

The Kew logo is displayed in a green serif font, with a stylized leaf graphic to the right of the word.

PLANTS PEOPLE  
POSSIBILITIES

Survey for baseline information on introduced  
vascular plants and invertebrates: **South Georgia**

# Introduced Vascular Plants

January 2009

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Undertaken as part of the South Atlantic Invasive Species Project (SAISP), co-ordinated by the Royal Society for the Protection of Birds and funded by the European Commission through EDF-9.

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## **Acknowledgements:**

Thanks are due to a great number of people who have contributed to this project. Firstly we would like to thank Clare Stringer, RSPB, for supporting our project proposal and for advice in the early stages of the project. Thanks are also due to the Government of South Georgia and the South Sandwich Islands, in particular Harriet Hall for her feedback on our original site selection and hospitality on Christmas day and to Darren Christie for all his help with logistics and arranging permits.

In South Georgia we would like to extend our gratitude to Richard Hall and the rest of the British Antarctic Survey (BAS) team at Bird Island for their hospitality, advice on dealing with fur seals and escorting us through the seal infested tussock during our first day of field work; likewise to Dr Angharad Jones, medical officer at the BAS base at King Edward Point for responding to requests for advice on dealing with fur seal bites; Thies and Kicki Matzen of the yacht Wanderer III for their assistance in collecting seed for the species we were unable to; Pat and Sarah Lurcock for their hospitality and discussions regarding introduced species in Grytviken; Ainslie Wilson at the Grytviken Museum for interesting discussions regarding *Cardamine flexuosa*; and to Sally Poncet for her advice and information provided.

In the Falkland Islands we would like to thank Brian Summers, Falklands Conservation, for all his help in organising transport including the use of a Landover and for leaving supplies to tide us over Christmas day. For opening their home to us on Christmas day and for feeding us we would like to thank Richard Lewis, RSPB and Brian Bond. Thanks also to Rebecca Upson for her advice pre-trip and for her assistance with the additional seed exports.

At BAS in Cambridge, our thanks go to Dave Walton for his advice on methodology and for freely sharing his knowledge gained from past field work on South Georgia; to Helen Peat for assistance with herbarium specimens from the BAS herbarium and the provision of the hand drawn Husvik map and other useful documents. The provision of the Cumberland Bay satellite image was also greatly appreciated. We would also like to thank Ron Lewis Smith for his advice and Professor John Croxall for sending us the Price Olav buttercup specimen.

At the Royal Botanic Gardens, Kew we would like to profusely thank Justin Moat in the GIS Unit for his expert advice, assistance with satellite images and for recommending the Sample Design software that enabled us to easily generate random points; similarly, Steve Bachmann also from the GIS Unit; Rogier de Kok, Assistant Keeper, for his unwavering support at all stages of the project; Martin Hamilton in the United Kingdom Overseas Territories (UKOTs) team for the provision of PDA equipment and training in the use of PDA and ArcPad; Marcella Corcoran, also of the UKOT team, for her advice and encouragement; William Milliken, head of the Tropical America team, for advice on survey techniques; Henk Beentje of the Dryland Africa team for his support in the early stages of this project; to Tom Cope and Dave Simpson in the Monocots Section for their assistance with identification of grasses and sedges.

From Buglife we should thank our fellow researchers and expedition companions, entomologists Roger and Rosy Key who gave us an insight into the insect world with their strange collecting contraptions and wonderful specimens. Thanks also to Jamie Roberts for his work on the original project proposal.

Finally, from SV Seal we would like to extend a massive thanks to the whole crew: skipper Hamish Laird whose expertise in navigating both the Southern Ocean and the incompletely charted waters around South Georgia, kept us safe throughout the trip and enabled us to visit as many survey sites as possible; Keith Jacobs for delivering us safely ashore and back each day, for all his work onboard and for his brave anchoring of the shore lines that stormy night at Cobblers Cove; Jess Abbott for her expert sailing, identification of *Trisetum spicatum*, keeping us well fed and for the numerous birthday cakes she skilfully whipped up during the trip. To Hamish and Jess, thanks are also due for collecting the coveted Prince Olav buttercup on their return trip to South Georgia. To all three we are eternally grateful for their kindness during bouts of seasickness and especially their combined effort and persistence in attempts to bring us back onboard when we were sure we would be spending a freezing cold and stormy night at Stromness.

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## Summary

This baseline survey of introduced vascular plants on South Georgia was carried out at 16 sample sites around the island over 27 days. The sample sites included historical hotspots for introduced species (former whaling stations and settlements), new potential hotspots for introductions (popular visitor sites) and comparative less-visited sites. Four survey strategies were used: i. random quadrat sampling, ii. belt transects, iii. general searching and recording and iv. monitoring historical records. Field data were recorded using hand-held computers and all records were automatically georeferenced by the in-built GPS. Herbarium specimens and DNA samples of introduced and native species were collected. Digital images were recorded for the species records, random quadrat samples and belt transect samples.

For each sample site a full description of the survey work and findings is given. This includes a list of the introduced species found and a summary of their distribution and abundance at the site. The native vegetation at each site is summarised and relevant site features are listed. Maps showing the records of each introduced species at each site are appended.

24 introduced vascular plant species were recorded during this survey including *Trisetum spicatum*, which had not previously been recorded on South Georgia. For each of these species the historical records from South Georgia and records from the current survey are discussed, the invasive potential is assessed and recommendations are given.

Overall we recommend the eradication of all introduced vascular plant species on South Georgia, though we recognise that some species are now so widespread that eradication would be impractical. However, there are a number of introduced species for which timely intervention could prevent further spread. We recommend the eradication of 20 of the 24 species recorded in this survey. Eradication methods are proposed and suggested methods discussed. Recommendations for further survey and monitoring are also included.

## Background

This survey is part of the South Atlantic Invasive Species (SAIS) project funded by the European Commission and managed by the Royal Society for the Protection of Birds (RSPB). The project aims to build capacity to deal with the issue of invasive species in the South Atlantic UK Overseas Territories. South Georgia and the South Sandwich Islands is one of five territories that are included in this program.

Invasive species are one of the most significant threats to the conservation of island habitats. The Environment Charter for South Georgia includes a commitment by the Government of South Georgia and the South Sandwich Islands to '*ensure the protection and restoration of key habitats, species and landscape features*' and to '*attempt the control and eradication of invasive species*' (GSGSSI, 2009). Invasive species groups recorded on South Georgia include plants, invertebrates and vertebrates. The Government have highlighted the need to augment the current baseline information on the introduced vascular plants and invertebrates, including the presence, distribution and invasive potential of these species. This survey work has been undertaken as a joint botanical and entomological expedition by The Royal Botanic Gardens, Kew and Buglife, the Invertebrate Conservation Trust.

The Royal Botanic Gardens, Kew is currently collaborating in several projects identifying and quantifying the invasive species threats in the UK Overseas Territories. This work is in line with Target 10 of the Global Strategy for Plant Conservation (GSPC) which aims to halt the current and continuing loss of plant diversity. This baseline survey of introduced plants on South Georgia and evaluation of the invasive potential of the introduced species will provide the Government with necessary information to make informed conservation management decisions for the future.

### Terminology:

**Vascular plants** refers to plants that have a vascular system. This includes the seed-bearing plants, ferns and clubmosses. (Mosses and liverworts are non-vascular and are not included in this survey).

**Native plants** are those plants that are considered to have colonised South Georgia before humans arrived on the island in the late 18<sup>th</sup> century.

**Introduced plants** are those that arrived on South Georgia as a result of human activity on the island. These are often referred to as 'aliens' in the literature.

**Invasive species** is a subjective term that can be defined in a number of different ways. Within the South Atlantic Invasive Species project, the Convention on Biological Diversity (CBD) definition of 'Invasive Alien Species' (IAS) is accepted. The CBD defines invasive alien species as 'species whose introduction and/or spread outside their natural distribution threatens biological diversity'. **For the purposes of this report, introduced plant species are considered to be invasive if they are successfully colonising natural habitats on South Georgia.** This definition encompasses both introduced plants that colonise native vegetation and those that colonise non-vegetated habitats. Non-vegetated natural habitats may be important for the survival of native fauna and could be threatened if colonised by introduced plants. Where introduced species colonise native vegetation, those that form dense populations, conspicuously displacing the native vegetation, may appear to be more 'invasive', posing more of a threat to native species. However, while this may be the case, even those that colonise at low density may pose a threat to the structure of native plant communities. The vegetation ecology on South Georgia is still little understood, particularly with regards to bryophytes, fungi and lichens, which form an important component of the biological diversity of South Georgia.

# Introduction

The vascular flora of South Georgia is well documented and a systematic account was published by Greene in 1964. At this time, 24 native species and five 'naturalised aliens' were recognised. In addition, a further 22 introduced species had been recorded on the island and were classed as 'transient aliens' (Greene, 1964).

The introduced vascular plants recorded by Greene arrived on South Georgia from northern Europe, firstly with sealers from the late 18<sup>th</sup> century and later with the whaling industry. Some plants were deliberately introduced for cultivation while most were introduced accidentally, brought in with building materials, soil, livestock and fodder.

In 1973 Walton and Smith published the *Status of the alien vascular flora of South Georgia*. This comprehensive study put together all records of introduced plants species from 1902-1972 and classified them into four categories:

- i. Transient
- ii. Persistent
- iii. Restricted naturalised
- iv. Widespread naturalised

This classification is used in the current report and the categories are defined as follows (adapted from Walton and Smith, 1973):

**Transient** species are those that have survived as one or a few individuals, only in habitats created by human activity and only for 1-2 years. By 1973, 20 transient introduced species had been recorded on South Georgia including plants that were introduced for cultivation such as potato *Solanum tuberosum* and caraway *Carum carvi*.

**Persistent** species are those that have survived as one or a few individuals for many years in either natural or anthropogenic habitats. 16 persistent introduced species were listed by Walton and Smith in 1973.

**Restricted naturalised** species are those that have survived as one or a few small populations for many years and have spread into and displaced the native vegetation, but usually only by vegetative spread. Eight restricted naturalised species were listed by Walton and Smith in 1973.

**Widespread naturalised** species are those that have survived for many years, forming numerous populations that have spread into and displaced the native vegetation, spreading by seed and often vegetatively as well. Seven widespread naturalised species were listed by Walton and Smith in 1973.

Overall, 51 introduced species had been recorded on South Georgia by 1973 and of these, 31 species were considered to be persistent or naturalised.

Since 1973, a further eleven introduced plants have been recorded on South Georgia (BAS, 2008). The most recent introduction is wavy-leaved bittercress *Cardamine flexuosa*, which was accidentally introduced during building works at King Edward Point in 2000 (Summers, 2009).

The threat of new vascular plant species being introduced on South Georgia has been greatly reduced in recent years since the Government have put strict biosecurity measures in place. Guidelines for visitors and commercial contractors include bootwashing with biocide and checking and cleaning all clothing, bags and equipment that will be brought ashore at each site visited around the island. However, there is still a risk of seed or spores being introduced and therefore monitoring the status of the introduced flora is essential.

Baseline survey and monitoring of introduced species is relevant in the light of increasing summer temperatures on South Georgia. The changing climate may result in persistent

introduced species (those that have not spread in the past) producing viable seed and becoming invasive. This could occur through provision of a longer growing season or through the survival of introduced insect pollinators.

## **Objectives**

The aim of this survey is to provide baseline information on the current status of the introduced vascular plants on South Georgia. In addition, we aim to provide an efficient and cost effective survey strategy that is fully repeatable so that it can be used for long term monitoring. The outputs of the survey include:

- Full details of survey methods used.
- Maps of locations sampled and distributions of introduced species.
- A user-friendly guide to all the introduced plant species found, including colour images and field characters for identification.
- Botanical specimens of the native and introduced plant species found. These will be digitally imaged, databased and catalogued at the Herbarium at the Royal Botanic Gardens, Kew and duplicates sent to the British Antarctic Survey in Cambridge.
- Assessment of introduced species, their phenology, reproductive fitness and invasive potential.
- Potential strategies for addressing any identified threats from introduced species.
- Recommendations for future work including monitoring, conservation assessments and future modelling with climate change.



## Methods

### Logistics:

South Georgia is remote and only accessible by sea. As a condition of the visitor permit issued by the Government of South Georgia and the South Sandwich Islands, all visitors are required to have vessel-based support for the duration of their visit. To increase the number of sites surveyed during this study and to keep in line with government permit requirements, an International Association of Antarctica Tour Operators (IAATO) registered vessel, SV Seal was chartered. For details of SV Seal, please see Appendix 2. Survey work was carried out at each of the sites marked below using the support vessel as a base. A motorised dinghy was used to travel between the support vessel and the survey sites each day.

South Georgia is under snow during the southern hemisphere winter months and has a large fur seal population with a breeding season running from November to January. During this time, fur seals can be notoriously aggressive making onshore work hazardous at some sites (Harriet Hall, pers. comm.). To avoid the peak fur seal breeding season and to maximise the chance of encountering as many plants in a fertile state as possible the field work was conducted in January.

### Site selection:

With a limited survey time of 27 days it was necessary to select sample sites to survey around the island. Primarily these had to be accessible bays with safe dinghy landing sites. From the accessible sites we chose to focus on both historical hotspots for introduced species (former whaling stations and settlements) and new potential hotspots for introductions (popular cruise ship visitor sites). We also selected some comparative less-visited sites. A final site selection was made in consultation with the Government of South Georgia and South Sandwich Islands. The actual sites surveyed and field time at each site were determined by the weather conditions and accessibility for dinghy landings at the time of survey. For a detailed itinerary please see Appendix 1.

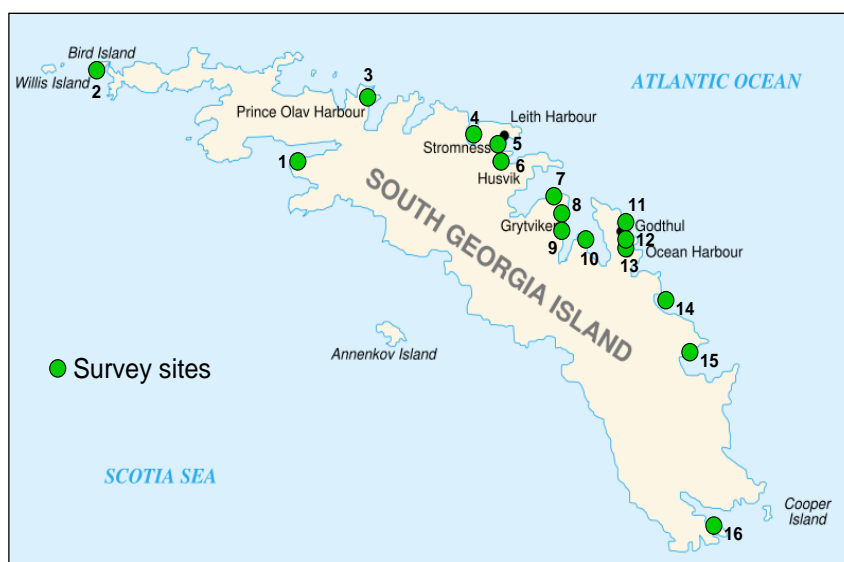


Figure 1: Survey sites

- |                        |                      |                    |
|------------------------|----------------------|--------------------|
| 1. Cape Rosa           | 7. Maiviken          | 13. Ocean Harbour  |
| 2. Bird Island         | 8. Grytviken         | 14. St Andrews Bay |
| 3. Prince Olav Harbour | 9. Hestesletten      | 15. Moltke Harbour |
| 4. Fortuna Bay         | 10. Greene Peninsula | 16. Larsen Harbour |
| 5. Stromness           | 11. Godthul          |                    |
| 6. Husvik              | 12. Cobblers Cove    |                    |

## Data capture:



**Figure 2: using a PDA in the field**

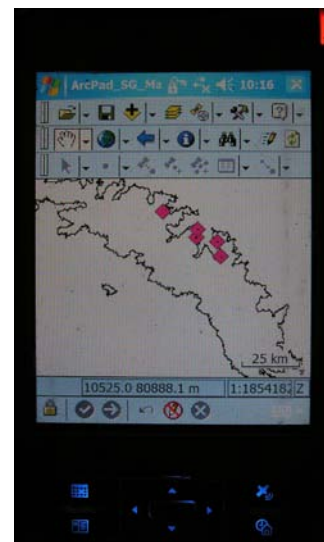
Handheld personal digital assistants (PDAs) (Fujitsu-Siemens LOOX N560) with an in-built Global Positioning System (GPS) were used to record survey data in the field.

Running ArcPad software (Version 7.1) developed by ESRI (ESRI, 2009), we used a pre-fixed series of dropdown menus and freestyle text fields to record survey data such as species composition and abundance in a uniform manner. Details of the information recorded and an explanation of each field is given in Appendix 3. These were adapted from Hamilton (2008) for the purpose of this survey.

Using ArcPad and the in-built GPS on the PDAs, it was possible to view satellite images or map outlines of each site on-screen with a symbol to indicate GPS-derived user location at that moment in time. When data was gathered using each of the survey methods detailed below each saved record was displayed as a new point on the map (see Figure 3).

To make the use of PDAs practical for field work in the South Georgia climate they were housed in sturdy waterproof cases (Otterbox, 2009) which protected them from even the heaviest of downpours.

Altitude readings were made using separate barometric altimeters, recalibrated at sea level each morning.



**Figure 3: outline map of South Georgia on a PDA**

## Survey methods:

Four survey strategies were used for this baseline survey:

1. Random quadrat sampling
2. Systematic sampling - belt transects
3. General searching and recording
4. Monitoring historical records

These survey methods were chosen to give the best representation of the status of introduced vascular flora in the time available for the study.

Where possible and appropriate the ideal methodology for each survey site was a combination of all four methods, carried out over a period of two days or more. Getting ashore to conduct fieldwork was dependent on safe weather and landing conditions however and not always possible.

### 1. Random quadrat sampling

Random quadrat sampling was conducted on the first day at most sites, with the rationale that a large area of each survey site was covered as we walked from one random point to another, allowing us to simultaneously implement method three: general searching and recording. This increased the amount of data gathered during day one, should we be unable to land again at the site. Random sampling also allowed the survey of a relatively large area in the limited time we had for each site.

Satellite images from Google Earth (2008) and images supplied by the British Antarctic Survey, where available, were consulted for each site along with Poncet and Crosbie's *A Visitor's Guide to South Georgia* (2005) to select a survey area across which the random quadrat points would be generated. The area was selected with the aim of achieving reasonable coverage of the survey site in one day, including as great a range of the geographic features and vegetation types present as possible.

Random points were generated using a downloadable extension for Arcpad called Sample Design (Sample Design, 2009). The desired survey area was

selected by drawing an outline polygon over the digital satellite image for the site. Random points were then automatically generated within the polygon area, transferred to the PDAs and taken on-site, where the in-built GPS and tracking function allowed each point to be located.

At each random point a marker peg was put in the ground and a 1x1 m nylon string quadrat pegged out using a compass to orient the sides of the quadrat north-south and east-west. The 'ACFOR' scale was used to describe the abundance of each species of vascular plant present within each quadrat (see Table 1). The percentage cover for each species was also estimated and recorded. A digital photograph of each quadrat was taken from above (where the terrain allowed).



**Figure 4: random sample 1x1 m string quadrat**

A	<b>Abundant</b>	The species observed is " <b>A</b> bundant" within the given area.
C	<b>Common</b>	The species observed is " <b>C</b> ommon" within the given area.
F	<b>Frequent</b>	The species observed is " <b>F</b> requent" within the given area.
O	<b>Occasional</b>	The species observed is " <b>O</b> ccasional" within the given area.
R	<b>Rare</b>	The species observed is " <b>R</b> are" within the given area.

