the Nordenskjöld and Neumayer glaciers, which are two of the largest on the island. Using molecular genetics, Robertson and Gemmell (2004) demonstrated that there is no gene flow between the rat populations on the Thatcher and Greene Peninsulas and therefore they can be considered demographically independent populations.

Figure 1. South Georgia is divided into discrete Zones, which are separated by glaciers (Figure reproduced from Poncet and Poncet 2009).

Phase 2 of the SGHT project, which is planned to start in March 2013, will extend the eradication to the remaining rodent infested parts of the island (SGHT 2012). A key prerequisite for the success of Phase 2 is to ascertain the effectiveness of the glaciers in preventing rodent dispersal. In order to address this question, the current project collected samples of rats that will be used to characterise the population genetic structure of rats in each baiting Zone by using a suite of single nucleotide polymorphism (SNP) markers. The project would also have examined the mouse populations if mice had been found. This technique should allow assessment of the levels of genetic divergence between sites, and from this estimation of the levels of both historical and contemporary dispersal can be inferred.

A key unknown risk factor for the rodent eradication project relates to the presence or absence of mice. At present, mice are only known to exist in two areas, Cape Rosa and Nuñez Peninsula, where rats are absent (Bonner and Leader-Williams 1977, Cuthbert *et al.*

2012). However, there is a possibility that mice are present in other areas but remain undetected, as competitive pressure from rats may suppress mouse numbers (e.g. Brown *et al.* 1996) and much of the island is very rarely visited. Should mice be present in additional areas, there is a risk that these populations will rapidly increase after the removal of rats as it is unlikely that the proposed baiting regime for rat areas is adequate to eradicate mice.

A database of population genetic signatures of current rodent populations will also be of use post-eradication in association with monitoring efforts. If a rodent or rodents are trapped post-eradication, it will be possible to determine the provenance of the animals from the genetic data; that is, whether animals survived eradication at any particular location, or have migrated from another area within or from outside of South Georgia, indicating failure of biosecurity procedures. This will have an impact on further design and fundraising efforts for latter stages of the project, and on the biosecurity management procedures GSGSSI have in place on the island.

Phase 1 of the South Georgia rat eradication identified several non-target species that are vulnerable to primary and secondary poisoning, including brown skua (*Stercorarius lonnbergi*), snowy sheathbill (*Chionis alba*), South Georgia pintail (*Anas georgica georgica*), speckled teal (*Anas flavirostris*) and kelp gull (*Larus dominicanus*) (Black 2011). Determining the distribution and population size of these species within the Phase 2 Zones will enable the potential impact on these species to be assessed. Once the risk in each Zone has been assessed, mitigation measures and monitoring can be targeted at areas where non-target mortality is likely to be highest.

The monitoring priorities associated with the operational period of Phase 2 (during and post-baiting) are yet to be determined. However, it is likely that some of the areas visited during the summers of 2011/12 and 2012/13 will be revisited during or immediately following the bait drop, which is planned to start in March 2013. An assessment of the impact on non-target species will take place at this time. Results from intensively monitored areas may be able to be extrapolated to determine the overall impact on the island wide populations of the species concerned.

Additionally, it is important to identify sites containing remnant populations of burrowing petrels that are easily accessible (primarily in the Barff and Stromness Zones) to monitor the post-eradication recovery of these species.

1.2 Aims

- Collect tissue samples from as many rats as trapping allows (minimum of 25 rats) from each baiting Zone.
- Analyse all genetic samples and establish DNA database on the rat populations.
- Determine if populations in each baiting Zone are separate and examine mixing within baiting Zones.
- Determine the distributions of species that are potentially vulnerable to non-target mortality during Phase 2 of the rat eradication.
- Determine the distribution of species that are likely to benefit from the removal of rats.
- Survey for the presence of mice.

This report describes preliminary findings following the first season of fieldwork.

2. FIELD TEAMS

In total, eight fieldworkers participated in the project but only six were employed at any one time (divided into three two-person teams).

- **Team 1**

Team 1 remained consistent throughout the field season and consisted of Sally Poncet (SP) & Darren Peters (DP). Sally has a wealth of knowledge of South Georgia and her input during the pre-deployment planning was invaluable. Darren was seconded from New Zealand's Department of Conservation, where he is an expert in trapping rodents and other invasive mammals.

- **Team 2**

Before Christmas, Team 2 comprised Anton Wolfaardt (AW) & Leigh-Anne Wolfaardt (LW). Anton is a conservation ecologist with 16 years experience in the field, a large part of this focussed on seabird conservation. Since March 2008, he has been employed by the UK's Joint Nature Conservation Committee (JNCC) as the Agreement on the Conservation of Albatrosses and Petrels (ACAP) officer for the UK South Atlantic Overseas Territories. Leigh-Anne is a professional artist and has worked extensively with Anton in the field.

Anton Wolfaardt (AW) and Mark Tasker (MT) worked together after Christmas. Mark is currently the Head of Marine Advice with the JNCC and has a wealth of experience concerning seabird conservation and invasive species eradications.

- **Team 3**

Andy Black (AB) worked with Tom Hart (TH) pre-Christmas. Andy has previously worked on a number of projects on South Georgia over the past 13 years. Tom is a researcher affiliated with Oxford University and the London Zoological Society and is a self-styled penguinologist. Much of Tom's work is focused on the genetic diversity of penguins in the South Atlantic sector of the Southern Ocean.

Andy Black (AB) and Kalinka Rexer-Huber (KRH) worked together post-Christmas. Kalinka is a conservation biologist whose major research strands are invasive species and seabirds. She worked on house mice on Gough Island, South Georgia and the Falkland Islands, with the RSPB, GSGSSI and Falklands Conservation. She has also been involved in seabird, raptor and passerine research over the last decade.

3. FIELD METHODS

3.1 Proposed fieldwork

The primary goal of the fieldwork was to collect sufficient tissue samples from rats from each baiting Zone to determine the genetic signature of each sub-population. In the first instance, this data will indicate whether each Zone contains an isolated population, which will better inform Phase 2 of the eradication. In the long-term, the genetic data will be useful in the event that rats are found during post-eradication monitoring. If rats are found, a comparison of the genetic signatures of these animals with those captured prior to baiting will help to determine whether the rats are the descendants of animals that survived the eradication or animals that have been introduced since the eradication.

On 6 November 2011, the OTEP team departed from Stanley on board the FPV *Pharos SG* bound for South Georgia. On arrival at King Edward Point (KEP), a day was spent undertaking an intensive field first aid course with the British Antarctic Survey (BAS) Doctor based at KEP. Time was also set aside for field training and to biosecure kit in preparation for deployment to the field. All teams were deployed on 14 November and further deployments occurred until 26 January. Leigh-Anne and Tom left South Georgia on 20 December, while Kalinka and Mark arrived on 1 January 2012. Dates of team deployments at each field camp are summarised in Table 1.

Table 1. Summary of OTEP team deployments

Site	Zone	Deployed	Retrieved	Team
Carlita Bay	Stromness	14/11/2011	26/11/2011	SP & DP
Sörling Valley	Barff	14/11/2011	26/11/2011	AW & LW
Corral Bay 1	Barff	14/11/2011	26/11/2011	AB & TH
Grass Island	Rat free	28/11/2011	28/11/2011	All teams
Bjornstadt Bay	Cape Charlotte	30/11/2011	07/12/2011	SP & DP
Gold Harbour	Cape Charlotte	30/11/2011	07/12/2011	AW & LW
Fortuna Bay	Stromness	29/11/2011	13/12/2012	AB & TH
Corral Bay 2	Barff	08/12/2011	13/12/2012	SP & DP
Corral Bay 2	Barff	08/12/2011	13/12/2011	AW & LW
Jason Harbour	Stromness	27/12/2011	29/12/2011	SP & DP
Corral Bay 3	Barff	26/12/2011	29/12/2011	AB & AW
Prion Island	Rat free	03/01/2012	03/01/2012	All teams
Prince Olav Harbour	Prince Olav	04/01/2012	12/12/2012	AW & MT
Sea Leopard Fjord	Salisbury	04/01/2012	12/12/2012	AB & KRH
Antarctic Bay	Blue Whale	16/01/2012	26/01/2012	SP & DP
Antarctic Bay	Blue Whale	16/01/2012	26/01/2012	AW & MT
Right Whale Bay	North West	15/01/2012	26/01/2012	AB & KRH

All fieldwork was conducted in accordance with GSGSSI biosecurity protocols, and with minimal wildlife and environmental impact a priority.

3.2 Choice of campsites

Campsites were chosen to allow access to as many Zones as possible within the time available. Figure 2 shows the location of each campsite and Table AI1 gives the latitude and longitude of each campsite. Effort was made to select sites with relatively sheltered landings under prevailing weather conditions to aid small-boat deployment and retrieval of teams. Further details concerning landing and campsite particulars are provided in Appendix I. Two Zones (Antarctic and King Haakon Zones) in the original schedule were not visited during this field season largely due to the difficulty of landing on these stretches of coast.

Local weather phenomena make it vital to select a good campsite. In particular, some locations are subject to strong katabatic winds that can damage tents and pose a risk to personnel. However, very strong wind can be encountered almost anywhere on the island; equipment recommendations are provided in Appendix II.

Additionally, the native wildlife, particularly southern elephant seals (*Mirounga leonina*), can damage camping gear, especially tents. Antarctic fur seals (*Arctocephalus gazella*) may also pose a threat to safety through aggressive interactions with people. Camping in areas occupied by elephant seals is strongly discouraged. With care, it is possible to work around fur seals.

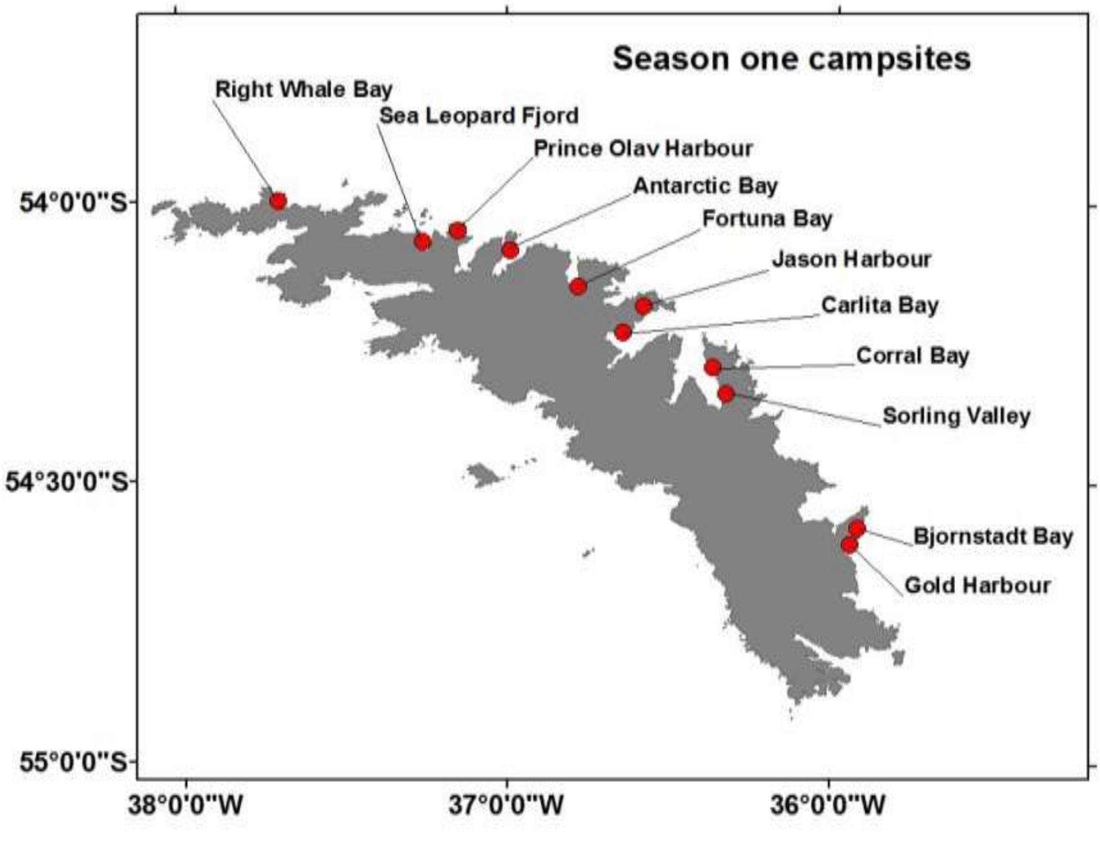

Figure 2. South Georgia map showing the sites of field camps.

3.3 Rat trapping

For each baiting Zone a minimum of 25 samples was required for genetic analysis but efforts were made to obtain 50 samples to improve the power of the statistical analysis. Within some Zones, field teams were deployed at more than one location. Where this occurred, each team aimed to collect 25 rats from each site (i.e. a total of 50 samples for the Zone).

Prior to Phase 1 of SGHT's rat eradication, difficulties were experienced trapping a sufficient number of rats on the Thatcher and Greene Peninsulas, despite the investment of considerable time and effort. It was hoped that catch rates would be improved through the use of highly palatable bait (Provoke rat attractant, Bell Labs, Madison, USA) and a high trapping density (100 traps per team, Victor Professional snap traps). Instruction was given on trap setting and location selection to ensure that prime habitats were being targeted to give the greatest chance of success. However, this was no substitute for experience gained in the field and trapping strategy developed as the field season progressed.

To prevent incidental mortality and accidental triggering of traps, collapsible pre-fabricated trap covers were provided. Trap covers consisted of tunnels constructed from 5mm plywood (approximately 60 cm long) with a 7 cm diameter hole in each end. Initially, each box was fitted with two Victor Professional rat traps, positioned back to back, so that rats entering from both ends of the box were confronted with a trap. Boxes were placed squarely on the ground to ensure the box was stable and would not move when a rat attempted to enter. Traps were placed near rat runs, latrines or burrows, under the cover of vegetation (tussac grass *Parodiochloa flabellata*) or at the base of rocky outcrops (rat sign indicated where rats were regularly travelling). To cover an area effectively, traps were spaced at intervals of 25-50m. Traps were baited with Provoke and/or peanut butter, and the location marked with a GPS waypoint and coloured tape was used to aid relocation of each trap.

Once baited, traps were initially checked every other day but daily checks were soon standard practice. On each visit, the condition of the trap was recorded as one of the following: Untouched, Rat caught, Sprung with bait or Sprung bait gone. This information was used to calculate the number of trap nights to give an index of trapping efficiency (rats caught per 100 trap nights). The number of trap nights was corrected to account for traps that were sprung, whether they caught rats or not. It was assumed that on average each sprung trap had been sprung for 50% of the period since the last trap check.

Traps were only rebaited if the bait was taken or had deteriorated (mouldy). Teams were deployed for relatively short periods so untouched bait typically lasted for the entire trapping period.

It was not unusual for large rats to be found dead close to traps. It was thought that these animals triggered traps and were fatally injured but were not held by the trap. When a sprung trap was found, a thorough search of the surrounding area was required to check for dead or stunned rats.

Once caught, rats were:

1. Weighed to the nearest 5 g;
2. Sexed;
3. Measured (total length, head+body length and tail length) to the nearest mm on a stopped rule;
4. Approximately 10mm from the end of the tail was clipped off and placed into 100% ethanol in an Eppendorf tube (label with a sample No. in permanent marker and pencil); and
5. Samples were stored at 4^{o}C or less, so best efforts were made to keep samples cool in the field. On returning to the FPV *Pharos SG,* samples were stored in the ship's science fridge (not the galley fridge).
6. Female rats were externally checked for signs of lactation and examined internally for the presence of foetuses.

Genetic samples were numbered with a two letter Campsite code and number (e.g. the first sample from Sörling Valley was SO01), labelling tubes in permanent marker and pencil with the sample number only.

3.4 House mouse survey

Visual survey, for sign or burrows, was the primary means of detecting mice around the island. As an additional means of detecting and confirming mouse presence, each team was supplied with 50 Snap-E mouse traps with rat proof covers (Kness Manufacturing, USA). However, the Victor rat snap traps would also be triggered by the weight of a mouse (D. Peters pers. comm.).

Mouse sign is not as obvious as rat sign and therefore a thorough search (on hands and knees) is required to detect their presence. A training field trip was arranged for those based in the Falklands prior to deployment of teams to South Georgia. Searches concentrated on prime habitat (coastal tussac grass). However, it is possible that competitive exclusion (or predation) by rats may restrict mice to marginal habitats (Brown *et al.* 1996) and therefore searches were attempted throughout all vegetated areas. If any indication of mice was found, traps were set in that area to attempt to catch animals for positive identification. If there was no clear indication of mice presence the traps were interspersed among the rat traps. A waypoint for each trap and a description of the habitat (as with all waypoints; vegetation type and rodent sign) was recorded. If mouse sign was detected during visual searches, a waypoint, a description/photograph and a sample of the evidence would have been taken. Any droppings thought to be from mice would have been collected for DNA analysis (with sample labels linked to a waypoint to ensure the location was accurately recorded).

Apart from sightings of live animals or carcasses, droppings provide the best evidence of rodent presence. Tracks in mud or snow might have been found and small mouse sized holes may have been noted, but without additional evidence it would have been unsafe to ascribe these to mice.

3.5 Brown skua survey

Following Phase 1 of the South Georgia rat eradication, the brown skua was one of the most heavily impacted non-target species (Black 2011). Mitigation measures have been proposed for this species, although at present it has not been decided whether or not these measures will be employed. However, if mitigation measures are used it will be very useful to have determined the breeding distribution of this species prior to Phase 2.

For all survey work, it is important to clearly define search areas. The stratification of areas was determined once ashore, with local geographic features used to demarcate each area. Skua territories are conspicuous and field parties aimed to record all territories within surveyed areas, using the codes 'Probably nest' or 'Confirmed nest'.

When a skua territory was encountered, a waypoint was taken to mark each nest and the status of the birds was assessed, using the codes listed in Appendix III. Depending on the stage of breeding, chicks may have already left the nest and can be difficult to locate. The timing of surveys is important, too early and birds have not laid, too late and birds may have failed or chicks fledged.

Whenever skua middens and/or pellets were encountered, observers attempted to identify the remains found to determine the composition of skuas diet. When encountered, the locations of skua clubs were also recorded and the number of birds present noted.

GPS tracks were downloaded at the end of each deployment, helping to clearly define the areas searched. The area surveyed was marked and measured using ARC GIS software. Surveyed area was used to calculate the density of confirmed nests and to assess the density of possible nests at each site. Complete censuses of Prion and Albatross Islands skua populations were also conducted; see Poncet (2012) for full details.

3.6 South Georgia pintail survey

Although a comprehensive census of the pintail population was not possible within the time available, an assessment of the extent of good pintail habitat (i.e. freshwater pools and wallows within areas of dense tussac, areas where ducks were found in large numbers) and the number of adults present were made. When good pintail habitat was found a single waypoint was taken. Observations of breeding (nest sites and /or ducklings) were recorded.
Over recent years, a number of pintail have been ringed from KEP and Bird Island with plastic (darvic) rings (A. Martin pers. comm.). If ringed birds were sighted attempts were made to read the number.

3.7 Snowy sheathbill distribution

Although sheathbills are widespread, the number of breeding pairs appears to be limited by the lack of suitable nest sites. Whenever encountered (usually on the beach), the location of sheathbills was recorded and efforts made to locate nest sites. Nests are often situated in rock crevices or under boulders and are used for several seasons, which results in a build-up of guano. Sheathbills do not start to lay before early December (Poncet and Crosbie 2005), therefore, the first deployment of the field season was too early to confirm breeding.

3.8 Kelp gull distribution

Although few kelp gull carcasses were found following Phase 1 of the rat eradication, this species is potentially vulnerable (DPIPWE 2010). If breeding colonies and/or roosting sites were located, a waypoint and an indication of the number of pairs/birds present was noted.

In the Cumberland Bay area, the majority of kelp gulls are observed feeding over kelp beds offshore, which might explain why few birds were killed during Phase 1. Elsewhere, kelp gulls may be more inclined to forage terrestrially, particularly in the vicinity of large king penguin (*Aptenodytes patagonicus*) colonies or aggregations of Antarctic fur seals. When terrestrial foraging was observed, notes on behaviour were made.

3.9 Giant petrel survey

During the austral summers of 2005 and 2006, an island-wide census of South Georgia's southern and northern giant petrels (*Macronectes giganteus* and *M. halli* respectively) was carried out (Poncet *et al.* in prep). The results indicate that the South Georgia breeding populations number 8,700 and 17,200 pairs for southern and northern giant petrels respectively (Clarke *et al.* 2012). Although the counts achieved were as comprehensive as possible, (with >95% of South Georgia's giant petrel population censused), a few areas likely to support giant petrels were not visited. Where possible, gaps in the 2005-2006 coverage were filled during this season of OTEP fieldwork.

When nests were encountered the following information was recorded; a waypoint, species, number of breeding pairs, status and vegetation type following Appendix III. Where large king penguin colonies or aggregations of fur seals occur, giant petrels may be more terrestrial in their foraging habits. This behaviour could make them vulnerable to non-target mortality (DPIPWE 2010). Observations of terrestrially feeding giant petrels were noted.

3.10 Burrowing petrel distribution

Burrowing petrels colonies were recorded whenever they were encountered for use in establishing a set of monitoring sites to track any post-eradication changes in numbers and distribution

The distribution of remnant populations of burrowing petrels was recorded in order to establish sites to monitor the long-term, post-eradication, recovery of burrowing petrels. For logistical reasons, colonies located within Cumberland Bay (within the boating range of KEP) were of particular interest.

There is considerable difference in the laying date of the different species of burrowing petrel encountered on South Georgia, and many will not start laying until well into December (Poncet and Crosbie 2005). Nonetheless, there is likely to be evidence of birds' presence before laying occurs (fresh digging, droppings, calling) (e.g. Brooke 1987). If colonies of burrowing petrels were encountered, the position was recorded on a GPS, attempts were made to identify the species and the number of apparently occupied burrows was counted. Without a burrow-scope or play-back recorder, it was difficult to determine whether the burrow was occupied or not.

3.11 South Georgia pipit distribution

Pipits are unlikely to be successfully breeding in areas that contain rats. However, if pipits were sighted, the position of these birds was recorded and an attempt made to determine whether they were breeding. Observations of behaviour such as singing, carrying nesting material, carrying food items or faecal sacks may indicate that birds were breeding.

4. RESULTS AND DISCUSSION

4.1 Rat trapping

Trapping took place between the 14th November 2011 and 25th January 2012 with teams deployed at 11 different sites, covering six baiting Zones (Table 1). The Salisbury and Prince Olav Zones were until recently separated by the Morris Glacier. However, the Morris Glacier has now retreated, leaving no barrier between these areas. Genetic samples from each side of the Morris Glacier will reveal how much mixing of the rat populations has occurred. For this reason, Salisbury and Prince Olav will be considered as separate Zones hereafter.

For a number of reasons, such as mitigating against non-target mortality, rat traps were deployed within plywood boxes. The poor catch rate of boxed traps prompted fieldworkers to experiment with uncovered traps, which proved to be far more successful at catching rats (Table 2). In order to catch the required number of rats, the use of covers was not continued. Towards the end of the field season (late January), the team deployed at Right Whale Bay experimented once more with boxed traps. Seven boxes were deployed for three nights during which time one rat was caught, a substantially lower catch rate than the uncovered traps (Table 2). Despite the trap cover, the rat was scavenged by a skua. Table 2 compares the catch rate of rats in boxed and uncovered traps at sites where both were used.

Table 2. Comparison of catch rates between boxed and uncovered traps at different locations

Location	Trap type	Trap nights	Rats caught	Rats/100 trap nights
Corral Bay	Boxed	401.0	0	0.0
	Uncovered	403.5	15	3.72
Sörling Valley	Boxed	450.5	1	0.22
	Uncovered	203.5	1	0.49
Carlita Bay	Boxed	241.0	0	0.0
	Uncovered	404.5	16	3.96
Right Whale Bay	Boxed	18.5	1	5.41
	Uncovered	751.5	72	9.58

Incidental bird mortality in the uncovered traps was limited to four pintail ducks (three ducklings and one adult) over the entire trapping period (in excess of 7,200 trap nights). At times, skuas found the carcasses of trapped rats before the field teams and some rats were lost, both from uncovered traps and those in covers. However, it was usually possible to obtain a tissue sample from the remains, although the full suite of morphometric measurements was not always possible. There was also evidence that some rats were cannibalised by other rats.

4.1.1 Rat samples

In total, 373 rat tissue samples were collected from the six baiting Zones visited (Figure 3). Details of each sample can be found in Appendix V. The majority of samples (n = 357) consisted of tails removed from trapped rats, with the remainder consisting of tissue or blood samples taken from the remains of trapped rats, that had been scavenged by skuas or other rats, or the remains of rats that had died of natural causes. All tissue samples were stored in 100% ethanol for future DNA analysis.

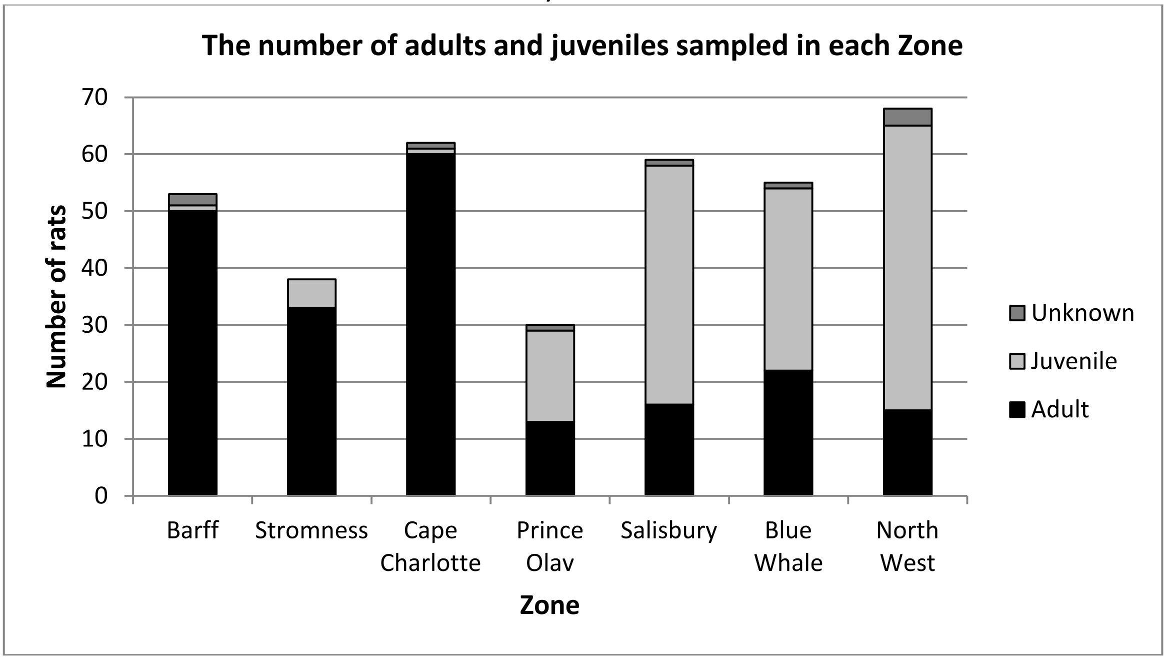

Figure 3. The number of adult and juvenile rats sampled in each Zone.

The weight, total length, head and body length, tail length and sex of each animal was recorded. The mass of rats plotted against date of capture is shown in Figure 4. We use a body weight division at 170 g to distinguish between adult and juvenile rats (Figure 4). This corresponds well with Pye and Bonner (1980) who report the smallest pregnant rat they sampled as 179 g. Perforate female rats were dissected to determine their reproductive state. Table 3 summarises the breeding biology and morphometric data collected.

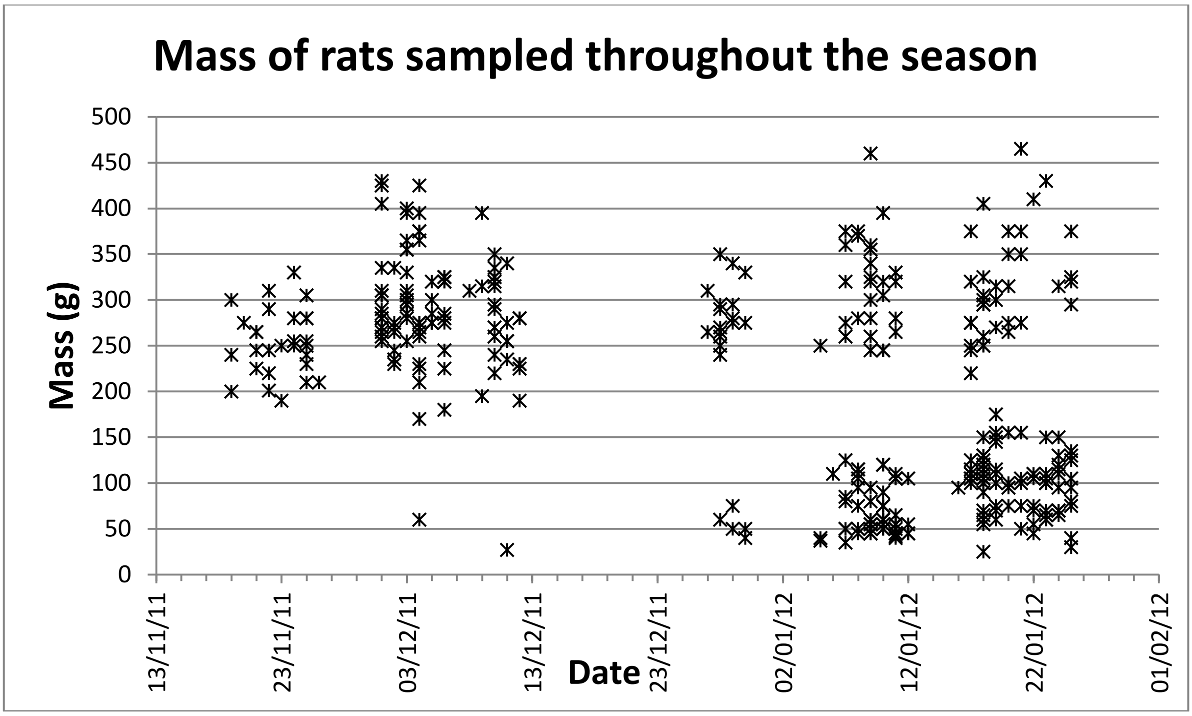

Figure 4. The mass of all rats sampled against the date of capture

Overall, 65% of rats caught were adult-sized rats (> 170 g), however, the proportion of juvenile rats caught increased as the season progressed (Figure 4). The first juvenile rat was caught in early December but very few juveniles were sampled before the last week of December (largely due to a cessation of trapping in mid-December).