**Table 1: ACFOR scale**

required. It allowed us to cover a much larger area of each site than belt transects alone would have in the given time. This was important to maximise our chances of finding introduced vascular plant species in areas outside our belt transects and contributed to method number three in the above list: general searching and recording.

If any random point was unusable (for example, it fell in the middle of an elephant seal wallow, or down an inaccessible cliff face), the random point was discounted.

Random sampling has the advantages of reducing surveyor bias and generating data suitable for statistical analysis if

## 2. Systematic sampling - belt transects



**Figure 5: 2x10 m belt transect line, St Andrews Bay**

At most sample sites a consecutive series of 2x10 m belt transects were measured out using a 10 m length of nylon rope. These were taken radiating out from likely points of introduction – whaling station boundaries, places of past and present habitation, and present day landing sites. The degree bearing of the first transect section was recorded using a standard compass, and checked for each consecutive section to ensure a straight line. Data points, including GPS coordinates, were made at the beginning of each 2x10 m section. The ACFOR scale was used to indicate the abundance of each vascular plant species in each transect. The percentage cover for each species was also estimated. Where transects crossed large homogenous stands of vegetation the transect sections were increased to 2x50 m.

### 3. General searching & recording

General searching and recording of introduced species were carried out throughout the survey. Walking around the survey sites (particularly when moving from one random quadrat point to another) provided an opportunity to observe and record introduced species falling outside the random quadrats and belt transects.

This method was particularly aimed at species with restricted distributions where small populations may have been present, but did not occur within the random quadrat and belt transect samples. Widespread species that fell within the vegetation samples were not exhaustively recorded.

### 4. Monitoring historical records

A list of known introduced plant species and their locations (where available) was compiled from the available published literature, websites and herbarium databases at Kew and the British Antarctic Survey (BAS, 2008). Staff at BAS also provided an unpublished paper (MacAlister, 1995) and an annotated plan of Husvik whaling station (BAS, unknown) with the locations of several introduced species indicated.

Where possible the historical records were monitored, searching the recorded localities for each species. GPS coordinates, the current size of the population and reproductive status were recorded for each species found, providing baseline data against which future measurements can be taken. Full details of the data recorded are given in Appendix 3.



Figure 6: General searching at Husvik

#### Collection of herbarium specimens:

Herbarium specimens were made for each of the native and introduced vascular plant species encountered. Wherever possible two or more duplicates of each collection were made, to be deposited at Kew (K\*) and the British Antarctic Survey herbarium, Cambridge (AAS\*). In due course all specimens collected will be digitally scanned and available to view on the RBG Kew website (<http://apps.kew.org/herbcat/navigator.do>). Images will also be held at BAS, Cambridge. For a detailed account of plant collecting methodology please refer to *The Herbarium Handbook* (Bridson & Forman, 1993). Specimens were dried successfully over the heater in the foul weather gear locker onboard the support vessel SV Seal. [\*Holmgren *et al.* (1990)]

#### Collection of samples for DNA analysis:

DNA samples of both native and introduced species were collected. Approximately five grams of fresh plant material were harvested for each sample and deposited as soon as possible into a small sealable plastic bag containing 50 grams of fine grain silica gel with added indicator (Sigma-Aldrich silica gel, grade 12, 28-200 mesh with coloured indicator). For every DNA sample a herbarium specimen was also taken for verification and future reference. DNA samples have been sent to the Jodrell Laboratory at the Royal Botanic Gardens, Kew, where they will be stored, available for future DNA analysis.



Figure 7: plant specimens dried in silica gel, for DNA analysis

### Seed collection:



**Figure 8: collecting seeds of *Colobanthus subulatus* at Maiviken**

Seed of native taxa was collected at the request of the South Georgia Government for *ex-situ* conservation of the island's flora. The seed will be stored at Kew's Millennium Seed Bank (MSB), Wakehurst Place, Sussex, UK and will be available for future *in-situ* conservation initiatives should the need arise.

Seed of introduced taxa was also collected and sent to the MSB for germination tests to assess their viability. Studies are ongoing and results will be forwarded to the South Georgia Government as they become available.

For a comprehensive explanation of seed collecting methods, please see Way (2003). The data sheet used for recording information for seed collection is included in Appendix 4.

### Survey Equipment:

A detailed list of the equipment used is given in Appendix 2.

## Results and discussion

24 introduced vascular plant species were recorded on South Georgia during the current survey (see Table 2). One of these species, *Trisetum spicatum*, has not previously been recorded on South Georgia.

Species	Family
<i>Achillea millefolium</i>	Compositae
<i>Agrostis capillaris</i>	Poaceae
<i>Agrostis vinealis</i>	Poaceae
<i>Anthriscus sylvestris</i>	Umbelliferae
<i>Cardamine flexuosa</i>	Cruciferae
<i>Carex aquatilis</i>	Cyperaceae
<i>Carex nigra</i>	Cyperaceae
<i>Cerastium fontanum</i>	Caryophyllaceae
<i>Deschampsia cespitosa</i>	Poaceae
<i>Elymus repens</i>	Poaceae
<i>Festuca rubra</i>	Poaceae
<i>Nardus stricta</i>	Poaceae
<i>Poa annua</i>	Poaceae
<i>Poa pratensis</i>	Poaceae
<i>Pratia repens</i>	Campanulaceae
<i>Ranunculus repens</i>	Ranunculaceae
<i>Rumex acetosella</i>	Polygonaceae
<i>Rumex crispus</i>	Polygonaceae
<i>Sagina procumbens</i>	Caryophyllaceae
<i>Taraxacum officinale</i>	Compositae
<i>Trifolium repens</i>	Poaceae
<i>Trisetum spicatum</i>	Poaceae
<i>Vaccinium vitis-idaea</i>	Ericaceae
<i>Veronica serpyllifolia</i>	Scrophulariaceae

**Table 2: Introduced vascular plant species recorded on South Georgia, January 2009**

### Survey sites

A full description of the survey work and findings at each of the 16 survey sites is given in Appendix 8. The 16 site accounts include a map of the survey records, a list of the introduced species and a summary of the distribution and abundance of each species at the site. In the distribution and abundance summaries, species are classed as either 'widespread' or 'restricted'. Species are considered widespread if found at more than one locality within the site and at a distance greater than 500 m apart. Abundance is categorised using the ACFOR scale (see Table 1). Maps showing the introduced species recorded at each site are included in Appendix 10. The native vegetation at each site is summarised and relevant site features are listed. Historical records of introduced species at the survey sites are discussed where applicable.

### Introduced species

In Appendix 9, accounts for each of the 24 recorded species are given. These include a short discussion of the historical records from South Georgia, records from the current survey, invasive potential and recommendations. Key field characters, notes on habitat and global distribution are also included.

### Introduced species summary table

A species summary table including recommendations is given below (see Table

3). In addition to the 24 species recorded in the current survey, 20 species recorded at the survey sites in the past are also included. These 20 species were classed as persistent or naturalised by Walton and Smith (1973), or have been recorded since 1973. Species classed as transient by Walton and Smith are not included unless they have subsequently been recorded. The table indicates the status of introduced species as classified by Walton and Smith in 1973 and a classification from the current survey (see Introduction for a definition of the classes used).

A number of the introduced species seen in 1973 were not found during the current survey. While it is likely that some of these species are no longer present on South Georgia, others may still be present within the whaling station exclusion zones and in other areas not covered during the current survey. Interestingly, none of the species that were both classified by Walton and Smith in 1973 and found in the current survey appear to have changed in status. However, some species classed as 'persistent' that were not observed to set seed in the past now appear to set seed and therefore have potential to become invasive. The invasive potential of each species is summarised in the table as either 'high' or 'low'. Species that are widespread and those that appear to be setting seed are classed as having a 'high' invasive potential.

**Table 3: Introduced species summary table**

Species	Family	Previous classification, 1973*	Current classification, January 2009	Invasive Potential	Notes and Recommendations
<i>Achillea millefolium</i>	Compositae	Restricted naturalised	Restricted naturalised	Low	Eradication recommended
<i>Achillea ptarmica</i>	Compositae	Restricted naturalised	Not found	-	
<i>Agrostis canina</i>	Poaceae	-	Not found	-	
<i>Agrostis capillaris</i>	Poaceae	Widespread naturalised	Widespread naturalised	High	Priority for eradication - highly invasive. Further survey and mapping recommended
<i>Agrostis vinealis</i>	Poaceae	-	Restricted naturalised	Low	Eradication recommended
<i>Alchemilla monticola</i>	Rosaceae	Transient	Not found	-	
<i>Allium schoenoprasum</i>	Alliaceae	Persistent	Not found	-	
<i>Anthoxanthum odoratum</i>	Poaceae	-	Not found	-	Further survey at Husvik recommended
<i>Anthriscus sylvestris</i>	Umbelliferae	Persistent	Persistent	High	Priority for eradication - may be setting viable seed
<i>Artemisia</i> sp.	Compositae	Persistent	Not found	-	
<i>Capsella bursa-pastoris</i>	Cruciferae	Persistent	Not found	-	
<i>Cardamine flexuosa</i>	Cruciferae	-	Widespread naturalised	High	Priority for eradication - highly invasive
<i>Carex aquatilis</i>	Cyperaceae	Persistent	Persistent	Low	Eradication recommended
<i>Carex nigra</i>	Cyperaceae	Restricted naturalised	Restricted naturalised	Low	Eradication recommended
<i>Cerastium fontanum</i>	Caryophyllaceae	Widespread naturalised	Widespread naturalised	High	Currently so widespread that eradication would be impractical
<i>Deschampsia cespitosa</i>	Poaceae	Widespread naturalised	Widespread naturalised	Low	Eradication recommended
<i>Deschampsia flexuosa</i>	Poaceae	-	(Restricted naturalised - identification uncertain)	-	Further survey at Husvik recommended
<i>Elymus repens</i>	Poaceae	Restricted naturalised	Restricted naturalised	Low	Eradication recommended
<i>Empetrum rubrum</i>	Empetraceae	Persistent	Not found	-	Further survey at Hestesletten recommended
<i>Festuca ovina</i>	Poaceae	-	Not found	-	
<i>Festuca rubra</i>	Poaceae	Restricted naturalised	Restricted naturalised	Low	Eradication recommended
<i>Juncus filiformis</i>	Juncaceae	Restricted naturalised	Not found	-	
<i>Lotus corniculatus</i>	Leguminosae	-	Not found	-	
<i>Nardus stricta</i>	Poaceae	Persistent	Persistent	Low	Eradication recommended



Species	Family	Previous classification, 1973*	Current classification, January 2009	Invasive Potential	Notes and Recommendations
<i>Plantago media</i>	Plantaginaceae	Persistent	Not found	-	
<i>Poa annua</i>	Poaceae	Widespread naturalised	Widespread naturalised	High	Currently so widespread that eradication would be impractical
<i>Poa pratensis</i>	Poaceae	Widespread naturalised	Widespread naturalised	High	Currently so widespread that eradication would be impractical
<i>Poa trivialis</i>	Poaceae	Restricted naturalised	Not found	-	Further survey at Grytviken recommended
<i>Pratia repens</i>	Campanulaceae	-	Restricted naturalised	Low	Eradication recommended
<i>Ranunculus acris</i>	Ranunculaceae	Persistent	Not found	-	
<i>Ranunculus repens</i>	Ranunculaceae	Restricted naturalised	Restricted naturalised	High	Priority for eradication - may be setting viable seed
<i>Rorippa islandica</i>	Cruciferae	Persistent	Not found	-	
<i>Rumex acetosella</i>	Polygonaceae	Widespread naturalised	Widespread naturalised	High	Priority for eradication - highly invasive. Further survey and mapping recommended
<i>Rumex crispus</i>	Polygonaceae	Persistent	Persistent	Low	Eradication recommended
<i>Sagina procumbens</i>	Caryophyllaceae	Persistent	Persistent	High	Priority for eradication - may be setting viable seed
<i>Sinapis</i> sp.	Cruciferae	-	Not found	-	
<i>Sonchus</i> sp.	Compositae	-	Not found	-	
<i>Stellaria media</i>	Caryophyllaceae	Transient	Not found	-	
<i>Taraxacum officinale</i>	Compositae	Widespread naturalised	Widespread naturalised	High	Currently so widespread that eradication would be impractical
<i>Trifolium hybridum</i>	Leguminosae	Persistent	Not found	-	
<i>Trifolium repens</i>	Poaceae	Persistent	Persistent	Low	Eradication recommended
<i>Trisetum spicatum</i>	Poaceae	-	Widespread naturalised	High	Currently so widespread at Stromness that eradication may be impractical. Further survey and mapping recommended.
<i>Vaccinium vitis-idaea</i>	Ericaceae	-	Restricted naturalised	Low	Eradication recommended
<i>Veronica serpyllifolia</i>	Scrophulariaceae	Persistent	Persistent	High	Priority for eradication - may be setting viable seed

\* Walton and Smith, 1973.

### **Introduced species native to the southern hemisphere**

Most of the introduced species recorded are native to the northern hemisphere and it is easy to conclude that they were introduced on South Georgia as a result of human activity. However, this is less clear-cut with species that are native to the southern hemisphere as it is possible that they could colonise naturally from the Falkland Islands or South America. Colonisation of islands by new species is a natural process and management policy should take this into consideration to avoid preserving island floras in a static and artificial state. *Pratia repens* and *Trisetum spicatum* are both native to the Falkland Islands and southern South America. However, we feel that since these species are found in the vicinity of the whaling stations on South Georgia, it is most likely that they were introduced.

### **Survey data**

Overall, 600 vegetation samples were recorded, including 284 1x1 m random quadrat samples and 316 belt transect samples (2x10 m or 2x50 m). The full survey data collected are included in the attached database (CD ROM). These data include all the records of native and introduced vascular plants recorded within the random quadrats, belt transects, during general searching and monitoring of historical records. Digital images of the samples are included.

### **Herbarium specimens and DNA samples**

111 herbarium specimens were collected during the survey, including 42 specimens of introduced vascular plants and 69 specimens of native vascular plants. The specimens will be digitally imaged, databased and catalogued at the Herbarium at Kew, available to view on the RBG Kew website (<http://apps.kew.org/herbcat/navigator.do>) and duplicates sent to the British Antarctic Survey in Cambridge. A list of the herbarium specimens is given in Appendix 6. DNA samples were taken from 108 of these specimens. In addition, 19 moss specimens were collected. These will be sent to the Natural History Museum in London and duplicates sent to the British Antarctic Survey in Cambridge.

### **Seed collections**

10 seed collections were made during the survey, including seed of three introduced species and seven native species. The seed will be stored at RBG Kew's Millennium Seed Bank. A further 64 seed collections were made by Kiki and Thies Matzen, who are based on South Georgia for a year and who volunteered to continue the seed collecting after we left the island as many species had not yet set seed. In total, seed of 30 species (16 native and 14 introduced species) has been collected and most collections have now arrived at the Millennium Seed Bank, where the seed will be tested for viability and stored in the seed bank. A list of seed collections is given in Appendix 7.

### **Survey methods**

Four strategies were used in the current survey (see Methods). Given the time constraints for the survey work and the scale of the survey sites, we found that monitoring historical records and random quadrat sampling were the most successful methods for surveying introduced vascular plants on South Georgia.

Random quadrat sampling enabled us to rapidly sample the vegetation across large areas of each site in an unbiased manner. We achieved an average of 24 random quadrat samples per day, working in two teams. Varying quadrat densities were used at each of the survey sites as the sites varied in size and we tried to cover as much of each site as possible. The coverage ranged from 15 to 134 quadrats per km<sup>2</sup>. If random sampling is to be used for vegetation analysis in the future then ideally the quadrat density should be standardised. We recommend a density of >100 quadrats per km<sup>2</sup>.

Belt transects were also a useful survey method but took longer to implement. In most cases the distributions of introduced species were either widespread and patchy or restricted to localised populations and patterns of radiation from points of introduction were not seen along the transects. However, there is one example (at a small scale) for *Carax aquatilis* at Husvik (see Map 6.3), which appears to be spreading out from the radio hut. Belt transects are not recommended for future surveys unless much longer field time is available.

General searching and recording was an important method allowing for small populations that occurred outside the vegetation samples to be recorded when they were found. Searching and recording is particularly recommended around the whaling stations and other hotspots of introduction.

Historical records of introduced vascular plants were extremely helpful for this survey as many of the introduced species had restricted distributions. The records from this survey are all geo-referenced and future monitoring of these records will be facilitated by GIS and satellite image technology.

In addition to the four survey strategies, we collected herbarium specimens and recorded digital images during the survey. Herbarium specimens provide a tangible record of introduced species. They enable accurate identification and future taxonomic work. The identification of all the vascular plant specimens collected during this survey has been confirmed at the Herbarium at Kew. We also recorded digital images for species records, random quadrat samples and belt transect samples. These images are helpful for identification and provide an important resource for future monitoring work.

### **Reindeer**

As indicated by Leader Williams *et al.* (1987) and the South Georgia Management Plan (McIntosh and Walton, 2000), reindeer have a significant and detrimental impact on the native vegetation. The impact of reindeer grazing on the introduced plant species on South Georgia appears to vary according to the species. Reindeer appear to control the population of *Taraxacum officinale* but act as a vector for the spread of *Poa annua* also maintaining this species in dense, closely grazed swards. Because of their impact on the native vegetation, we recommend that the reindeer are removed as soon as possible. The subsequent effects of reindeer removal on introduced plant species should be monitored in addition to monitoring the recovery of the native vegetation.

# Recommendations

## Eradication of introduced vascular plant species

Overall we recommend the eradication of all introduced vascular plant species on South Georgia, though we recognise that some species are now so widespread that eradication would be impractical. However, there are a number of introduced species for which timely intervention could prevent further spread. The recommendations for each of the introduced species found during this survey are summarised in Table 3. We recommend the eradication of 20 of the 24 species recorded in this survey. Suggested methods for their eradication are given in Table 4 below. Many of the introduced species are currently restricted to small populations in Grytviken and their removal should be quick and cheap.

### Eradication methods

The methods listed below are generic and trials are recommended to determine the most effective methods for individual species. All populations should be geo-referenced, measured (area) and photographed before eradication methods are applied, to facilitate monitoring of the sites for regrowth or seedlings. Marking the sites with posts may be useful in the short term. Each population should then be treated, monitored at appropriate intervals and re-treated as necessary until no re-growth is observed and no new plants are recorded for several years.

#### 1. Manual removal

Labour intensive, but the most ecologically sound method. Shallow rooted species can be pulled out by hand. Deeper rooted species will need to be dug out. If possible, all underground parts should be removed to prevent re-growth and vegetative spread. Accurate timing is needed to catch the plants before they set seed (if applicable) and sites will have to be revisited over several seasons to ensure that the soil seed bank is exhausted. The plant material should be incinerated or removed from the island if possible. Soil disturbance is a disadvantage of this method.

#### 2. Weed mat

Appropriate for smaller areas in localities where the ground is unlikely to be disturbed by animals. A light-excluding woven membrane that is either pegged down or weighted down with a layer of stones and gravel can suppress plant growth for several seasons. A robust, biodegradable weed mat is recommended. This solves the problems of both vegetative spread and regeneration from the soil seed bank. The initial cost of the weed mat is balanced by a reduction in the need to re-treat the area. Restoration of native vegetation following treatment with a weed mat may be required and could be achieved by either seeding or transplanting.

#### 3. Flame weeding/weed burners

Most appropriate for smaller areas such as disturbed ground around the whaling stations. This method should kill seeds on the soil surface as well as shallow-rooted plants. This is a possible solution for *Cardamine flexuosa*, which is quick growing and produces seeds continuously throughout the summer season. However, frequent repeat applications may be necessary, making it labour intensive.

#### 4. Herbicides

The cheapest solution for large areas, but potentially harmful to native species and generally not recommended for South Georgia. However, herbicide treatments may be appropriate in some cases where other control methods are impractical. Further consultation is recommended on selection of herbicides.

Species	Suggested methods of eradication
<i>Achillea millefolium</i>	Manually remove
<i>Agrostis capillaris</i>	Survey populations and trial manual removal and weed mat
<i>Agrostis vinealis</i>	Manually remove
<i>Anthriscus sylvestris</i>	Manually remove
<i>Cardamine flexuosa</i>	Intensify current treatment (manual removal & spraying) and trial flame weeding and weed mat
<i>Carex aquatilis</i>	Manually remove
<i>Carex nigra</i>	Manually remove
<i>Deschampsia cespitosa</i>	Survey populations and trial manual removal
<i>Elymus repens</i>	Manually remove
<i>Festuca rubra</i>	Manually remove
<i>Nardus stricta</i>	Manually remove
<i>Pratia repens</i>	Manually remove
<i>Ranunculus repens</i>	Manually remove
<i>Rumex acetosella</i>	Survey populations and trial manual removal
<i>Rumex crispus</i>	Manually remove
<i>Sagina procumbens</i>	Manually remove
<i>Trifolium repens</i>	Manually remove
<i>Trisetum spicatum</i>	Survey populations and trial manual removal
<i>Vaccinium vitis-idaea</i>	Manually remove
<i>Veronica serpyllifolia</i>	Manually remove

**Table 4: Suggested methods for the eradication of introduced vascular plant species on South Georgia**

### Further survey

The whaling stations were the point of introduction for most of the introduced vascular plant species and many of the historical records are from within their boundaries. We were unable to survey within the 200m exclusion zones around Prince Olav Harbour, Husvik and Stromness whaling stations due to safety protocols. In addition, Leith Harbour was not selected as a survey site for similar safety reasons following advice from the South Georgia Government (Harriet Hall, pers. comm.). When the safety issues have been addressed, further survey is recommended within all the whaling station exclusion zones and at Leith Harbour.

Further survey is also recommended for a number of the introduced species (see Table 3). In particular, *Agrostis capillaris*, *Deschampsia cespitosa*, *Rumex acetosella* and *Trisetum spicatum* have large populations over wide areas, so we recommend further survey work to map the extent of the populations and assess the feasibility of eradication. In addition, further survey to monitor historical records of *Anthoxanthum odoratum*, *Empetrum rubrum* and *Poa trivialis* is recommended as the localities of these records were not covered in the current survey.

### Monitoring

Regular vegetation monitoring is recommended to identify any newly arrived plant species, measure the success of eradication work, measure the rate of spread of naturalised species and record changes precipitated through new management practices. We recommend:

- Repeat general survey of introduced vascular plant species every 5 years
- Monitoring of eradication sites monthly during the growing season

Recommendations for repeat general surveys every 5 years include:

- Planning of logistics starting at least two years before the field work is carried out as suitable support vessels may be booked up more than a year in advance
- Use of random quadrat sampling (1x1 m), monitoring historical records (including those from this survey) and general searching and recording methods
- A recommended random quadrat density >100 quadrats per km<sup>2</sup>
- Repeat survey at all sites covered in this survey with the addition of Leith Harbour and Prion Island
- Survey within all the current whaling station exclusion zones (once the safety issues have been addressed)
- Use of hand-held computers with the latest GPS technology to record field data
- Use of GPS altimeters (barometric altimeters are not recommended due to rapid changes in barometric pressure throughout the day)
- Use of waterproof cameras (or cameras with fully waterproof cases) to record digital images for all records
- Collection of herbarium specimens for all recorded taxa

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## Appendix 1: Field work itinerary

Date	Itinerary	Survey Site	Time Onshore (hours)
27/12/2008	Depart Stanley, Falkland Islands 10:35 (five day voyage to South Georgia)		
01/01/2009	Arrive Elsehul, South Georgia 08:00 Depart Elsehul 15:00 Arrive Bird Island 16:00 Meetings at BAS Research Station Onshore 17:00-22:00	Bird Island	4
02/01/2009	Depart Bird Island 07:45 Arrive Cape Rosa 12:30 Onshore 13:30-19:30 Depart Cape Rosa 22:15	Cape Rosa	6
03/01/2009	Arrive Bird Island 06:00 Onshore 12:00-16:00 Depart Bird Island 16:00 Arrive Prince Olav Harbour 22:00	Bird Island	4
04/01/2009	Onshore 10:00-19:30	Prince Olav Harbour	9
05/01/2009	Onshore 10:30-20:30	Prince Olav Harbour	10
06/01/2009	Depart Prince Olav Harbour 07:00 Arrive Fortuna Bay 09:30 Onshore 10:30-20:30	Fortuna Bay	10
07/01/2009	Depart Fortuna Bay 11:00 (dinghy landing not possible) Arrive Husvik 13:30 Onshore 14:30-18:30	Husvik	4
08/01/2009	Onshore 10:00-20:30	Husvik	10
09/01/2009	Onshore 09:30-20:00	Husvik	10
10/01/2009	Onshore 11:00-19:30	Stromness	8
11/01/2009	Onshore 11:00-22:30 (strong katabatic winds delayed return to support vessel)	Stromness	11
12/01/2009	Depart Stromness Arrive Grytviken Museum visit Meeting with Sarah Lurcock at King Edward Point. Onshore 16:30-21:30	Grytviken	5
13/01/2009	Walk to Maiviken Onshore 11:00-21:00	Grytviken-Maiviken	10
14/01/2009	Onshore 09:00-17:30	Greene Peninsula	8
15/01/2009	Grytviken to King Edward Point and Hope Point. Onshore 09:00-19:30	Grytviken	10
16/01/2009	Walk to Hestesletten Onshore 09:00-19:00	Hestesletten	10
17/01/2009	Onshore 09:00-21:00	Grytviken	12

Date	Itinerary	Survey Site	Time Onshore (hours)
18/01/2009	Onshore 11:00-18:00 Depart Grytviken 18:00 Arrive Cobbler's Cove 20:30	Grytviken	
19/01/2009	Depart Cobbler's Cove 06:30 Arrive Ocean Harbour 07:45 Onshore 09:00-18:30	Ocean Harbour	9
20/01/2009	Onshore 09:30-18:00 Depart Ocean Harbour 19:00 Arrive Cobblers Cove 20:00	Ocean Harbour	8
21/01/2009	Depart Cobbler's Cove 09:00 Arrive Godthul 10:00 Onshore 10:00-18:00 Depart Godthul 18:00 Arrive Cobblers Cove	Godthul	8
22/01/2009	(dinghy landing at Godthul not possible) Onshore 11:00-18:00	Cobbler's Cove	7
23/01/2009	(dinghy landing at Godthul not possible) Onshore 10:00-17:30	Cobbler's Cove	7
24/01/2009	Depart Cobbler's Cove Arrive St Andrews Bay Onshore 11:00-18:00	St Andrews Bay	7
25/01/2009	Depart St Andrews Bay Arrive Moltke Harbour Onshore 11:00-16:00 Depart Moltke Harbour Arrive Larsen Harbour	Moltke Harbour	5
26/01/2009	Onshore 11:00-14:00	Larsen Harbour	3
27/01/2009	Onshore 15:30-17:30	Larsen Harbour	2
28/01/2009	Depart Larsen Harbour 12:00 (seven days voyage to the Falkland Islands)		
04/02/2009	Arrive Stanley, Falkland Islands 10:00		

## Appendix 2: Equipment and logistics

1. **Boat** - SV-Seal. A 56-foot-long aluminium cutter, Seal - skippered by Hamish Laird, was specially designed for incompletely charted waters such as those surrounding South Georgia, with safety features such as a swing-up keel and rudder to handle groundings. SV-Seal also has a raised saloon design that was very practical for sorting and pressing plant specimens (<http://www.expeditionsail.com>).

### 2. Safety equipment and clothing

A waterproof survival bag was left on shore every day, this should be securely weighted or tied down against strong winds. It included:

- Two 3-man tents
- Two sleeping mats
- Two warm fleece bags
- 6 thermal suits
- Water and high energy food
- Camping stove and gas
- CB radio

The following safety equipment was carried by the survey teams:

- Iridium satellite phone
- CB Radio
- Extra clothes (dry socks, hat, gloves, thermals)
- Bothy bag (temporary shelter)
- Torch with extra batteries
- Whistle
- Wooden broom handles (for protection against seal attacks)
- First Aid Kit with antibiotics for fur seal bites
- Sunglasses, sun cream (SPF 30+), sunhat
- Binoculars
- Penknife
- Day pack lined with a waterproof canoe bag to keep equipment dry

Clothing recommended:

- Neoprene insulated tall rubber boots or wellingtons – exceptionally useful
- Waterproof Mittens and two more pairs of insulated gloves
- Windproof and waterproof jacket and trousers (Goretex or Nylon)
- Expedition thermals (top and bottom) 3 sets
- Fleece jacket and trousers (Polartec 200 or 300 or equivalent) 1-2
- Two balaclavas / hats (wool or windblocker fleece)
- Hiking and mountaineering socks 3-6 pairs

### 3. Field survey equipment

The following equipment remained on the boat because it was often difficult to get bulky or fragile equipment ashore:

- Field presses with straps
- Paper flimsies or newspapers
- Blotting paper for drying specimens
- Thick corrugated aluminium sheets for heat distribution during drying
- Laptop computers

The following equipment was carried by each survey team, protected in waterproof canoe bags during landings:

- Jewellers tags for labelling specimens
- Compass
- Altimeter
- GPS
- Digital cameras
- Laminated maps and satellite images
- Copies of *The Vascular Flora of South Georgia* (Greene, 1964)
- PDAs with in-built GPS and spare batteries, spare memory cards with our most recent data (see Methods for details of software used)
- Power Monkey and solar panel to recharge PDA
- Backup paper collecting sheets with weather proof folders (in case of PDA failure)
- Waterproof notebook, pencils
- Trowel, tweezers, hand lenses
- 1x1 m nylon rope quadrat and 10 m nylon rope transect line with flagged tent pegs for each corner/end
- Bags with 50g of silica gel for DNA samples
- Plastic bags for collecting herbarium specimens to be pressed on the boat
- Paper and cotton seed collecting bags of various sizes and data recording sheets

## Appendix 3: Field data collection - fields and standards

(Modified from Hamilton, 2008)

Field Name	Note	Standards for survey	Guidance Notes
SG ID	Unique identifier for database purposes	Sequential numbering given to each new record added to database with an indication of the type of record it is.	E.G. HS 1, HS 2, HS 3...for herbarium specimen records; ISP 1, ISP 2...for invasive species point records out with quadrats and transects; VAP 1, VAP 2...for random quadrat and belt transect records (vegetation assessment point); SAP 1, SAP 2... for native species record points (species assessment point); MIN 1, MIN 2...for minimum data points.
RorT; RorT ID; RorT no.	Unique identifier for transects and random quadrats	Unique ID composed of "R" for random plot, "T" for transect, sequential number of transect and the number of that particular random plot or transect.	E.G. 'R 2 1' for 2 <sup>nd</sup> set of random points, 1 <sup>st</sup> quadrat of that set
COLLECTOR	Collector or Recorder name(s)	Surnames first, followed by a comma and a space, then initials (uppercase) followed by a full stop.	E.G. 'Osborne, J.' <b>OR</b> 'Cable, S.'
ADDCOLL	Additional collectors names	Surnames first, followed by a comma and a space, then initials (uppercase) followed by a full stop, each additional name separated by a semicolon then space.	E.G. 'Osborne, J.; Cable, S.; Briggs, M.'
PREFIX	Number prefix	All collection numbers should have a character prefix that is the initials of the collector (E.G. 'SC' for Cable, S.).	E.G. if a herbarium collection number is SC 3300; 'SC' should be put in this field.
NUMBER	Specimen collection number	Specimen numbers are in numeric format and must be unique. This must be filled in!	E.G. '3300'. The collection number does not have prefixes or suffixes only the number itself.
DATE	Generated date field	Used by ArcPad to automatically generate the date from calendar selection.	E.G. '12/01/2009'
COLLDD	Collection day	numeric day of the month on which the collection was made: two digits.	E.G. '2' or '30', for the 2 <sup>nd</sup> or 30 <sup>th</sup> day of a month.
COLLMM	Collection month	The numeric month in which the collection was made: two digits.	E.G. '2' or '12', for the 2 <sup>nd</sup> or 12 <sup>th</sup> month of the year.
COLLYY	Collection year	The numeric year in which the collection was made: four digits.	E.G. '2009' for the year.

Field Name	Note	Standards for survey	Guidance Notes
FAMILY	Family	The family name appropriate to the genus with capital of first letter only.	USE <i>Vascular Plant Families and Genera</i> (Brummitt, 1992) or, where available, World Checklist of Selected Plant Families (2008).
GENUS	Genus	This field must contain a validly published generic name. It should be entered in full with the first letter capitalised.	USE Brummitt's Families and Genera or, where available, World Checklist of Selected Plant Families (2008).
SP1	First species epithet	All lowercase, no embedded spaces. It may contain one or two hyphens.	Use country checklist or 'sp.' for unknown species.
DET STATUS	Verification of name	Indicate if the record identified in the field was later verified in the herbarium.	'Field identification' or 'herbarium confirmation'
RANK1	Rank	Rank of the second specific epithet if there is one.	E.G. ssp. (subspecies), var. (variety)
ACFOR	ACFOR scale	<b>Abundant, Common, Frequent, Occasional, Rare.</b>	Used to indicate the abundance of a particular taxon in the random quadrat or transect in question.
PERCENTAGE	% ground cover	percentage of the ground covered by each taxon within a quadrat / transect given as % number	Percentage of the ground covered in total for each quadrat / transect can be > 100% due to plant overlap
INTRODUCED	Introduced / native plant	Is the taxon in question introduced or native to South Georgia	E.G. 'introduced'
BOTRECAT	Plant record type	Sight record or vouchered record	E.G. 'vouchered record' if herbarium specimen made; 'sight record' if taxon seen and recorded but no voucher taken
COUNTRY	Country of collection	Store valid country names here.	E.G. South Georgia
GAZETTEER	Nearest named place - needs to be mapable	The gazetteer field is used to store the name of the nearest mapable place to the collection site. This may be a small town, a village, a spring. The smaller the place is, the better the resolution.	Gazetteer entries are important as each entry in the gazetteer dictionary can be given a latitude/longitude map reference. This field should not end with a full stop. Capitalise first letter of names.
PLOT	Sample area	Size of sample area recorded in meters.	E.G. '2X10'
LOCNOTES	Plain language description of the locality.	This locality information should not start with a capital letter (unless it is a place name) nor end with a full stop.	E.G. 1) 'at the southern edge of the bog'; 2) 'along the main trail to Maiviken'. Do not repeat information entered elsewhere.
HABITATCOD	Habitat Description	Defined text description of the habitat. Refer to standards - in this case, vegetation communities (Scott & Poncet, 2003) – see Appendix 4.	This must be a recognised and agreed habitat type in the standards (E.G. ' <i>Festuca</i> grassland'; 'mire & bog', etc...).
LAT	Latitude in decimal degrees	Automatically entered by built in GPS.	E.G. '21.87596500'
NS	N or S	North or south of equator.	E.G. 'S'
LONG	Longitude in decimal degrees	Automatically entered by built in GPS.	E.G. '72.097778'

Field Name	Note	Standards for survey	Guidance Notes
EW	E or W	East or west of Greenwich meridian.	E.G. 'W'
GPSDATUM	Datum used to record lat/long	Datum used by the GPS to record coordinates.	E.G. 'D_WGS_1984'
ALT	Altitude in Meters	Altitude must be entered in metres.	E.G. "30" for 30m above sea level
PLANTDESC	Plant Description	Free text description of the plant in the following sequence: Life Form; Size; Leaves; Stems; Flowers; Fruits; Bark; Other unique characters...	E.G. 'Tree 8-10m; leaves glossy green; flowers yellow; fruit red.' Start with a capital, end with full stop.
FLCODE	Flowering information	Record whether specimen is in flower/reproducing.	E.G. 'Flowers', 'Buds', 'Repro structures', 'None'
FRCODE	Fruiting information.	Record here whether specimen is in fruit/reproducing.	E.G. 'Fruits', 'Cones', 'Spores', 'None'
FREQUENCY	Frequency/Abundance Estimate	Using the ACFOR scale, record if the specimen is locally: Abundant, Common, Frequent, Occasional, or Rare.	Start with capital <b>DO NOT</b> end with a full stop!
RECRUIT	Recruiting population	Indicates if species is successfully recruiting.	E.G. 'Propagules', 'Seedlings', 'None'
HABITATTXT	Description of habitat	Free text description of the plant habitat. Start with a capital, end with full stop.	E.G. 'Exposed hillside'
SLOPE	Slope of the land	Number representing the percentage of the slope of the land rounded to nearest 5.	E.G. '75' means 75% slope
ASPECT	Dominant Aspect	1 or 2 letters representing the dominant aspect of the collection point.	E.G. 'NW' means north-western aspect
GROUNDCC	Ground cover	Number representing percentage of ground cover of vegetation at collection point.	Refer to Standards; E.G. '50' means 50% ground cover
NUMDUPS	Number of herbarium specimen duplicates that were collected	Should describe the number of specimens collected, including specimens that will be sent to other herbaria at a later date.	E.G. '2' if there were 2 specimens taken.
MSB	Seed collection	Indicates that seeds were collected for the MSBP.	Should be described with a "Y" if material was collected and "N" if it was not collected.
DNA	DNA collection	Indicates that plant material was collected in silica gel to make a DNA collection.	Should be described with a "Y" if material was collected and "N" if it was not collected.
PHOTOS	Photos taken of the specimen	Indicates that a photo was taken when the collection was made.	If a photo was taken, use photographers name in same format as COLLECTOR. If no photo was taken, leave blank!
PHOTOID	Unique identifier of the photo taken	Unique ID usually refers to the image number.	For herbarium specimens: photographer's initials, collector's initials and collection number E.G. 'JOSC5925'.The rest of the camera.

## **Appendix 4: Vegetation communities (Scott and Poncet, 2003)**

### **Grassland Communities**

#### **Tussac Grassland Communities**

- Tussac
- Tussac and *Festuca*
- Tussac and moss
- Tussac and *Acaena*
- Tussac, moss and *Poa annua*
- Tussac and mud

#### **Short Grassland Communities**

- *Festuca* grassland
- *Festuca*-fellfield mosaic
- Short mixed grassland
- *Deschampsia* grassland

### **Mire, Bog and Herbfield Communities**

**Mire and bog**

**Acaena herbfield**

### **Moss-Dominated Communities**

**Moss with tussac**

**Hard mossbank**

### **Fellfield-Like Communities**

**Moist lowland “fellfield”**

**Sparse lowland “fellfield”**



# Appendix 5: Seed collection data sheet

Serial Number

## MSB COLLECTION DATA FORM (Bold type= Obligatory Fields)

PLEASE USE BLOCK CAPITALS

**Date Collected**

**Collector(s)**

Collection No.