Where conditions are suitable, brown rats will reproduce year-round. However, it appears that rats are seasonal breeders on South Georgia (Pye and Bonner 1980, this study). Elsewhere, the gestation period is 21-23 days, juvenile rats are weaned at about 25 days (approximately 60 g) and young rats reach maturity in five weeks, although the exact timing will depend on environmental factors, such as diet, and sex. If the same applies on South Georgia, the first recently weaned rat was caught on 4 December (Figure 4) indicating a date of conception around mid October (6-7 weeks earlier).

The variation in the mean size of rats caught in each Zone (Table 3) is a function of the date that the samples were collected (see Table 1). Early in the season, most of the rats caught in the Barff, Stromness and Cape Charlotte Zones were adults and therefore the mean mass was relatively high. As the season progressed, more juvenile rats were trapped in the Prince Olav, Salisbury, North West and Blue Whale Zones and therefore the mean mass was lower. The minimum rat mass was reasonably consistent throughout and reflects the size of juvenile rats as they emerged from the burrow. The mean adult rat mass increased slightly as the season progressed reflecting the growth of individuals (Figure 4).

Of the 82 mature female rats that were examined, 34 contained foetuses. Pregnancy rates ranged from 10.7–37.5% between trapping Zones. The number of foetuses ranged from 2 to 12, with a mean of 7.9. The first pregnant female was recorded on 17 November. In the early season, not all female rats were examined for the presence of foetuses. These animals are recorded as ‘Mature unknown’ in Figure 5.

Table 3. Summary of the breeding biology and morphometric data of rats collected from each Zone

	Overall	Barff	Stromness	Cape Charlotte	Prince Olav	Salisbury	Blue Whale	North West
Demographics								
No. samples	373	53	43	68	30	59	55	65
No. rats measured	351	50	39	61	30	56	54	61
No. Adult (>170g)	203 (58[a])	49 (98[a])	34 (87[a])	56 (92[a])	13 (43[a])	15 (27[a])	22 (41[a])	14 (23[a])
No. Adult Females	118 (34[b])	28 (56[b])	22 (56[b])	31 (51[b])	7 (23[b])	10 (18[b])	14 (26[b])	6 (10[b])
No. Ad. Females sampled	82	21	16	16	7	10	13	6
% Pregnant	34 (41[c])	3 (14[c])	6 (38[c])	8 (50[c])	3 (43[c])	3 (30[c])	7 (54[c])	4 (67[c])
% Lactating	16 (20[c])	0 (0[c])	2 (13[c])	2 (13[c])	2 (29[c])	3 (30[c])	5 (38[c])	2 (33[c])
% Pregnant & Lactating	11 (13[c])	0 (0[c])	0 (0[c])	3 (19[c])	0 (0[c])	2 (20[c])	4 (31[c])	2 (33[c])
Morphometrics								
Mass range (g)	25-465	60-395	27-375	60-430	50-375	35-460	25-410	30-465
Mass mean (g)	208	268	247	295	189	133	181	151
St. Dev.	112.9	52.6	87.4	66.3	115.8	122.4	109.2	106.7
Total length range (mm)	131-435	219-409	173-406	210-422	185-386	131-435	160-417	176-426
Total length mean (mm)	311	358	339	367	286	252	286	292
Body length range (mm)	88-248	107-216	93-234	111-237	89-212	88-242	90-220	103-248
Body length mean (mm)	170	193	188	199	150	141	154	160
Tail length mean (mm)	73-208	112-193	80-195	99-208	95-178	73-174	65-195	73-182
Tail length mean (mm)	142	166	151	169	136	112	132	131

[a] – Percentage of measured rats
[b] – Percentage of adult rats
[c] – Percentage of adult females

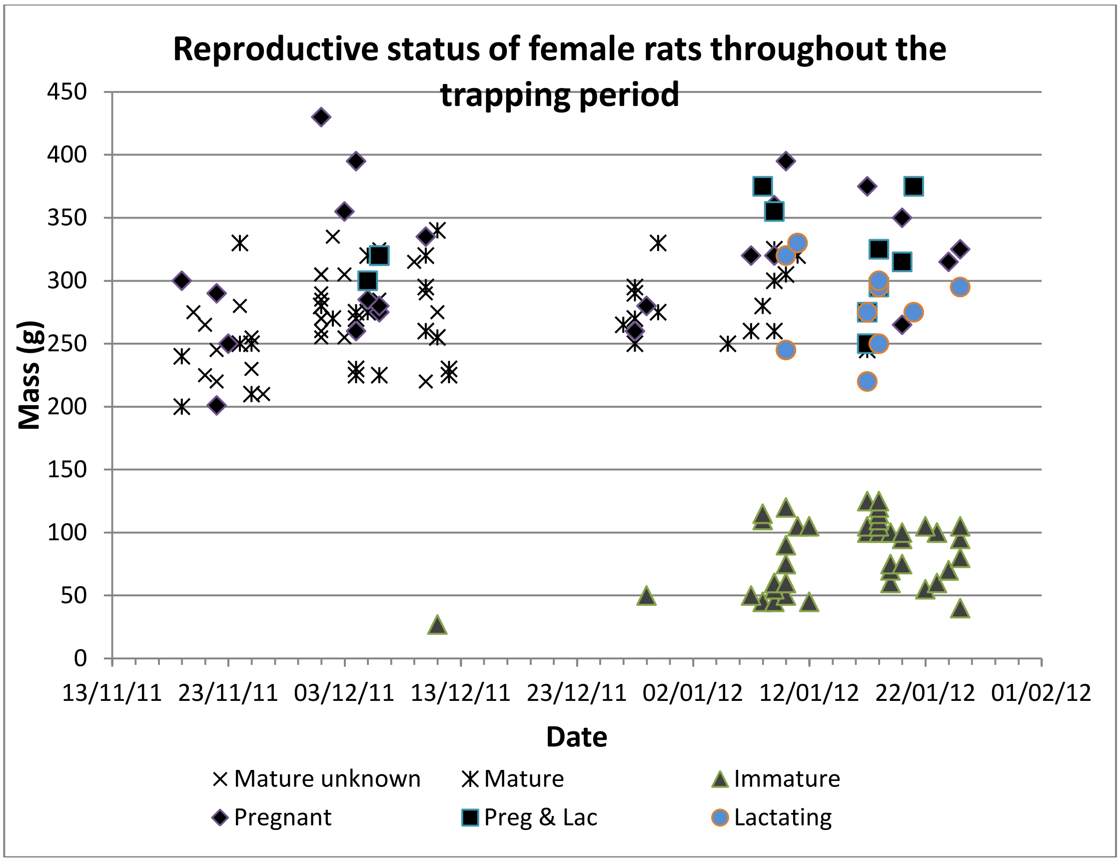

Figure 5. Mass of female rats sampled and reproductive status against date of capture

The first lactating pregnant female, carrying the second litter of the season, was recorded on 5 December. By mid-January virtually all mature female rats were pregnant or lactating (Figure 5).

Female rats over 200 g in weight were reproductively active, with the proportion of breeding animals in each size class increasing as mass increased (Figure 6). All female rats with a mass greater than 350 g were pregnant (Figure 6). Animals that are reproducing are likely to be in reasonably good physical condition and the developing pups can add substantially to the females' overall weight, with pups close to birth weighing 5 g (A. Black & K. Rexer-Huber pers. obs.).

The smallest perforate female rat was 130 g and the smallest pregnant female recorded weighed 201 g. However, for the sake of simplicity, rats born during the 2011/2012 summer were considered to still be juvenile at the end of the trapping season (25 January). In practice this gave a cut-off point of approximately 170 g between juvenile and mature rats (Figures 4 and 6).

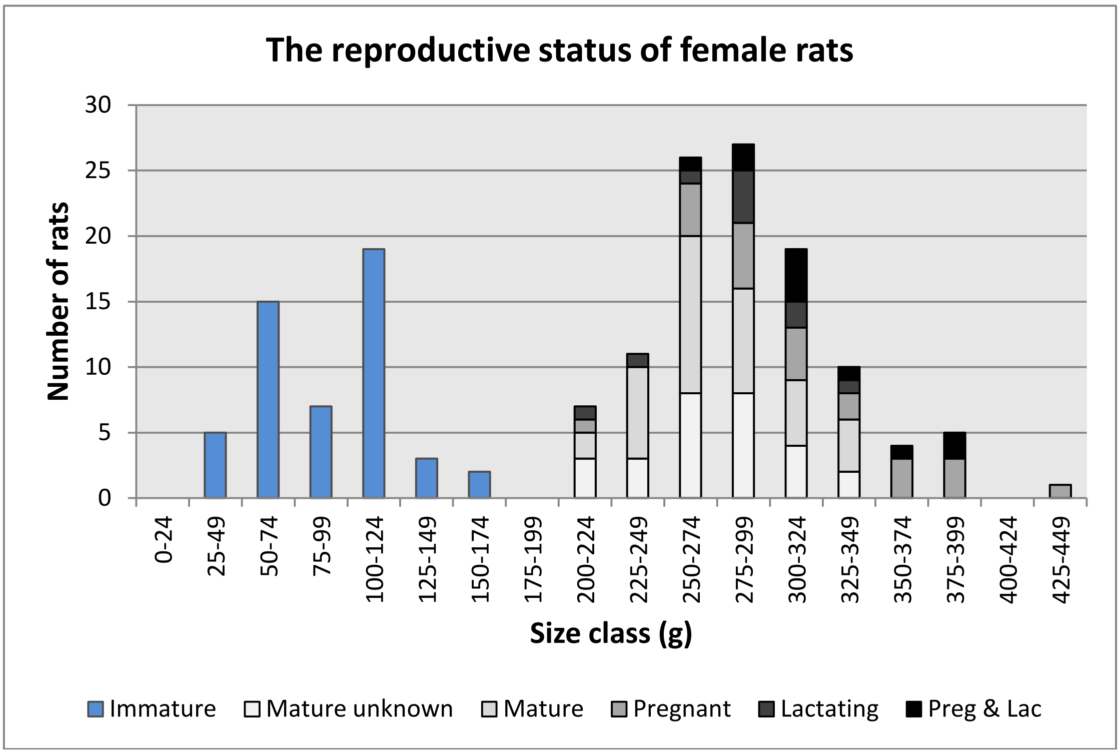

Figure 6. The reproductive status of female rats of different size classes

By the end of January, juvenile rats were apparently caught from several distinct cohorts. If weight is used as a proxy for age, peaks in the number of animals weighing approximately 70, 110 and 150g were caught at this time, suggesting three possible cohorts (Figure 7). The size of juvenile rats caught towards the end of the trapping period (Figure 4) suggests that the first cohort of the season is reaching maturity (170 g) by the end of January.

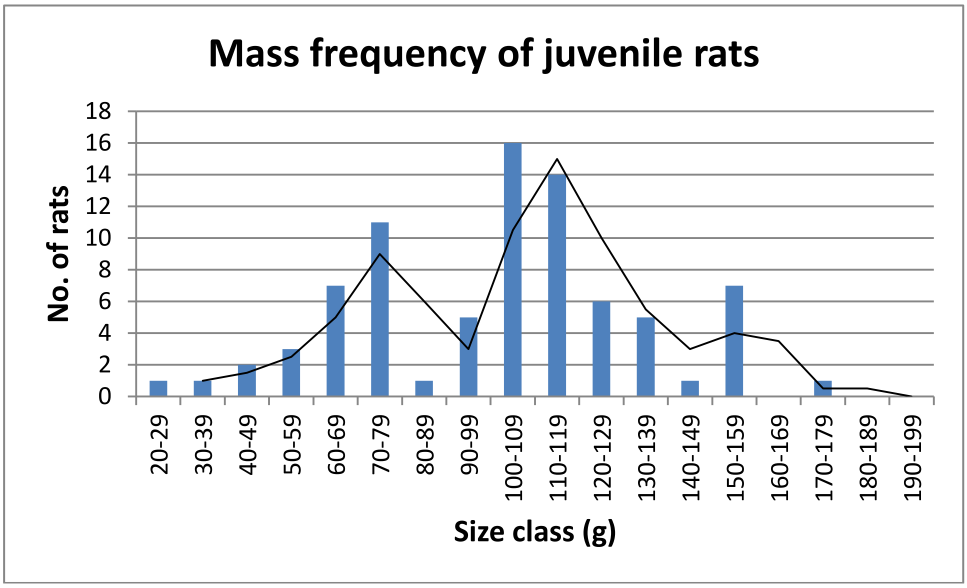

Figure 7. Mass frequency of juvenile rats

4.1.2 Relative rat abundance

An estimate of the size of the rat population cannot be calculated from the catch data as sampling was biased by only trapping in areas with ample rat sign, rather than randomly set in grids or transects. Additionally, it is likely that the ability of the field teams to catch rats improved as the season progressed. However, an indication of the relative abundance of rats between trapping sites can be obtained by comparing catch rates (rats per 100 trap nights).

Generally, the catch rate increased as the season progressed, reflecting the increase in the rat population throughout the summer and, to a lesser extent, better trapping technique (Figure 8). The improved catch rate was largely due to the increase in the number of juvenile rats caught with the number of adults caught per 100 trap nights declining as the season progressed (Figure 8, see Table 1 for dates). It is thought that few wild rats live for more than a year (Davis 1948) and therefore adult mortality will account, in part, for the observed decline in adult catch rate.

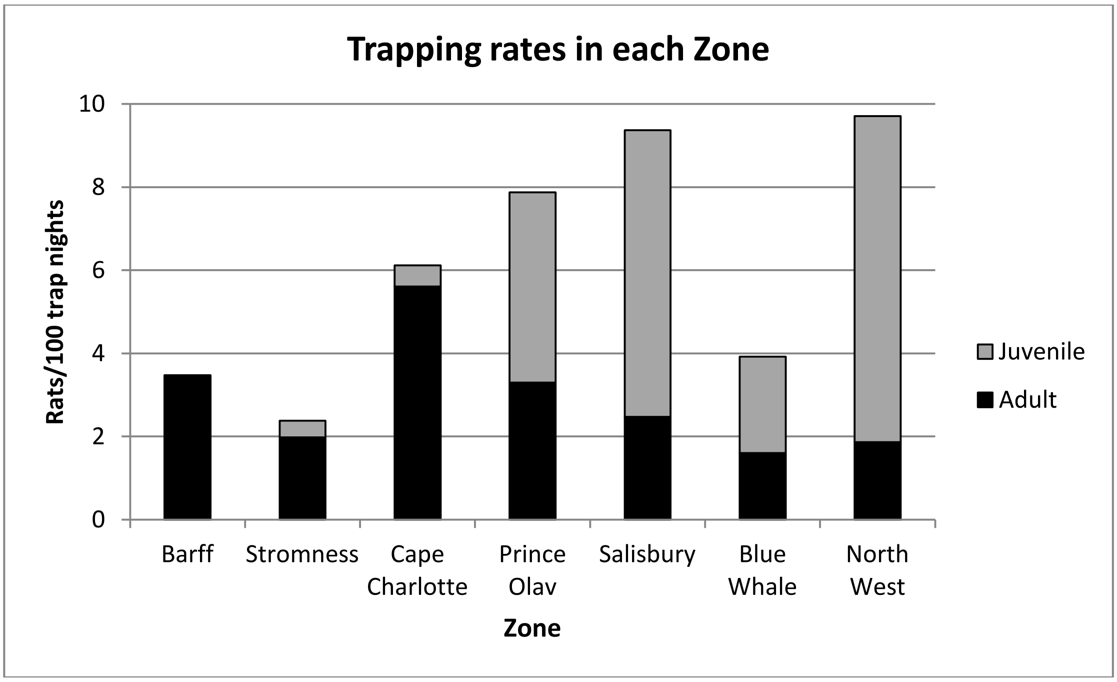

Figure 8. Catch rates in each Zone (excluding boxed traps) for all rats and adults.

In each Zone, traps were set in several different trapping locations, sometimes several hours walk from the campsite. Table 4 lists the locations trapped in each Zone and maps showing the location of traps can be found in Appendix IV. Between locations, large areas were apparently devoid of rats, or contained little sign that rats were present in sufficient numbers to warrant trapping.

Table 4. Locations trapped within each Zone

Zone	Barff	Stromness	Cape Charlotte	Prince Olav	Salisbury	Blue Whale	North West
Locations	Corral Bay 1	Carlita Bay	Bjornstadt Bay	Prince Olav Harbour	Sea Leopard Fjord	Blue Whale Harbour	Nameless Point
	Corral Bay 2	Olsen Valley	Gold Harbour	Beckmann Fjord	Salisbury Plain	Antarctic Bay	Binder Beach
	Corral Bay 3	Husvik Harbour		Elephant Lagoon			
	Rookery Point	Stromness					
	Lucas Point	Fortuna Bay					
	Sandebugten	Jason Harbour					
	Sörling Valley						

The catch rate at each location varied considerably (from zero to over 17 rats per 100 trap nights, Figure 9) but the general trend was for catch rate to increase as the summer progressed.

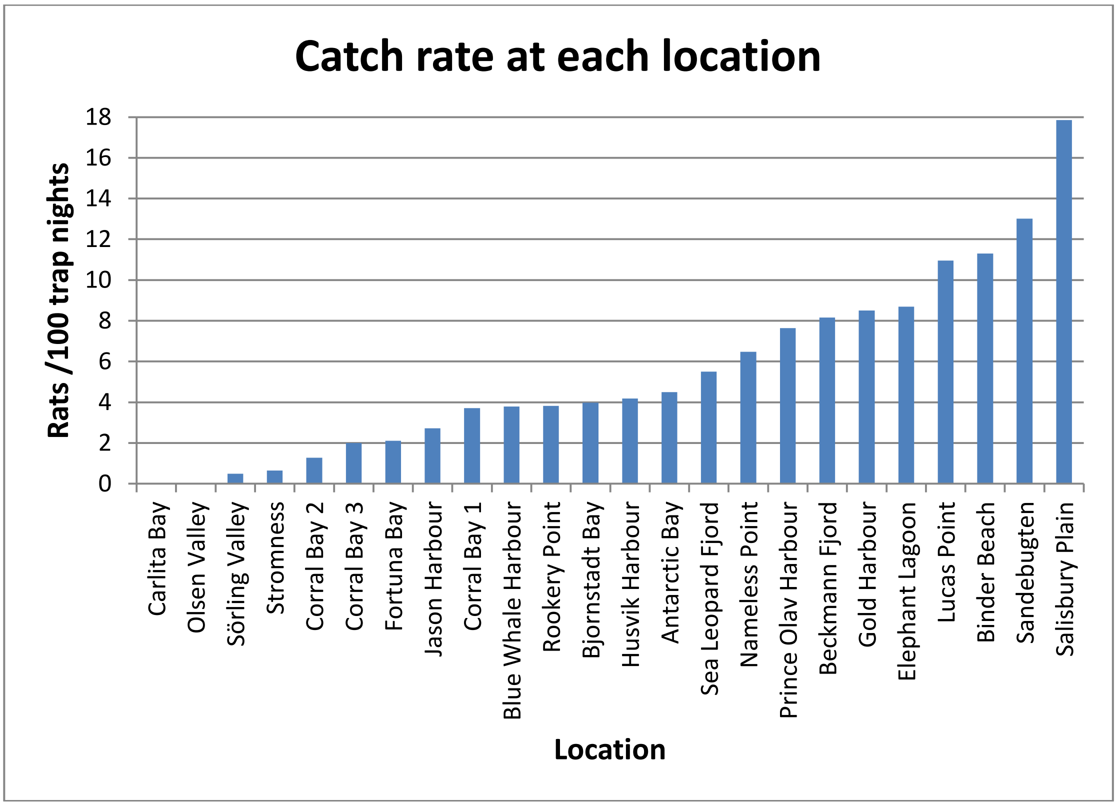

Figure 9. Rat catch rate (rats per 100 trap nights) at each trapping location

4.1.3 Genetic analysis

The tissue samples have been delivered to Dr. Stuart Piertney at Aberdeen University. At the time of writing, the analysis is ongoing with full results pending.

4.1.4 Rat discussion

4.1.4.1 Timing of trapping

At the locations visited early in the season, catch rates were very low, suggesting that the rat populations suffered from a high mortality rate over the winter months. Early in the fieldwork, the majority of rats were apparently confined to the coastal fringe. Catching sufficient rats for genetic work proved to be harder than anticipated and trapping became the overriding focus of the team's time and effort.

It was not until January that it became possible to catch a sample of 50 or more rats within the allotted time at any one campsite. However, many of these animals were juveniles and at times it was very likely that several animals from the same litter were sampled. Traps were set over a wide area in an attempt to sample animals from different family groups.

4.1.4.2 Rat trap covers

Trap covers were used initially, in order to avoid non-target mortality (primarily pintail and pipits), protect trapped rats from scavengers (primarily skuas), prevent the accidental triggering and help preserve the bait. However, following very low catch rates, it was decided to experiment with uncovered traps. Immediately the uncovered traps started to catch rats while those remaining in boxes, only a few metres away, remained untouched.

It is believed that trap covers were unsuccessful for a number of reasons. Rats are regarded by many to be neophobic, that is suspicious of unfamiliar objects in a familiar environment (Clapperton 2006). This may explain the initial reluctance of rats to enter a box but not why they were still box-shy nearly two weeks later. Several boxes were modified by removing the plywood floor panel to see if this made them more acceptable to the rats. Although left in situ for several days, none of the traps in these modified boxes caught rats.

Another possible reason for the poor catch rate when using boxes is the inability to place traps in prime locations (rat runs, near burrow entrances) due to the size of the boxes, although rats would undoubtedly still encounter boxed traps. By placing uncovered traps carefully it was found that non-target mortality could be avoided (although four pintail ducks were caught). At times, skuas found trapped rats before the field teams and some rats were lost. However, it was usually possible to obtain a tissue sample from the remains. There was also evidence that some rats were cannibalised by other rats.

In addition to the issue of low rat capture rates when traps were set in boxes, trap covers was inefficient to deploy. At all field camps, trapping sites were spread over a wide area, sometimes more than two hours walk from the campsite. The weight and bulk of the trap covers made it difficult to carry more than 10 sets of boxes and traps, whereas a single person could quite easily carry 50 traps.

In summary, trap covers are not necessary on South Georgia for short-term use. The risk to non-target species is minimal and trapping with covers was inefficient and ineffective. However, increased maintenance and higher risk of accidental triggering mean that uncovered traps are not a viable option for long-term monitoring for post eradication incursions. The data presented here indicate that boxed traps are also not a viable option for long-term monitoring and novel trapping methods should be investigated.

4.1.4.3 Rat bait

The field teams were supplied with Provoke professional rat attractant (Bell Laboratories, Madison, USA). Initially, the bait was used by all teams but soon alternative baits were trialled in an effort to boost catch rates. Sardines, pâté, oats and chocolate were all tried; in the end peanut butter became the bait of choice, although some persisted with Provoke or a combination of Provoke and peanut butter. Low catch rates were more likely due to low rat density than to the performance of Provoke; however, peanut butter proved to be more cost-effective.

4.1.4.4 Rat distribution and habitat

The South Georgia rat population appears to be subjected to high mortality over the winter with survivors concentrated on the coast in the spring. The deployment of the field teams in mid-November was too early in the season to catch rats efficiently. Although old rat sign was found everywhere, it was difficult to find fresh sign at this time. Even at the height of summer, the distribution of rat sign was patchy and it was not always possible for a two person team to catch 50 rats within a two week period.

The lack of young rats caught in the early weeks of fieldwork suggests a cessation of breeding over the winter months. As the season progressed, young rats began to figure in the catches. The distribution of fresh rat sign indicated that rats dispersed away from the coast as the summer progressed, likely to be young males displaced from their natal territories.

4.1.4.5 Rats and king penguins

At several sites (Gold Harbour, Sea Leopard Fjord, Salisbury Plain and Right Whale Bay), most fresh rat sign and best catch rates were found in the tussac fringing king penguin colonies. We suggest that there are several reasons for the association between king penguin colonies and rats. Firstly, king penguins raise chicks year-round, including throughout the winter months. Inevitably, there is a high mortality rate of chicks in the winter and therefore king penguin colonies provide a reliable source of food during the winter. Perhaps more importantly, a sizable king penguin colony can effectively exclude fur seals from large areas of tussac. Along with nutrient enrichment from penguin guano, the lack of fur seal damage results in lush tussac stands, which provide ideal habitat for rats.
On a few occasions, traps were placed in the tussac fringing Macaroni penguin colonies (at Lucas Point and Rookery Point), these locations proved to be quite

successful but generally not as productive as trapping adjacent to king colonies. Macaroni penguins vacate colonies outside the summer breeding period and therefore do not provide a potential source of food to rats throughout the winter. This might explain the apparent difference in rat catch rate associated with king and Macaroni colonies.

4.1.4.6 Rats and reindeer

It was noticeable that rats were apparently less abundant in Zones occupied by reindeer (Barff and Stromness) than those with no reindeer (Cape Charlotte). This was particularly evident during early summer when rat numbers were low following apparently high over-winter mortality. Reindeer and rats are competitors for the same resource, tussac grass. Rats rely heavily on tussac grass for food and shelter (Pye and Bonner 1980), particularly in the winter. We suggest that the presence of reindeer degrades the tussac habitat to such an extent that the rat population is suppressed, through high winter mortality. These observations support those of Leader-Williams *et al.* (1989) who suggest that '*the grazing pressure and consequent destruction of tussocks may have a controlling effect on rat populations, at least ensuring that any existing, burrow-nesting bird populations continue to survive*.'
Later in the season, the catch rate of adults was lower in areas without reindeer, which in contrary to the above hypothesis (see below). Clearly there are other factors that determine the density of rats in a particular area. Poncet (2000) provides further insights into the relationship between rats and reindeer. '*The interactions between burnet, skua predation and rat distribution require clarification, but it is possible that in those areas where this plant is abundant, rats are able to travel further inland than in less vegetated areas. The presence of burnet may be a critical factor in facilitating natural rodent invasions. For example, it may account for the absence of large colonies of Dove Prions and South Georgia Diving-petrels in the Grytviken and Greene Peninsula areas where extensive stands of burnet cover slopes up to 1.5 km inland, in contrast to the Barff Peninsula and Stromness Bay areas which are covered mainly in Festuca erecta, with very little burnet remaining due to over-grazing by reindeer, and where several large prion and diving-petrel colonies on inland scree and boulder slopes have been recorded (pers obs).*

The impact of reindeer on rat distribution and abundance may therefore also be significant: grazing primarily on tussock and Acaena magellanica, reindeer have radically altered the distribution and abundance of these two plants, and in so doing have reduced the availability of winter food and shelter for rats and no doubt affected their abundance, distribution and breeding success (pers. obs, Leader-Williams et al. 1989 in Pye, 2000). While there is no evidence to suggest that local bird populations in reindeer-grazed tussock areas are benefitting from lower rat predation in the presence of reindeer, it is possible that inland populations of Dove Prion and South Georgia Diving-petrel on non-vegetated scree slopes, are better able to survive in the presence of reindeer (Prince and Poncet, unpubl.).'

4.1.4.7 Adult rat abundance

The catch rate of adult rats (rats per 100 trap nights) declined as the season progressed, although overall rat catch rate increased. This could be for several reasons; adults were less abundant in the sites visited later in the season, adult mortality during the summer accounted for the decline (life expectancy of a wild rat is less than a year), adults were more wary of traps than juveniles or juveniles were just too easy to catch (on several occasions, juvenile rats were caught within minutes of setting a trap in broad daylight).

4.2 Mouse trapping

No mouse sign was found at any of the Zones visited between November 2011 and January 2012. Mouse traps were deployed at six sites (Carlita Bay, Corral Bay, Sörling Valley, Gold Harbour, Bjornstadt Bay and Prince Olav Harbour). Snap traps set to catch rats are also capable of catching mice. No mice were caught.

Due to low rat abundance, rat trapping had to take precedence and the deployment of mouse traps was discontinued. If suspected mouse sign had been detected, the mouse traps would have been set to attempt to confirm these suspicions.

In March 2012, a team funded by the Darwin Initiative visited Cape Rosa and the Nuñez Peninsula on the south coast of South Georgia to study the house mouse populations there (Cuthbert *et al.* 2012). Although the presence of mice was confirmed, a high level of trapping effort was required, with catch rates as low as 1.7%. Furthermore, even at sites known to support mice there was very little physical sign to indicate their presence. Therefore, the lack of mouse sign or trapped mice by no means guarantees that an area is free of mice.

While maintaining perimeter signs at Leith Harbour whaling station in March 2012, two of the building team saw a mouse (D. Livermore pers. comm.). Further work is required, particularly around the whaling stations, to determine whether mice are coexisting with rats on South Georgia.

4.2.1 Mouse survey discussion

Although no mice were caught or sign detected during the OTEP fieldwork, we cannot conclude that mice are not present in the areas visited. Subsequent experience at Cape Rosa and the Nuñez Peninsula, areas with confirmed mouse populations, showed that mouse sign is hard to detect and a high level of dedicated effort is required to catch mice on South Georgia (Cuthbert *et al.* 2012).

4.3 Brown skua survey

4.3.1 Skua nest density

The timing of the skua survey was not ideal and many of the pairs recorded were not on eggs or with chicks. Those that were considered to be holding territories and likely to breed that season were recorded as 'probable breeders'. Pairs on eggs or with chicks were recorded as 'confirmed breeders'. The combined total of confirmed and probable nests is presented as 'possible nests' below.

In total, 147 confirmed and 217 possible skua nests were recorded. In surveyed areas, the density of possible brown skua nests ranged from zero to 14.18 km^{-2} (Table 5) (mean 5.59 st.dev. 4.05). A return visit to the Olsen Valley in mid-January confirmed that many of the probable nests were indeed active (M. Collins pers. comm.).

Table 5. Skua nest density recorded at each of the sites surveyed

Zone	Site (see App.VI)	Area surveyed (km^2)	Confirmed nests	Possible nests [a]	Confirmed density (nests/km^2)	Possible density (nests/km^2)
Barff	1	1.02	0	7	0.00	6.86
Barff	2	1.27	4	9	3.15	7.09
Barff	3	1.41	0	2	0.00	1.42
Barff	4	0.42	3	3	7.14	7.14
Barff	5	0.69	4	4	5.80	5.80
Barff	6	1.74	4	15	2.30	8.62
Barff	7	3.81	2	10	0.53	2.63
Barff	8	6.12	2	3	0.33	0.49
Barff	9	1.51	11	15	7.28	9.93
Stromness	1	1.89	2	9	1.06	4.76
Stromness	2	0.92	4	4	4.37	4.37
Stromness	3	1.16	3	4	2.60	3.46
Stromness	4	0.31	2	2	6.37	6.37
Stromness	5	11.44	5	19	0.44	1.66
Stromness	6	1.03	6	6	5.84	5.84
Cape Charlotte	1	0.32	0	0	0.00	0.00
Cape Charlotte	2	3.81	5	13	1.31	3.41
Cape Charlotte	3	1.77	9	19	5.09	10.74
Prince Olav	1	0.16	1	2	6.25	12.50
Prince Olav	2	0.39	4	4	10.38	10.38
Prince Olav	3	0.32	0	0	0.00	0.00
Prince Olav	4	0.33	2	2	6.05	6.05
Salisbury	1	0.75	8	8	10.72	10.72
Salisbury	2	1.32	15	15	11.33	11.33
Salisbury	3	0.78	11	11	14.18	14.18
Salisbury	4	0.37	0	0	0.00	0.00

Table 5 cont.

Zone	Site (see App.VI)	Area surveyed (km^2)	Confirmed nests	Possible nests [a]	Confirmed density (nests/km^2)	Possible density (nests/km^2)
Blue Whale	1	2.08	2	3	0.96	1.44
Blue Whale	2	0.83	0	0	0.00	0.00
Blue Whale	3	2.55	18	19	7.06	7.45
North West	1	1.08	13	13	12.01	12.01
North West	2	1.85	0	0	0.00	0.00
North West	3	0.81	6	6	7.41	7.41
North West	4	1.20	10	11	8.37	9.20
N/A	Prion Island	0.39	35	41	102.94	120.59
N/A	Albatross Island	1.00	78	83	78.00	83.00
Total		**57.19**	**269**	**362**		

[a] – 'Possible nests' is the sum of 'confirmed' and 'probable nests'

Skua survey areas and the position of skua nests recorded are shown in Appendix VI. The distribution of skua nests was very patchy and densities varied considerably between different sites in the same Zone (Table 5 and Appendix VI).

4.3.2 Skua population estimate

An indication of the number of skua pairs breeding in the Zones surveyed was estimated by extrapolating the densities recorded to the overall vegetated area in each Zone (Table 6). It should be noted that the data presented here only comes from surveys on the mainland of South Georgia. Skua nest density on Albatross and Prion Islands was much higher than on the mainland (Table 5, data from Poncet 2012).

Based on the density of confirmed nests, the minimum population ranged from 24 to 472 breeding pairs in each Zone, with a total of 763 pairs for all Zones surveyed (Table 6). The upper limit of our estimate is derived from the number of possible nests recorded, which indicates that 1,004 pairs may be breeding in the Zones visited, assuming that all probable pairs were breeding and that unsurveyed areas hold similar skua densities as surveyed areas.

Table 6. Skua nest density recorded and the extrapolated population estimate for each Zone (breeding pairs). Surveyed vegetated area is given with the percentage of the total vegetated area in parentheses.

Zone	Total Area km^2	Surveyed Area km^2	Confirmed Density	Possible Density	Min Pop. [a]	Max Pop. [b]
Barff	56.85	17.99 (32)	1.67	3.78	95	215
Stromness	44.00	16.74 (38)	1.31	2.63	58	116
Cape Charlotte	12.17	6.03 (50)	2.32	5.31	28	65
Prince Olav	7.77	1.19 (15)	5.83	6.67	45	52
Salisbury	3.42	2.85 (83)	11.95	11.95	41	41
Blue Whale	6.45	5.46 (85)	3.66	4.03	24	26
North West	50.30	3.09 (6)	9.39	9.72	472	489
				Total	**763**	**1,004**

[a] Min Pop. is the population estimate based on the density of confirmed active nests
[b] Max Pop. is the population estimate based on the density of territories held and confirmed nests

4.3.3 Skua chick wing length measurements

Due to a combination of poor weather and more pressing work commitments, only two skua chicks were weighed and measured, one on the 24 January at Blue Whale Harbour and the other at Antarctic Bay, both in the Blue Whale Zone. Table 7 shows the data collected.

Table 7. Skua chick wing lengths

Date	Location	Wing length	Feather sample
24/01/2012	Blue Whale Harbour	149	Y
24/01/2012	Antarctic Bay	203	Y

4.3.4 Skua clubs

When encountered, the locations of skua clubs were recorded and the number of birds present noted (Figure. 10). Skua clubs were usually someway inland, beyond the range of breeding territories, and usually associated with freshwater pools. It will be useful to revisit these areas when monitoring non-target mortality following Phase 2 of the South Georgia rat eradication.

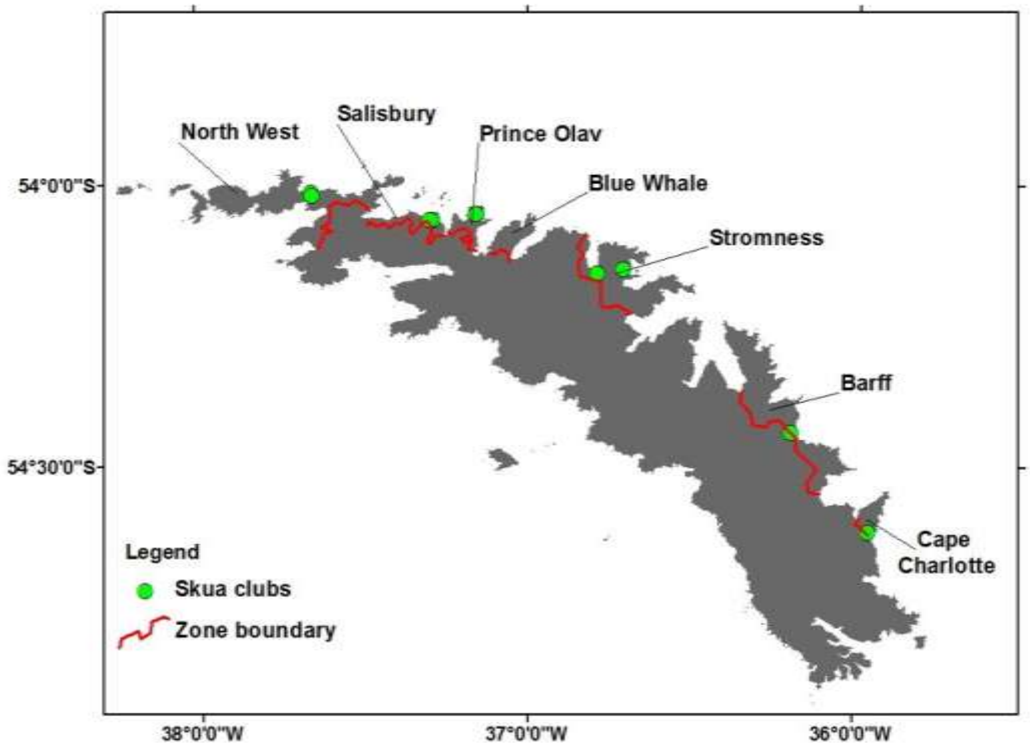

Figure 10. The locations of skua clubs recorded.

4.3.5 Skua diet

Whenever skua middens and/or pellets were encountered, observers attempted to identify the remains found (Figure 11). Prion species were by far the most commonly recorded prey, present in over 60% of all samples. Rats also featured highly (found in over 20% of samples), indicating that rats contribute to the diet of some skuas. Fur seal remains were recorded in 20% of samples; however, the importance of fur seal (placentas, flesh) in the diet of skuas is likely to be underestimated due to the lack of hard remains but field observations suggest that this is a common food source.

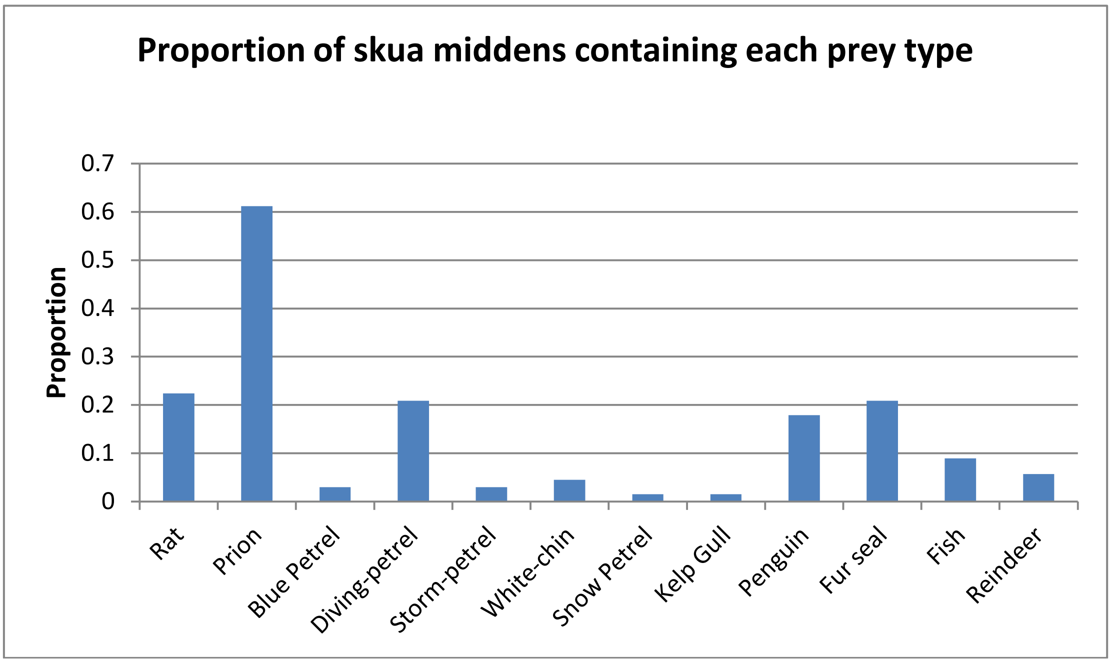

Figure 11. Skua diet derived from remains found in skua middens

4.3.5 Skua discussion

Ideally, bird surveys should be conducted soon after the end of laying, since surveying too late or too early can underestimate breeding. On Bird Island, brown skuas lay over a six week period (from early November to mid December, Osborne 1985). Observations in this study indicate that the mean hatching occurred around the end of December. With an incubation period of 29 days (Osborne 1985), this suggests that mean laying occurred in late November. When fieldwork commenced in mid-November, many skuas had not yet laid. Pairs that were holding territories were recorded as probable breeders but it is likely that not all of these pairs subsequently bred. Due to trapping commitments, little effort was directed towards capturing and measuring skua chicks. Our understanding of skua laying dates would have been enhanced had more chicks been aged.

An extrapolation of the data collected during our surveys indicates that the breeding skua population within the surveyed Zones numbers between 750 and 952 pairs. Over half of these pairs came from the North West Zone, which had relatively low survey effort. Along with the data to be collected during the 2012/2013 field season and data from Bird Island, it will be possible to calculate a more accurate estimation of the South Georgia breeding population.

It should be noted that in the early part of the field season, mid-November, was too early to effectively survey breeding skuas, producing some uncertainty regarding how many of the pairs on apparently occupied territories actually bred. Further surveys are also needed within the North West Zone to refine the estimate from this very large area.

Determining diet composition from the remains found in pellets is fraught with problems. The nature of the data collected here is very anecdotal; however, it does confirm that rats feature in the diet of many skuas.

Skuas are likely to exploit whatever resources are within or close to their territories, which will vary from place to place. Evidence gathered from middens suggests that skuas subsist mainly on prion spp., with rat, diving petrel, fur seal and penguin remains also found. However, fur seal is likely to be under-represented in skua middens, due to the lack of hard parts (Duffy and Jackson 1986). It is assumed that fur seal carrion form a major part of the diet of most of the pairs recorded as burrowing petrels and large penguin colonies were absent from many of the areas sampled. Although rats appear to contribute to the diet of some skuas, rat remains were not found in all middens. This suggests a degree of specialisation, with some birds actively hunting rats with others targeting alternative food sources.

Available food resources will influence the timing of laying. In order to maximise breeding success, chick rearing will coinciding with the period of greatest food supply. In the case of fur seals, there is a plentiful supply of food from early December onwards.

4.4 South Georgia pintail habitat

Whenever aggregations of South Georgia pintail were encountered their position was marked (Figure 12). The areas surveyed are shown on the maps in Appendix VI. Prime pintail habitat usually consisted of freshwater pools fringed by dense tussac grass. In the presence of reindeer, the quality of pintail habitat was degraded due to grazing pressure, which reduces cover and leads to drying of the peat and pools. We suggest that the removal of reindeer is likely to significantly improve the quantity and quality of habitat available to South Georgia pintail in the Stromness and Barff Zones.

Due to time constraints, systematic surveys or counts of pintail were not attempted.

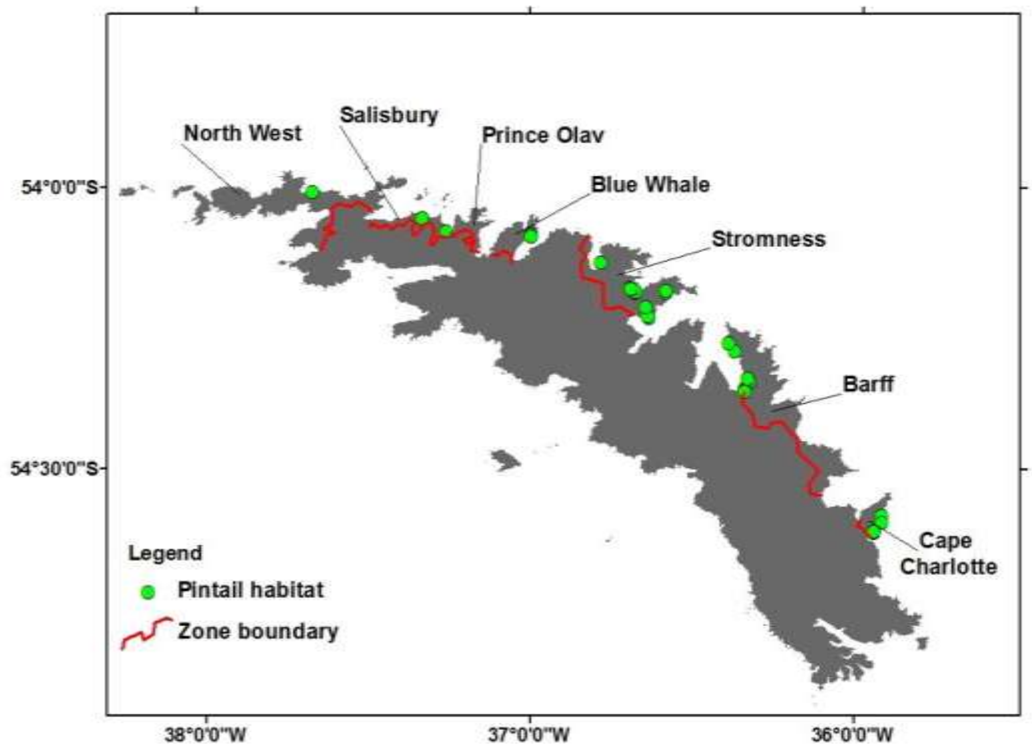

Figure 12. Areas of prime pintail habitat identified during the OTEP fieldwork

4.5 Giant petrel survey

During the austral summers of 2005 and 2006, an island-wide census of South Georgia's giant petrels was carried out. The results indicate that the South Georgia breeding populations number 8,700 and 17,200 pairs for southern and northern giant petrels respectively (Clarke *et al.* 2012, Poncet *et al.* in prep). Although the counts achieved were as comprehensive as possible (with >95% of South Georgia's giant petrel population censused), a few areas likely to support giant petrels were not visited. When possible, gaps in the 2005-2006 coverage were filled during this season of OTEP fieldwork. Figure 13 indicates the sites where giant petrel counts were made.

A total of 80 northern giant petrel and 186 southern giant petrel active nests were counted across 14 separate sites (Table 8). Four of these sites (Barff Point, Jane Point, Blue Whale Harbour, Antarctic Bay) had not been surveyed in the 2005-2006 surveys.

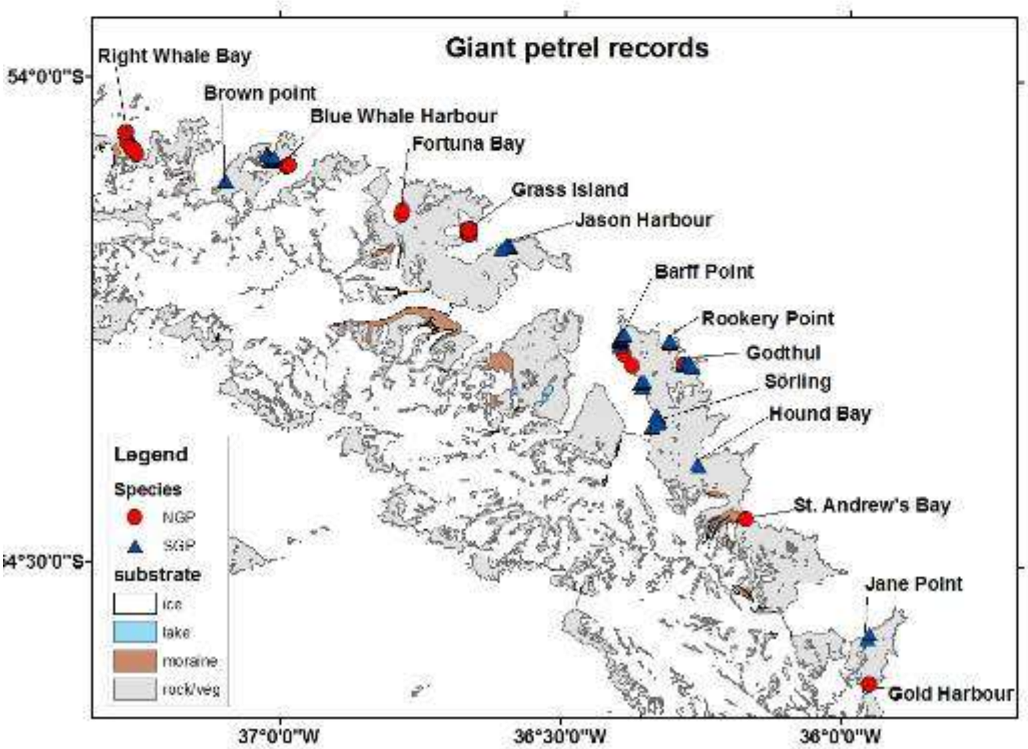

Figure 13. Sites where giant petrel surveys were conducted

Table 8. Northern giant petrel (NGP) and southern giant petrel (SGP) counts at each site. Counts were not corrected for the effect of survey date.

Date	Site	NGP	SGP
17-25/01/2012	Antarctic Bay	29	0
20/11/2011	Barff Point	1	21
16-24/01/2012	Blue Whale Harbour	0	21
21/01/2012	Brown Point, Possession Bay	0	3
10/12/2011	Fortuna Bay	2	0
16/11/2011	Godthul	2	11
04/12/2011	Gold Harbour	3	0
28/11/2011	Grass Island	30	4
21/11/2011	Hound Bay	0	27
05/12/2012	Jane Point, Royal Bay	0	5
28/12/2012	Jason Harbour	0	10
08-09/12/2011	Rookery Point	0	5
18/11/2011	Sandebugten	1	28
05-10/01/2012	Sea Leopard Fjord	11	4
14-24/11/2011	Sörling Valley	0	46
20/11/2011	St. Andrew's Bay	1	0
	Total	**80**	**186**

Ideally, counts should have been made as close to the end of laying as possible, around mid October for northern and the end of November for southern giant petrels (*c.f.* Poncet *et al.* in prep). Fieldwork was conducted from 14 November until 25 January. The raw uncorrected count data is presented here (Table 8); correction factors would help to account for any failed breeding attempts. Once corrected, these data will help improve the island-wide distribution map for southern and northern giant petrels.

4.6 Snowy sheathbill survey

Snowy sheathbill nest sites were rarely encountered. Figure 14 shows the locations of the sheathbill nests encountered during our fieldwork, the areas surveyed are shown on the maps in Appendix VI. Most nest sites were near large colonies of king penguins or fur seal aggregations, both of which provide a reliable and plentiful source of food. A relatively high number of sheathbill nests were found on Grass Island (five confirmed nests). Although Grass Island was one of the few rat free areas surveyed, high numbers of sheathbills were also recorded prior to the eradication of rats from the island in 2000.

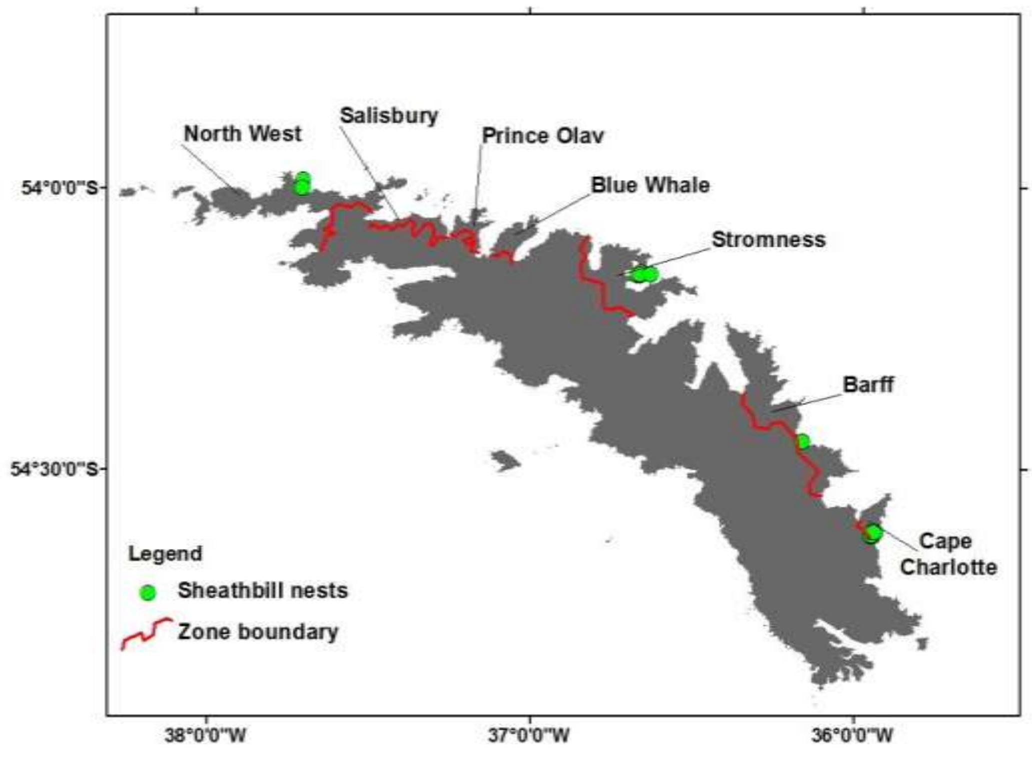

Figure 14. Location of sheathbill nests recorded during OTEP fieldwork

4.7 Kelp gull survey

Due to time constraints, little effort was directed at recording kelp gull breeding or roost sites.

4.8 Burrowing petrel distribution

The distribution of the small burrowing petrel colonies encountered are shown in Figure 15, the areas surveyed are shown on the maps in Appendix VI. Note that burrows of the larger white-chinned petrel are not included as they are able to breed in the presence of rats (Martin *et al.* 2009) and can be found in low numbers at most of the sites visited.

The distribution of burrowing petrels in the Stromness and Barff Zones is shown in more detail in Figures 16 and 17, respectively. The species recorded include; Antarctic prion *Pachytila desolata* (AP), South Georgia diving-petrel *Pelecanoides georgicus* (GDP) and diving-petrel species *Pelecanoides spp.* (DP). Reasonable-sized colonies of Antarctic prion and diving-petrels can still be found in the Sörling and Olsen Valleys, Jason Harbour and the hills behind Corral Bay. Small burrowing petrels were more numerous in these areas, which support reindeer and rats (Barff and Stromness), than those that were infested by rats alone (Figure 14).

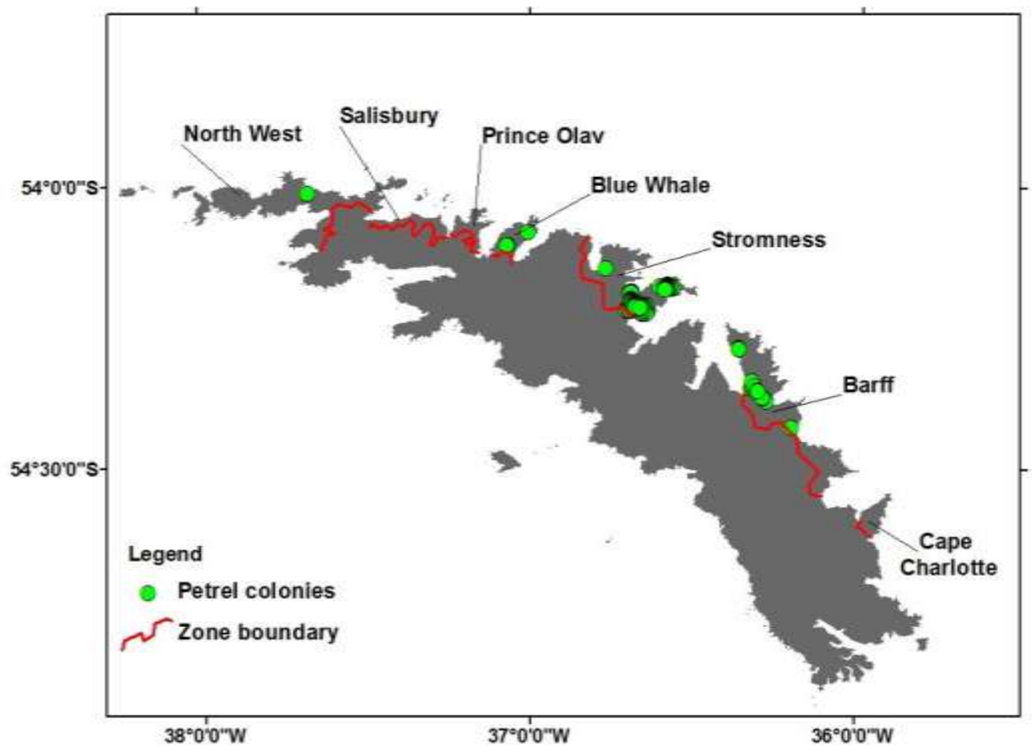

Figure 15. The locations of all small burrowing petrel records, yellow dots.

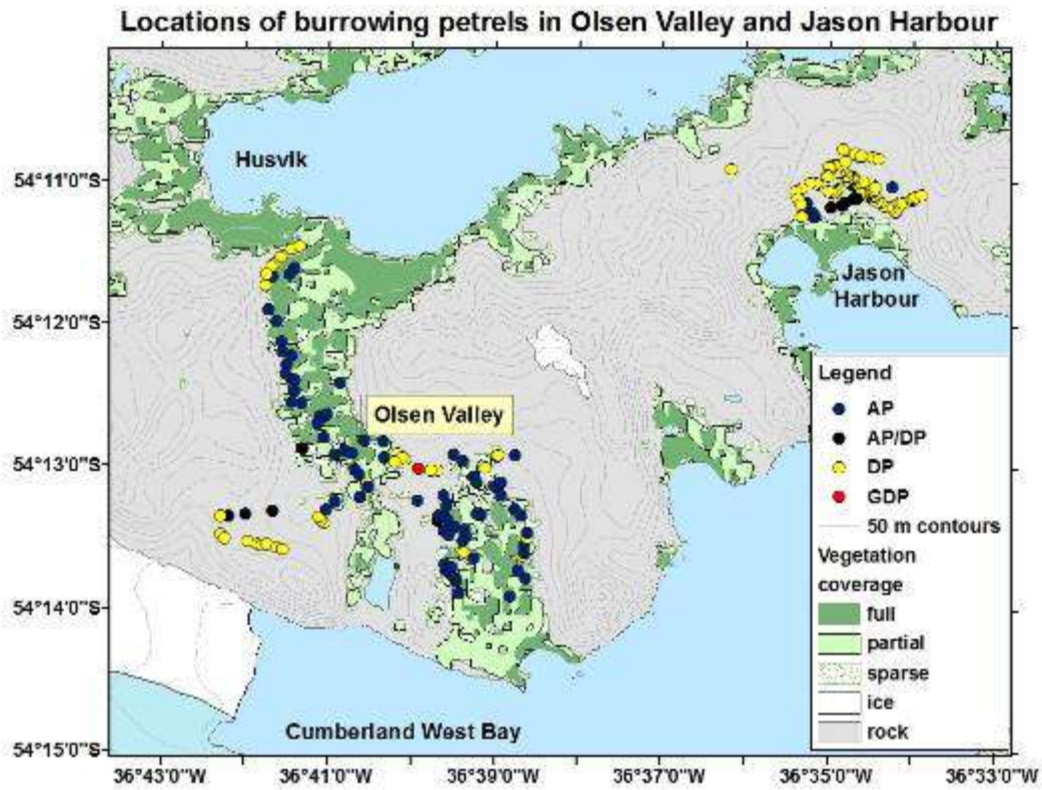

Figure 16. The locations of small burrowing petrels in Olsen Valley and Jason Harbour, Stromness Zone

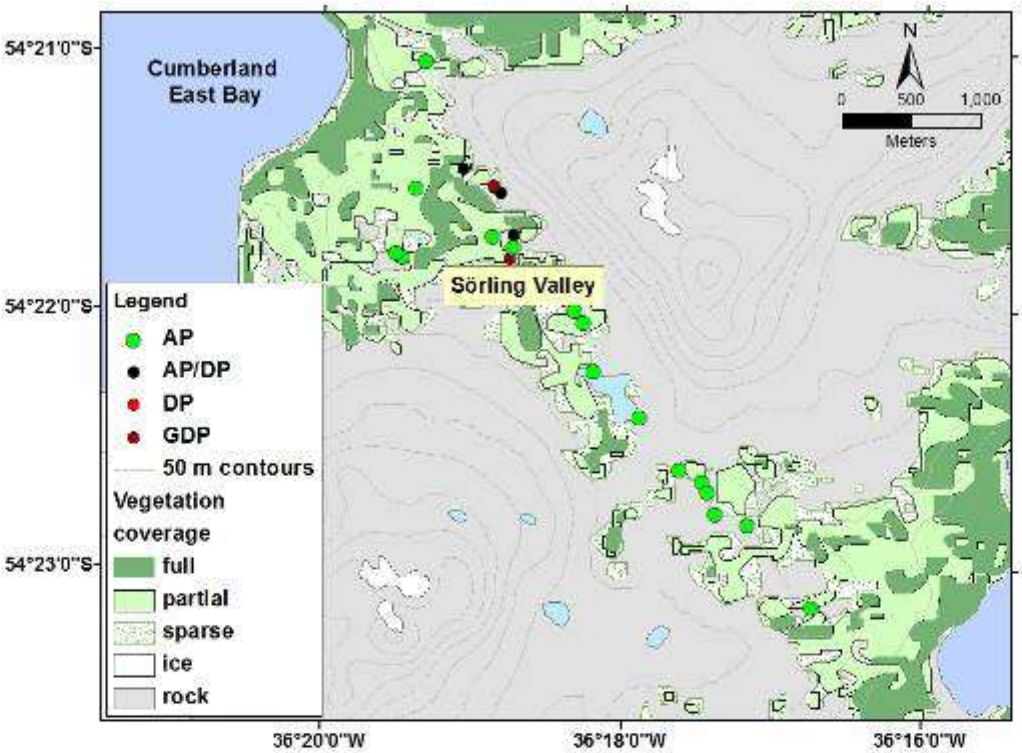

Figure 17. The location of small burrowing petrels within Sörling Valley, Barff Zone

It is unusual to find these species breeding in areas where rats are abundant. We suggest that reindeer-associated rat suppression (Section 4.1.4.5) appears to have contributed to the survival of remnant populations of burrowing petrels.