### SITE DATA

**Country**

Province/State

Local Situation

**Latitude**  GPS used (YES/NO)  If no, see over.

**Longitude**

**Altitude**  GPS Datum  WGS84 or

### HABITAT DATA

Habitat Code

**Habitat and**

**Assoc. Species**

Modifying Factors

Land Form	<input type="text"/>	Slope°	<input type="text"/>
Land Use	<input type="text"/>	Aspect	<input type="text"/>
Geology	<input type="text"/>	Soil pH	<input type="text"/>
Soil Colour	<input type="text"/>		
<b>Soil Texture</b>	<input type="text"/>		
Drainage	<input type="text"/>		

### COLLECTION DATA

Family

Genus

Species

Infra-specific

**No. of Voucher Duplicates**  Area sampled (m<sup>2</sup>)

**No. of Plants Sampled**  % population producing seed

**No. of Plants Found**  Seed Harvesting (*early, mid, late season*) Please circle.

Seeds Collected from (*plants, ground, both*)  State of seeds (*moist, dry, both, other*)

### HERBARIUM DATA

Plant Habit *Tree Shrub Erect herb Creeping herb Climbing herb Succulent* **Plant Height (m)**

Other descriptors

### ETHNOBOTANICAL DATA

Vernacular name

Use - *please circle.* Food Food Additive Animal Food Bee Plant Invertebrate Food

Materials Fuel Social Use Vertebrate Poison Non-Vertebrate Poison

Medicine Environmental Use Gene Source

## Appendix 6: Herbarium specimen list

Name	Family	Locality	Date	Collector	Number
<i>Acaena magellanica</i>	Rosaceae	Cape Rosa	02/01/2009	Borosova, R.	RB 60
<i>Acaena magellanica</i>	Rosaceae	Larsen Harbour	26/01/2009	Cable, S.	SC 5937
<i>Acaena magellanica</i>	Rosaceae	Cobblers Cove	22/01/2009	Borosova, R.	RB 89
<i>Acaena magellanica x tenera</i>	Rosaceae	Cape Rosa	02/01/2009	Borosova, R.	RB 61
<i>Acaena magellanica x tenera</i>	Rosaceae	Grytviken	17/01/2009	Borosova, R.	RB 81
<i>Acaena magellanica x tenera</i>	Rosaceae	Bird Island	03/01/2009	Briggs, M.	MB 203
<i>Acaena tenera</i>	Rosaceae	Cape Rosa	02/01/2009	Borosova, R.	RB 62
<i>Acaena tenera</i>	Rosaceae	Stromness	10/01/2009	Cable, S.	SC 5916
<i>Acaena tenera</i>	Rosaceae	Cobblers Cove	22/01/2009	Briggs, M.	MB 235
<i>Achillea millefolium</i>	Compositae	Grytviken	15/01/2009	Borosova, R.	RB 76b
<i>Agrostis capillaris</i>	Poaceae	Grytviken	15/01/2009	Briggs, M.	MB 223
<i>Agrostis capillaris</i>	Poaceae	Stromness	10/01/2009	Cable, S.	SC 5920
<i>Agrostis capillaris</i>	Poaceae	Husvik	09/01/2009	Osborne, J.	JO 545
<i>Agrostis capillaris</i>	Poaceae	Husvik	09/01/2009	Osborne, J.	JO 541
<i>Agrostis capillaris</i>	Poaceae	Husvik	08/01/2009	Borosova, R.	RB 70
<i>Agrostis vinealis</i>	Poaceae	Husvik	07/01/2009	Briggs, M.	MB 211
<i>Agrostis vinealis</i>	Poaceae	Husvik	08/01/2009	Briggs, M.	MB 213
<i>Alopecurus magellanicum</i>	Poaceae	Stromness	10/01/2009	Borosova, R.	RB 75a
<i>Alopecurus magellanicum</i>	Poaceae	Stromness	10/01/2009	Briggs, M.	MB 218
<i>Alopecurus magellanicum</i>	Poaceae	Stromness	10/01/2009	Cable, S.	SC 5919
<i>Anthriscus sylvestris</i>	Umbelliferae	Grytviken	15/01/2009	Cable, S.	SC 5926
<i>Callitriche antarctica</i>	Callitrichaceae	Cape Rosa	02/01/2009	Briggs, M.	MB 202
<i>Callitriche antarctica</i>	Callitrichaceae	Cobblers Cove	22/01/2009	Osborne, J.	JO 558
<i>Cardamine flexuosa</i>	Cruciferae	Grytviken	15/01/2009	Cable, S.	SC 5927
<i>Carex aquatilis</i>	Cyperaceae	Husvik	07/01/2009	Cable, S.	SC 5902
<i>Carex nigra</i>	Cyperaceae	Ocean Harbour	20/01/2009	Osborne, J.	JO 555
<i>Cerastium fontanum</i>	Caryophyllaceae	Fortuna Bay	06/01/2009	Briggs, M.	MB 209
<i>Cerastium fontanum</i>	Caryophyllaceae	Cobblers Cove	23/01/2009	Briggs, M.	MB 236
<i>Colobanthus quitensis</i>	Caryophyllaceae	Prince Olav Harbour	05/01/2009	Osborne, J.	JO 534
<i>Colobanthus quitensis</i>	Caryophyllaceae	Fortuna Bay	06/01/2009	Cable, S.	SC 5901
<i>Colobanthus quitensis</i>	Caryophyllaceae	Fortuna Bay	06/01/2009	Borosova, R.	RB 67
<i>Colobanthus quitensis</i>	Caryophyllaceae	Hestesletten	16/01/2009	Osborne, J.	JO 552
<i>Colobanthus quitensis</i>	Caryophyllaceae	Prince Olav Harbour	05/01/2009	Briggs, M.	MB 207
<i>Colobanthus quitensis</i>	Caryophyllaceae	Grytviken	15/01/2009	Briggs, M.	MB 225
<i>Colobanthus subulatus</i>	Caryophyllaceae	Bird Island	03/01/2009	Borosova, R.	RB 63
<i>Colobanthus subulatus</i>	Caryophyllaceae	Cobblers Cove	22/01/2009	Osborne, J.	JO 557
<i>Colobanthus subulatus</i>	Caryophyllaceae	Moltke Harbour	25/01/2009	Cable, S.	SC 5934
<i>Cystopteris fragilis</i>	Woodsiaceae	Ocean Harbour	19/01/2009	Borosova, R.	RB 86
<i>Cystopteris fragilis</i>	Woodsiaceae	Husvik	09/01/2009	Borosova, R.	RB 72
<i>Deschampsia antarctica</i>	Poaceae	Hestesletten	16/01/2009	Osborne, J.	JO 550
<i>Deschampsia antarctica</i>	Poaceae	Husvik	09/01/2009	Osborne, J.	JO 544

<i>Deschampsia antarctica</i>	Poaceae	Husvik	08/01/2009	Cable, S.	SC 5907
<i>Deschampsia cespitosa</i>	Poaceae	Ocean Harbour	19/01/2009	Osborne, J.	JO 553
<i>Deschampsia cespitosa</i>	Poaceae	Grytviken	15/01/2009	Briggs, M.	MB 224
<i>Elymus repens</i>	Poaceae	Husvik	08/01/2009	Borosova, R.	RB 69
<i>Festuca contracta</i>	Poaceae	Ocean Harbour	20/01/2009	Borosova, R.	RB 87
<i>Festuca contracta</i>	Poaceae	Cobblers Cove	22/01/2009	Briggs, M.	MB 234
<i>Festuca contracta</i>	Poaceae	Cape Rosa	02/01/2009	Osborne, J.	JO 530
<i>Festuca rubra</i>	Poaceae	Husvik	08/01/2009	Cable, S.	SC 5909
<i>Galium antarcticum</i>	Rubiaceae	Husvik	08/01/2009	Cable, S.	SC 5910
<i>Galium antarcticum</i>	Rubiaceae	Greene Peninsula	14/01/2009	Briggs, M.	MB 220
<i>Galium antarcticum</i>	Rubiaceae	Maiviken	13/01/2009	Briggs, M.	MB 219
<i>Galium antarcticum</i>	Rubiaceae	Fortuna Bay	06/01/2009	Briggs, M.	MB 210
<i>Grammitis poeppigiana</i>	Grammitidaceae	Larsen Harbour	26/01/2009	Cable, S.	SC 5935
<i>Grammitis poeppigiana</i>	Grammitidaceae	Larsen Harbour	26/01/2009	Borosova, R.	RB 90b
<i>Hymenophyllum falklandicum</i>	Hymenophyllaceae	Ocean Harbour	19/01/2009	Briggs, M.	MB 230
<i>Hymenophyllum falklandicum</i>	Hymenophyllaceae	Prince Olav Harbour	04/01/2009	Borosova, R.	RB 64
<i>Hymenophyllum falklandicum</i>	Hymenophyllaceae	Larsen Harbour	26/01/2009	Briggs, M.	MB 238
<i>Hymenophyllum falklandicum</i>	Hymenophyllaceae	Cobblers Cove	23/01/2009	Borosova, R.	RB 90a
<i>Juncus scheuchzerioides</i>	Juncaceae	Hestesletten	16/01/2009	Osborne, J.	JO 551
<i>Juncus scheuchzerioides</i>	Juncaceae	Cobblers Cove	22/01/2009	Osborne, J.	JO 559
<i>Juncus scheuchzerioides</i>	Juncaceae	Fortuna Bay	06/01/2009	Osborne, J.	JO 537
<i>Lycopodium magellanicum</i>	Lycopodiaceae	Fortuna bay	06/01/2009	Borosova, R.	RB 68
<i>Lycopodium magellanicum</i>	Lycopodiaceae	Husvik	09/01/2009	Osborne, J.	JO 540
<i>Lycopodium magellanicum</i>	Lycopodiaceae	Husvik	09/01/2009	Briggs, M.	MB 215
<i>Montia fontana</i>	Portulacaceae	Husvik	07/01/2009	Osborne, J.	JO 538b
<i>Montia fontana</i>	Portulacaceae	Godthul	21/01/2009	Briggs, M.	MB 232
<i>Montia fontanum</i>	Portulacaceae	Ocean Harbour	19/01/2009	Cable, S.	SC 5930
<i>Nardus stricta</i>	Poaceae	Maiviken	13/01/2009	Osborne, J.	JO 548
<i>Ophioglossum crotalophoroides</i>	Ophioglossaceae	Maiviken	13/01/2009	Osborne, J.	JO 547
<i>Ophioglossum crotalophoroides</i>	Ophioglossaceae	Grytviken	18/01/2009	Borosova, R.	RB 82
<i>Ophioglossum crotalophoroides</i>	Ophioglossaceae	Husvik	08/01/2009	Cable, S.	SC 5913
<i>Parodiochloa flabellata</i>	Poaceae	Bird Island	03/01/2009	Osborne, J.	JO 533
<i>Parodiochloa flabellata</i>	Poaceae	Cobblers Cove	23/01/2009	Cable, S.	SC 5932
<i>Phleum alpinum</i>	Poaceae	Prince Olav Harbour	05/01/2009	Briggs, M.	MB 206
<i>Phleum alpinum</i>	Poaceae	Cobblers Cove	23/01/2009	Briggs, M.	MB 237a
<i>Phleum alpinum</i>	Poaceae	Fortuna Bay	06/01/2009	Borosova, R.	RB 66
<i>Poa annua</i>	Poaceae	Husvik	09/01/2009	Osborne, J.	JO 542
<i>Poa annua</i>	Poaceae	Cobblers Cove	23/01/2009	Borosova, R.	RB 91
<i>Poa annua</i>	Poaceae	Prince Olav Harbour	04/01/2009	Briggs, M.	MB 204
<i>Poa pratensis</i>	Poaceae	Husvik	09/01/2009	Osborne, J.	JO 539
<i>Poa pratensis</i>	Poaceae	Grytviken	15/01/2009	Borosova, R.	RB 79
<i>Poa pratensis</i>	Poaceae	Godthul	21/01/2009	Briggs, M.	MB 233
<i>Poa pratensis</i>	Poaceae	Stromness	10/01/2009	Cable, S.	SC 5917
<i>Poa pratensis</i>	Poaceae	Husvik	07/01/2009	Cable, S.	SC 5903
<i>Poa pratensis</i>	Poaceae	Husvik	08/01/2009	Briggs, M.	MB 214

<i>Polystichum mohrioides</i>	Dryopteridaceae	Larsen Harbour	26/01/2009	Briggs, M.	MB 237b
<i>Polystichum mohrioides</i>	Dryopteridaceae	Husvik	08/01/2009	Briggs, M.	MB 212
<i>Polystichum mohrioides</i>	Dryopteridaceae	Larsen Harbour	26/01/2009	Osborne, J.	JO 560
<i>Pratia repens</i>	Campanulaceae	Husvik	09/01/2009	Briggs, M.	MB 217
<i>Pratia repens</i>	Campanulaceae	Grytviken	15/01/2009	Briggs, M.	MB 222
<i>Ranunculus biternatus</i>	Ranunculaceae	Husvik	09/01/2009	Borosova, R.	RB 73
<i>Ranunculus biternatus</i>	Ranunculaceae	Cape Rosa	02/01/2009	Osborne, J.	JO 531
<i>Ranunculus biternatus</i>	Ranunculaceae	Godthul	21/01/2009	Cable, S.	SC 5931
<i>Ranunculus biternatus</i>	Ranunculaceae	Prince Olav Harbour	05/01/2009	Borosova, R.	RB 65
<i>Ranunculus repens</i>	Ranunculaceae	Grytviken	15/01/2009	Briggs, M.	MB 221
<i>Ranunculus repens</i>	Ranunculaceae	Grytviken	18/01/2009	Borosova, R.	RB 83
<i>Ranunculus repens</i>	Ranunculaceae	Grytviken	15/01/2009	Cable, S.	SC 5925
<i>Rostkovia magellanica</i>	Juncaceae	Ocean Harbour	20/01/2009	Osborne, J.	JO 556
<i>Rostkovia magellanica</i>	Juncaceae	Fortuna Bay	06/01/2009	Cable, S.	SC 5900
<i>Rumex acetosella</i>	Polygonaceae	Grytviken	15/01/2009	Borosova, R.	RB 78
<i>Rumex acetosella</i>	Polygonaceae	Husvik	08/01/2009	Borosova, R.	RB 71
<i>Sagina procumbens</i>	Caryophyllaceae	Grytviken	15/01/2009	Borosova, R.	RB 75b
<i>Taraxacum officinale</i>	Asteraceae	Husvik	08/01/2009	Cable, S.	SC 5911
<i>Taraxacum officinale</i>	Asteraceae	Husvik	08/01/2009	Cable, S.	SC 5908
<i>Trifolium repens</i>	Leguminosae	Grytviken	15/01/2009	Borosova, R.	RB 77
<i>Trisetum spicatum</i>	Poaceae	Stromness	10/01/2009	Borosova, R.	RB 76a
<i>Uncinia macrolepis</i>	Cyperaceae	Ocean Harbour	20/01/2009	Borosova, R.	RB 88
<i>Uncinia macrolepis</i>	Cyperaceae	Husvik	08/01/2009	Cable, S.	SC 5912
<i>Vaccinium vitis-idaea</i>	Ericaceae	Husvik	09/01/2009	Briggs, M.	MB 216
<i>Veronica serpyllifolia</i>	Scrophulariaceae	Grytviken	15/01/2009	Osborne, J.	JO 549

## Appendix 7: Seed collections

Name	Family	Collector	Number
<i>Acaena magellanica</i>	Rosaceae	Ericson, K.	30
<i>Acaena magellanica</i>	Rosaceae	Ericson, K.	22
<i>Acaena magellanica x tenera</i>	Rosaceae	Ericson, K.	47
<i>Acaena magellanica x tenera</i>	Rosaceae	Ericson, K.	29
<i>Acaena tenera</i>	Rosaceae	Cable, S.	5916
<i>Acaena tenera</i>	Rosaceae	Ericson, K.	41
<i>Acaena tenera</i>	Rosaceae	Ericson, K.	7
<i>Acaena tenera</i>	Rosaceae	Ericson, K.	12
<i>Achillea millefolium</i>	Compositae	Ericson, K.	54
<i>Agrostis capillaris</i>	Poaceae	Ericson, K.	27
<i>Agrostis capillaris</i>	Poaceae	Ericson, K.	17
<i>Agrostis capillaris</i>	Poaceae	Ericson, K.	18
<i>Alopecurus antarcticus</i>	Poaceae	Ericson, K.	58
<i>Alopecurus antarcticus</i>	Poaceae	Ericson, K.	60
<i>Anthriscus sylvestris</i>	Umbelliferae	Ericson, K.	52
<i>Callitriche antarctica</i>	Callitrichaceae	Ericson, K.	46
<i>Callitriche antarctica</i>	Callitrichaceae	Ericson, K.	57
<i>Cardamine flexuosa</i>	Brassicaceae	Cable, S.	5927
<i>Cerastium fontanum</i>	Caryophyllaceae	Ericson, K.	36
<i>Cerastium fontanum</i>	Caryophyllaceae	Ericson, K.	43
<i>Colobanthus quitensis</i>	Caryophyllaceae	Cable, S.	5901
<i>Colobanthus quitensis</i>	Caryophyllaceae	Ericson, K.	13
<i>Colobanthus quitensis</i>	Caryophyllaceae	Ericson, K.	9
<i>Colobanthus quitensis</i>	Caryophyllaceae	Ericson, K.	5
<i>Colobanthus quitensis</i>	Caryophyllaceae	Ericson, K.	2
<i>Colobanthus subulatus</i>	Caryophyllaceae	Cable, S.	5934
<i>Colobanthus subulatus</i>	Caryophyllaceae	Ericson, K.	8
<i>Colobanthus subulatus</i>	Caryophyllaceae	Ericson, K.	10
<i>Deschampsia antarctica</i>	Poaceae	Ericson, K.	23
<i>Deschampsia antarctica</i>	Poaceae	Ericson, K.	32
<i>Deschampsia antarctica</i>	Poaceae	Ericson, K.	26
<i>Festuca contracta</i>	Poaceae	Ericson, K.	21
<i>Festuca contracta</i>	Poaceae	Ericson, K.	15
<i>Festuca contracta</i>	Poaceae	Ericson, K.	35
<i>Galium antarcticum</i>	Rubiaceae	Ericson, K.	28
<i>Galium antarcticum</i>	Rubiaceae	Ericson, K.	38
<i>Juncus scheuchzerioides</i>	Juncaceae	Ericson, K.	64
<i>Juncus scheuchzerioides</i>	Juncaceae	Ericson, K.	63
<i>Juncus scheuchzerioides</i>	Juncaceae	Ericson, K.	62
<i>Juncus scheuchzerioides</i>	Juncaceae	Ericson, K.	61
<i>Montia fontana</i>	Portulacaceae	Cable, S.	5930
<i>Montia fontana</i>	Portulacaceae	Ericson, K.	14
<i>Montia fontana</i>	Portulacaceae	Ericson, K.	11
<i>Parodiochloa flabellata</i>	Poaceae	Cable, S.	5932
<i>Parodiochloa flabellata</i>	Poaceae	Ericson, K.	6