Sites within the Sörling Valley and possibly the Olsen Valley will be selected to monitor the long-term recovery of burrowing petrels following the eradication of rats and reindeer from these areas. Similar sites will be established on the Thatcher Peninsula, which was cleared of rats in 2011, and Albatross Island, a rat free control site.

4.9 South Georgia pipit survey

South Georgia pipits were recorded on rat-free Grass Island (see Section 6.1 below) in the act of display flying, which is a good indication that these birds were breeding. Elsewhere, a single pipit was observed near the king penguin colony at Salisbury Plain. It was assumed that this was a young bird from one of the rat free islands in the Bay of Isles.

5. GENERAL DISCUSSION

5.1 Rodent ecology and distribution

Rat sign and trapping rates suggested that rat populations on South Georgia appear subject to high winter mortality. In addition, breeding appears to be seasonal, ceasing over winter. The first juvenile rat was caught on 4 December, suggesting that breeding commences in mid-October, although the first pregnant female was not caught until mid-November. In early summer, those rats that could be found were restricted to patches of coastal tussac. It is recommended that any further rat trapping is conducted from January onwards, to maximise trapping rates.

Even in late summer when rat abundance was highest, rat distribution was still patchy and catch rates were moderate. Areas where rat catch rates were high were often associated with dense tussac adjacent to king penguin colonies. Penguin colonies, and associated tussac potentially provide an important winter food resource (*c.f.* Pye and Bonner 1980). As the summer progressed rat sign was found further from the coast. Young rats, especially males, are likely to disperse from the natal territory as they reach maturity. By the end of the summer, rats were found in areas with very sparse vegetation, particularly where alternative food sources, such as burrowing petrels, occur. Patchy coastal distribution emphasises that double-baiting coastal areas during the eradication is critical, while baiting inland areas is clearly also important, particularly later in the summer.

Trap covers reduced the effectiveness of trapping, making trap placement in rat runs more difficult and potentially introducing neophobic effects. Having trialled the use of uncovered traps, we suggest that the risk to non-target species is minimal and that trap covers are not necessary on South Georgia for short-term use. Our observations suggest that the use of boxed traps to monitor rat incursions is of limited value, which has been confirmed following trials with DOC200 traps (A. Black pers. obs.). An alternative to conventional traps should be considered for long-term incursion monitoring. Chew tags can reliably indicate whether rats are present or not, assuming that enough tags are deployed. However, chew tags do not kill or capture rats. The benefit of retaining a carcass is that the animal's DNA would indicate whether the rat was a survivor of the eradication intervention or a subsequent incursion. Novel trapping methods are being developed in New Zealand (e.g. www.goodnature.co.nz) that could be applied to South Georgia. In particular, resetting traps should be considered for several reasons; the risk to non-target species is minimal and they are low maintenance. However, a means of retaining rats (or at least a tissue sample) would have to be incorporated into the design. Monitoring for incursions is not straight forward and will probably require a combination of measures (chew tags, traps, bait stations and possibly sniffer dogs) to be effective.

The ultimate results from this fieldwork will not become evident until the results of the genetic analysis become available. At the time of writing, preliminary results indicate that the Phase 2 Zones support demographically independent populations of rats. Further analysis is ongoing.

No sign to indicate the presence of mice in the areas visited was found. Subsequent fieldwork in areas of South Georgia that are known to contain mice (Cuthbert *et* al. 2012), indicates that where present mice are likely to exist in very low numbers and leave little physical sign of their presence. In conclusion, we would cautiously declare that mice are not likely to be present in the areas visited. Further work is required to determine whether mice are coexisting with rats on South Georgia, particularly around the abandoned whaling stations.

5.2 Non-target and beneficiary species

The presence of reindeer in rat-infested areas appears to limit rat populations, potentially by degrading habitat that is thought to be critical to rats' winter survival, primarily tussac vegetation, but also *Acaena*, which may provide an important food source for rats in the winter. Reindeer-associated rat suppression may have contributed to the survival of remnant populations of small burrowing petrel species in rat-infested areas (*c.f.* Leader-Williams 1989, corroborated by the results reported here). Small burrowing petrels are typically heavily impacted by rats and it is unusual to find colonies of these species in rat-infested areas of South Georgia. We suggest that reindeer eradication should be followed by rat eradication as soon as possible, to prevent increases in rat numbers from impacting on these remnant colonies of small burrowing petrels. The presence of these remnant burrowing petrel colonies will almost certainly facilitate a more rapid recovery of the burrowing petrel populations following the eradication of rats.

For the purposes of post-baiting monitoring, baseline data have been gathered on the distribution of South Georgia pintail, brown skua, giant petrels and sheathbill. All are present throughout the baiting Zones, but the distribution is patchy and in some cases birds are only found in a few discrete locations. Where practicable, post-eradication monitoring should revisit these known locations.

5.3 Proposed fieldwork in Year 2 of the project

Several sites to monitor the long-term recovery of habitats and indigenous species are planned following the removal of rats and reindeer from South Georgia. These will be situated on the Thatcher (rats), Barff (rats and reindeer) and Albatross Island (control). Fieldwork conducted during the first season of the OTEP project will inform the location of study plots. A plan for the exact nature of the monitoring is in preparation.

Samples of rats from untrapped Zones will be obtained during the second field season. Key Zones will be at the extremes of the known distribution of brown rats at Pegotty Bluff (King Haakon Zone) and Drygalski Fjord (Cooper Zone) in the south of the island.

Appendix II contains notes regarding recommended field kit and methodology for the second season of the project.

6. ADDITIONAL WORK

6.1 Grass Island survey

On 28th November, all six of the OTEP team visited Grass Island in Stromness Bay. Grass Island was cleared of rats in 2000, and was declared free of rats in 2002 (Poncet *et al*. 2002). The purpose of this visit was to confirm that the island remains rat free, as it lies only 375 m from the rat infested Tønsberg Peninsula on the mainland. The work also aimed to determine the number of pipit pairs breeding (first recorded in 2005) and to census the giant petrel and skua populations.

Once ashore, the team split up into three groups to systematically search the island for sign of rats. None was found. Observations of several (at least four) displaying South Georgia pipits indicate that these birds are breeding on the island. On the day of the visit the weather was cold and damp, which would make it harder to detect pipits, as they are less active in these conditions.

6.2 Prion Island wandering albatross survey

On 03 January, all six of the OTEP team landed on Prion Island to conduct a census of the wandering albatross (*Diomedea exulans*), giant petrel and skua populations breeding on the island. These counts are conducted every January and form part of a long-term monitoring project on Albatross and Prion Islands.

Prion Island is a rat free island situated within the Bay of Isles, South Georgia (Figure 18). This is the only wandering albatross colony that receives regular visits from cruise ship passengers. In order to facilitate passenger access, prevent damage and disturbance to nesting birds and protect delicate plant communities, a boardwalk was installed in 2007.

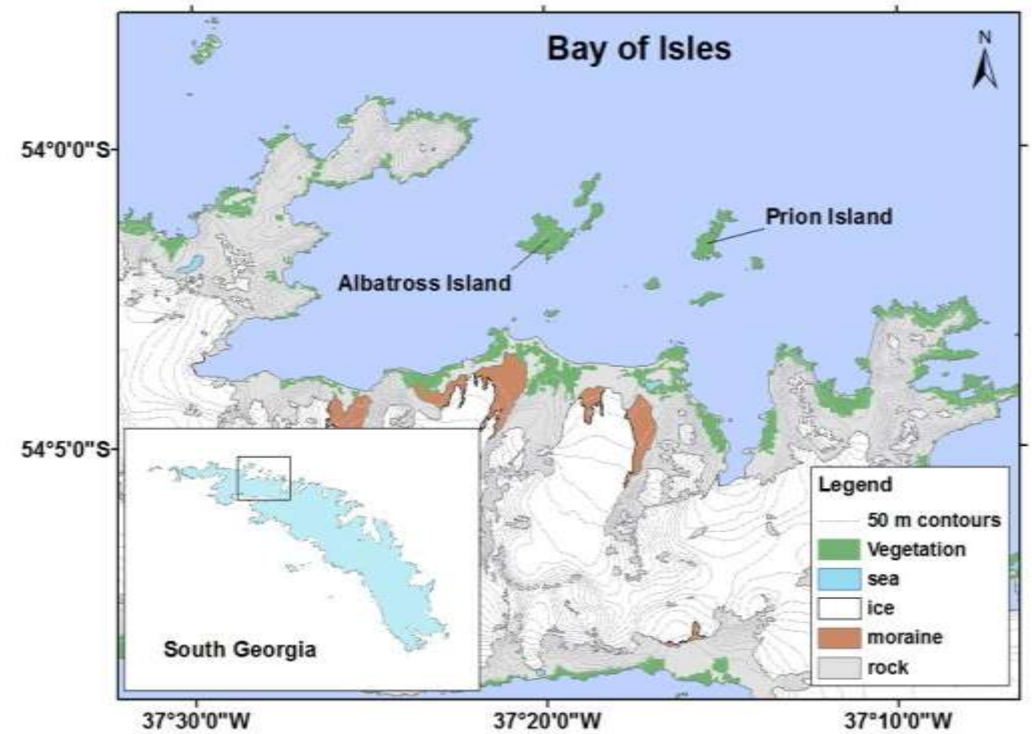

Figure 18. Prion Island, situated in the Bay of Isles off the north coast of South Georgia

The wandering albatross monitoring programme on Prion and Albatross Islands (Section 6.3 below) is managed by South Georgia Surveys (SGS) in collaboration with the GSGSSI. Annual counts of the breeding populations on these islands have been made since 1999 (Poncet 2012). Counts are made in January, March/April and October/November to determine the number of breeding pairs, hatching rate and breeding success respectively.

Methodology

A complete census of the breeding wandering albatross population was conducted during this visit. Nests were marked with numbered plastic canes and recorded on a handheld GPS (Figure 19). For each nest, the vegetation type, tussock quality, the numbers of fur seals present and the impact on vegetation caused by fur seals was recorded. If nests were within 20 m of the boardwalk, the distance to the boardwalk was measured.

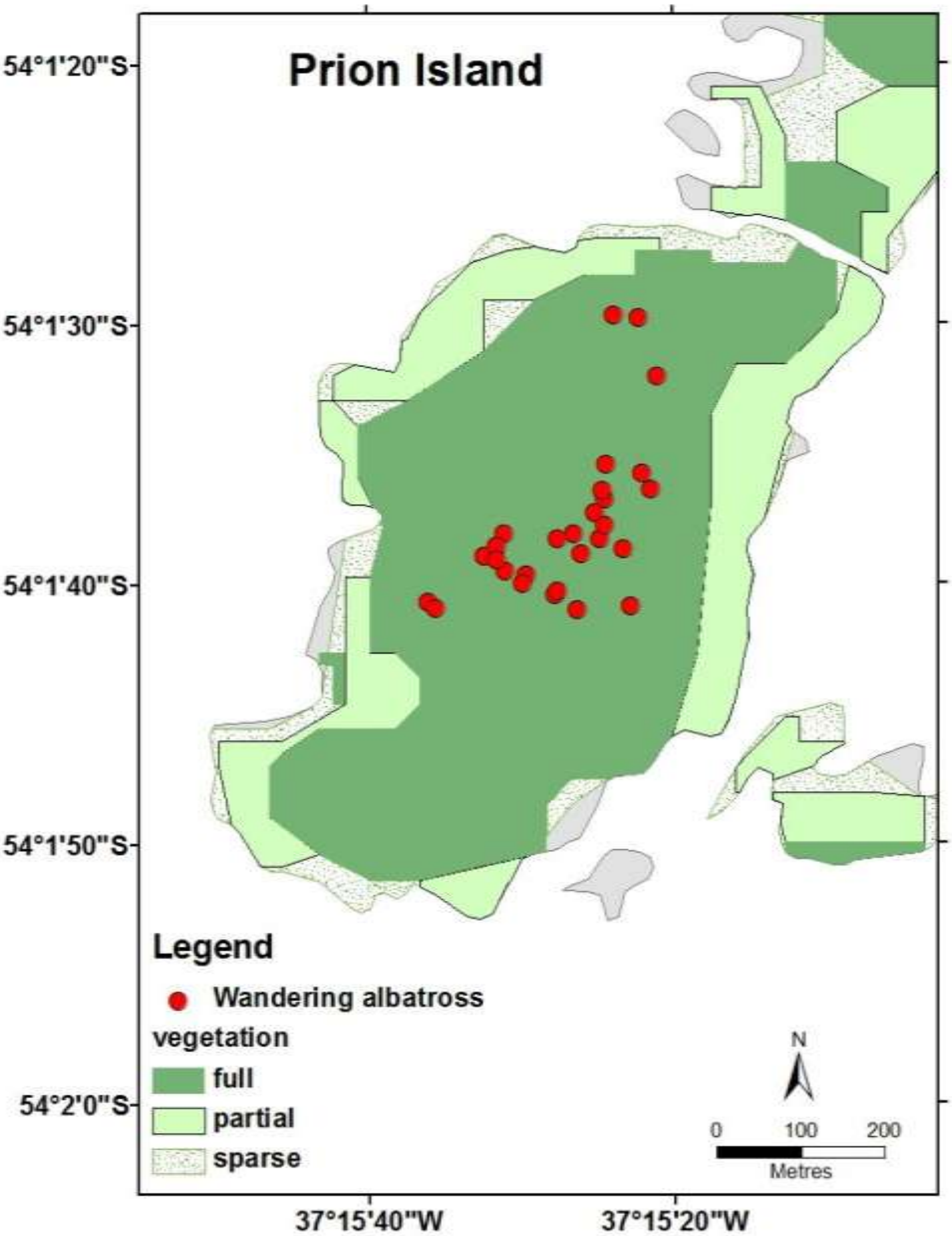

Figure 19. The location of active wandering albatross nests on Prion Island (03 January 2012).

Results

In total, 28 wandering albatross nests were recorded during this visit in January 2012.

Since surveys began in 1999, the number of breeding pairs on Prion Island has declined from 40 in 1999 and 2000 (Poncet 2012) to the 28 recorded during this survey. See Poncet (2012) for more detail and maps showing the distribution of giant petrels and skuas.

6.3 Albatross Island

While Teams 2 and 3 were deployed to catch rats on the South Georgia mainland, Team 1 was deployed on Albatross Island during January 2012 to conduct the annual wandering albatross and giant petrel census. The results of the work conducted on Albatross Island are reported in Poncet (2012).

6.4 Greene Peninsula rat checks

Following the OTEP fieldwork, Team 3 took the opportunity to visit the Greene Peninsula between 20 and 23 February 2012 to deploy wax tags. The Greene Peninsula was baited during March 2011 as part of SGHT's Phase 1 of the rat eradication. Wax tags are a monitoring tool used to remotely check for signs of rats. Any rats present will leave tooth marks in the peanut infused wax. A copy of the Greene report is reproduced in Appendix VII.

6.5 Penguin genetic samples

Samples of DNA can be extracted from shed penguin feathers and the membranes from the inside of egg shells can be used for genetic and stable isotope analysis.

Penguin feather (n=50), egg shell (n=20) and blood samples (n=50) were collected from a number of sites for further analysis by Tom Hart (Table 9). Feathers were taken from a wide area to increase the likelihood of collecting feathers from as many individuals as possible. All feathers collected at a single colony can be stored in a single zip-lock bag. Egg shells were collected from several gentoo penguin colonies. When collected, each egg shell was placed in a separate bag. Blood samples were taken from the king penguin colony at Fortuna Bay.

The material collected will contribute to on-going work to determine the genetic make-up of the gentoo populations in the Scotia Sea. The egg shells will also be used for stable isotope analysis and king penguin blood samples will be used in genomic studies looking to sequence the king penguin genome and estimate migration between the Falklands, South Georgia and Crozet.

Table 9. Penguin feather, egg shell and blood samples collected

Site	Samples
Godthul	Gentoo feathers
Cave Point	Gentoo feathers
Rudolph Bay	Gentoo egg shells
Stromness	Gentoo feathers/egg shells
Fortuna Bay	King blood samples

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8. APPENDICES

Appendix I. LANDINGS AND CAMPSITE RECOMMENDATIONS

- **Corral Bay, Sörling Valley (Barff Zone) and Carlita Bay (Stromness Zone) huts**

At all these sites, field teams utilised the GSGSSI field huts. Although in varying states of repair, these all provided luxurious accommodation with cold potable running water near-by.

- **Fortuna Bay, Stromness Zone**

Landing was made in the south east corner of the bay close to a freshwater stream. The beach and flat *Poa annua* grassland behind the beach is occupied by many fur and elephant seals. In order to avoid interactions with these animals, a campsite was selected someway behind the beach in the shelter of a spur (see Table AI.1 for positions of all campsites). Fortuna Bay is regularly subjected to strong wind blowing down the König Glacier the selected campsite afforded shelter from the worst of these winds. A small freshwater stream behind the campsite provided a source of clean freshwater.

A large stream, fed by melt-water from the König Glacier, bisects the beach at the head of Fortuna Bay. After some searching, a point was found where it was possible to wade across barefoot (at 54.157S 36.804W), which was very refreshing. Throughout the time spent camping at Fortuna Bay, the level of the stream rose steadily. It is likely that the stream becomes impassable later in the summer.

- **Gold Harbour, Cape Charlotte Zone**

The campsite at Gold Harbour was located at the back of the tussac dominated coastal plain, at the foot of the ridge which forms the western part of the 'amphitheatre'. The site is sufficiently far from the shore to avoid interactions with elephant seals. The campsite was located in a flat area of stunted (lawn-like) vegetation. The surrounding ridges afford good shelter from a number of wind directions. Although there were no gentoo penguins breeding in the immediate vicinity of the campsite, it has certainly been used by penguins in the past and may be used by again in the future. There are a number of drainage lines (with a reliable supply of fresh water) that descend from the ridges surrounding the coastal plain. These provide relatively easy access to fresh water, although it is necessary to walk a short distance to get to a point above where the gentoos have frequented.

The landing site used by cruise ships, at the northern end of the beach (between two prominent offshore rocks), is the easiest and safest place to land passengers and gear. Although not necessarily the most direct route, the easiest route from the landing beach to the campsite, or other potential campsites at the back of the coastal plain, is to follow one of the drainage lines. There are very few fur seals at Gold Harbour. Gentoo and king penguins use the drainage lines to access colonies and sites inland, so one is required to walk carefully to minimise disturbance.

- **Bjornstadt Bay, Cape Charlotte Zone**

The larger and more northerly of the two bays in Bjornstadt Bay was selected for a landing as it appeared to be better protected from swell; also its tussac slopes above the beach are comparatively less steep and access to the interior is easier. Swell along this coastline between Cape Charlotte and Gold Harbour makes landings difficult at times, and the rocky approaches to the inner parts of Bjornstadt Bay add a further complication.
A landing was made at the east end of the main beach in Bjornstadt Bay avoiding (just) the numerous reefs and submerged rocks that dot the approach; the gear was unloaded onto a semi-submerged slippery rock platform surrounded by densely packed fur seal harems which also hindered access to the back of the beach. Once safely through the seals, the gear was hauled to the closest level fur seal-free (bar one or two occasional visitors) site at the top of the steep coastal tussac slope at about 50 m elevation. Camp (for two people) was made on level ground at the foot of a near vertical 100 m high cliff that appeared to deflect wind and provided effective protection from most quarters. Winds appeared to be channelled down the large valley at the head of the bay and out into the bay, leaving the campsite untouched apart from the occasional buffet as gusts hit the rock face above. Tents were pitched on Poa annua between sparsely scattered tussac bogs, and using dips in the terrain to further minimise the risk of wind damage. A large rock overhang provided a dry sheltered cooking and eating area with abundant clean freshwater flowing from an underground stream at the foot of the cliff, just a few metres from the campsite.

A better site for a dinghy landing was found at the west end of the beach, where the dinghy was able to come along side a large boulder in deep water. Weather conditions were favourable during our eight days there, but it is likely that even in bad weather and heavy rain, this campsite remains well protected.

Access to the interior from the site is easy, with Gold Harbour 4 km to the south and the southern shore of Royal Bay (at the Jane Point area) 3km to the northwest, over easy terrain. The un-named bay lying 1.5 km north of Bjornstadt Bay is also easily accessible from the camp site. Cape Charlotte however, is likely to be inaccessible via this route due to a section of steep probably impassable cliffs to the north of the un-named bay. Easier access would be via the Jane Point route, then keeping to the higher slopes along the south shore of Royal Bay. Access to Brisbane Bay via the Jane Point coastal route may be limited by cliff sections; it was not investigated.

In hindsight, it would have been better to have landed two teams at Gold Harbour with one of the teams accessing Bjornstadt Bay on foot for trapping as it is less than a two hour walk away. However, leaving aside the tricky landings, dense fur seals and steep hike up from the beach, this was a 5 star campsite with stunning sea views and lovely walks.

- **Sea Leopard Fjord, Salisbury Zone**

Sea Leopard Fjord was chosen as a campsite over Salisbury Plain because of its more sheltered location. Although a reasonable campsite was found near to the landing beach, on a patch of flat consolidated gravel amongst the tussac, the choice of good sites was limited. The site also had to be shared with fur seals, which could be an issue earlier in the season (pre-January). A source of clean freshwater was found close by but fresh water could be a limiting factor at this site as the waterfall periodically ran at very low levels.

- **Prince Olav Harbour, Prince Olav Zone**

Prince Olav was previously considered to be separate from the Salisbury Zone, however, the retreat of the Morris Glacier has left no effective barrier between these areas.

Our campsite was located above the old reservoir on the northern side of the North Bay. Given the 200m restriction around the whaling station, this is likely the best location in the area for a campsite. The site was flat, comprised short vegetation, and was reasonably well sheltered. A number of ephemeral drainage lines cut through the area. These may not be obvious if it has not been raining, so it's good to investigate the site topography properly in order to position tents outside of these drainage lines. During and after a decent amount of precipitation, one can obtain freshwater very close to the campsite, otherwise there are permanent ponds of freshwater within 500m of the campsite (above and to the east of the reservoir) and running water can be obtained from a stream west of the whaling station.

There were a large number of fur seals along the shore of the landing beach, en route to the campsite, and in reduced numbers around the campsite itself, so one needs to be careful when walking and working in the broader area. Fur seals are ubiquitous. Landing at the beginning of the fur seal breeding season (when males are aggressively defending territories), would be more challenging than what we experienced in January. Given the dense nature of the inshore kelp, the best place to land was adjacent to the stone shelter building just below the reservoir. In order to ensure a safe landing, it may be necessary to land just within the 200m exclusion Zone (adjacent to the stone shelter). From here, the best route to the campsite is up along the 'track' that follows the pipeline, up to the dam wall, over the dam wall, and then around the eastern side of the reservoir. It is also possible to walk along the western side of the reservoir to the campsite (and this may avoid the awkward climb up the cliff by the pipeline); if this route is taken, a landing even further into the 200m Zone would be best. The campsite affords easy access to Abrahamsen Point. With the 200m restricted Zone around the whaling station, access to sites further south (such as Elephant Lagoon) and west (such as Beckmann Fjord) requires a relatively steep scree slope climb behind the whaling station.

For any future field work of an official nature, it is recommended that GSGSSI consider allowing access into the restricted area behind the whaling station (not IN the whaling station), which would allow use of a much easier track up the ridge behind the whaling station.

- **Right Whale Bay, North West Zone**

Cairn Beach, on the north side of Binder Beach provided a sheltered landing. An excellent sheltered campsite with running water was found in the bowl above the waterfall between Cairn and Binder Beaches. The campsite was accessible from Cairn Beach up a steep fur seal eroded slope or from a gently sloping ramp from the Binder Beach side. Binder Beach was frequently subjected to very strong winds blowing down Ernesto Pass and would not be a great place to camp.

- **Antarctic Bay, Blue Whale Zone**

Antarctic Bay was used as a campsite for 4 people from which to work at both Antarctic Bay and Blue Whale Harbour, and given the easy walk over to Blue Whale Harbour, was convenient in this respect. Landing at Antarctic Bay was on a gently sloping shingle and sand beach about 750 m south of the Antarctic Bay king penguin colony. Conditions were calm, so the landing was safe and without challenges. Although the direct distance from the shore to the campsite was not great, we had to meander around a number of standing water bodies. We chose a site on level ground covered in Poa annua at the base of a small tussac slope to afford protection from winds coming off the Crean Glacier at the head of the bay. Although it provided some shelter, the site was very exposed and we were regularly buffeted by strong winds, both from the glacier and from the valley leading over to Blue Whale Harbour. There was a lot of standing water around the campsite, most of it affected by the many fur seals, loafing and moulting king penguins and elephant seals that inhabit the area. Use of the area earlier in the fur seal breeding season would (as at most places on the north coast) be much more challenging. We were landed with more than two weeks worth of fresh water, and so didn’t need to re-supply. Blue Whale Harbour where trapping was also carried out was less than 2 km from our camp site through gentle valley and over a low col. The shoreline of Antarctic Bay between the campsite and a large valley near head of the bay is also easy walking. This valley provides access across to the Brown Point area in Possession Bay.

A second location was found that would have made for a better campsite, both in terms of providing greater shelter from most wind directions, and access to usable fresh water. The site was at the back of a small beach immediately north of the Antarctic Bay king penguin colony and near a large cave. Potential downsides of this site are the greater density of fur seals, which may be a problem if one were camping here in the early part of the breeding season, a longer commute to Blue Whale Harbour and other parts of Antarctic Bay and a very sandy substrate which might not provide good holding for tent pegs. While the landing beach on this part of the Antarctic Bay shoreline is not subject to swell, the very strong winds which often blow out of the bay from the Crean Glacier, may limit ship and landing operations on some days.

Table AI.1. Positions of campsites.

Campsite	Latitude	Longitude
Fortuna Bay	54.154 S	36.788 W
Gold Harbour	54.618 S	35.945 W
Bjornstadt Bay	54.586 S	35.923 W
Prince Olav Harbour	54.057 S	37.151 W
Sea Leopard Fjord	54.075 S	37.258 W
Antarctic Bay	54.093 S	36.994 W
Right Whale Bay	54.004 S	37.690 W

Appendix II. EQUIPMENT AND METHODOLOGY: RECOMMENDATIONS FOR THE SECOND FIELD SEASON

Field kit

While camping for extended periods on South Georgia, fieldworkers will inevitably experience high winds, sub-zero temperatures and substantial precipitation as both rain and snow. Given the remoteness of many of the field camps and the difficulty and expense of implementing Search and Rescue, camping equipment should be of the highest quality, designed for 4-season mountain use. Experience gained over the 2011/2012 field season suggests the following field kit is essential for work based from field camps on South Georgia:

- **Tents.** The Terra Nova Hyperspace tents provided were adequate but required adaptation for extended use on South Georgia. Tents should be double-poled to help prevent poles snapping in strong winds, and pegged out with reinforced pegs (at least 30cm long angle-aluminium/steel rebar or purpose made reinforced pegs). Each team should be provided with a comprehensive tent repair kit (with spare pole sections) and a backup tent (in the event that the primary tent is irreparably damaged). Additional groundsheet/footprints would help to protect from rocks and prolong tent-life.

- **Sleeping bags and mats.** Sleeping bags should be designed for 4-season use. Synthetic bags are more bulky than down-filled but still function when damp. However, down bags have been used effectively on South Georgia and because they do not degrade/compress, as synthetic bags do over time, may ultimately offer better value for money. For additional warmth and improved hygiene/cleanliness sleeping bags should be used with silk or fleece 'mummy' style liners.

  A solid ridge-rest type sleeping mat would be preferable over an inflatable mat, which are prone to punctures. Most of the mats supplied for the first field season (Karrimor X-lite) developed leaks long before the end of the field season and in their deflated state did not provide sufficient insulation from the ground. Experience with other brands of inflatable mat (notably Therm-a-rest) has shown them to be more robust. If inflatable mats are used again, a mat repair kit should be taken.

- **Clothing and footwear.** Essential pieces of safety equipment when working in the sub-Antarctic are; a good quality waterproof shell (jacket and trousers). Wet clothing rapidly conducts heat away from the body and when wet, even in relatively mild conditions, hypothermia is a serious risk. Likewise, a sturdy pair of waterproof boots is essential to avoid injury to feet and ankles and to prevent cold injury.

Clothing and footwear should either be provided for all field workers or a subsidy to cover wear and tear should be provided for workers who prefer to use their own equipment.

When conducting fieldwork each individual should carry a first aid kit, bivy bag, VHF radio, GPS, compass, laminated map, head-torch, spare warm clothing, snacks, water bottle/thermos and the appropriate spare batteries.

Methodology

- **Timing.** It was found that trapping is best conducted from January onwards. Most rat populations appear to be at very low density at the end of winter, so trapping is best left for later in the season, after the first litter has been weaned (the first young rats were trapped in the first week of December). Trapping should be conducted as late as logistically possible, up until April.

  Avoiding the peak of fur seal breeding is another good reason to trap late season: seal bites are the highest risk encountered in the field and keeping fieldworkers off the beaches during the peak of fur seal breeding (mid November to late December) is the obvious way to minimise this risk.

- **Standardised data.** Prior to commencing fieldwork, it would be useful to create a database to ensure that data is recorded consistently. Great care and thought is required before embarking on a project of this nature to ensure that the data collected answers the questions being asked and can be analysed in a statistically rigorous manner.

  To assist in the standardisation of data collection, a universal numbering system for traps should be established at the start of fieldwork. Rather than duplicating trap numbers between teams, for instance Team 1 could use traps numbered 1 to 100, Team 2 101 to 200 and Team 3 201 to 300. A location code should be used to identify each trap (for instance CA001 for trap 1 at Carlita). If traps are moved, the trap number remains the same but a suffix A, B, C etc is added.

- **Multiple samples.** Consideration should be given to taking two tissue samples from each rat. This would ensure that a back-up was available should the primary sample be lost in transit and would allow further analysis (such as stable isotope) of the samples,.

- **Breeding data.** More information and possibly samples could be recorded/collected from captured rats. Although not originally planned, all teams started to systematically open up mature females and record the number of identifiable foetuses. In the future, all females over 150g should be dissected to check for foetuses. It would also be worth checking for lactation and recording whether perforate/non-perforate to provide insight into breeding demographics.

- **Biosecurity.** Between site biosecurity is critical. Traps from the KEP and Grytviken area and Stromness Peninsula (particularly locations within Stromness Bay) should be thoroughly washed to prevent accidental spread of bittercress and *Sagina* seeds from the first area and of introduced beetle larvae from the latter.

Appendix III. NOTES TO OBSERVERS

In order to standardise methodology between field teams, guidelines were issued to each team leader. Key points are summarised below.

Handheld GPS units were used to record the positions of rat and mouse traps, nest sites and any other features of interest. The 'track' feature on the GPS helped to demarcate the boundaries of search areas. The accurate recording of notes associated with each waypoint is critical for later interpretation. In order to collect data on vegetation and rat distribution the following information was recorded with every waypoint (Fig. AIII.1): the feature marked, vegetation type, % tussac cover, rat sign and notes, as described below.

Figure AIII.1 Example waypoint data recording sheet.

Date *20/11/11*

Wpt	Feature	Status	Veg. type	% T	Rat	Notes
001	*Trap*		*T,R*	*90*	*Y*	*2 traps (#1&2) in same box*
002	*SK*	*NY*	*T,M,Fe*	*50*	*Y*	*2 chicks*
003	*PT*		*T,F*	*60*	*Y*	*12 pintail present*

Wpt. In most instances, it was easier to use the default waypoint number, generated automatically by the GPS, rather than attempting to keep track of the named waypoints.

Feature. A description of what is recorded. This is likely to be a species code but may also include geographic features (GEO). Table A3.1 lists the codes that were used during the first season's fieldwork.

Table AIII.1. Commonly used feature codes.

Code	Feature	Code	Feature
AP	Antarctic prion	**NGP**	Northern Giant Petrel
AP/DP	Prion or diving-petrel	**PIP**	South Georgia Pipit
AT	Antarctic Tern	**PT**	South Georgia Pintail
DP	Diving-petrel species	**RAT**	Rat
GDP	South Georgia diving-petrel	**SB**	Snowy Sheathbill
GEO	Geographic reference	**SGP**	Southern Giant Petrel
GP	Gentoo Penguin	**SGS**	South Georgia Shag
KG	Kelp Gull	**SK**	Brown Skua
KP	King Penguin	**TRAP**	Rat/mouse trap
LMSA	Light-mantled Sooty Albatross	**WCP**	White-chinned Petrel
MP	Macaroni Penguin		

Status. This indicates the breeding status of birds recorded or describes other aggregations of birds (for example skua clubs or moulting penguins). Table A3.2 lists the status codes used.

Veg. Type. For ease of recording, the vegetation types listed below were used (Table A3.3). Observers should assess which vegetation type(s) is dominant within a 5 m radius of the waypoint and record these in order of descending abundance (maximum of three).

Table AIII.2. Bird status codes.

Code	Status
ON	Bird on nest or in burrow, apparently incubating eggs and or chicks but nest contents not checked
NE	Bird on nest with one or more eggs
NY	Bird on nest with chicks
NB	Active nest bowl but no birds present
UN	Old nest site or burrow, apparently not occupied
DI	Bird displaying courtship behaviour
TE	Bird displaying territorial behaviour eg defending nest site,
LT	Likely territory
CO	Colony
CL	Skua Club
MI	Midden or lookout (skua)
LO	Loafing birds, resting, no indication of breeding
MO	Moulting birds, not necessarily a breeding site
FL	Fly past, for rare sightings such as pipits

Table AIII.3. Vegetation type codes

Code	Vegetation type
A	*Acaena* species
B	Bare ground
D	*Deschampsia antarctica*
E	Bog and mire
F	*Festuca contracta*
G	Shingle, beach sand
H	Hard moss
L	Fellfield
M	Soft moss
O	Other vegetation, type is given in the notes
P	*Poa annua*
R	Rock
S	Scree
T	Tussac grass
U	Mud
W	Freshwater (ponds or streams)

% tussac. Record the percentage cover of tussac within a 5m radius (approximate to the nearest 10%).

Rat. Record the presence (Y) or absence (N) of rat sign. If present note the type of sign (droppings, burrows, runs or gnawed tussac).

Notes. Notes should indicate any additional information. For instance, any samples taken, the number of breeding pairs/chicks, skua pellet contents.

Appendix IV. RAT TRAPPING LOCATIONS

The position of trapping sites within each baiting Zone is illustrated below (Figs AIV.1-AIV.6), with the limits of each baiting Zone demarcated by red lines. On each map, vegetated areas are marked in green (dark green indicates 100% vegetation cover, light green = partial vegetation cover, dappled green = sparse vegetation), glaciers are white and grey areas indicate bare rock and scree.

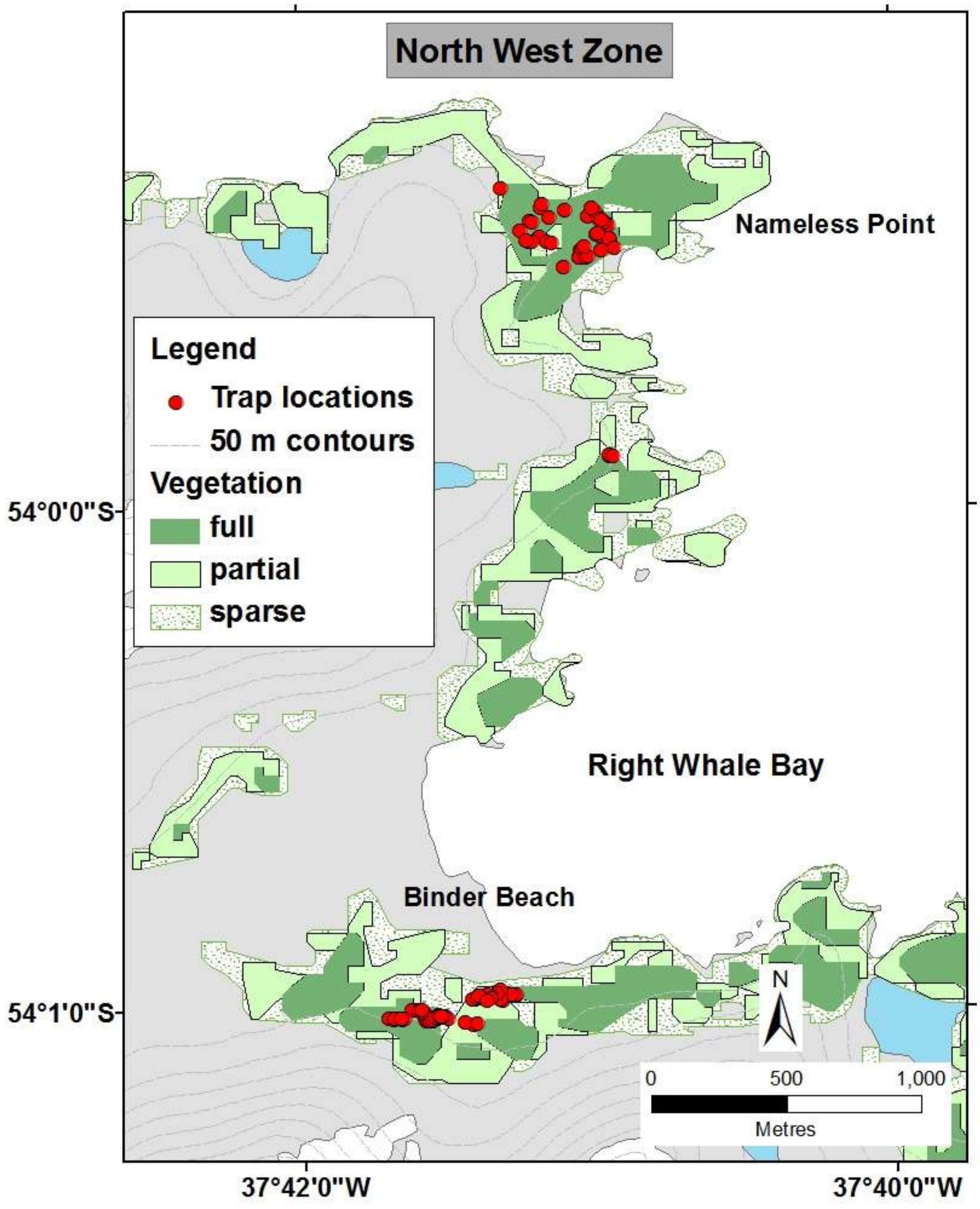

Figure AIV.1. Trapping sites within the North West Zone

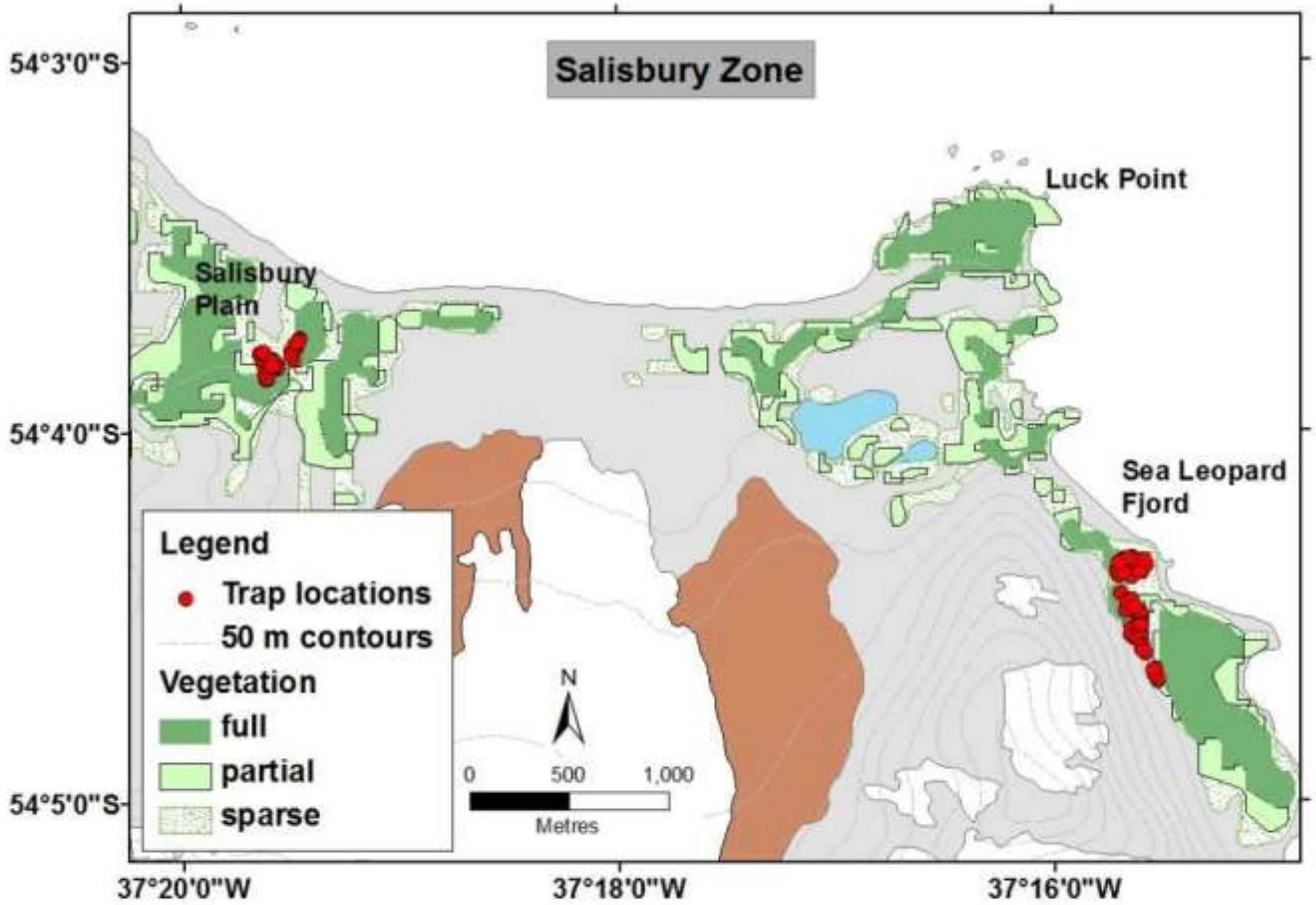

Figure AIV.2. Trapping sites within the Salisbury Zone

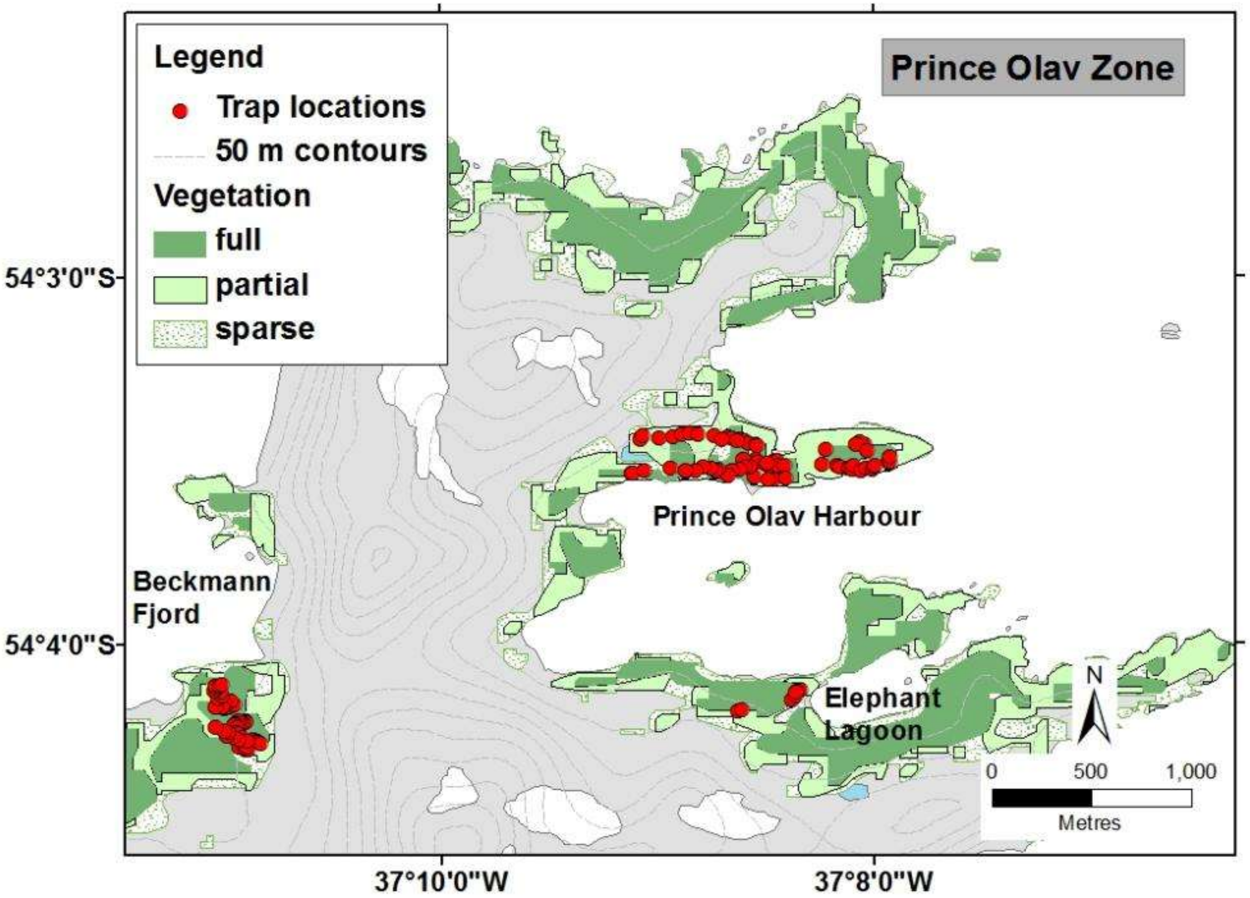

Figure AIV.3. Trapping sites within the Prince Olav Zone

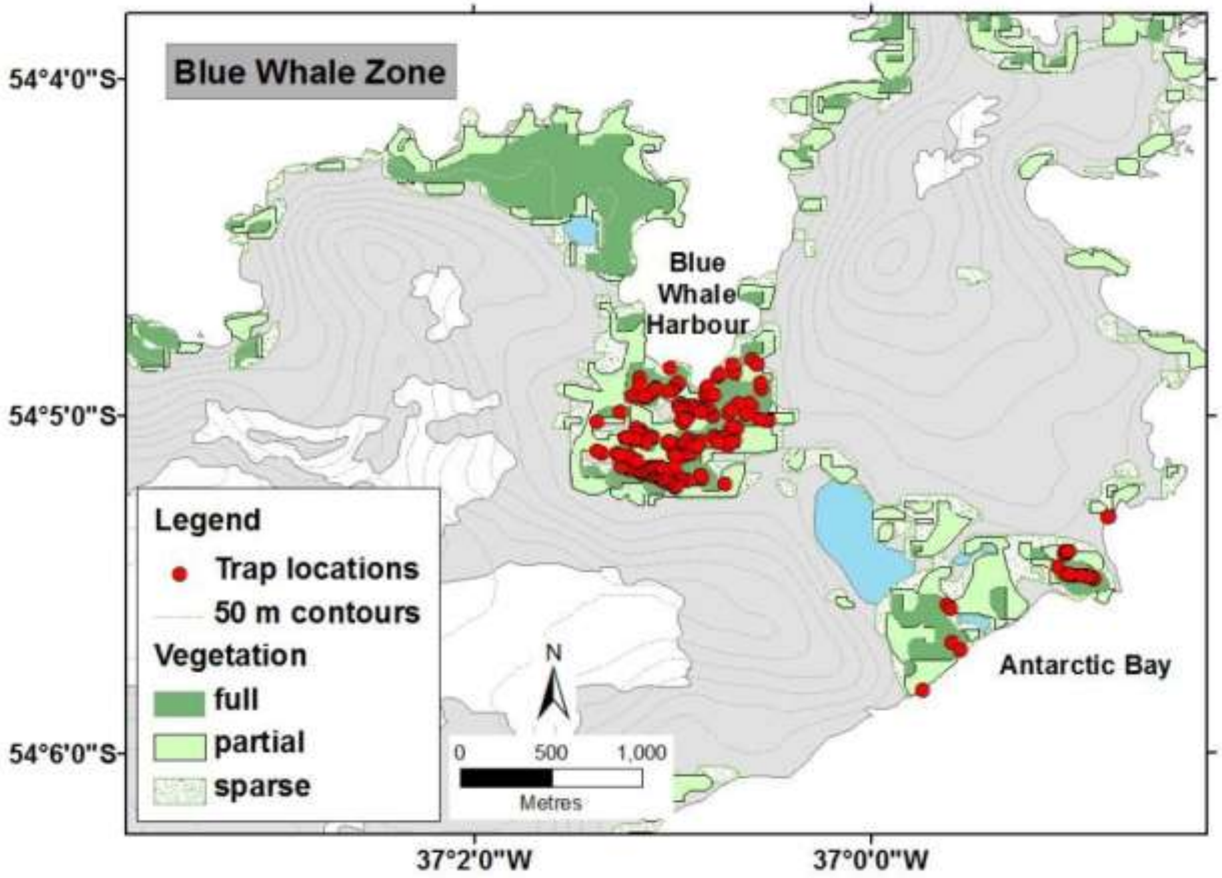

Figure AIV.4. Trapping sites within the Blue Whale Zone

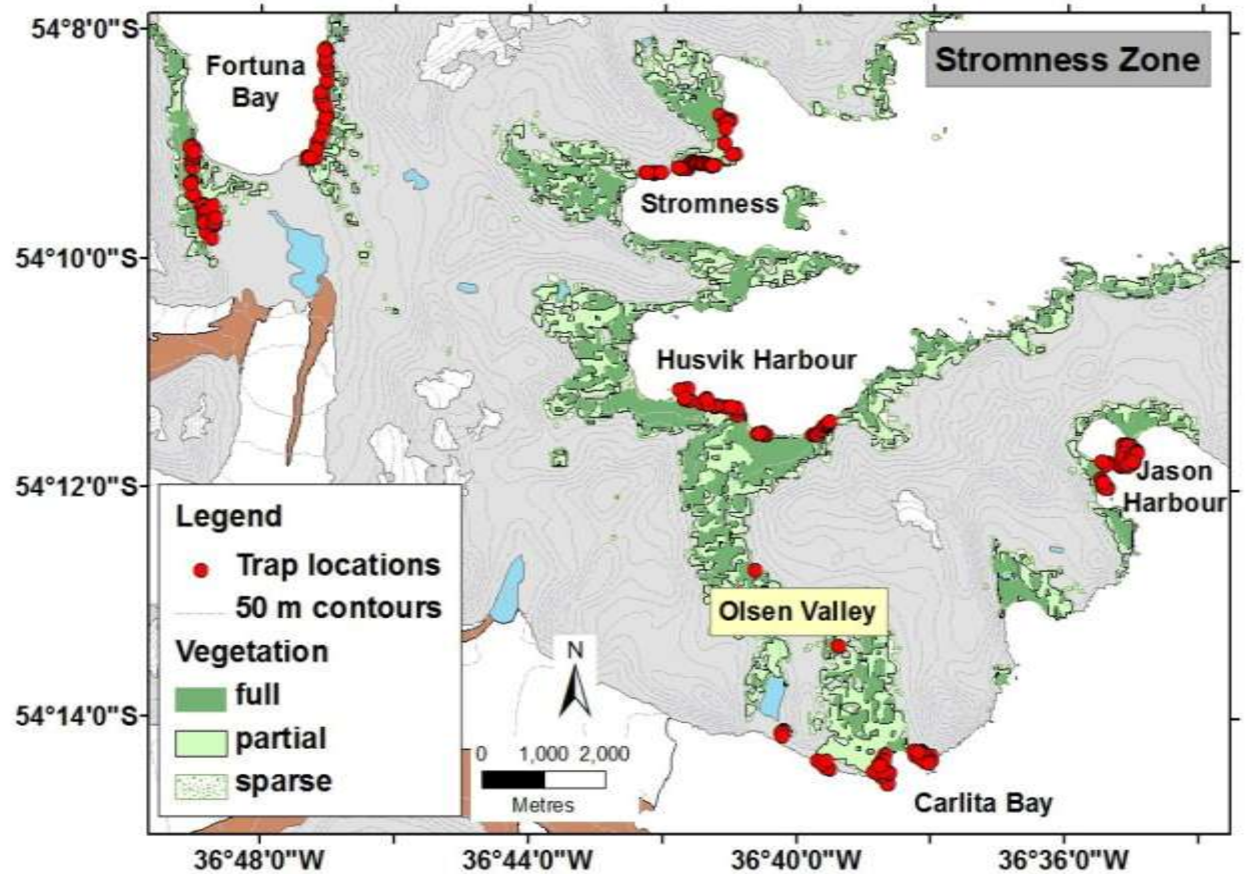

Figure AIV.5. Trapping sites within the Stromness Zone

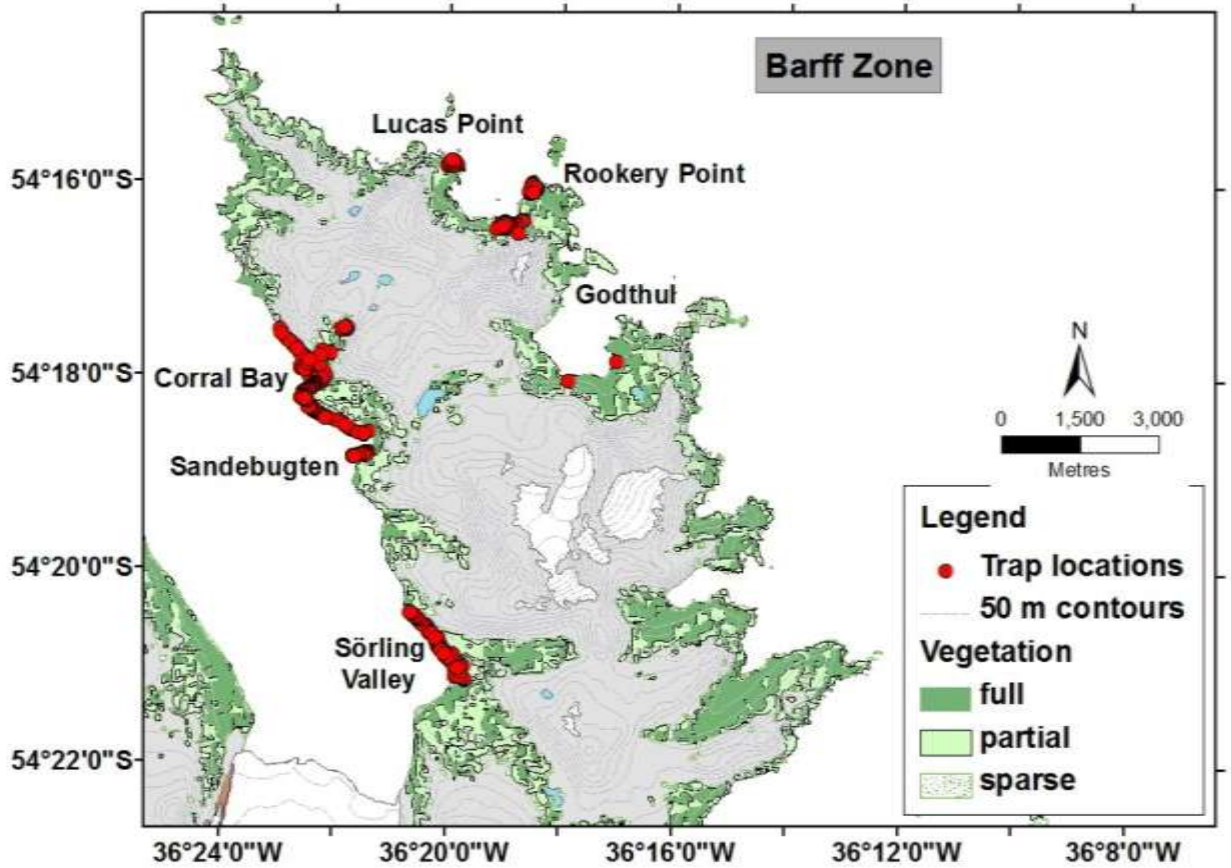

Figure AIV.6. Trapping sites within the Barff Zone

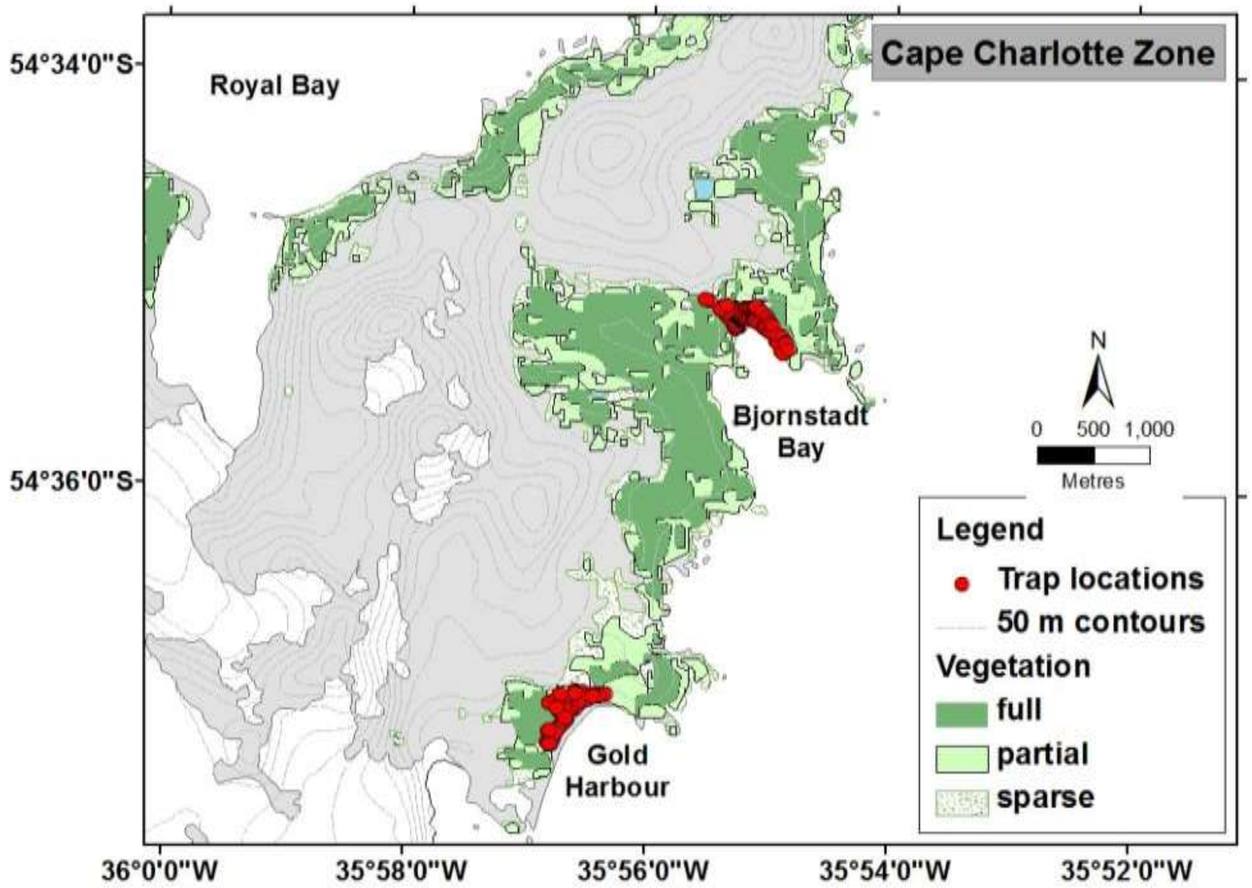

Figure AIV.7. Trapping sites within the Cape Charlotte Zone

Appendix V. RAT SAMPLE DATA

Table AV.1 Raw trapping data for rat samples South Georgia 2011-2012.