Name	Family	Collector	Number
<i>Phleum alpinum</i>	Poaceae	Ericson, K.	40
<i>Phleum alpinum</i>	Poaceae	Ericson, K.	19
<i>Phleum alpinum</i>	Poaceae	Ericson, K.	16
<i>Poa annua</i>	Poaceae	Ericson, K.	33
<i>Poa annua</i>	Poaceae	Ericson, K.	24
<i>Poa pratensis</i>	Poaceae	Ericson, K.	25
<i>Poa pratensis</i>	Poaceae	Ericson, K.	31
<i>Pratia repens</i>	Campanulaceae	Briggs, M.	217
<i>Pratia repens</i>	Campanulaceae	Ericson, K.	55
<i>Ranunculus acris</i>	Ranunculaceae	Ericson, K.	56
<i>Ranunculus acris</i>	Ranunculaceae	Ericson, K.	49
<i>Ranunculus biternatus</i>	Ranunculaceae	Cable, S.	5931
<i>Ranunculus biternatus</i>	Ranunculaceae	Ericson, K.	39
<i>Ranunculus biternatus</i>	Ranunculaceae	Ericson, K.	44
<i>Rostkovia magellanica</i>	Juncaceae	Cable, S.	5900
<i>Rostkovia magellanica</i>	Juncaceae	Ericson, K.	4
<i>Rostkovia magellanica</i>	Juncaceae	Ericson, K.	1
<i>Sagina procumbens</i>	Caryophyllaceae	Ericson, K.	20
sp.	Poaceae	Ericson, K.	42
sp.	Poaceae	Ericson, K.	59
<i>Taraxacum officinale</i>	Asteraceae	Cable, S.	5911
<i>Taraxacum officinale</i>	Asteraceae	Ericson, K.	3
<i>Trifolium repens</i>	Leguminosae	Ericson, K.	51
<i>Trifolium repens</i>	Leguminosae	Ericson, K.	50
<i>Uncinia macrolepis</i>	Cyperaceae	Ericson, K.	48
<i>Uncinia macrolepis</i>	Cyperaceae	Ericson, K.	34
<i>Uncinia macrolepis</i>	Cyperaceae	Ericson, K.	37
<i>Uncinia macrolepis</i>	Cyperaceae	Ericson, K.	45
<i>Veronica serpyllifolia</i>	Scrophulariaceae	Ericson, K.	53

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## Site 1: Cape Rosa



### Site features:

- Historic site 'Cave Cove'
- Reindeer-free site
- Rat-free site
- Specially Protected Area (SPA)

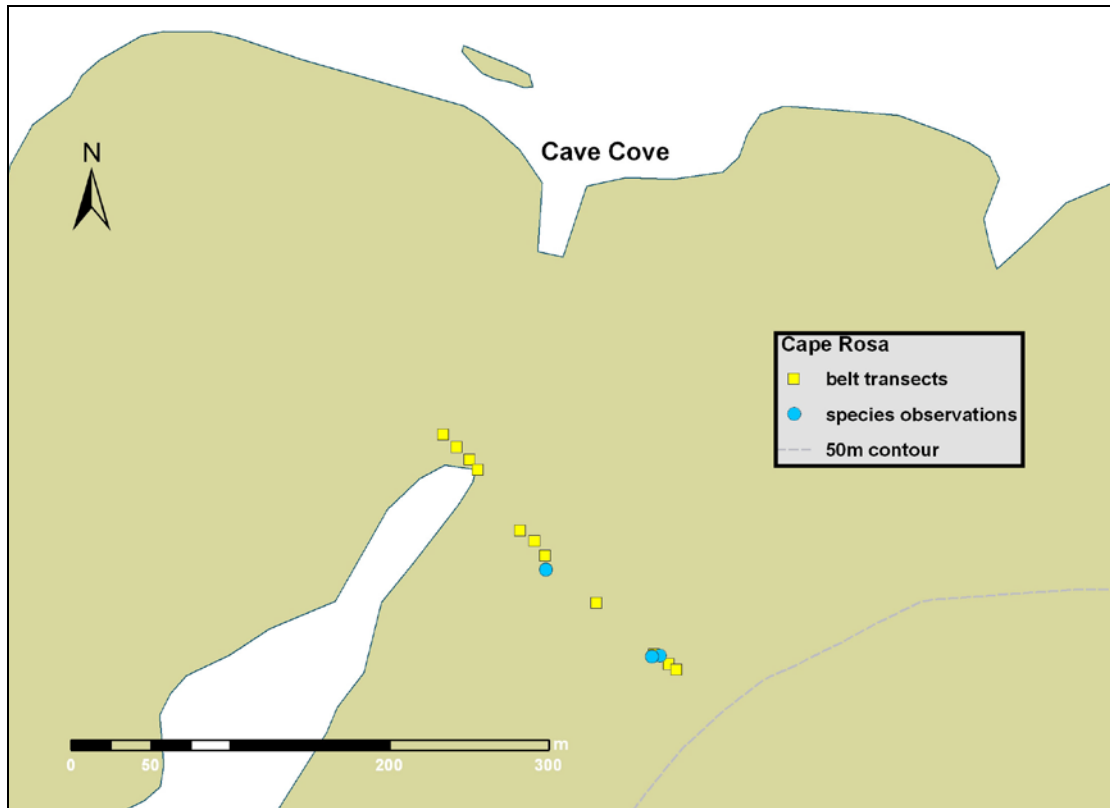
Cape Rosa was the only site surveyed on the more inaccessible southwest side of the island. This site was selected for survey as a comparative less-visited area, where fewer introduced plant species are expected to occur. There is no historic settlement at Cape Rosa, though it is the historic landing site of Shackleton in the boat James Caird and Cave Cove is a popular site for visitors. In 2000 the site was included within the southwest coastal Environmentally Sensitive Area as it is rat-free (McIntosh and Walton, 2000) (though it is mouse infested (GSGSSI, 2009)). It is now designated as a Specially Protected Area (Pasteur and Walton, 2006) and entry is prohibited unless a Government permit has been granted. More details for visitors to the site can be found in the South Georgia Government's Visitor Management plan for Cape Rosa (GSGSSI, 2009).

### Vegetation survey:

One day of survey work was carried out at Cape Rosa. Weather conditions were fine.

One belt transect (230 m long) was surveyed starting on the saddle above the beach at 'Cave Cove' continuing northwest along the ridge. General searching and recording was also carried out around the site.





**Figure 9: Survey records at Cape Rosa**

**Native vegetation:**

The dominant vegetation types in the survey area include 'tussac', and 'tussac and *Acaena*'. Pure homogenous stands of tussac were found to cover large areas of the saddle and slopes, forming important nesting sites for burrowing petrels and and prions.

**Introduced vascular plant species:**

None recorded.

## Site 2: Bird Island



### Site features:

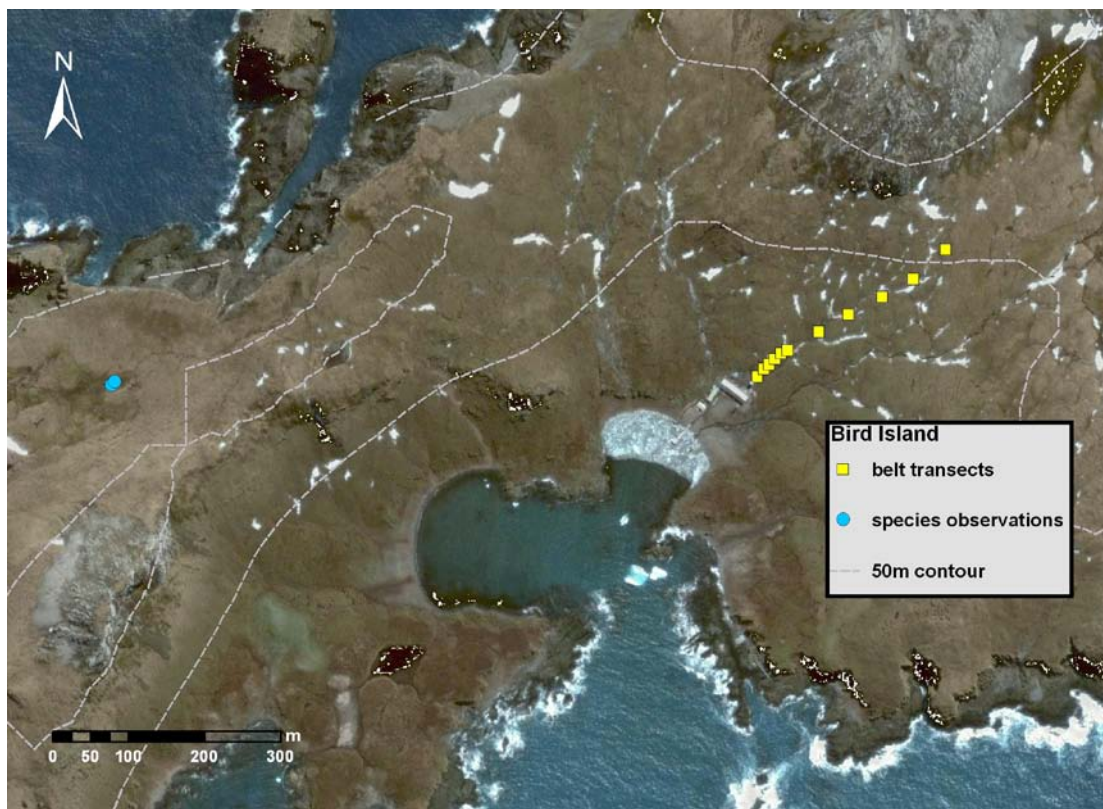
- British Antarctic Survey (BAS) research station
- Rat-free site
- Reindeer-free Site
- Specially Protected Area (SPA)

Bird Island was selected as our first survey site as it provided a sheltered anchorage where the support vessel Seal could be prepared for survey work after the sea voyage from the Falkland Islands and a good site from which to approach Cape Rosa on the exposed southwest coast. This was also an ideal place to start the survey work as the BAS research team were able to provide advice and guidelines on working in fur seal-populated areas. Bird Island was not used by the whaling industry and is a visitor-restricted area, where fewer introduced plant species were expected to occur. Scientific Research has been carried out here since the 1950's and there is a possibility of plants being accidentally introduced through these activities. The site was designated as a Protected Area in 2000 (McIntosh and Walton, 2000) and as a Specially Protected Area in 2006 (Pasteur and Walton, 2006). Entry to the area is prohibited unless a Government permit has been granted.

### Vegetation survey:

The survey was carried out over two days at Bird Island. Weather conditions were fine.

One belt transect (350 m long) was surveyed starting near the stream behind the BAS research station, heading northeast. General searching and recording was carried out around this site.



**Figure 10: Recording localities at Bird Island**

**Native vegetation:**

The dominant vegetation type is 'tussac', often flattened and eroded by fur seals in lower altitudes, and growing in most areas, commonly with *Callitriche antarctica*. 'Hard moss bank', 'tussac and *Acaena*' and 'mire and bog' vegetation can also be found especially on flat areas on higher ground.

**Introduced vascular plant species:**

None recorded.

## Site 3: Prince Olav Harbour



### Site features:

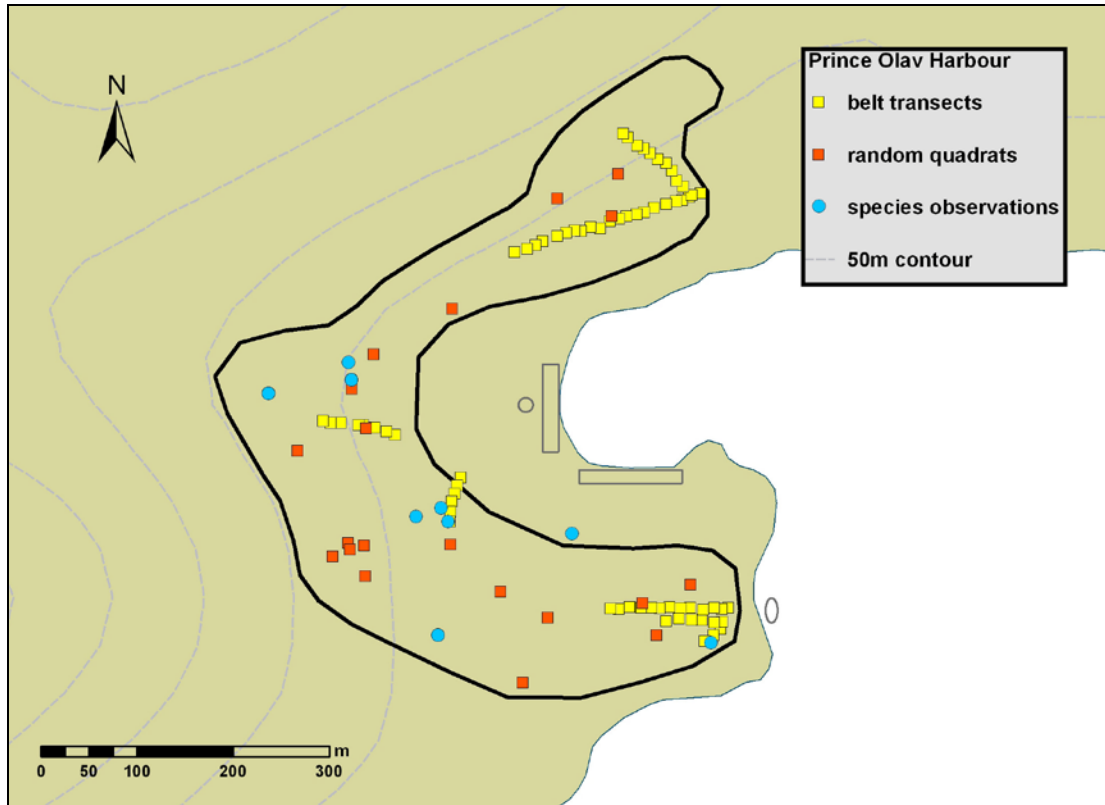
- Whaling station
- Cemetery
- Reservoir and dam
- Reindeer-free site

Prince Olav Harbour is a historic hotspot for plant introductions due to the whaling station. It is also a potential hotspot for new introductions as it is a popular visitor site. There is a 200 m exclusion zone around the whaling station (the boundary has not yet been marked out on-site).

### Vegetation survey:

Survey work was carried out over two days at Prince Olav Harbour. Weather conditions were fine.

20 random 1x1 m quadrat samples were recorded from the area outside the whaling station and seven belt transects were surveyed. Two transects were surveyed radiating west (210 m) and northwest (110 m) from the edge of the reservoir. Two short transects (80 m and 60 m long) were surveyed radiating from the edge whaling station exclusion zone and three from the landing beach behind the wreck of the Brutus (130 m, 30 m and 60 m long). General searching and recording was carried out around the site including the cemetery, the football pitch and the reservoir.



**Figure 11: Survey records at Prince Olav Harbour**

**Native vegetation:**

The dominant vegetation types within the survey area include ‘tussac’, ‘*Festuca*-fellfield mosaic’ and ‘short mixed grassland’. The native filmy fern *Hymenophyllum falklandicum* can be found in shaded, damp rock crevices at this site.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Prince Olav Harbour
Poaceae	<i>Poa annua</i>	Widespread and abundant
Ranunculaceae	<i>Ranunculus repens</i>	Restricted and rare

Two introduced plant species were recorded at Prince Olav Harbour. *Poa annua* is widespread throughout the site and frequently occurs at high densities on disturbed ground in flat areas and on slopes with ‘tussac’ vegetation. The vegetation at this site is heavily impacted by fur seals and this grass tends to colonise the seal-trampled areas. A small patch of *Ranunculus repens* was observed with binoculars in flower growing within the whaling station buildings on the south side of the station. A specimen has recently been collected during an archaeological survey of the whaling station and the data will be appended to the database from this survey.

**Additional historical records:**

In addition to the introduced species recorded during the current survey, a number of other introduced species have been recorded at Prince Olav Harbour in the past (BAS, 2008). Those listed in Table 5 were classed as persistent or naturalised by Walton and Smith (1973), or have been recorded since 1973. Species classed as transient by Walton and Smith in 1973 are not included unless they have subsequently been recorded.

Family	Species
Compositae	<i>Achillea ptarmica</i>
Poaceae	<i>Agropyron repens</i>
Poaceae	<i>Agrostis canina</i>
Poaceae	<i>Agrostis capillaris</i>
Poaceae	<i>Poa pratensis</i>
Poaceae	<i>Poa trivialis</i>

The species in Table 5 were all recorded by Smith in 1981 (BAS, 2008) but were not found during the current survey at Prince Olav Harbour. However, they may still be present with the whaling station, which was a restricted area at the time of survey. Follow-up survey within the whaling station exclusion zone is recommended.

**Table 5: Additional historical records of introduced species at Prince Olav Harbour**

## Site 4: Fortuna Bay



### Site features:

- Reindeer grazing
- King penguin colony
- Shackleton Walk

Fortuna Bay is a potential hotspot for new introductions as it is a popular visitor site. The site is approached by visitors both from the shore and from inland following the Shackleton walk over the pass from Stromness. The most popular landing sites are on the western shore, near Whistle Cove and on the eastern shore to the south of Hodson Point (for the Shackleton Walk). More details about the site can be found in the South Georgia Government's Visitor Management plans for Fortuna Bay and the Shackleton Walk (GSGSSI, 2009).

### Vegetation survey:

One day of survey work was carried out at Fortuna Bay. Weather conditions were fine. A second day was planned but landing was not possible due to bad weather.

18 random 1x1 m quadrat samples were recorded from the area along the west side of Fortuna Bay. (Two more random quadrat samples were planned but couldn't be recorded as they fell within a tern nesting area at the east side of the survey area). General searching and recording were also carried out around the site.

### Native vegetation

The vegetation at Fortuna Bay has been mapped in detail by Scott and Poncet (2003). 'Sparse lowland fellfield' is the dominant vegetation type on the outwash plain, with 'Festuca -fellfield mosaic' and 'moist lowland fellfield'. 'Short mixed grassland' consisting almost entirely of introduced *Poa annua* is found around the king penguin colony. 'Festuca grassland', and 'mire and bog' with *Juncus scheuchzerioides* and *Rostkovia magellanica* are predominant on the slopes to the west of the outwash plain. There is very little 'tussac' vegetation at this site, this is mainly found on the slopes above Whistle Cove.