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
20/11/2011	Barff	BA01	Corral Bay 1	TR351	-54.301	-36.373	275	356	198	158	F
21/11/2011	Barff	BA02	Corral Bay 1	TR384	-54.301	-36.373	225	340	180	160	F
21/11/2011	Barff	BA03	Corral Bay 1	TR385	-54.302	-36.373	265	N/A	205	N/A	M
21/11/2011	Barff	BA04	Corral Bay 1	TR354	-54.302	-36.374	245	351	184	167	M
21/11/2011	Barff	BA05	Corral Bay 1	TR362	-54.306	-36.372	265	344	187	157	F
22/11/2011	Barff	BA06	Corral Bay 1	TR397	-54.302	-36.375	245	343	184	159	F
22/11/2011	Barff	BA07	Corral Bay 1	TR356	-54.303	-36.376	N/A	N/A	N/A	N/A	N/A
22/11/2011	Barff	BA08	Corral Bay 1	TR402	-54.304	-36.376	220	332	183	149	F
24/11/2011	Barff	BA09	Corral Bay 1	TR355	-54.303	-36.376	280	N/A	196	N/A	F
24/11/2011	Barff	BA10	Corral Bay 1	TR363	-54.306	-36.373	255	353	195	158	M
25/11/2011	Barff	BA11	Corral Bay 1	TR384	-54.301	-36.373	280	358	188	170	M
25/11/2011	Barff	BA12	Corral Bay 1	TR405			230	344	189	155	F
25/11/2011	Barff	BA13	Corral Bay 1	No. 02	-54.307	-36.370	305	382	205	177	M
25/11/2011	Barff	BA14	Corral Bay 1	No. 03	-54.307	-36.370	255	356	192	164	F
25/11/2011	Barff	BA15	Corral Bay 1	TR359	-54.304	-36.377	280	360	198	162	M
23/11/2011	Barff	BA16	Sörling Valley	SR7	-54.344	-36.339	190	345	185	160	F
25/11/2011	Barff	BA17	Sörling Valley	SR72	-54.347	-36.336	N/A	N/A	N/A	N/A	N/A
26/11/2011	Barff	BA18	Sörling Valley	SR105	-54.346	-36.336	210	342	175	167	F
09/12/2011	Barff	BA19	Rookery Point	RR71	-54.268	-36.308	395	381	195	186	M
09/12/2011	Barff	BA20	Rookery Point	RR60	-54.267	-36.308	315	344	186	158	F
09/12/2011	Barff	BA21	Rookery Point	RR34	-54.274	-36.318	195	322	167	155	F
10/12/2011	Barff	BA22	Rookery Point	RR114	-54.268	-36.308	325	367	201	166	M
10/12/2011	Barff	BA23	Rookery Point	RR112	-54.274	-36.316	350	388	212	176	M
10/12/2011	Barff	BA24	Rookery Point	RR32	-54.274	-36.319	315	409	216	193	M

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
10/12/2011	Barff	BA25	Rookery Point	RR38	-54.274	-36.319	220	373	198	175	F
10/12/2011	Barff	BA26	Rookery Point	RR83	-54.268	-36.309	335	387	211	176	F
10/12/2011	Barff	BA27	Rookery Point	RR109	-54.268	-36.310	320	364	197	167	F
10/12/2011	Barff	BA28	Rookery Point	RR26	-54.274	-36.318	260	346	190	156	F
10/12/2011	Barff	BA29	Rookery Point	RR24	-54.267	-36.309	295	378	202	176	F
10/12/2011	Barff	BA30	Rookery Point	RR30	-54.267	-36.309	270	381	196	185	M
11/12/2011	Barff	BA31	Rookery Point	RR131	-54.274	-36.318	235	352	191	161	M
11/12/2011	Barff	BA32	Rookery Point	RR11	-54.268	-36.309	255	361	195	166	F
12/12/2011	Barff	BA33	Rookery Point	RR112	-54.274	-36.316	230	364	189	175	F
12/12/2011	Barff	BA34	Rookery Point	RR34	-54.274	-36.318	230	350	191	159	M
12/12/2011	Barff	BA35	Rookery Point	RR88	-54.268	-36.310	225	350	194	156	F
12/12/2011	Barff	BA36	Rookery Point	RRGulley	-54.275	-36.313	280	374	205	169	M
12/12/2011	Barff	BA37	Rookery Point	RR175	-54.274	-36.316	280	367	196	171	M
11/12/2011	Barff	BA38	Corral Bay 2	CR233	-54.299	-36.376	340	383	209	174	F
11/12/2011	Barff	BA39	Corral Bay 2	CR201	-54.301	-36.373	255	388	205	183	F
27/12/2011	Barff	BA40	Sandebugten	SA232	-54.313	-36.358	265	353	185	168	F
27/12/2011	Barff	BA41	Sandebugten	SA109	-54.313	-36.358	310	368	200	168	M
28/12/2011	Barff	BA42	Corral Bay 3	CN29	-54.296	-36.378	270	365	200	165	F
28/12/2011	Barff	BA43	Sandebugten	SA32	-54.314	-36.361	240	367	195	172	M
28/12/2011	Barff	BA44	Sandebugten	SA65	-54.314	-36.361	250	361	199	162	F
28/12/2011	Barff	BA45	Sandebugten	SA109	-54.313	-36.358	265	347	189	158	M
28/12/2011	Barff	BA46	Sandebugten	SA222	-54.314	-36.359	350	377	199	178	M
29/12/2011	Barff	BA47	Corral Bay 3	CN18	-54.294	-36.380	295	362	197	165	M
29/12/2011	Barff	BA48	Sandebugten	SA32	-54.314	-36.361	280	332	178	154	F
29/12/2011	Barff	BA49	Sandebugten	SA204	-54.314	-36.359	340	376	195	181	M
28/12/2011	Barff	BA50	Lucas Point	RN247	-54.264	-36.334	260	372	198	174	F
28/12/2011	Barff	BA51	Lucas Point	RN08	-54.263	-36.333	295	369	200	169	F
28/12/2011	Barff	BA52	Lucas Point	RN58	-54.263	-36.332	N/A	N/A	N/A	N/A	N/A

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
28/12/2011	Barff	BA53	Lucas Point	(RN)272	-54.264	-36.334	60	219	107	112	M
19/11/2011	Stromness	BU01	Husvik Harbour	145	-54.187	-36.690	300	360	200	160	F
19/11/2011	Stromness	BU02	Husvik Harbour	156	-54.188	-36.689	240	356	196	160	F
19/11/2011	Stromness	BU03	Husvik Harbour	140	-54.188	-36.689	200	347	195	152	F
22/11/2011	Stromness	BU04	Husvik Harbour	166	-54.187	-36.694	310	335	210	125	M
22/11/2011	Stromness	BU05	Husvik Harbour	174	-54.192	-36.663	201	330	180	150	F
22/11/2011	Stromness	BU06	Husvik Harbour	178	-54.192	-36.662	290	360	205	155	F
23/11/2011	Stromness	BU07	Husvik Harbour	131	-54.192	-36.677	250	330	175	155	F
18/11/2011	Stromness	BU08	Husvik Harbour	146	-54.187	-36.689	N/A	N/A	N/A	N/A	N/A
20/11/2011	Stromness	BU09	Husvik Harbour	145	-54.187	-36.690	N/A	N/A	N/A	N/A	N/A
22/11/2011	Stromness	BU10	Husvik Harbour	165	-54.187	-36.694	N/A	N/A	N/A	N/A	N/A
24/11/2011	Stromness	BU11	Husvik Harbour	193	-54.191	-36.660	330	375	210	165	F
24/11/2011	Stromness	BU12	Husvik Harbour	199	-54.186	-36.696	250	323	175	148	F
25/11/2011	Stromness	BU13	Husvik Harbour	149	-54.187	-36.691	210	339	195	144	F
25/11/2011	Stromness	BU14	Husvik Harbour	165	-54.187	-36.694	250	366	210	156	F
25/11/2011	Stromness	BU15	Husvik Harbour	197	-54.190	-36.659	240	345	195	150	M
30/11/2011	Stromness	BU16	Stromness Bay	N/A			N/A	N/A	N/A	N/A	N/A
01/12/2011	Stromness	BU17	Fortuna Bay	TF18	-54.152	-36.788	305	388	205	183	F
02/12/2011	Stromness	BU18	Stromness Bay	N/A			245	381	202	179	M
02/12/2011	Stromness	BU19	Stromness Bay	TF63	-54.153	-36.696	235	351	180	171	F
03/12/2011	Stromness	BU20	Fortuna Bay	TF21	-54.153	-36.817	310	386	207	179	M
03/12/2011	Stromness	BU21	Fortuna Bay	TF22	-54.155	-36.817	305	360	196	164	F
03/12/2011	Stromness	BU22	Fortuna Bay	TF23	-54.162	-36.814	330	389	216	173	M
03/12/2011	Stromness	BU23	Fortuna Bay	TF24	-54.162	-36.814	300	335	201	134	M
04/12/2011	Stromness	BU24	Fortuna Bay	TF20	-54.152	-36.788	265	351	196	155	M
04/12/2011	Stromness	BU25	Fortuna Bay	TF05	-54.150	-36.786	375	398	234	164	M
04/12/2011	Stromness	BU26	Fortuna Bay	TF23	-54.162	-36.814	260	366	205	161	F
05/12/2011	Stromness	BU27	Fortuna Bay	TF02A	-54.162	-36.812	320	380	200	180	F

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
05/12/2011	Stromness	BU28	Fortuna Bay	TF15A	-54.160	-36.814	285	349	190	159	F
08/12/2011	Stromness	BU29	Stromness Bay	TF92	-54.153	-36.690	310	388	193	195	F
10/12/2011	Stromness	BU30	Fortuna Bay	TF90A	-54.137	-36.784	290	345	184	161	F
10/12/2011	Stromness	BU31	Fortuna Bay	TF02A	-54.162	-36.812	240	395	215	180	M
10/12/2011	Stromness	BU32	Fortuna Bay	TF15A	-54.160	-36.814	325	406	218	188	M
11/12/2011	Stromness	BU33	Stromness Bay	TF92	-54.153	-36.690	275	372	192	180	F
11/12/2011	Stromness	BU34	Stromness Bay	TF90A	-54.137	-36.784	27	173	93	80	F
12/12/2011	Stromness	BU35	Fortuna Bay	TF09A	-54.160	-36.814	190	295	156	139	M
28/12/2011	Stromness	BU36	Jason Harbour	J96	-54.196	-36.586	290	375	225	150	F
29/12/2011	Stromness	BU37	Jason Harbour	J01	-54.196	-36.586	275	330	210	120	M
29/12/2011	Stromness	BU38	Jason Harbour	J30	-54.194	-36.583	50	200	105	95	F
29/12/2011	Stromness	BU39	Jason Harbour	J20	-54.200	-36.590	75	229	125	104	M
30/12/2011	Stromness	BU40	Jason Harbour	J107	-54.196	-36.584	330	380	220	160	F
30/12/2011	Stromness	BU41	Jason Harbour	J26	-54.194	-36.583	50	180	100	80	?
30/12/2011	Stromness	BU42	Jason Harbour	J86	-54.195	-36.582	40	183	100	83	?
30/12/2011	Stromness	BU43	Jason Harbour	J173	-54.194	-36.583	275	365	205	160	F
01/12/2011	Cape Charlotte	GO01	Gold Harbour	GHR6	-54.617	-35.941	260	359	181	178	F
01/12/2011	Cape Charlotte	GO02	Gold Harbour	GHR13	-54.617	-35.939	265	350	180	170	M
01/12/2011	Cape Charlotte	GO03	Gold Harbour	GHR24	-54.618	-35.943	310	350	190	160	F
01/12/2011	Cape Charlotte	GO04	Gold Harbour	GHR25	-54.618	-35.943	280	352	190	162	F
01/12/2011	Cape Charlotte	GO05	Gold Harbour	GHR32	-54.618	-35.944	N/A	N/A	N/A	N/A	N/A
01/12/2011	Cape Charlotte	GO06	Gold Harbour	GHR33	-54.618	-35.944	270	355	186	169	F
01/12/2011	Cape Charlotte	GO07	Gold Harbour	GHR34	-54.617	-35.944	N/A	N/A	N/A	N/A	N/A
01/12/2011	Cape Charlotte	GO08	Gold Harbour	GHR37	-54.618	-35.944	425	408	208	200	M
01/12/2011	Cape Charlotte	GO09	Gold Harbour	GHR49	-54.617	-35.945	270	369	188	181	F
01/12/2011	Cape Charlotte	GO10	Gold Harbour	GHR55	-54.617	-35.946	N/A	N/A	N/A	N/A	N/A
01/12/2011	Cape Charlotte	GO11	Gold Harbour	GHR58	-54.617	-35.946	290	378	200	178	F
01/12/2011	Cape Charlotte	GO12	Gold Harbour	GHR63	-54.618	-35.945	430	407	205	202	F

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
01/12/2011	Cape Charlotte	GO13	Gold Harbour	GHR70	-54.619	-35.944	N/A	N/A	N/A	N/A	N/A
01/12/2011	Cape Charlotte	GO14	Gold Harbour	GHR99			285	376	191	185	F
01/12/2011	Cape Charlotte	GO15	Gold Harbour	GHR5	-54.617	-35.941	255	366	194	172	F
01/12/2011	Cape Charlotte	GO16	Gold Harbour	GHR13	-54.617	-35.939	335	380	195	185	M
01/12/2011	Cape Charlotte	GO17	Gold Harbour	GHR19	-54.617	-35.943	305	351	185	166	F
01/12/2011	Cape Charlotte	GO18	Gold Harbour	GHR26	-54.617	-35.944	405	422	214	208	M
02/12/2011	Cape Charlotte	GO19	Gold Harbour	GHR36	-54.618	-35.944	230	310	160	150	M
02/12/2011	Cape Charlotte	GO20	Gold Harbour	GHR29	-54.617	-35.944	335	387	200	187	F
02/12/2011	Cape Charlotte	GO21	Gold Harbour	GHR55	-54.617	-35.946	265	341	174	167	M
02/12/2011	Cape Charlotte	GO22	Gold Harbour	GHR68	-54.618	-35.945	N/A	367	209	158	F
03/12/2011	Cape Charlotte	GO23	Gold Harbour	GHR3	-54.616	-35.942	295	364	186	178	M
03/12/2011	Cape Charlotte	GO24	Gold Harbour	GHR7	-54.617	-35.941	355	383	192	191	M
03/12/2011	Cape Charlotte	GO25	Gold Harbour	GHR16	-54.617	-35.942	255	355	190	165	F
03/12/2011	Cape Charlotte	GO26	Gold Harbour	GHR75	-54.617	-35.944	285	366	201	165	M
03/12/2011	Cape Charlotte	GO27	Gold Harbour	GHR27	-54.617	-35.945	280	374	193	181	M
03/12/2011	Cape Charlotte	GO28	Gold Harbour	GHR43	-54.618	-35.945	295	333	168	165	M
03/12/2011	Cape Charlotte	GO29	Gold Harbour	GHR51	-54.617	-35.946	300	356	198	158	M
03/12/2011	Cape Charlotte	GO30	Gold Harbour	GHR76	-54.618	-35.946	400	390	211	179	M
03/12/2011	Cape Charlotte	GO31	Gold Harbour	GHR69	-54.618	-35.944	395	415	220	195	M
03/12/2011	Cape Charlotte	GO32	Gold Harbour	GHR72	-54.619	-35.945	365	410	221	189	F
03/12/2011	Cape Charlotte	GO33	Gold Harbour	GHR94	-54.620	-35.947	355	388	208	180	F
04/12/2011	Cape Charlotte	GO34	Gold Harbour	GHR1	-54.616	-35.943	365	411	211	200	M
04/12/2011	Cape Charlotte	GO35	Gold Harbour	GHR16	-54.617	-35.942	210	350	190	160	F
04/12/2011	Cape Charlotte	GO36	Gold Harbour	GHR70	-54.619	-35.944	395	396	210	186	F
04/12/2011	Cape Charlotte	GO37	Gold Harbour	GHR73	-54.619	-35.945	375	399	209	190	M
04/12/2011	Cape Charlotte	GO38	Gold Harbour	GHR79	-54.619	-35.945	425	381	216	165	M
04/12/2011	Cape Charlotte	GO39	Gold Harbour	GHR86	-54.620	-35.946	60	210	111	99	M
05/12/2011	Cape Charlotte	GO40	Gold Harbour	GHR64	-54.618	-35.945	N/A	379	195	184	M

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
06/12/2011	Cape Charlotte	GO41	Gold Harbour	GHR100	-54.617	-35.945	285	397	208	189	F
06/12/2011	Cape Charlotte	GO42	Gold Harbour	GHR13	-54.617	-35.939	325	376	206	170	F
06/12/2011	Cape Charlotte	GO43	Gold Harbour	GHR18	-54.617	-35.942	245	349	180	169	M
06/12/2011	Cape Charlotte	GO44	Gold Harbour	GHR85	-54.620	-35.946	N/A	N/A	N/A	N/A	N/A
06/12/2011	Cape Charlotte	GO45	Gold Harbour	GHR89	-54.621	-35.946	N/A	390	210	180	F
01/12/2011	Cape Charlotte	GO46	Bjornstadt Bay	BO039	-54.016	-37.688	280	350	180	170	F
02/12/2011	Cape Charlotte	GO47	Bjornstadt Bay	BO040	-54.017	-37.691	275	363	210	153	M
02/12/2011	Cape Charlotte	GO48	Bjornstadt Bay	BO083	-54.017	-37.691	270	336	183	153	F
03/12/2011	Cape Charlotte	GO49	Bjornstadt Bay	BO105	-54.586	-35.921	N/A	N/A	N/A	N/A	N/A
04/12/2011	Cape Charlotte	GO50	Bjornstadt Bay	BO064	-54.587	-35.922	230	320	180	140	F
04/12/2011	Cape Charlotte	GO51	Bjornstadt Bay	BO114	-54.585	-35.919	225	338	193	145	F
04/12/2011	Cape Charlotte	GO52	Bjornstadt Bay	BO107	-54.586	-35.921	270	362	207	155	F
04/12/2011	Cape Charlotte	GO53	Bjornstadt Bay	BO004	-54.587	-35.919	275	347	197	150	M
04/12/2011	Cape Charlotte	GO54	Bjornstadt Bay	BO096	-54.586	-35.924	275	361	203	158	F
04/12/2011	Cape Charlotte	GO55	Bjornstadt Bay	BO029	-54.589	-35.915	170	N/A	N/A	N/A	N/A
05/12/2011	Cape Charlotte	GO56	Bjornstadt Bay	BO058	-54.586	-35.922	300	375	215	160	F
05/12/2011	Cape Charlotte	GO57	Bjornstadt Bay	BO063	-54.587	-35.922	275	361	203	158	F
05/12/2011	Cape Charlotte	GO58	Bjornstadt Bay	BO066	-54.587	-35.922	275	369	215	154	M
05/12/2011	Cape Charlotte	GO59	Bjornstadt Bay	BO017	-54.587	-35.917	275	335	205	130	M
06/12/2011	Cape Charlotte	GO60	Bjornstadt Bay	BO022	-54.588	-35.916	320	383	218	165	F
06/12/2011	Cape Charlotte	GO61	Bjornstadt Bay	BO055	-54.586	-35.921	280	358	210	148	F
06/12/2011	Cape Charlotte	GO62	Bjornstadt Bay	BO017	-54.587	-35.917	325	400	225	175	M
06/12/2011	Cape Charlotte	GO63	Bjornstadt Bay	BO064	-54.587	-35.922	325	407	237	170	M
06/12/2011	Cape Charlotte	GO64	Bjornstadt Bay	BO023	-54.588	-35.915	N/A	N/A	N/A	N/A	N/A
06/12/2011	Cape Charlotte	GO65	Bjornstadt Bay	BO103	-54.586	-35.921	275	362	210	152	F
06/12/2011	Cape Charlotte	GO66	Bjornstadt Bay	BO011	-54.586	-35.918	320	374	220	154	F
06/12/2011	Cape Charlotte	GO67	Bjornstadt Bay	BO015	-54.587	-35.917	225	377	220	157	F
06/12/2011	Cape Charlotte	GO68	Bjornstadt Bay	BO080	-54.586	-35.921	180	352	202	150	M

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
06/01/2012	Prince Olav	PO01	Prince Olav Harbour	POR30	-54.058	-37.132	110	252	130	122	M
07/01/2012	Prince Olav	PO02	Prince Olav Harbour	POR30	-54.058	-37.132	125	235	119	116	M
07/01/2012	Prince Olav	PO03	Prince Olav Harbour	POR21	-54.059	-37.135	260	339	184	155	F
07/01/2012	Prince Olav	PO04	Prince Olav Harbour	POR36	-54.058	-37.134	320	318	173	145	F
07/01/2012	Prince Olav	PO05	Prince Olav Harbour	POR15	-54.059	-37.141	275	341	185	156	M
07/01/2012	Prince Olav	PO06	Prince Olav Harbour	POR6	-54.058	-37.142	375	379	201	178	M
08/01/2012	Prince Olav	PO07	Prince Olav Harbour	POR26	-54.059	-37.134	110	254	130	124	F
08/01/2012	Prince Olav	PO08	Prince Olav Harbour	POR30	-54.058	-37.132	115	257	126	131	M
08/01/2012	Prince Olav	PO09	Prince Olav Harbour	POR35	-54.058	-37.134	105	256	130	126	M
08/01/2012	Prince Olav	PO10	Beckmann Fjord	BF20	-54.071	-37.181	280	362	194	168	F
08/01/2012	Prince Olav	PO11	Elephant Lagoon	EL6	-54.069	-37.139	115	252	130	122	F
08/01/2012	Prince Olav	PO12	Beckmann Fjord	BF22	-54.071	-37.181	370	386	210	176	M
09/01/2012	Prince Olav	PO13	Beckmann Fjord	BF4	-54.070	-37.182	340	383	209	174	M
09/01/2012	Prince Olav	PO14	Beckmann Fjord	BF12	-54.071	-37.182	95	233	115	118	M
09/01/2012	Prince Olav	PO15	Beckmann Fjord	BF14	-54.071	-37.182	280	383	212	171	M
09/01/2012	Prince Olav	PO16	Beckmann Fjord	BF18	-54.071	-37.182	320	343	192	151	F
09/01/2012	Prince Olav	PO17	Beckmann Fjord	BF36	-54.069	-37.183	N/A	N/A	N/A	N/A	F
09/01/2012	Prince Olav	PO18	Beckmann Fjord	BF39	-54.069	-37.184	80	210	108	102	M
09/01/2012	Prince Olav	PO19	Prince Olav Harbour	POR5	-54.058	-37.143	300	351	183	168	F
09/01/2012	Prince Olav	PO20	Prince Olav Harbour	POR20	-54.059	-37.136	60	195	95	100	F
09/01/2012	Prince Olav	PO21	Prince Olav Harbour	POR30	-54.058	-37.132	360	364	203	161	F
10/01/2012	Prince Olav	PO22	Beckmann Fjord	BF8	-54.070	-37.183	305	360	196	164	F
10/01/2012	Prince Olav	PO23	Beckmann Fjord	BF14	-54.071	-37.182	245	336	182	154	M
10/01/2012	Prince Olav	PO24	Beckmann Fjord	BF20	-54.071	-37.181	90	219	109	110	F
10/01/2012	Prince Olav	PO25	Beckmann Fjord	BF39	-54.069	-37.184	75	217	110	107	M
10/01/2012	Prince Olav	PO26	Prince Olav Harbour	POR20	-54.059	-37.136	50	185	89	96	F
11/01/2012	Prince Olav	PO27	Prince Olav Harbour	POR18	-54.059	-37.137	55	188	91	97	M?
11/01/2012	Prince Olav	PO28	Prince Olav Harbour	POR28	-54.059	-37.133	105	240	120	120	F

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
11/01/2012	Prince Olav	PO29	Prince Olav Harbour	POR31	-54.058	-37.132	105	255	131	124	M
12/01/2012	Prince Olav	PO30	Prince Olav Harbour	POR23	-54.059	-37.135	55	190	95	95	M
05/01/2012	Salisbury	SL01	Sea Leopard Fjord	SL58	-54.075	-37.260	250	435	185	162	F
05/01/2012	Salisbury	SL02	Sea Leopard Fjord	SL28	-54.073	-37.262	40	133	93	80	M
05/01/2012	Salisbury	SL03	Sea Leopard Fjord	SL05	-54.073	-37.262	37	131	94	82	M
06/01/2012	Salisbury	SL04	Sea Leopard Fjord	N/A			N/A	N/A	N/A	N/A	N/A
07/01/2012	Salisbury	SL05	Sea Leopard Fjord	SL02	-54.073	-37.260	85	237	120	117	M
07/01/2012	Salisbury	SL06	Sea Leopard Fjord	SL05	-54.073	-37.262	50	184	98	86	M
07/01/2012	Salisbury	SL07	Sea Leopard Fjord	SL05	-54.073	-37.262	50	182	98	84	F
07/01/2012	Salisbury	SL08	Sea Leopard Fjord	SL47A	-54.073	-37.262	35	170	88	82	M
07/01/2012	Salisbury	SL09	Sea Leopard Fjord	SL54	-54.076	-37.260	360	359	195	164	M
07/01/2012	Salisbury	SL10	Sea Leopard Fjord	SL68	-54.075	-37.260	80	233	126	107	M
08/01/2012	Salisbury	SL11	Sea Leopard Fjord	SL02	-54.073	-37.260	95	271	150	121	M
08/01/2012	Salisbury	SL12	Sea Leopard Fjord	SL05	-54.073	-37.262	45	190	109	81	F
08/01/2012	Salisbury	SL13	Sea Leopard Fjord	SL39	-54.073	-37.262	50	195	116	79	M
08/01/2012	Salisbury	SL14	Sea Leopard Fjord	SL63	-54.075	-37.260	75	250	146	104	M
08/01/2012	Salisbury	SL15	Sea Leopard Fjord	SL67	-54.078	-37.259	375	385	223	162	F
09/01/2012	Salisbury	SL16	Salisbury Plain	SP26	-54.063	-37.327	55	196	111	85	M
09/01/2012	Salisbury	SL17	Sea Leopard Fjord	SL05	-54.073	-37.262	50	199	116	83	M
09/01/2012	Salisbury	SL18	Sea Leopard Fjord	SL47A	-54.073	-37.262	245	343	207	136	M
09/01/2012	Salisbury	SL19	Sea Leopard Fjord	SL39	-54.073	-37.262	55	200	115	85	F
09/01/2012	Salisbury	SL20	Salisbury Plain	SP75	-54.064	-37.327	355	377	214	163	F
09/01/2012	Salisbury	SL21	Salisbury Plain	SP90	-54.064	-37.327	260	335	187	148	F
09/01/2012	Salisbury	SL22	Salisbury Plain	SP50	-54.063	-37.326	45	193	110	83	F
09/01/2012	Salisbury	SL23	Salisbury Plain	SP29	-54.063	-37.326	45	195	112	83	M
09/01/2012	Salisbury	SL24	Salisbury Plain	SP92	-54.063	-37.327	460	416	242	174	M
09/01/2012	Salisbury	SL25	Salisbury Plain	SP17	-54.063	-37.325	325	382	218	164	F
09/01/2012	Salisbury	SL26	Salisbury Plain	SP34	-54.063	-37.327	60	212	125	87	F