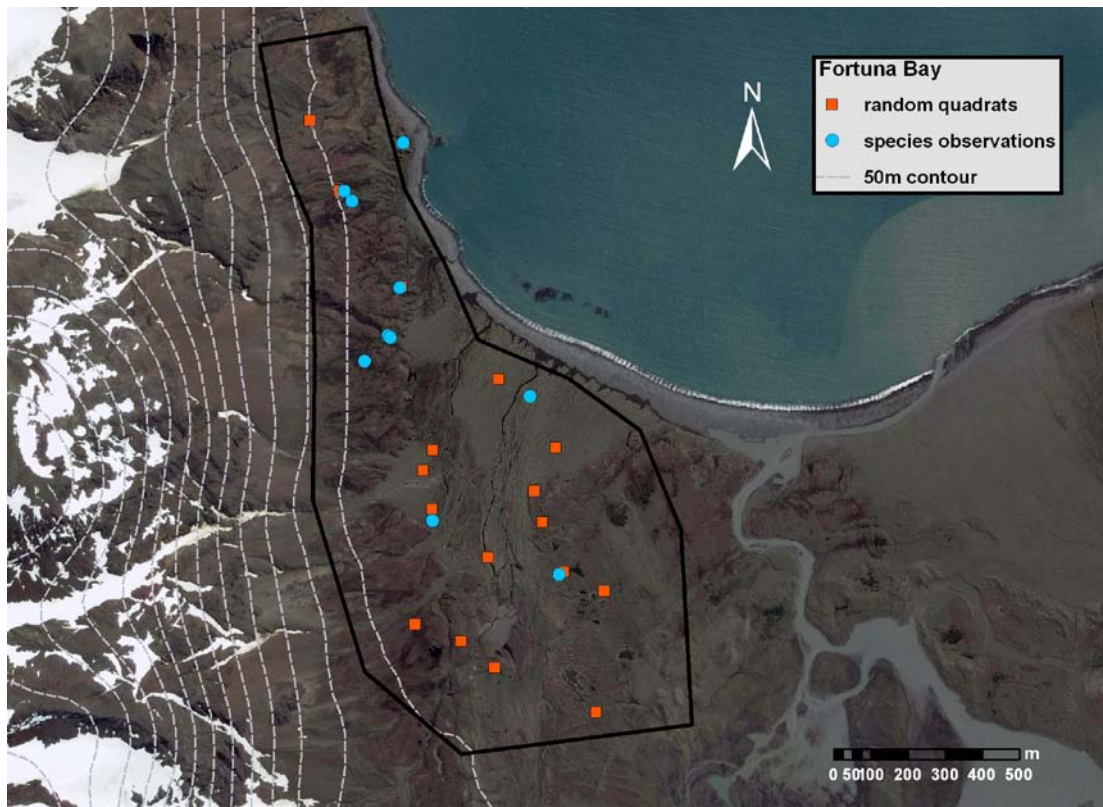


Figure 12: Survey records at Fortuna Bay

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Fortuna Bay
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and frequent
Poaceae	<i>Poa annua</i>	Widespread and abundant

Two introduced plant species were recorded at Fortuna Bay. *Poa annua* and *Cerastium fontanum* are widespread throughout the site and they were recorded in a large proportion of our random quadrat samples across all habitats. Both species were found to be growing over a kilometre from the landing beach at Whistle Cove.



## Site 5: Stromness



### Site features:

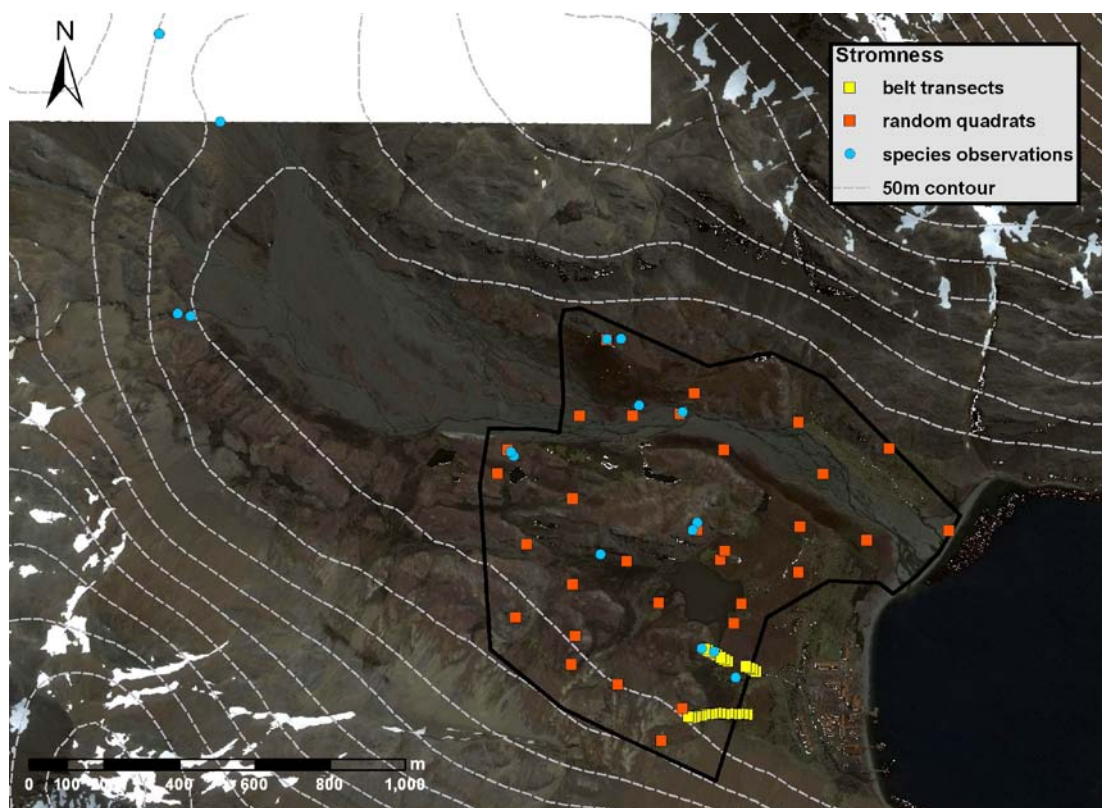
- Stromness whaling station
- Shackleton Walk
- Reindeer grazing

Stromness is a historic hotspot for plant introductions due to the whaling station. It is also a potential hotspot for new introductions as it is a popular visitor site. Visitors can approach this site both from the shore and from inland following the Shackleton walk over the pass from Fortuna Bay. There is a 200 m exclusion zone around the whaling station. More details about the site can be found in the South Georgia Government's Visitor Management plan for the Shackleton Walk (GSGSSI, 2009).

### Vegetation survey:

Survey work was carried out over two days at Stromness. Weather conditions were fine but with strong wind during the second day, when return to the support vessel in the evening was delayed by three hours and it was necessary to use temporary shelters (bothy bags).

31 random 1x1 m quadrat samples were recorded from the area outside the whaling station exclusion zone. Two belt transects (160 m and 180 m long) were surveyed, radiating from the edge of the 200 m exclusion zone. General searching and recording were carried out around the site, walking inland along the braided river following the Shackleton Walk to the 'Shackleton Waterfall' and following another stream valley to the north towards the edge of the snow line.



**Figure 13: Survey records at Stromness.**

**Native vegetation:**

The vegetation at Stromness has been mapped in detail by Scott and Poncet (2003). The dominant vegetation types include ‘*Festuca* grassland’ and ‘*Festuca*-fellfield mosaic’, which are prevalent on the drier areas, and large expanses of ‘mire and bog’, especially along the valley bottom. There is very little ‘tussac’ vegetation at this site. Distinctive areas of grassland dominated by *Alopecurus antarcticus* were noted along the braided river during this survey. This grassland vegetation was not observed anywhere else on South Georgia.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Stromness
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and frequent
Compositae	<i>Taraxacum officinale</i>	Restricted and rare
Poaceae	<i>Agrostis capillaris</i>	Restricted and abundant in a single patch
Poaceae	<i>Poa annua</i>	Widespread and abundant
Poaceae	<i>Poa pratensis</i>	Widespread and abundant
Poaceae	<i>Trisetum spicatum</i>	Widespread and abundant

Six introduced plant species were recorded at Stromness including *Trisetum spicatum*, a new record for South Georgia. *Poa annua* and *Cerastium fontanum* are widespread throughout the site with *Poa annua* frequently occurring at high densities on flat areas and slopes where it is maintained by reindeer grazing. *Poa pratensis* is also widespread and abundant here, particularly behind the whaling station. The *Trisetum spicatum* was found growing in ‘*Festuca* grassland’ and ‘short mixed grassland’ over a fairly extensive area just under 1 km in diameter. A single patch of *Agrostis capillaris* was recorded, invading ‘*Festuca* grassland’ with native *Alopecurus antarcticus* along the braided river, forming a dense patch 3 m in diameter. Only three individual plants of *Taraxacum officinale* were found, growing high up on slopes to the north of the Shackleton Waterfall, approximately 2 km from the shore.

The vegetation at this site is heavily impacted by reindeer, which selectively graze certain species, modifying the native vegetation. The low abundance of *Taraxacum officinale* at this site is probably due to reindeer grazing as it is a palatable species.



**Figure 14:** *Poa annua* can be found growing in damp moss at the head of the Shackleton Valley.

**Additional historical records:**

In addition to the introduced species recorded during the current survey, a number of other introduced species have been recorded at Stromness in the past (BAS, 2008). Those listed in Table 6 were classed as persistent or naturalised by Walton and Smith (1973), or have been recorded since 1973. Species classed as transient by Walton and Smith in 1973 are not included unless they have subsequently been recorded.

Family	Species
Alliaceae	<i>Allium schoenoprasum</i>
Compositae	<i>Achillea ptarmica</i>
Poaceae	<i>Deschampsia cespitosa</i>
Poaceae	<i>Festuca rubra</i> subsp. <i>rubra</i>
Polygonaceae	<i>Rumex acetosella</i>

**Table 6:** Additional historical records of introduced species at Stromness.

The species in Table 6 were not found during the current survey at Stromness. However, they may still be present with the whaling station, which was a restricted area at the time of survey. Follow-up survey within the whaling station exclusion zone is recommended.

## Site 6: Husvik



### Site features:

- Husvik whaling station
- Manager's villa
- Cemetery
- Reindeer grazing
- Reindeer enclosure

Husvik is a historic hotspot for plant introductions due to the whaling station. It is also a potential hotspot for new introductions as it is a popular visitor site. There is a 200 m exclusion zone around the whaling station.

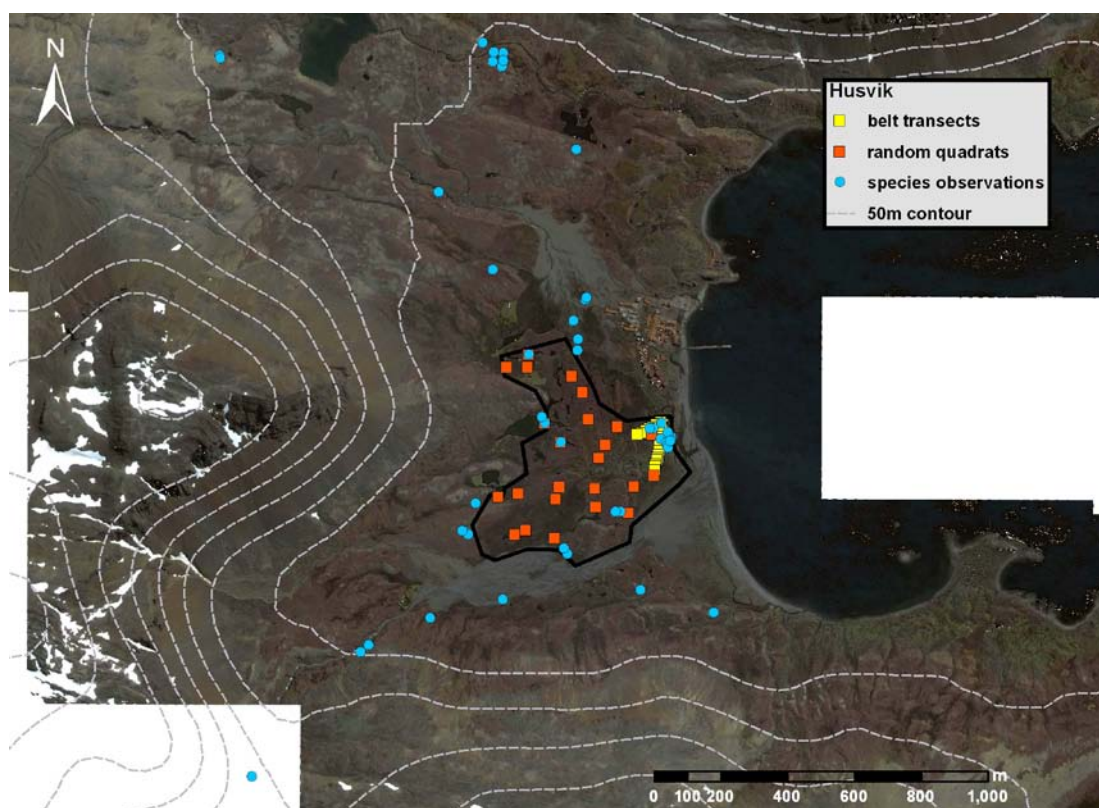
### Vegetation survey:

The survey was carried out over two and a half days at Husvik. (We moved to Husvik, where dinghy landing was easier, when the weather conditions prevented a second day of survey work at Fortuna Bay). Weather conditions were wet on the first day and then fine for the rest of the survey.

24 random 1x1 m quadrat samples were recorded from the area behind the manager's villa and southwest of the whaling station. Two belt transects (150 m and 90 m long) were surveyed, radiating approximately south and southwest from the radio shack near manager's villa. Historical records of introduced species were monitored where possible. General searching and recording were also carried out around the site, walking some distance up the Karrakatta and Husdal valleys and around the cemetery. The area around manager's villa was searched thoroughly as there were many historical records from this site.

### Native vegetation:

The dominant vegetation types at Husvik include large areas of 'mire and bog' with *Juncus scheuchzerioides* and *Rostkovia magellanica* and 'hard moss bank', mainly on the flat areas behind the manager's villa and whaling station. There is also a significant area of 'sparse



**Figure 15: Survey records at Husvik**

lowland fellfield’ on the outwash plain behind the whaling station. ‘Short mixed grassland’ and ‘*Festuca* grassland’ are common on undulating ground higher up. There is very little ‘tussac’ and ‘*Acaena* herbfield’ at this site, probably due to reindeer grazing. However, within the reindeer enclosure in the Husdal Valley, *Acaena magellanica* covered almost 100% of the ground with a number of plants of introduced *Taraxacum officinale* observed in flower and fruit (see Figure 16). Results from the exclusion experiment and the influence of reindeer on the vegetation are discussed by Leader-Williams *et al.* (1987) and further monitoring was carried out in 2008 (Upson, unpublished).

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Husvik
Campanulaceae	<i>Pratia repens</i>	Restricted and common in a large patch
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and frequent
Compositae	<i>Taraxacum officinale</i>	Widespread and occasional
Cyperaceae	<i>Carex aquatilis</i>	Restricted and common
Ericaceae	<i>Vaccinium vitis-idaea</i>	Restricted and abundant
Poaceae	<i>Agrostis capillaris</i>	Widespread and abundant in patches
Poaceae	<i>Agrostis vinealis</i>	Restricted and abundant in a small patch
Poaceae	<i>cf. Deschampsia flexuosa</i> *	Restricted and common
Poaceae	<i>Elymus repens</i>	Restricted and rare
Poaceae	<i>Festuca rubra</i>	Restricted and rare
Poaceae	<i>Poa annua</i>	Widespread and abundant
Poaceae	<i>Poa pratensis</i>	Widespread and occasional
Polygonaceae	<i>Rumex acetosella</i>	Widespread and frequent in patches

\*Identification uncertain – only seen in vegetative state in an area heavily trampled by seals.

13 introduced plant species were recorded at Husvik, *Poa annua* being the most common, occurring in more than a half of our random quadrat samples in all habitats except mire and bog. *Cerastium fontanum* was also widespread throughout the site, occurring mostly in drier habitats. This herb was recorded all the way up Husdal Valley to near the snow line. *Poa pratensis* and *Taraxacum officinale* are widespread around the site but not very abundant. Reindeer grazing is probably keeping the population of *Taraxacum officinale* low as this herb is palatable for reindeer. There are several large patches of *Rumex acetosella* at this site, growing on dry stony ground behind the whaling station exclusion zone and also in 'Festuca grassland' on slopes in the Karrakatta Valley. *Agrostis capillaris* was commonly growing in large circular patches behind the whaling station and on the slopes in Karrakatta Valley. *Carex aquatilis* only occurred at one locality around the manager's villa. A vegetative grass was also found here and was tentatively recorded as *Deschampsia flexuosa* (for which there is a historical record at this site) though the plants were heavily trampled by seals and the identification is uncertain. *Agrostis vinealis* was found in two small patches around the manager's villa. A small, single clump of *Elymus repens* and another of *Festuca rubra* were found growing against the walls of the manager's villa and small shed to the south. Historical records for *Pratia repens* in the Karrakatta Valley near Block Lake and *Vaccinium vitis-idaea* in the Husdal Valley (MacAlister, 1995) were monitored. The *Pratia* population occupies an area of approximately 10x5 m and does not appear to have expanded since 1991. *Vaccinium vitis-idaea* is found over an area approximately 10x10 m. This population (or possibly individual) appears to have expanded vegetatively since 1991 when it occupied an area of only 'several square meters' (MacAlister, 1995).



**Figure 16: A reindeer enclosure in Husdal Valley strikingly demonstrates the effect of reindeer grazing on the vegetation.**

**Additional historical records:**

In addition to the introduced species recorded during the current survey, a number of other introduced species have been recorded at Husvik in the past (BAS, 2008). Those listed in Table 7 were classed as persistent or naturalised by Walton and Smith (1973), or have been recorded since 1973. Species classed as transient by Walton and Smith in 1973 are not included unless they have subsequently been recorded.

<b>Family</b>	<b>Species</b>
Apiaceae	<i>Anthriscus sylvestris</i>
Compositae	<i>Achillea millefolium</i>
Compositae	<i>Achillea ptarmica</i>
Cruciferae	<i>Capsella bursa-pastoris</i>
Juncaceae	<i>Juncus filiformis</i>
Leguminosae	<i>Lotus corniculatus</i>
Leguminosae	<i>Trifolium repens</i>
Poaceae	<i>Anthoxanthum odoratum</i>
Poaceae	<i>Deschampsia cespitosa</i>
Poaceae	<i>Festuca ovina</i>
Ranunculaceae	<i>Ranunculus repens</i>
Rosaceae	<i>Alchemilla monticola</i>

The species in Table 7 were not found during the current survey at Husvik. However, they may be present with the whaling station, which was a restricted area at the time of survey. Follow-up survey within the whaling station exclusion zone is recommended.

**Table 7: Additional historical records of introduced species at Husvik**

## Site 7: Maiviken



### Site features:

- Reindeer-free site
- Track to Grytviken
- Field hut

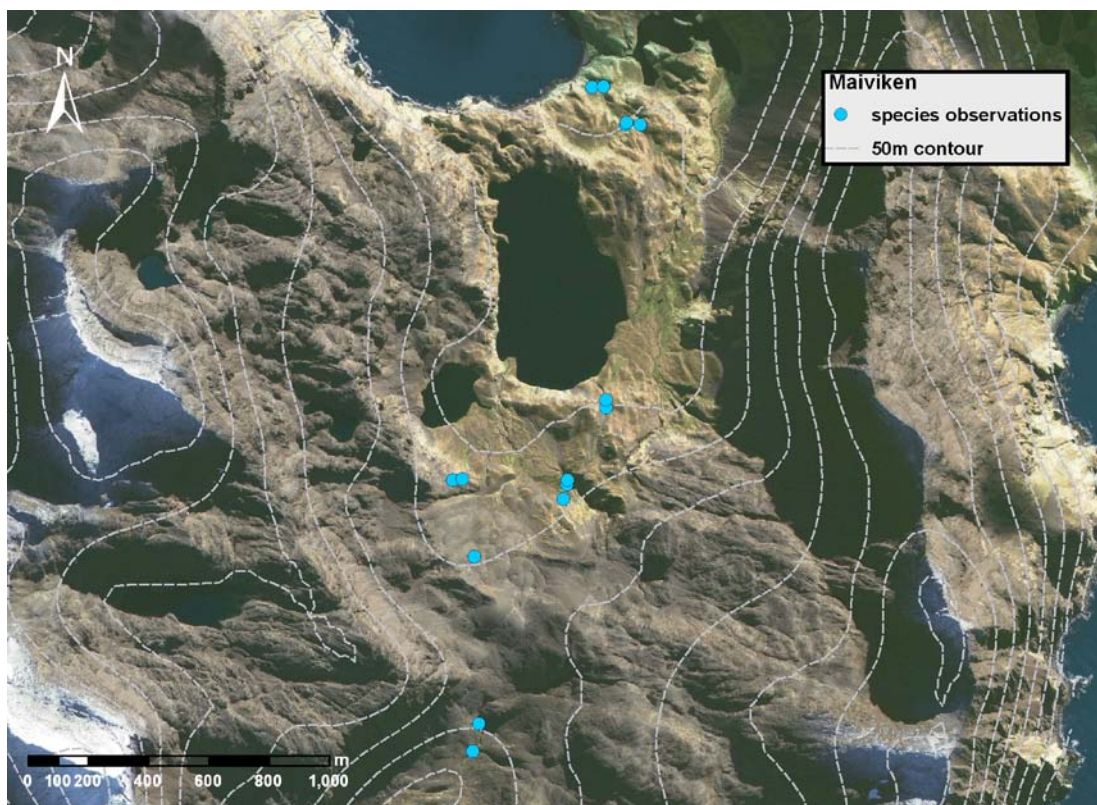
Maiviken is a potential hotspot for new introductions as it is a popular visitor site. Visitors can approach this site both from the shore and from inland following a track over the saddle from Grytviken. Although there is no settlement at Maiviken there is potential for introductions to be spread here overland from the whaling station at Grytviken, where numerous introduced plant species can be found. The site was included within the Thatcher Peninsula Environmentally Sensitive Area (McIntosh and Walton, 2000) but is not currently included within the Specially Protected Areas (Pasteur and Walton, 2006).