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
09/01/2012	Salisbury	SL27	Salisbury Plain	SP89	-54.063	-37.327	N/A	390	225	165	F
10/01/2012	Salisbury	SL28	Sea Leopard Fjord	SL02	-54.073	-37.260	120	267	142	125	M
10/01/2012	Salisbury	SL29	Sea Leopard Fjord	SL39	-54.073	-37.262	75	218	127	91	F
10/01/2012	Salisbury	SL30	Sea Leopard Fjord	SL04	-54.072	-37.261	245	346	201	145	F
10/01/2012	Salisbury	SL31	Sea Leopard Fjord	SL09	-54.073	-37.260	120	259	140	119	F
10/01/2012	Salisbury	SL32	Salisbury Plain	SP50	-54.063	-37.327	60	195	111	84	M
10/01/2012	Salisbury	SL33	Salisbury Plain	SP29	-54.063	-37.326	55	196	110	86	M
10/01/2012	Salisbury	SL34	Salisbury Plain	SP59	-54.063	-37.327	75	218	122	96	M
10/01/2012	Salisbury	SL35	Salisbury Plain	SP86	-54.064	-37.326	60	200	115	85	F
10/01/2012	Salisbury	SL36	Salisbury Plain	SP26	-54.063	-37.327	60	193	108	85	F
10/01/2012	Salisbury	SL37	Salisbury Plain	SP31	-54.063	-37.325	60	198	114	84	F
10/01/2012	Salisbury	SL38	Salisbury Plain	SP03	-54.063	-37.325	N/A	N/A	N/A	N/A	N/A
10/01/2012	Salisbury	SL39	Salisbury Plain	SP03	-54.063	-37.325	50	183	110	73	M
10/01/2012	Salisbury	SL40	Salisbury Plain	SP89	-54.063	-37.327	320	370	215	155	F
10/01/2012	Salisbury	SL41	Salisbury Plain	SP56	-54.064	-37.327	395	375	231	144	F
11/01/2012	Salisbury	SL42	Sea Leopard Fjord	SL02	-54.073	-37.260	110	270	145	125	M
11/01/2012	Salisbury	SL43	Salisbury Plain	SP48	-54.063	-37.327	55	212	109	103	M
11/01/2012	Salisbury	SL44	Salisbury Plain	SP100A	-54.064	-37.326	45	187	101	86	M
11/01/2012	Salisbury	SL45	Salisbury Plain	SP16	-54.063	-37.327	55	207	104	103	M
11/01/2012	Salisbury	SL46	Salisbury Plain	SP66	-54.063	-37.327	65	217	112	105	M
11/01/2012	Salisbury	SL47	Salisbury Plain	SP03	-54.063	-37.325	N/A	N/A	N/A	N/A	N/A
11/01/2012	Salisbury	SL48	Salisbury Plain	SP03	-54.063	-37.325	50	184	97	87	M
11/01/2012	Salisbury	SL49	Salisbury Plain	SP03	-54.063	-37.325	45	177	93	84	M
11/01/2012	Salisbury	SL50	Salisbury Plain	SP21	-54.063	-37.325	N/A	196	106	90	M
11/01/2012	Salisbury	SL51	Salisbury Plain	SP31	-54.063	-37.325	40	173	90	83	M
11/01/2012	Salisbury	SL52	Salisbury Plain	SP31	-54.063	-37.325	42	179	96	83	M
11/01/2012	Salisbury	SL53	Salisbury Plain	SP56	-54.064	-37.327	320	364	208	156	F
11/01/2012	Salisbury	SL54	Salisbury Plain	SP14	-54.063	-37.325	265	356	185	171	M

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
11/01/2012	Salisbury	SL55	Salisbury Plain	SP35	-54.063	-37.325	280	353	200	153	M
11/01/2012	Salisbury	SL56	Salisbury Plain	SP17	-54.063	-37.325	330	379	206	173	F
12/01/2012	Salisbury	SL57	Salisbury Plain	SP100A	-54.064	-37.326	45	191	105	86	M
12/01/2012	Salisbury	SL58	Salisbury Plain	SP83	-54.063	-37.327	45	204	110	94	F
12/01/2012	Salisbury	SL59	Salisbury Plain	SP65	-54.063	-37.327	105	277	155	122	F
16/01/2012	North West	RW01	Binder Beach	RW76	-54.017	-37.694	N/A	N/A	N/A	N/A	N/A
16/01/2012	North West	RW02	Binder Beach	RW50	-54.017	-37.693	N/A	N/A	N/A	113	N/A
16/01/2012	North West	RW03	Binder Beach	RW91	-54.017	-37.695	95	271	115	156	M
17/01/2012	North West	RW04	Nameless Point	RW02	-53.990	-37.686	110	282	161	121	M
17/01/2012	North West	RW05	Binder Beach	RW26	-54.017	-37.693	110	287	156	131	M
17/01/2012	North West	RW06	Binder Beach	RW22	-54.017	-37.693	105	260	144	116	F
17/01/2012	North West	RW07	Nameless Point	RW80	-53.991	-37.684	275	373	213	160	F
17/01/2012	North West	RW08	Binder Beach	RW52	-54.017	-37.695	100	259	148	111	F
17/01/2012	North West	RW09	Nameless Point	RW92	-53.989	-37.689	275	378	206	172	F
17/01/2012	North West	RW10	Binder Beach	RW51	-54.017	-37.693	105	275	149	126	M
17/01/2012	North West	RW11	Nameless Point	RW32	-53.992	-37.684	125	272	149	123	F
18/01/2012	North West	RW12	Binder Beach	RW39	-54.017	-37.693	120	287	154	133	M
18/01/2012	North West	RW13	Binder Beach	RW97	-54.017	-37.693	55	222	125	97	M
18/01/2012	North West	RW14	Binder Beach	RW22	-54.017	-37.693	305	369	189	180	M
18/01/2012	North West	RW15	Binder Beach	RW54	-54.017	-37.693	115	260	138	122	F
18/01/2012	North West	RW16	Binder Beach	RW76	-54.017	-37.694	120	282	147	135	F
18/01/2012	North West	RW17	Binder Beach	N/A			N/A	N/A	N/A	N/A	N/A
18/01/2012	North West	RW18	Binder Beach	RW82	-54.017	-37.693	110	285	151	134	M
18/01/2012	North West	RW19	Binder Beach	RW51	-54.017	-37.693	295	362	198	164	F
18/01/2012	North West	RW20	Binder Beach	RW91	-54.017	-37.695	65	221	120	101	M
18/01/2012	North West	RW21	Binder Beach	RW16	-54.017	-37.694	300	361	199	162	F
18/01/2012	North West	RW22	Binder Beach	RW50	-54.017	-37.693	N/A	292	150	142	F
18/01/2012	North West	RW23	Binder Beach	RW63	-54.017	-37.693	70	229	121	108	M

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
18/01/2012	North West	RW24	Binder Beach	RW70	-54.017	-37.692	100	269	144	125	F
18/01/2012	North West	RW25	Binder Beach	RW68	-54.017	-37.693	60	232	130	102	M
18/01/2012	North West	RW26	Binder Beach	RW47	-54.017	-37.693	405	405	227	178	M
18/01/2012	North West	RW27	Binder Beach	RW30	-54.017	-37.692	105	283	146	137	M
18/01/2012	North West	RW28	Binder Beach	RW40	-54.017	-37.695	90	245	132	113	M
18/01/2012	North West	RW29	Nameless Point	RW21	-53.990	-37.684	110	282	154	128	M
18/01/2012	North West	RW30	Binder Beach	RW41	-53.991	-37.683	105	274	144	130	F
18/01/2012	North West	RW31	Nameless Point	RW46	-53.990	-37.683	125	295	154	141	F
18/01/2012	North West	RW32	Nameless Point	RW37	-53.991	-37.687	130	301	159	142	F
19/01/2012	North West	RW33	Binder Beach	RW72	-54.017	-37.693	60	213	118	95	F
19/01/2012	North West	RW34	Binder Beach	RW23	-54.017	-37.693	75	235	135	100	F
19/01/2012	North West	RW35	Nameless Point	RW17	-53.991	-37.683	150	313	177	136	M
19/01/2012	North West	RW36	Nameless Point	RW46	-53.990	-37.683	175	320	182	138	M
19/01/2012	North West	RW37	Nameless Point	RW86	-53.990	-37.683	155	315	183	132	M
19/01/2012	North West	RW38	Nameless Point	RW71	-53.990	-37.687	145	309	173	136	F
19/01/2012	North West	RW39	Nameless Point	RW55	-53.991	-37.686	N/A	N/A	N/A	88	M
19/01/2012	North West	RW40	Nameless Point	RW37	-53.991	-37.687	315	404	230	174	M
20/01/2012	North West	RW41	Nameless Point	RW37	-53.991	-37.687	155	313	174	139	M
21/01/2012	North West	RW42	Binder Beach	RW51	-54.017	-37.693	465	426	248	178	M
21/01/2012	North West	RW43	Binder Beach	RW60	-54.017	-37.693	105	267	154	113	M
21/01/2012	North West	RW44	Binder Beach	RW76	-54.017	-37.694	155	309	174	135	F
22/01/2012	North West	RW45	Binder Beach	RW48A	-54.016	-37.689	70	242	128	114	M
22/01/2012	North West	RW46	Binder Beach	RW47	-54.017	-37.693	110	286	153	133	M
22/01/2012	North West	RW47	Binder Beach	N/A			N/A	N/A	N/A	N/A	N/A
22/01/2012	North West	RW48	Binder Beach	RW95A	-54.016	-37.690	105	277	152	125	F
22/01/2012	North West	RW49	Binder Beach	RW46A	-54.016	-37.690	45	202	109	93	M
23/01/2012	North West	RW50	Binder Beach	RW14A	-54.016	-37.691	430	407	230	177	M
23/01/2012	North West	RW51	Binder Beach	RW100A	-54.016	-37.688	70	237	125	112	M

Date	Zone	Sample No.	Binder Beach	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
23/01/2012	North West	RW52	Nameless Point	RW41A	-54.016	-37.688	60	227	119	108	F
23/01/2012	North West	RW53	Binder Beach	RW48A	-54.016	-37.689	105	267	138	129	M
23/01/2012	North West	RW54	Binder Beach	RW44A	-54.017	-37.691	65	250	134	116	M
23/01/2012	North West	RW55	Binder Beach	RW50	-54.017	-37.693	100	263	140	123	F
23/01/2012	North West	RW56	Binder Beach	RW76	-54.017	-37.694	150	304	168	136	M
24/01/2012	North West	RW57	Binder Beach	RW30	-54.017	-37.692	110	292	163	129	M
24/01/2012	North West	RW58	Binder Beach	RW69	-54.017	-37.694	115	282	160	122	M
24/01/2012	North West	RW59	Binder Beach	RW49A	-54.016	-37.691	315	364	206	158	F
25/01/2012	North West	RW60	Binder Beach	RW14A	-54.016	-37.691	30	176	103	73	M
25/01/2012	North West	RW61	Binder Beach	RW86A	-54.016	-37.688	325	382	214	168	F
25/01/2012	North West	RW62	Binder Beach	RW17A	-54.016	-37.690	320	364	214	150	M
25/01/2012	North West	RW63	Binder Beach	RW06A	-54.016	-37.690	40	206	121	85	F
25/01/2012	North West	RW64	Binder Beach	RW83	-54.017	-37.694	130	312	168	144	F
25/01/2012	North West	RW65	Binder Beach	RW79	-54.017	-37.693	375	409	227	182	M
24/01/2012	North West	N/A	Binder Beach	RW41A	-54.016	-37.688	95	271	148	123	M
24/01/2012	North West	N/A	Binder Beach	RW44A	-54.017	-37.691	70	252	146	106	F
25/01/2012	North West	N/A	Binder Beach	RW44A	-54.017	-37.691	75	259	144	115	M
17/01/2012	Blue Whale	BW01	Blue Whale Harbour	BWP95	-54.084	-37.020	220	325	185	140	F
17/01/2012	Blue Whale	BW02	Blue Whale Harbour	BWP85	-54.082	-37.019	375	356	203	153	F
17/01/2012	Blue Whale	BW03	Blue Whale Harbour	BWP4	-54.084	-37.020	250	325	185	140	F
17/01/2012	Blue Whale	BW04	Blue Whale Harbour	BWP90	-54.084	-37.020	320	400	220	180	M
18/01/2012	Blue Whale	BW05	Blue Whale Harbour	BWP108	-54.084	-37.019	25	200	110	90	M
18/01/2012	Blue Whale	BW06	Blue Whale Harbour	BWP36	-54.082	-37.019	250	275	200	75	M
18/01/2012	Blue Whale	BW07	Blue Whale Harbour	BWP91	-54.085	-37.023	250	335	200	135	F
18/01/2012	Blue Whale	BW08	Blue Whale Harbour	no trap	-54.084	-37.019	N/A	N/A	N/A	N/A	N/A
20/01/2012	Blue Whale	BW09	Antarctic Bay	ABP166	-54.091	-36.981	100	255	140	115	F?
20/01/2012	Blue Whale	BW10	Antarctic Bay	ABP104	-54.090	-36.983	95	210	120	90	F?
20/01/2012	Blue Whale	BW11	Blue Whale Harbour	BWP115	-54.084	-37.021	75	215	120	95	F?

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
20/01/2012	Blue Whale	BW12	Blue Whale Harbour	BWP8	-54.083	-37.009	275	335	185	150	M
21/01/2012	Blue Whale	BW13	Antarctic Bay	ABP28	-54.091	-36.983	75	205	110	95	?
21/01/2012	Blue Whale	BW14	Antarctic Bay	ABP165	-54.091	-36.981	275	370	215	155	F
21/01/2012	Blue Whale	BW15	Blue Whale Harbour	BWP34	-54.084	-37.009	375	365	205	160	F
21/01/2012	Blue Whale	BW16	Blue Whale Harbour	BWP22	-54.083	-37.021	50	160	95	65	?
21/01/2012	Blue Whale	BW17	Blue Whale Harbour	BWP10	-54.085	-37.021	350	370	205	165	F
21/01/2012	Blue Whale	BW18	Blue Whale Harbour	BWP167	-54.083	-37.012	100	235	130	105	?
22/01/2012	Blue Whale	BW19	Antarctic Bay	ABP53	-54.090	-36.984	410	405	220	185	M
22/01/2012	Blue Whale	BW20	Antarctic Bay	ABP3	-54.091	-36.982	110	270	150	120	?
22/01/2012	Blue Whale	BW21	Blue Whale Harbour	BWP68	-54.084	-37.018	75	200	110	90	?
23/01/2012	Blue Whale	BW22	Antarctic Bay	ABP171	-54.091	-36.982	100	249	134	115	F
17/01/2012	Blue Whale	BW50	Blue Whale Harbour	BW14	-54.085	-37.017	245	309	167	142	F
17/01/2012	Blue Whale	BW51	Blue Whale Harbour	BW24	-54.083	-37.013	115	279	140	139	M
18/01/2012	Blue Whale	BW52	Blue Whale Harbour	BW28	-54.086	-37.014	260	350	180	170	M
18/01/2012	Blue Whale	BW53	Blue Whale Harbour	BW18	-54.085	-37.016	325	385	205	180	F
18/01/2012	Blue Whale	BW54	Blue Whale Harbour	BW56	-54.083	-37.014	110	255	130	125	F
18/01/2012	Blue Whale	BW55	Blue Whale Harbour	BW59	-54.083	-37.015	130	275	143	132	F
18/01/2012	Blue Whale	BW56	Blue Whale Harbour	BW60	-54.083	-37.015	150	288	146	142	F
18/01/2012	Blue Whale	BW57	Blue Whale Harbour	BW62	-54.083	-37.015	100	245	123	122	F
18/01/2012	Blue Whale	BW58	Blue Whale Harbour	BW67	-54.083	-37.016	295	359	194	165	F
19/01/2012	Blue Whale	BW59	Blue Whale Harbour	BW53	-54.086	-37.020	100	241	130	111	F
19/01/2012	Blue Whale	BW60	Blue Whale Harbour	ABP06	-54.090	-36.984	300	372	190	182	M
19/01/2012	Blue Whale	BW61	Blue Whale Harbour	BWP178	-54.083	-37.010	270	341	185	156	M
19/01/2012	Blue Whale	BW62	Blue Whale Harbour	ABP21	-54.091	-36.983	70	203	101	102	F
19/01/2012	Blue Whale	BW63	Blue Whale Harbour	BW97	-54.084	-37.013	115	264	130	134	M
19/01/2012	Blue Whale	BW64	Blue Whale Harbour	BW251	-54.084	-37.012	110	253	134	119	M
20/01/2012	Blue Whale	BW65	Antarctic Bay	CAMP	-54.093	-36.993	375	417	212	195	M
20/01/2012	Blue Whale	BW66	Blue Whale Harbour	BW83	-54.086	-37.018	265	343	182	161	F

Date	Zone	Sample No.	Location	Trap no	Lat	Long	Mass g	Total length mm	Head + body mm	Tail mm	Sex
20/01/2012	Blue Whale	BW67	Blue Whale Harbour	BW70	-54.083	-37.015	350	385	200	185	F
20/01/2012	Blue Whale	BW68	Blue Whale Harbour	BW98	-54.084	-37.013	315	371	197	174	F
22/01/2012	Blue Whale	BW69	Blue Whale Harbour	BW68	-54.083	-37.016	55	181	90	91	F
23/01/2012	Blue Whale	BW70	Blue Whale Harbour	BW23	-54.083	-37.013	110	255	134	121	M
23/01/2012	Blue Whale	BW71	Blue Whale Harbour	BW57	-54.083	-37.014	60	194	95	99	M
24/01/2012	Blue Whale	BW72	Blue Whale Harbour	BW67	-54.083	-37.016	65	203	99	104	M
24/01/2012	Blue Whale	BW73	Blue Whale Harbour	BW71	-54.083	-37.016	150	293	152	141	F
24/01/2012	Blue Whale	BW74	Blue Whale Harbour	BW257	-54.082	-37.013	70	210	111	99	F
24/01/2012	Blue Whale	BW75	Blue Whale Harbour	BWP87A	-54.081	-37.011	120	228	138	90	M
24/01/2012	Blue Whale	BW76	Blue Whale Harbour	BWP172A	-54.082	-37.014	130	270	140	130	M
25/01/2012	Blue Whale	BW77	Blue Whale Harbour	BW259	-54.081	-37.013	135	290	154	136	M
25/01/2012	Blue Whale	BW78	Blue Whale Harbour	BWP37	-54.083	-37.011	95	237	118	119	F
25/01/2012	Blue Whale	BW79	Blue Whale Harbour	BW262	-54.084	-37.011	125	273	132	141	M
25/01/2012	Blue Whale	BW80	Antarctic Bay	ABP50	-54.091	-36.983	80	223	116	107	F
25/01/2012	Blue Whale	BW81	Blue Whale Harbour	BWP184A	-54.081	-37.010	295	359	197	162	F
25/01/2012	Blue Whale	BW82	Blue Whale Harbour	BWP87A	-54.081	-37.011	105	244	120	124	F

Note that latitude and longitude utilise chart datum WGS 84.

Appendix VI. SKUA TERRITORIES

Figures AVI.1 to AVI.9 show the areas surveyed at each site and the position of skua nests recorded. Red dots represent confirmed nests and blue dots are probable nests (territory held but nest not active at the time of surveying). The sum total of confirmed and probable nests are presented as possible nests in Tables 8 and 10. The numbered areas (outlined in red) correspond to the location numbers in Table 8.

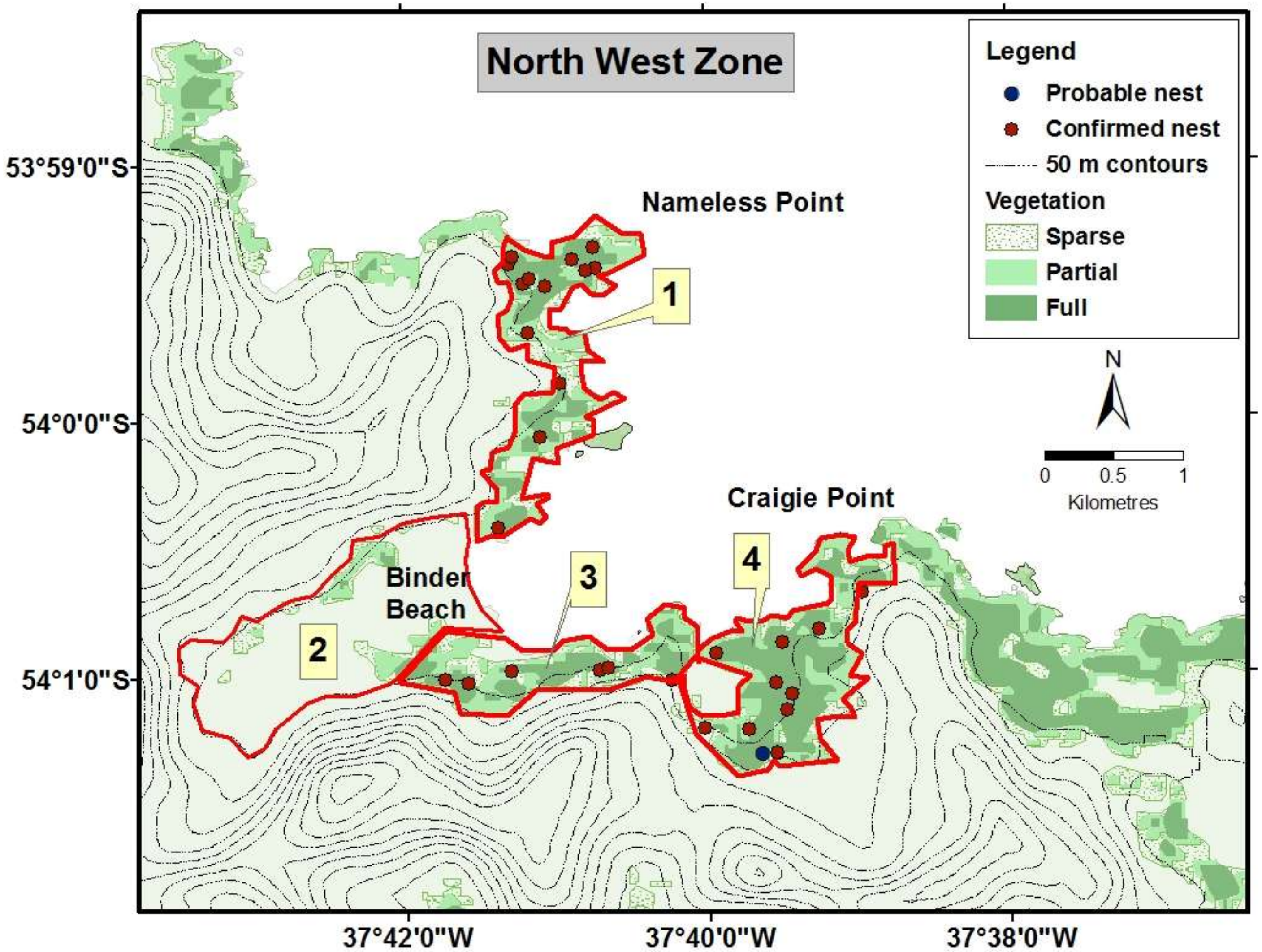

Figure AVI.1. Areas surveyed and the position of skua nests recorded in the North West Zone.

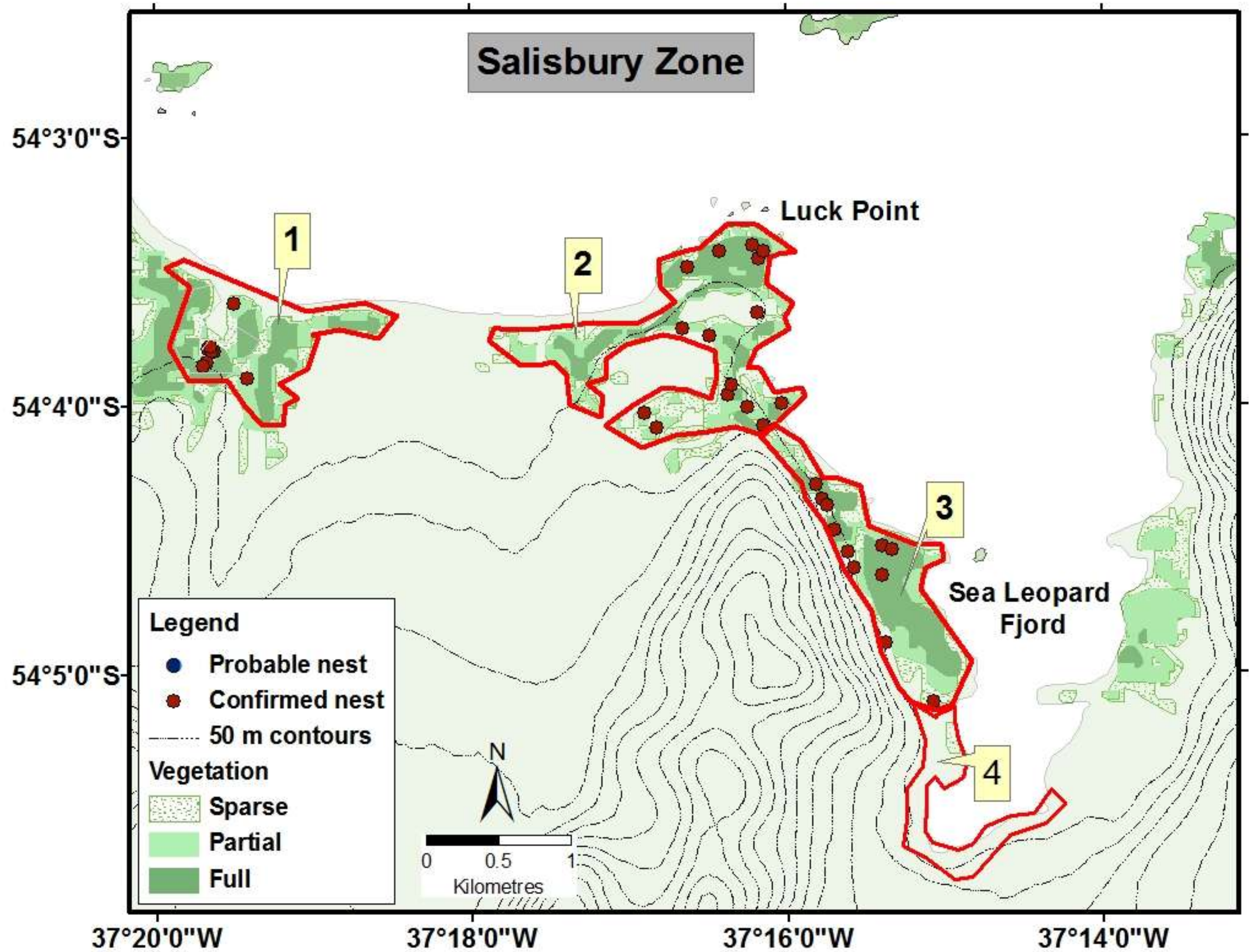

Figure AVI.2. Areas surveyed and the position of skua nests recorded from the Salisbury Zone

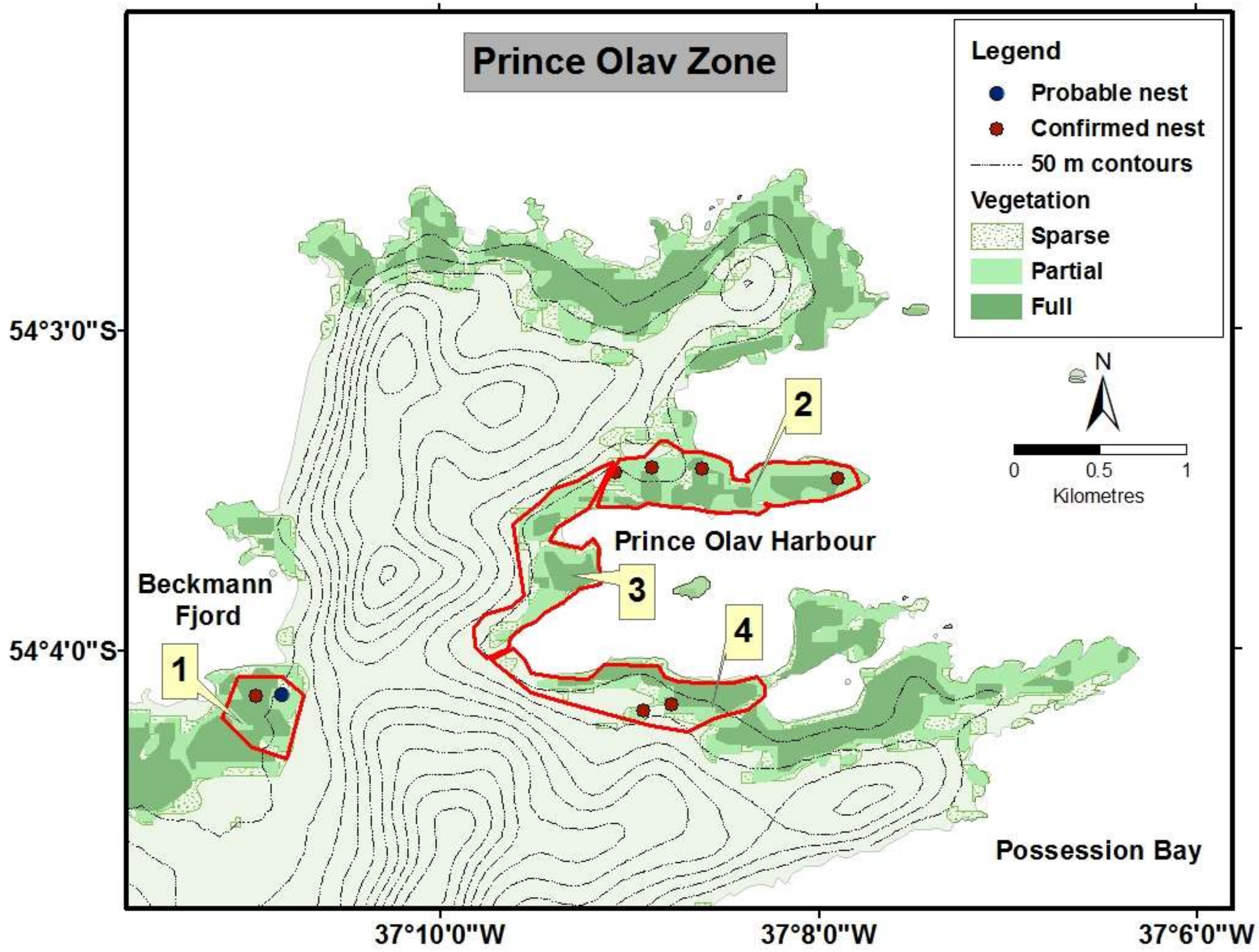

Figure AVI.3. Areas surveyed and the position of skua nests recorded in the Prince Olav Zone