### Vegetation survey:

One day of survey work was carried out at Maiviken, walking over the saddle from Grytviken. Weather conditions were fine.

Only general searching and recording were carried out at this site, walking down through Bore Valley, around Lancetes Lake and along the east side of Maivatn Lake down to the shore.





**Figure 17: Survey records at Maiviken**

**Native vegetation:**

The vegetation at Maiviken has been mapped in detail by Scott and Poncet (2003). The dominant vegetation types at Maiviken include 'Festuca grassland', 'Festuca-fellfield' mosaic and 'mire and bog' in Bore Valley and around the lakes. Large stands of 'Acaena herbfield' can be found by the stream between the two lakes. 'Tussac' vegetation occurs over a large area at the coast and to the east of the bay (this area was not covered in the current survey).

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Maiviken
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and occasional
Compositae	<i>Taraxacum officinale</i>	Widespread and abundant in patches
Poaceae	<i>Nardus stricta</i>	Restricted and rare
Poaceae	<i>Poa annua</i>	Widespread and abundant

Four introduced plant species were recorded at Maiviken. *Cerastium fontanum* is widespread, occurring across different native vegetation types, though few individual plants were seen. *Taraxacum officinale* and *Poa annua* are also widespread throughout the site, both growing near the beach and also around Maivatn Lake. *Poa annua* is most abundant near the shore on disturbed ground trampled by seals. A single clump of *Nardus stricta* was found growing in *Festuca* grassland at the edge of a boggy wet flush with *Rostkovia magellanica*, *Juncus scheuchzerioides* and moss.

## Site 8: Grytviken



### Site features:

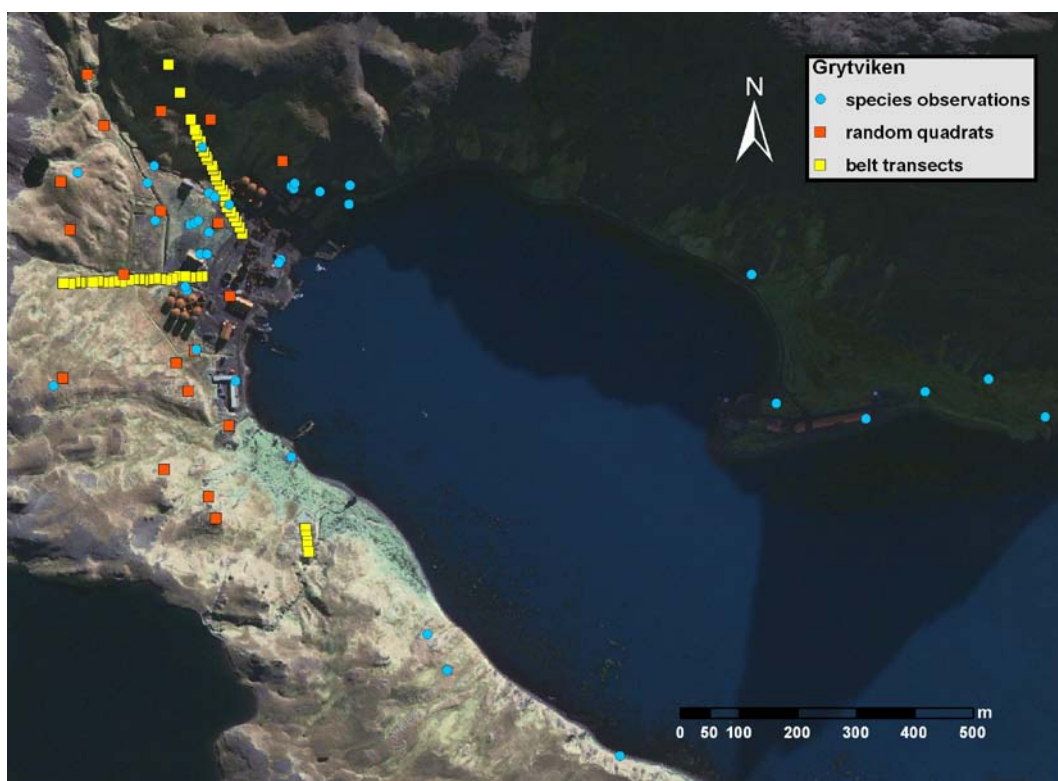
- Grytviken whaling station
- British Antarctic Survey research station, Post Office and Government buildings at King Edward Point (KEP)
- Museum, church and cemetery
- Shackleton's grave and memorial cross
- Reindeer-free site

Grytviken is a historic hotspot for plant introductions due to the whaling station, which was the first to be built on South Georgia. It is also a potential hotspot for new introductions as it is the most popular visitor site and the only settlement on the mainland. Every cruise ship and yacht visiting the island is required to stop here to meet with a Government official.

### Vegetation survey:

Survey was carried out over three days at Grytviken. Weather conditions were fine.

19 random 1x1 m quadrat samples were recorded from the area around the whaling station. Three belt transects were surveyed, two radiating west and northwest from the whaling station buildings (250 m and 360 m long) and one radiating south from the south corner of cemetery fence (50 m long). Historical records of introduced species at this site were monitored. General searching and recording were also carried out around the site walking around King Edward Cove from Hope Point to beyond the cemetery.



**Figure 18: Survey records at Grytviken.**

**Native vegetation:**

The vegetation at Grytviken has been mapped in detail by Scott and Poncet (2003). The stony ground within the whaling station is covered by 'short mixed grassland' with *Phleum alpinum*, *Acaena magellanica* and many introduced species. The 'short mixed grassland' spreads out around the whaling station in all directions but mostly up into the Bore Valley. The two most dominant vegetation types at Grytviken include 'Festuca grassland' and 'Festuca-fellfield mosaic', common mainly on the hills around the whaling station. There are also areas of 'sparse lowland fellfield' and 'mire and bog'. Only a few patchy areas of 'Acaena herbfield' can be found and there is little 'tussac' at this site.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Grytviken
Campanulaceae	<i>Pratia repens</i>	Restricted and rare
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and abundant
Caryophyllaceae	<i>Sagina procumbens</i>	Restricted and frequent
Compositae	<i>Achillea millefolium</i>	Restricted and rare
Compositae	<i>Taraxacum officinale</i>	Widespread and common
Cruciferae	<i>Cardamine flexuosa</i>	Widespread and frequent
Leguminosae	<i>Trifolium repens</i>	Restricted and rare
Poaceae	<i>Agrostis capillaris</i>	Widespread and abundant
Poaceae	<i>Deschampsia cespitosa</i>	Restricted and rare
Poaceae	<i>Poa annua</i>	Widespread and abundant
Poaceae	<i>Poa pratensis</i>	Widespread and abundant
Polygonaceae	<i>Rumex acetosella</i>	Widespread and common
Polygonaceae	<i>Rumex crispus</i>	Restricted and rare
Ranunculaceae	<i>Ranunculus repens</i>	Restricted and occasional
Scrophulariaceae	<i>Veronica serpyllifolia</i>	Restricted and frequent
Umbelliferae	<i>Anthriscus sylvestris</i>	Restricted and rare

16 introduced plant species were recorded at Grytviken. *Poa pratensis* and *Cerastium fontanum* were the most widespread and abundant species at this site, occurring in more than half of our quadrat samples and in all vegetation types except 'mire and bog'. *Poa annua* was also found to be widespread and abundant. *Taraxacum officinale* is widespread and common at this site. We recorded numerous large patches of *Agrostis capillaris* and *Rumex acetosella*, both successfully competing with native vegetation on the slopes behind the whaling station. *Ranunculus repens* occurs occasionally at this site. It can be found in small clumps mainly in the former whaling station area but also at King Edward Point and south of the whaling station at the old hydroelectric power station. *Cardamine flexuosa*, the most recently recorded introduction to South Georgia is spreading fast and was found at five locations, four around King Edward Point and one directly across the bay from King Edward Point. All other introduced species recorded here had restricted distributions around the whaling station (more details of these can be found in the species section of this report).

**Additional historical records:**

In addition to the introduced species recorded during the current survey, a number of other introduced species have been recorded at Grytviken in the past (BAS, 2008). Those listed in Table 8 were classed as persistent or naturalised by Walton and Smith (1973), or have been recorded since 1973. Species classed as transient by Walton and Smith in 1973 are not included unless they have subsequently been recorded.

The species in Table 8 were not found during the current survey at Grytviken and may no longer be present at this site. In some cases small populations may have been overlooked since coverage of the area was not exhaustive. The locality where *Poa trivialis* was recorded (to the west of cemetery) was not surveyed and follow-up survey is recommended for this species. Many of the introduced plants at King Edward Point were recently sprayed with herbicide (Sarah Lurcock, pers. comm.) and appear to have been eradicated. However, where these species have set viable seed in the past, especially in the case of annual species such as *Capsella bursa-pastoris*, dormant seed may persist in the ground and future monitoring is recommended.

Family	Species
Alliaceae	<i>Allium schoenoprasum</i>
Compositae	<i>Achillea ptarmica</i>
Compositae	<i>Artemisia</i> sp.
Compositae	<i>Sonchus</i> sp.
Cruciferae	<i>Capsella bursa-pastoris</i>
Cruciferae	<i>Rorippa islandica</i>
Cruciferae	<i>Sinapis</i> sp.
Caryophyllaceae	<i>Stellaria media</i>
Juncaceae	<i>Juncus filiformis</i>
Leguminosae	<i>Trifolium hybridum</i>
Plantaginaceae	<i>Plantago media</i>
Poaceae	<i>Elymus repens</i>
Poaceae	<i>Festuca rubra</i> subsp. <i>rubra</i>
Poaceae	<i>Poa trivialis</i>
Ranunculaceae	<i>Ranunculus acris</i>

**Table 8: Additional historical records of introduced species at Grytviken**

## Site 9: Hestesletten



### Site features:

- Historic site for livestock grazing
- Reindeer-free site

Hestesletten is a historic hotspot for plant introductions as the area was used for grazing livestock when the whaling station was in operation at Grytviken (Smith, 1973). The site was included within the Thatcher Peninsula Environmentally Sensitive Area (McIntosh and Walton, 2000) but is not currently included within the Specially Protected Areas (Pasteur and Walton, 2006).

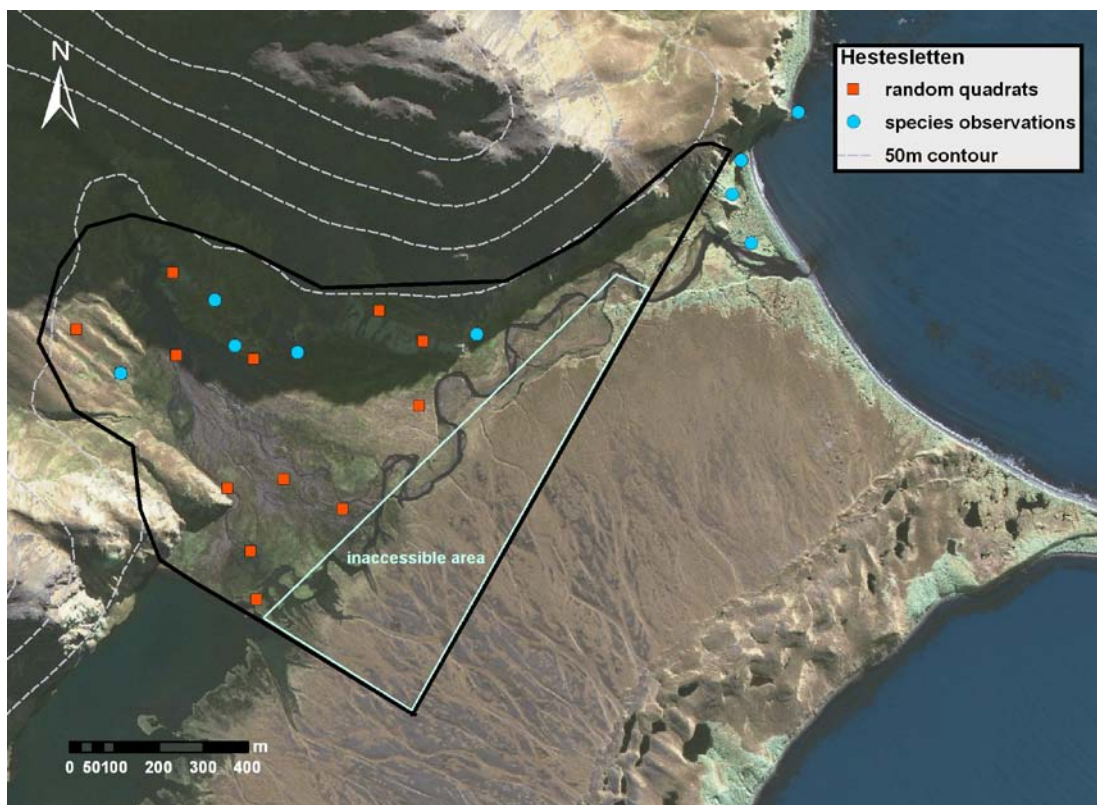
### Vegetation survey:

One day of survey work was carried out at Hestesletten. The site was accessed site by walking along the cliff-tops from Grytviken and descending onto the plain via the steep slopes overlooking the mouth of Penguin River. Weather conditions were fine. We had planned to conduct survey work on both sides of Penguin River, but were unable to cross to the southeastern side of the plain because water levels were high due to warm temperatures increasing the meltwater volume.

13 random 1x1 m quadrat samples were recorded from the area on the northwest side of Penguin River. No belt transects were surveyed at this site due to limited time. General searching and recording was carried out around the accessible parts of the site.

### Native vegetation:

'Mire and bog' dominated by *Rostkovia magellanica* is the dominant vegetation type at this site, covering large areas of low-lying land. Along the coast and around the river mouth there is a broad band of 'tussac' interspersed with areas of 'short mixed grassland' and



**Figure 19: Survey records at Hestesletten**

'*Deschampsia* grassland' especially in places heavily trampled by seals. Towards the west of the survey site the dry stony ground on the plain is dominated by 'sparse lowland fellfield' and 'moist lowland fellfield' vegetation types with patches of 'Acaena herbfield' often consisting of almost pure stands of *Acaena magellanica*. On the slopes to the north of the site '*Festuca* grassland' is dominant on drier slopes while 'Acaena herbfield' and 'mire and bog' are found on wetter slopes and in gullies.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Hestesletten
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and frequent
Compositae	<i>Taraxacum officinale</i>	Restricted and frequent
Poaceae	<i>Poa annua</i>	Widespread and frequent

Three introduced plant species were recorded from the survey area at Hestesletten. *Poa annua* is widespread and frequent, particularly at the coast, where it is often abundant, and along a stream at the base of slopes to the north of the survey area. *Cerastium fontanum* is widespread and frequent throughout the site. *Taraxacum officinale* was only found at one location near the shore where frequent plants were recorded growing in a lush stand of *Acaena magellanica* on an east-facing slope.

**Additional historical records:**

A persistent colony of *Empetrum rubrum* (diddle-dee) was recorded from the eastern side of Hestesletten in 1971 (Smith, 1973) and again in 1981 (BAS, 2008). The locality where it was recorded was not included in the current survey and follow-up survey is recommended for this species.

## Site 10: Greene Peninsula



### Site features:

- Reindeer-free site

Greene Peninsula was selected for survey as a comparative less-visited area, where fewer introduced plant species are expected to occur. There is no historic settlement on the peninsula. However, its proximity to Grytviken, where introduced species are numerous, does put this area at risk of colonisation. The site was designated as a Protected Area in 2000 and is recorded as being one of the most diverse areas for native vegetation on South Georgia (McIntosh and Walton, 2000). It is not currently included within the Specially Protected Areas (Pasteur and Walton, 2006) but is being considered as a trial area for the eradication of rats as it is isolated from the rest of the mainland by glaciers.

### Vegetation survey:

One day of survey was carried out along the northwest coast of Greene Peninsula. Weather conditions were fine.

31 random 1x1 m quadrat samples were recorded from the area. No belt transects were surveyed due to time limitation. General searching and recording were carried out around the site.

### Native vegetation:

The vegetation at Greene Peninsula has been mapped in detail by Scott and Poncet (2003). The dominant vegetation types within the survey area at Greene Peninsula include 'Festuca grassland', 'Festuca-fellfield mosaic' on the slopes and 'mire and bog' with *Juncus scheuchzerioides* and *Rostkovia magellanica* in more humid and flat areas. A narrow strip of 'tussac' grows along the coast with wider areas covered by 'tussac and *Acaena*' and 'tussac and *Festuca*' towards Dartmouth Point. There is also a broad, steep slope of 'tussac' vegetation near the end of the peninsula.