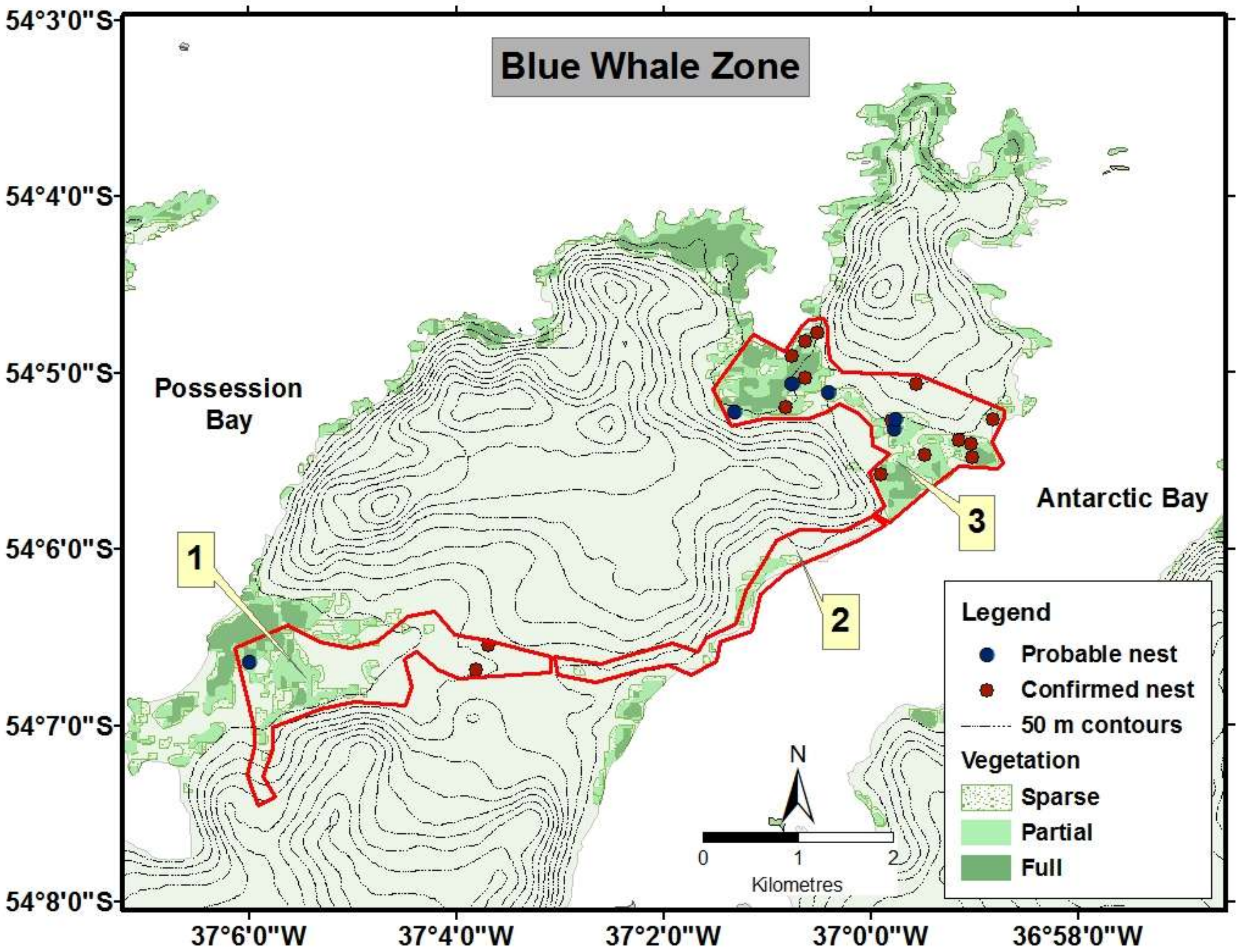

Figure AVI.4. Areas surveyed and the position of skua nests recorded in the Blue Whale Zone

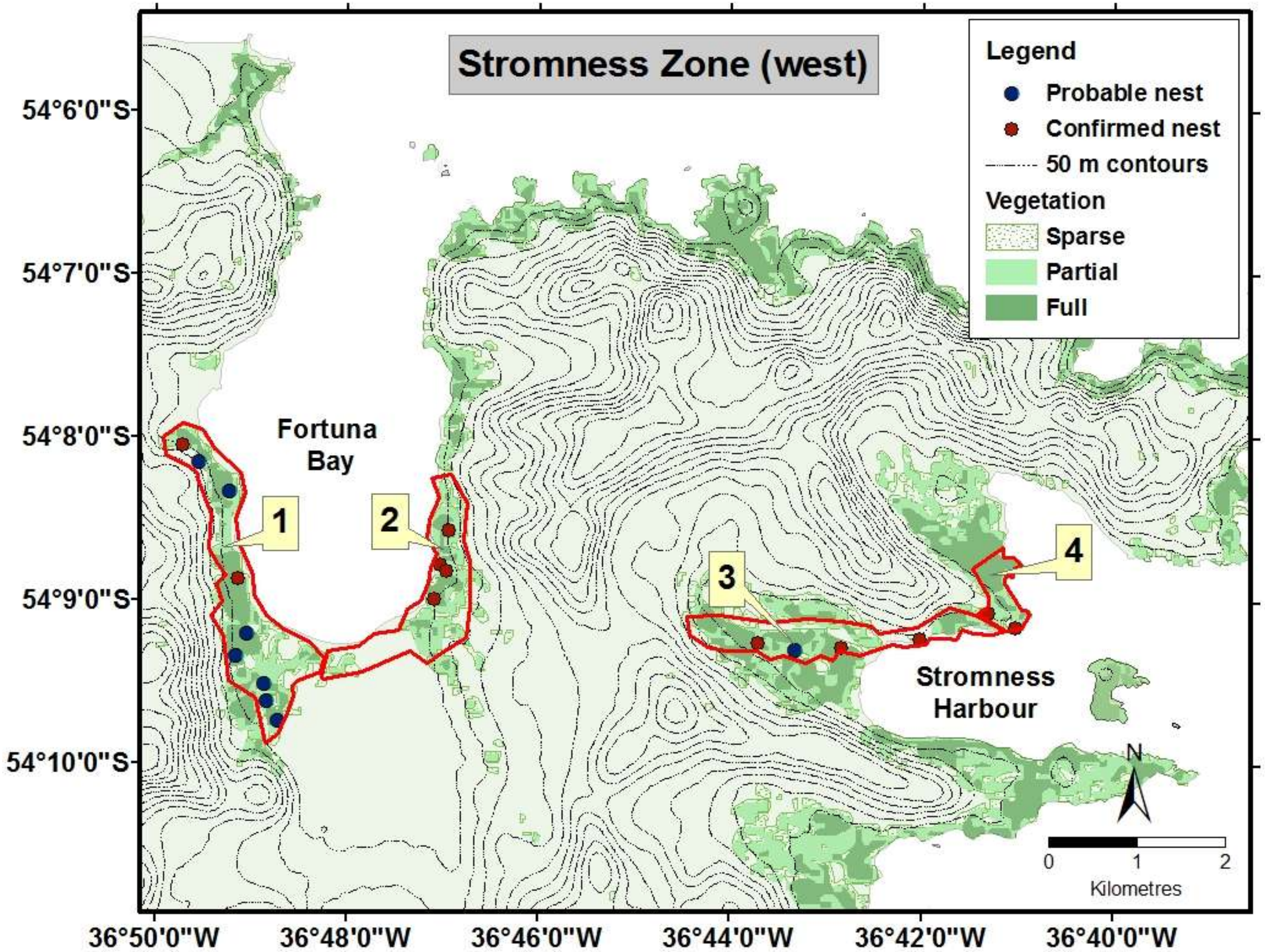

Figure AVI.5. Areas surveyed and the position of skua nests recorded in the western part of the Stromness Zone

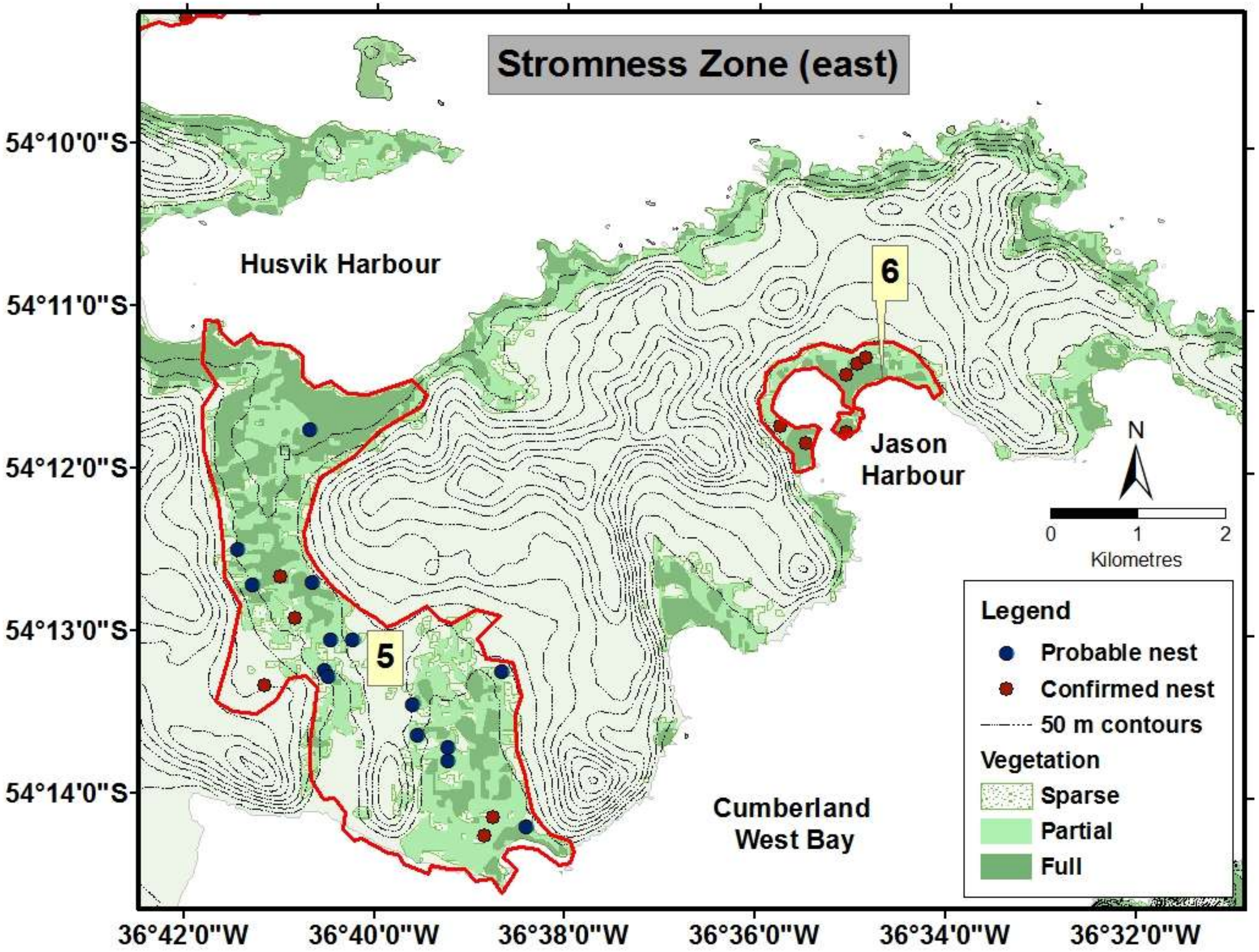

Figure AVI.6. Areas surveyed and the position of skua nests recorded in the eastern part of the Stromness Zone

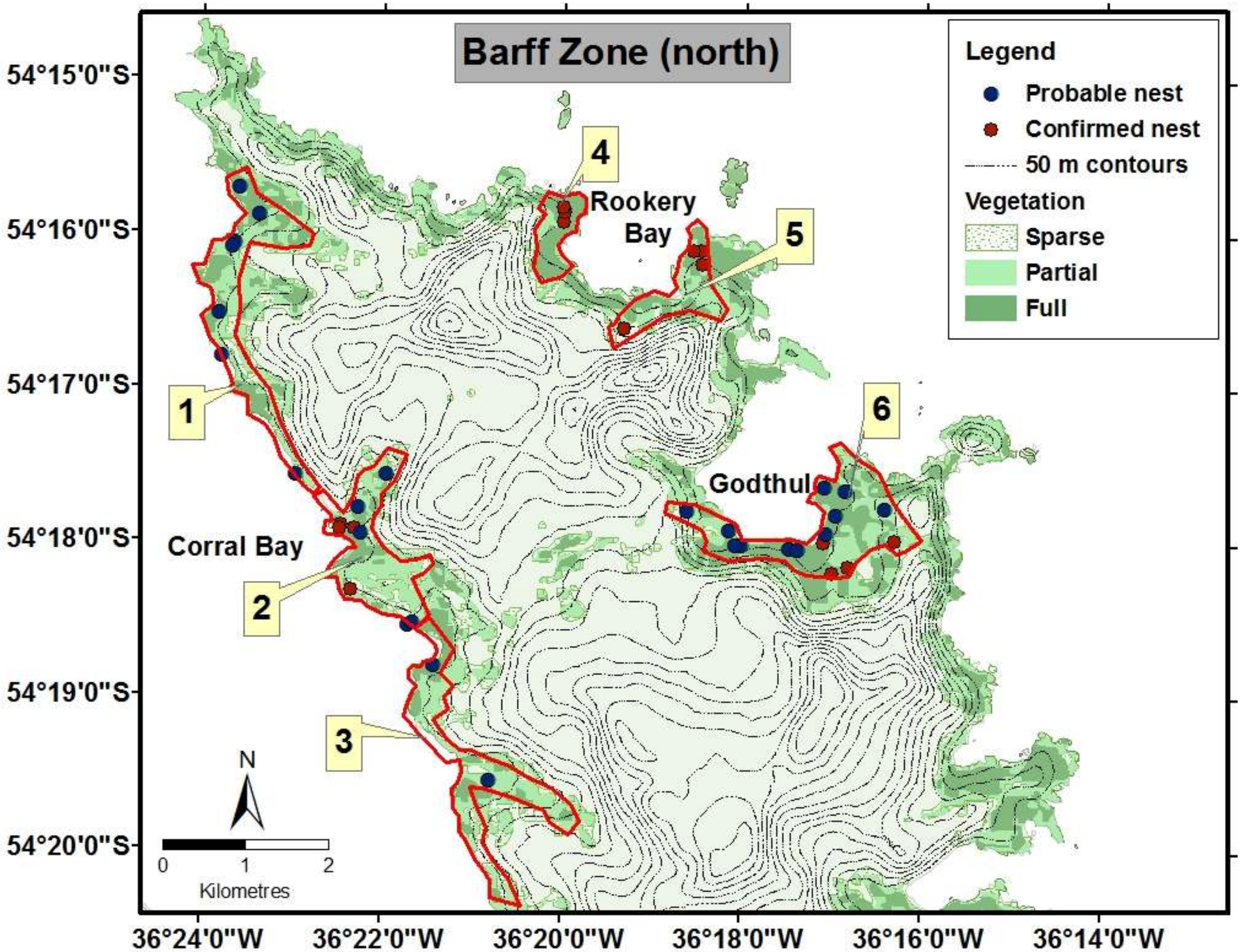

Figure AVI.7. Areas surveyed and the position of skua nests recorded in the northern part of the Barff Zone

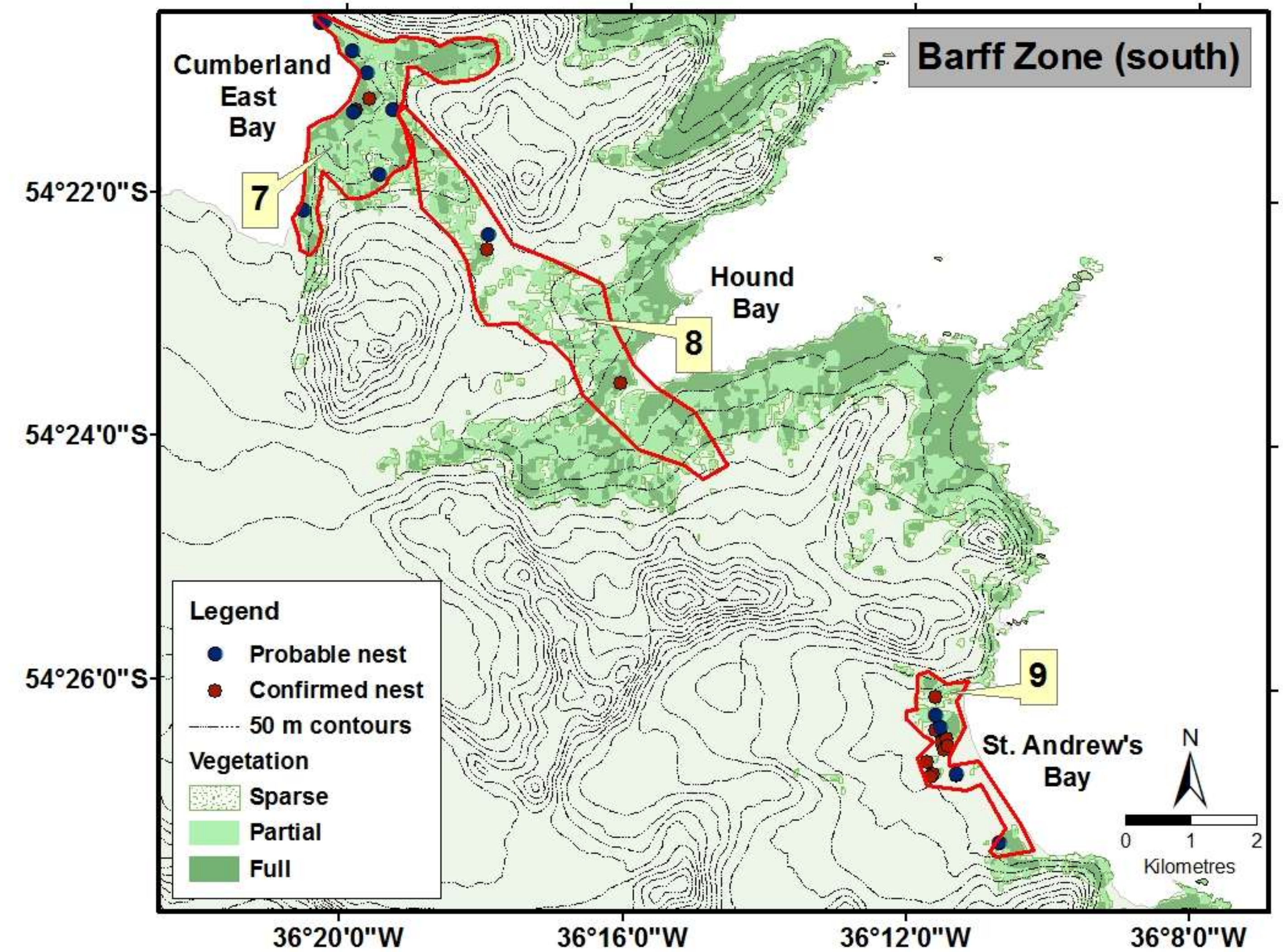

Figure AVI.8. Areas surveyed and the position of skua nests recorded in the southern part of the Barff Zone.

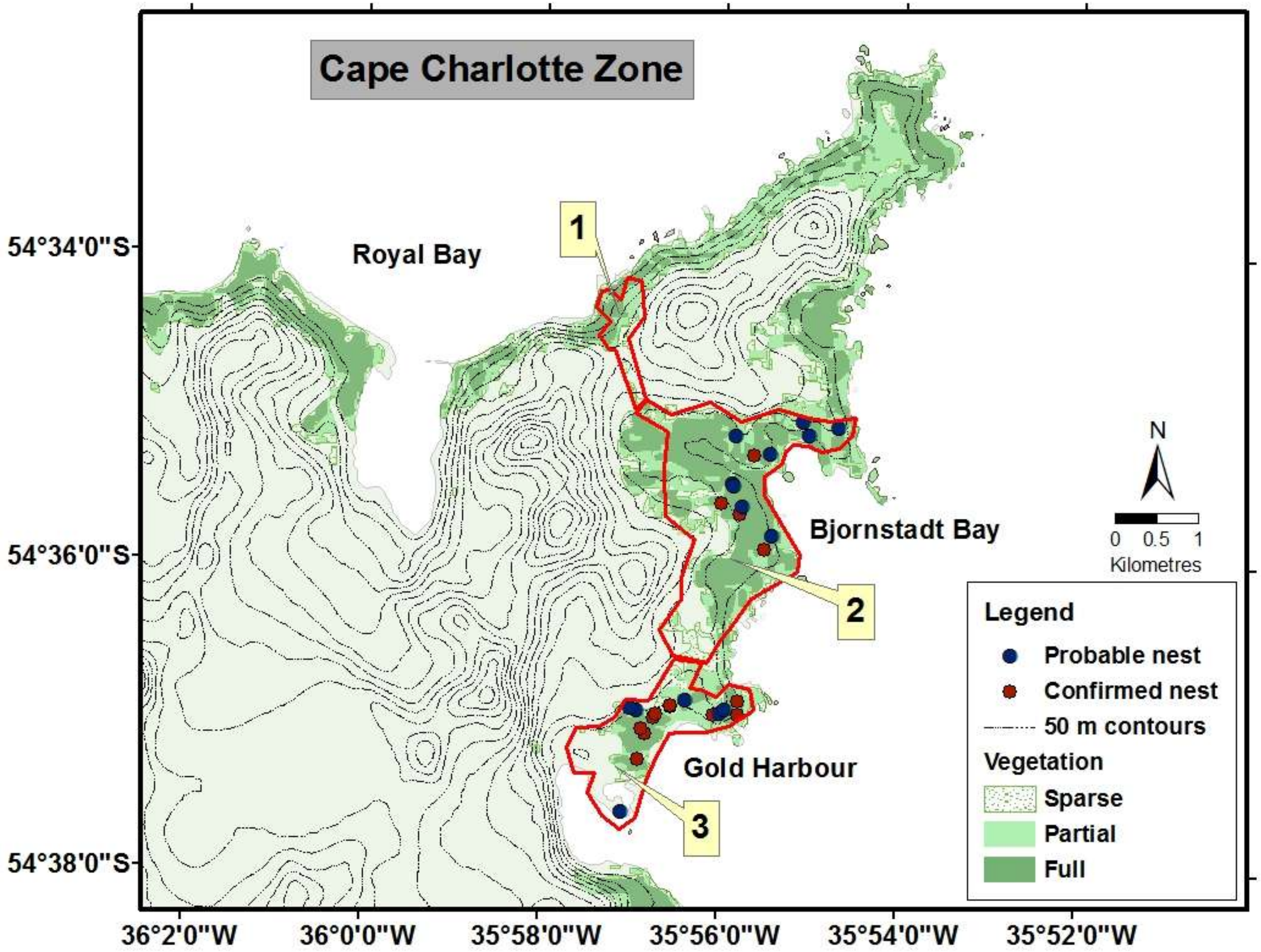

Figure AVI.9. Areas surveyed and the position of skua nests recorded in the Cape Charlotte Zone

Appendix VII. GREENE PENINSULA REPORT

Post-baiting rat monitoring on the Greene Peninsula

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Introduction

Greene Peninsula is situated within Cumberland Bay East and covers an area of approximately 4,100 hectares, of which 21% is vegetated (SGHT 2010). The Nordenskjöld and Harker Glaciers effectively isolated the population of rats on the Peninsula from those in the adjacent Barff and Thatcher zones.

As part of Phase 1 of the South Georgia Heritage Trust's rat eradication, the Greene Peninsula was baited via aerial spreading of brodifacoum pellets (supplied by Bell Laboratories, Wisconsin, USA) between 1st and 4th March 2011. The toxin was delivered within cereal based pellets (13 mm in diameter and weighing 3 g each). The concentration of the active ingredient in each pellet (25 parts per million) is designed to kill most rats after consumption of a single pellet. Bait was deployed on three separate passes. Initially, 2 kg of bait per hectare was dropped over the entire non-glaciated area, secondly an additional 4 kg/ha drop was made along the entire coastline before a final pass delivered a further 4.5 kg/ha over all densely vegetated areas (SGHT 2010).

Post-baiting monitoring is a critical part of pest eradications, particularly in trial areas where eradication protocols are being tested. In February 2012, two experienced fieldworkers took the opportunity to visit Greene Peninsula to search for signs of surviving rats and deploy wax chew tags for further monitoring.

Methods

Coastal and inland areas of the Greene Peninsula were searched from the 20th to the 23rd of February 2012, looking for sign that rats were present. Rat sign includes fresh feces, characteristically gnawed tussock, well-used runs and burrows. Although searches concentrated in areas with dense coastal tussock vegetation, tussock-acaena associations, festuca grassland and the edges of large rock outcrops or scree were also surveyed. GPS tracks were recorded as an indication of search area coverage (Fig. 1).

Figure 1. Monitoring for rat sign on the Greene Peninsula, February 2012. Tracks (red and black lines, see inset box) indicate area searched for rat sign, while squares show locations of wax tags.

During this period, peanut-flavoured wax chew tags (Pest Control Research, Christchurch New Zealand) were deployed for monitoring (Fig. 2). Tags were placed at 300–350 m intervals in the densely vegetated zone along the coast and at ~500 m intervals inland (reflecting the smaller area of likely rat habitat inland) (Fig. 1). The orange triangular tags were nailed to labeled red-topped wooden stakes (tag number WT ## at both ends of the stake), and placed to minimise disturbance by elephant seals and fur seals. Where possible, tags were located near old rat sign. Tag location was marked by GPS and site notes recorded.

Figure 2. The majority of the wax tags (orange triangle) were deployed in dense coastal tussock.

Results

Combined, the two observers covered 55 km of survey track in vegetated areas. Although old rat sign were found, there was nothing to indicate that live rats are currently present on the Greene Peninsula. Desiccated/old feces were found in runs, under ledges or on moss cushions, and old runs and burrows were clearly unused, with vegetation regrowth and infilling with leaf litter.

A total of 46 wax tags were deployed around the Greene (see Fig. 1 and Table 1). Of these, 37 were placed along the Sudan Beach and Balsam Beach coasts, mostly at the edge of tussock stands by the beach. Nine tags were placed inland, primarily in patches of tussock on the slopes of Eosin Hill (~200 m a.s.l.).

Table 1. Greene Peninsula rat monitoring wax tags deployed February 2012.

Tag #	latitude	longitude	notes	
WT01	-54.3229	-36.4486	coastal	Sudan Beach (N of hut). 3m up bank from striped boulder
WT02	-54.3209	-36.4454	coastal	Sudan Beach (N of hut). At inland edge of tussock flats on start of rise. On a tussock mound, behind a bog
WT03	-54.318	-36.4449	coastal	Sudan Beach (N of hut). At the start of the bank behind a tussock
WT04	-54.3155	-36.4465	coastal	Dartmouth Point. Right on the corner of the point.
WT05	-54.3263	-36.4568	coastal	Sudan Beach, south of hut.
WT06	-54.3289	-36.4583	coastal	Sudan Beach, south of hut.
WT07	-54.3317	-36.4601	coastal	Sudan Beach. By river, true left bank
WT08	-54.3345	-36.4627	coastal	Sudan Beach, on hillock.
WT09	-54.3375	-36.4642	coastal	Sudan Beach, at edge of beach
WT10	-54.3405	-36.4661	coastal	Sudan Beach, 3m from edge of beach
WT11	-54.3437	-36.4676	coastal	Sudan Beach, at edge of beach
WT12	-54.3465	-36.4702	coastal	Sudan Beach, at edge of beach by whalebone
WT13	-54.3487	-36.4741	coastal	Sudan Beach, at back edge of tussock
WT14	-54.3524	-36.4762	coastal	Sudan Beach. At big boulder at the edge of the beach.
WT15	-54.3551	-36.4793	coastal	Sudan Beach, 5m back from the beach
WT16	-54.3582	-36.4803	coastal	Sudan Beach, edge of beach on the glacier side of the river
WT17	-54.3613	-36.4824	coastal	Sudan Beach, in tussock
WT18	-54.3636	-36.4849	coastal	Sudan Beach, near end of tussock before moraine. Small stream on hill behind.
WT19	-54.3592	-36.3906	coastal	Balsam Beach edge of beach.
WT20	-54.3565	-36.3931	coastal	Balsam Beach edge of beach.
WT21	-54.3535	-36.3951	coastal	Balsam Beach edge of beach.
WT22	-54.3507	-36.3971	coastal	Balsam Beach edge of beach.
WT23	-54.3482	-36.4001	coastal	Balsam Beach edge of beach, 2m into tussock
WT24	-54.3461	-36.4032	coastal	Balsam Beach edge of beach.
WT25	-54.3435	-36.4063	coastal	Balsam Beach on ridge 5m back from edge of beach.
WT26	-54.341	-36.4093	coastal	Balsam Beach, 1m in from beach edge
WT27	-54.3384	-36.4123	coastal	Balsam Beach, edge of beach
WT28	-54.3356	-36.415	coastal	Balsam Beach, edge of beach
WT29	-54.3334	-36.4189	coastal	Balsam Beach, edge of beach
WT30	-54.3309	-36.4217	coastal	Balsam Beach, edge of beach
WT31	-54.3278	-36.4235	coastal	Balsam Beach, edge of beach
WT32	-54.3249	-36.4262	coastal	Balsam Beach, 1m in from beach edge
WT33	-54.322	-36.4275	coastal	Balsam Beach, 1m in from beach edge
WT34	-54.319	-36.4291	coastal	Balsam Beach ~2m from flat boulder at 'corner' in coast
WT35	-54.3246	-36.4536	coastal	Sudan Beach just below hut. By stream, right-hand bank
WT36	-54.3244	-36.4493	inland	Small flat-topped rock in festuca at edge of Eosin slope (old rat latrine under rock)
WT37	-54.3168	-36.4412	coastal	North-facing coast; tussock-acaena cluster.
WT38	-54.3174	-36.4349	coastal	North-facing coast; edge of a deep stream cut.
WT39	-54.3218	-36.4324	inland	At top edge of NW-facing slope (old rat latrine on moss)
WT40	-54.3242	-36.4379	inland	At top edge of NW-facing slope, near Eosin scree
WT41	-54.3281	-36.4326	inland	East slope of Eosin, below outcrop (old rat feces)
WT42	-54.3323	-36.4284	inland	East slope of Eosin, hard under rock outcop (old rat feces nearby)
WT43	-54.3369	-36.4258	inland	East slope of Eosin, top edge of tussock near outcrop (old rat feces)
WT44	-54.3349	-36.4512	inland	West-facing slope above Sudan Beach. Near small river, up on outcrop among white-chin burrows
WT45	-54.3316	-36.4496	inland	West facing slope; roughly SE of hut in high tussock, below outcrop (old rat feces nearby)
WT46	-54.3305	-36.4449	inland	West facing slope; up deep stream gully on true right bank, next to rock outcrop

All tags placed 20th-22nd February 2012

Conclusions

It is still too early to declare that the eradication of rats from the Greene Peninsula was successful but it is encouraging that the presence of rats is not evident a year after the bait was dropped.

We would recommend that all the tags are checked before the onset of winter and again in the early spring.

A single sub-adult pipit was observed on Sudan Beach, in the same area as others were seen in the late summer of 2011. Although pipits have apparently not recolonised the area yet, the presence of young birds in consecutive years bodes well for the future establishment of pipits on Greene Peninsula.

References

SGHT (2010) Operational Plan for the eradication of rodents from South Georgia: Phase 1. South Georgia Heritage Trust, 21 December 2010.

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