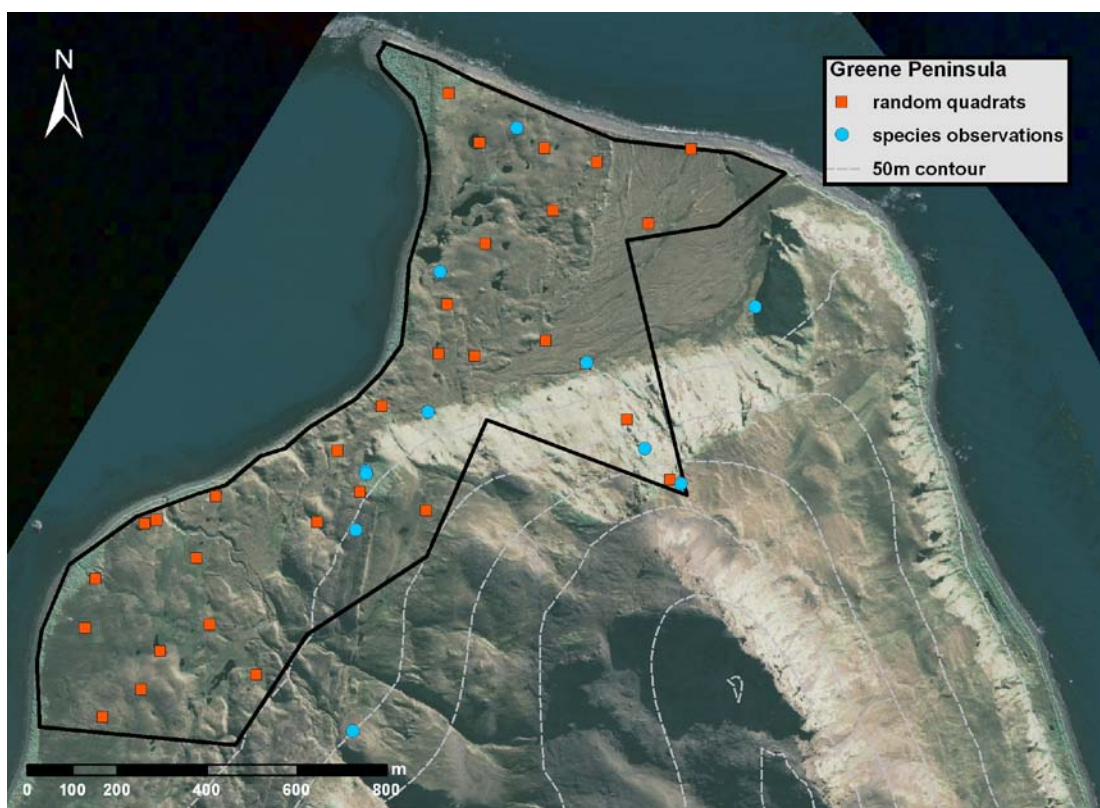


Figure 20: Survey records at Greene Peninsula

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Greene Peninsula
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and frequent
Poaceae	<i>Poa annua</i>	Widespread and occasional
Compositae	<i>Taraxacum officinale</i>	Widespread and common

Three introduced plant species were recorded at Greene Peninsula. *Cerastium fontanum* was the most common species, occurring in almost all habitats. *Taraxacum officinale* was also widespread throughout the site growing near the beach and also on the slopes as far as 600 m inland. In some locations it was observed to be abundant in large patches, particularly invading 'Acaena herbfield' vegetation. *Poa annua* was observed to be abundant in a narrow strip along the shoreline but was only recorded three times within the survey area inland. Two of these records were amongst 'tussac' near the beach and single record from a moss-dominated community at higher altitude, approximately 650 m inland.



## Site 11: Godthul



### Site features:

- Historic whaling shore depot
- Gentoo penguin colony
- Reindeer grazing

Godthul is a historic hotspot for plant introductions because of the whaling depot. It is also a potential hotspot for new introductions as it is a popular visitor site. More details about the site can be found in the South Georgia Government's Visitor Management plan for Godthul (GSGSSI, 2009).

### Vegetation survey:

One day of survey work was carried out at Godthul. Weather conditions were fine with strong winds. A second day was planned but landing was not possible due to large waves breaking onshore.

32 random 1x1 m quadrat samples were recorded from an area behind the depot ruins and around Lake Aviemore to the south-east of the ruins. No belt transects were surveyed at this site due to limited time. General searching and recording were carried out around the site within the polygon area where the random samples were taken.

### Native vegetation:

The vegetation at Godthul has been mapped in detail by Scott and Poncet (2003). The survey area is hilly with well-drained slopes dominated by '*Festuca* grassland'. There are also large areas of heavily grazed 'short mixed grassland' dominated by *Poa annua*, frequent patches of 'hard mossbank' and areas of 'mire and bog'. Around the coast there is a broad strip of tussac vegetation and behind this, a degraded area of 'tussac, moss and *Poa annua*'. Tussac can also be found on the steeply sloping sides of a deep stream gully running down from the lake to the coast.

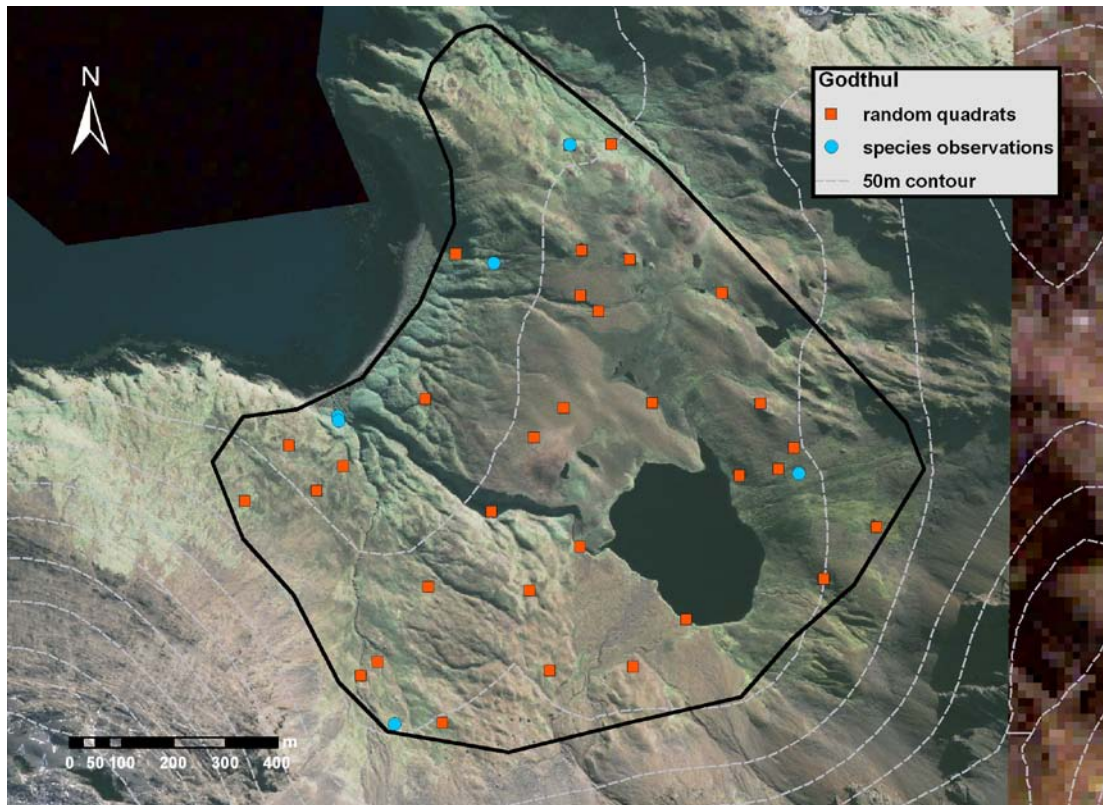


Figure 21: Survey records at Godthul

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Godthul
Caryophyllaceae	<i>Cerastium fontanum</i>	Restricted and rare
Poaceae	<i>Poa annua</i>	Widespread and abundant
Poaceae	<i>Poa pratensis</i>	Restricted and abundant
Compositae	<i>Taraxacum officinale</i>	Widespread and rare

Four introduced species were found at Godthul: *Poa annua* is widespread and abundant, often occurring in dense lawns maintained by reindeer grazing. *Poa pratensis* was only found at one locality within the survey area, growing in a heavily grazed, dense lawn on slopes north-east of the shore depot. *Cerastium fontanum* was also only found at one locality, and only a single plant was recorded, growing in the stream gully running out of the lake. *Taraxacum officinale* was found at two localities fairly wide apart within the survey area and very few individual plants were seen. The low abundance of *Taraxacum officinale* and *Cerastium fontanum* at this site is likely to be due to reindeer grazing as these are palatable species. The impact of the reindeer on the vegetation at this site is very apparent. *Poa annua* lawns are extensive and in some areas the mossbanks were observed to be breaking up, exposing the peat beneath and leading to soil erosion.

## Site 12: Cobblers Cove



### Site features:

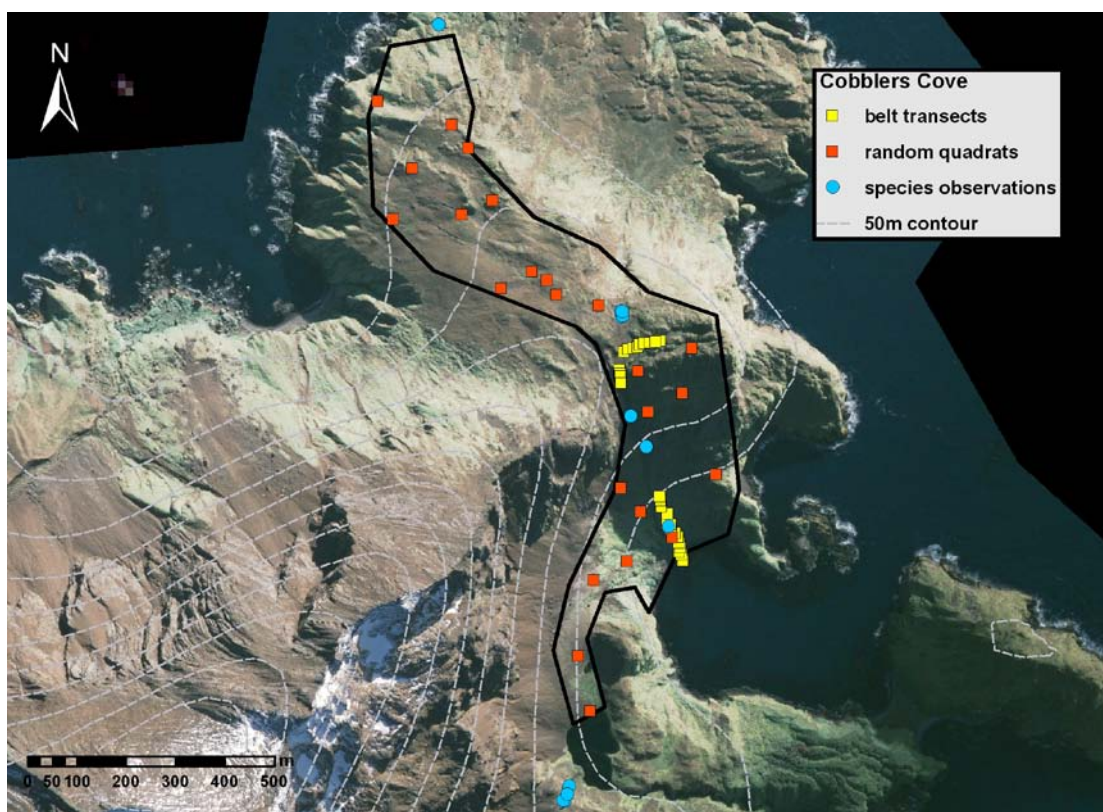
- Macaroni penguin colony
- Reindeer grazing

Cobblers Cove is a potential hotspot for new introductions as it is a popular visitor site, particularly as the cove provides a sheltered yacht anchorage. There is no historical settlement at this site and little recorded human history (Poncet and Crosbie, 2005).

### Vegetation survey:

The survey was carried out over two days at Cobblers Cove. This site was not initially selected for the vegetation survey but it was a convenient survey site, providing a safe and sheltered anchorage where dinghy landings were possible when strong winds prevented landings at Godthul. Weather conditions were fine with very strong winds.

24 random 1x1 m quadrat samples were recorded from a linear area following popular walking routes to the macaroni penguin colony on Rookery Point and to the small lake south-west of the Cove. Three belt transects were surveyed, one (140 m long) running north from the edge of the beach up the steep slope towards the saddle; the second (90 m long) running along the top of the saddle from a small pond in a north-easterly direction; the third (50 m) a short transect running south down the steep slope from the saddle. General searching and recording were carried out around the site, walking to macaroni penguin colony and up to a waterfall above the lake to the south-west of the cove.



**Figure 22: Survey records at Cobblers Cove**

**Native vegetation:**

A number of different vegetation types can be found in the area around Cobbler’s Cove and Rookery Point. Above the beach at Cobbler’s Cove there is a conspicuous area of ‘short mixed grassland’ dominated by introduced *Poa annua*. This area is heavily impacted by fur seals. On the steeper slopes above this area the vegetation grades into ‘moist lowland fellfield’ and ‘sparse lowland fellfield’. The saddle to the north of the cove is dominated by ‘tussac and moss’ and ‘hard mossbank’ and there is much evidence of erosion of the moss and peat that may result from trampling and from reindeer grazing the tussac vegetation. There are still large areas of coastal tussac intact on steep slopes around the cove and at Rookery Point. Drier slopes towards Rookery Point are dominated by ‘*Festuca* grassland’ and ‘*Festuca*-fellfield mosaic’.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Cobblers Cove
Poaceae	<i>Poa annua</i>	Widespread and abundant
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread but rare
Compositae	<i>Taraxacum officinale</i>	Restricted and rare

Three introduced species were found at Cobblers Cove: *Poa annua* is widespread and abundant, occurring at highest density in the seal-impacted area of ‘short mixed grassland’ above the beach. *Cerastium fontanum* was only found in two localities, a small population was recorded growing in wet moss beside the waterfall above the lake and a single seedling was recorded in ‘moist lowland fellfield’ along the path leading to the macaroni penguin colony. *Taraxacum officinale* was also found beside the waterfall and a single plant was noted on the route from the beach to the lake. The low abundance of *Taraxacum officinale* and *Cerastium fontanum* at this site may be due to reindeer grazing as these are palatable species.

## Site 13: Ocean Harbour



### Site features:

- Whaling station ruins
- Field hut
- Cemetery
- Reindeer grazing

Ocean Harbour is a historic hotspot for plant introductions because of the whaling station. It is also a potential hotspot for new introductions as it is a popular visitor site.

### Vegetation survey:

The survey was carried out over two days at Ocean Harbour. Weather conditions were fine.

32 random 1x1 m quadrat samples were recorded from the area behind the whaling station ruins and on the slopes to the south and west of the bay. Two belt transects were surveyed at this site, starting at the field hut and running northwest (210 m) and south (270 m). Historical records were monitored where possible. General searching and recording was carried out around the site within the polygon area where the random samples were taken.

### Native vegetation:

Around the whaling station ruins the vegetation consists mainly of 'short mixed grassland' dominated by introduced *Poa annua*, which forms dense lawns maintained by reindeer grazing. The *Poa annua* lawns are also prevalent on the lower slopes near the beach. On the flat plain behind the ruins the vegetation includes areas of 'sparse lowland fellfield' and 'moist lowland fellfield' interspersed with 'mire and bog'. On the slopes '*Festuca* grassland' and 'hard mossbank' are dominant.

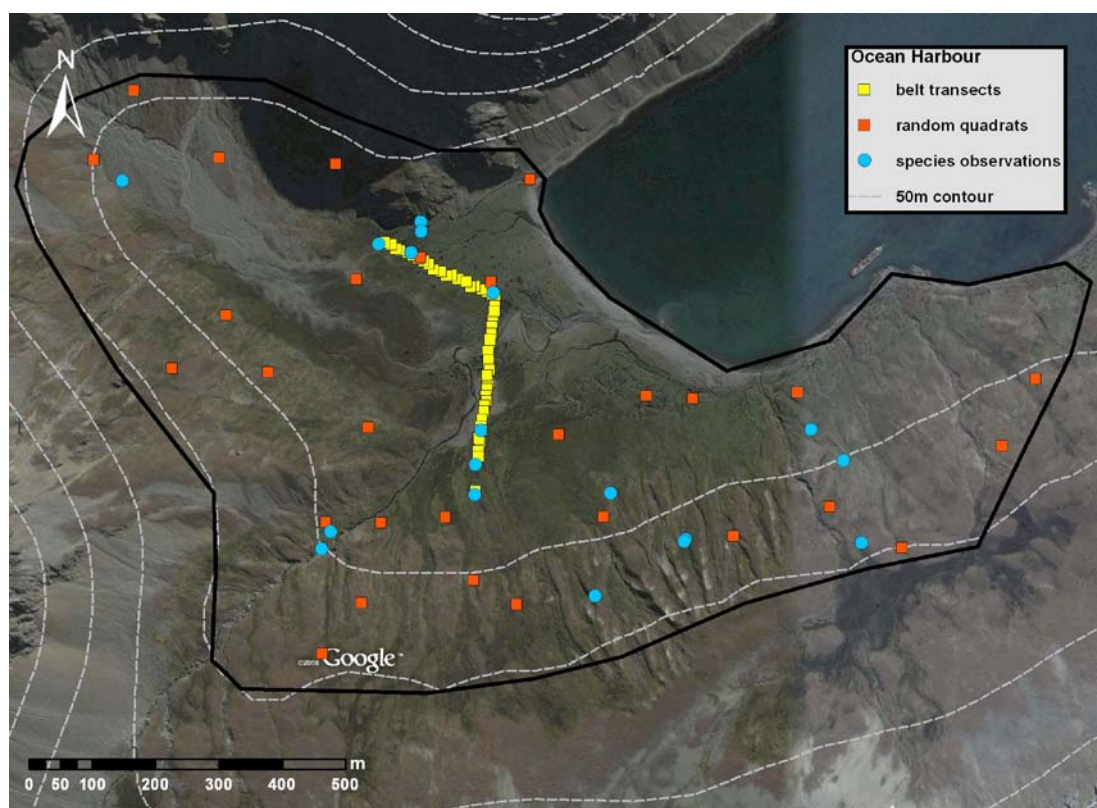


Figure 23: Survey records at Ocean Harbour

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Ocean Harbour
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and occasional
Compositae	<i>Taraxacum officinale</i>	Widespread and rare
Cyperaceae	<i>Carex nigra</i>	Restricted and abundant
Poaceae	<i>Agrostis capillaris</i>	Widespread and abundant
Poaceae	<i>Deschampsia cespitosa</i>	Restricted and abundant
Poaceae	<i>Poa annua</i>	Widespread and abundant
Poaceae	<i>Poa pratensis</i>	Widespread and abundant
Polygonaceae	<i>Rumex acetosella</i>	Widespread and frequent

Eight introduced species were found at Ocean Harbour during this survey. *Poa annua*, *Poa pratensis* and *Agrostis capillaris* are widespread and abundant at this site. *Poa annua* and *Poa pratensis* often occur together in dense lawns maintained by reindeer grazing, particularly in areas that are heavily trampled by seals. *Agrostis capillaris* is found both on the flat plain and on the slopes. On the slopes it forms conspicuous round patches to 20 m diameter in the native 'mire and bog' and 'Festuca grassland' vegetation, sometime coalescing to form larger, irregular shaped patches.

*Cerastium fontanum* is widespread, with records over 1 km apart within the survey area, but only occasional plants were recorded. *Taraxacum officinale* was found at three localities widely distributed within the survey area but very few individual plants were seen. The low abundance of *Taraxacum officinale* and *Cerastium fontanum* at this site is likely to be due to reindeer grazing as these are palatable species.

*Carex nigra* occurs at a single locality on the flat plain northwest of the field hut, where it grows a dense patch approximately 22x10 m. Ocean Harbour is the only site where this introduced species was found during the current survey.

*Deschampsia cespitosa* was found at two localities within the survey area. A small clump (0.3 m diameter) was recorded on the flat plain to the northwest of the hut, growing along a stream. A larger population was found on slopes to the south of the harbour. This population consisted of frequent patches approximately 2 m in diameter within an area 20x20 m in a broad, damp gully between raised areas of 'hard moss-bank'.

*Rumex acetosella* was found both on the flat plain, growing at low density but forming large, spreading patches in 'sparse lowland fellfield' vegetation, and on steep slopes in '*Festuca* grassland'.

**Additional historical records:**

*Ranunculus repens* and *Juncus filiformis* have both been recorded at Ocean Harbour on the north side of the whaling station. These species were classed as persistent aliens by Walton and Smith (1973). In the current survey the area around the whaling station ruins was searched thoroughly but these species were not found.

## Site 14: St Andrews Bay



### Site features:

- King penguin colony
- Elephant seal beach
- Reindeer grazing
- Field hut

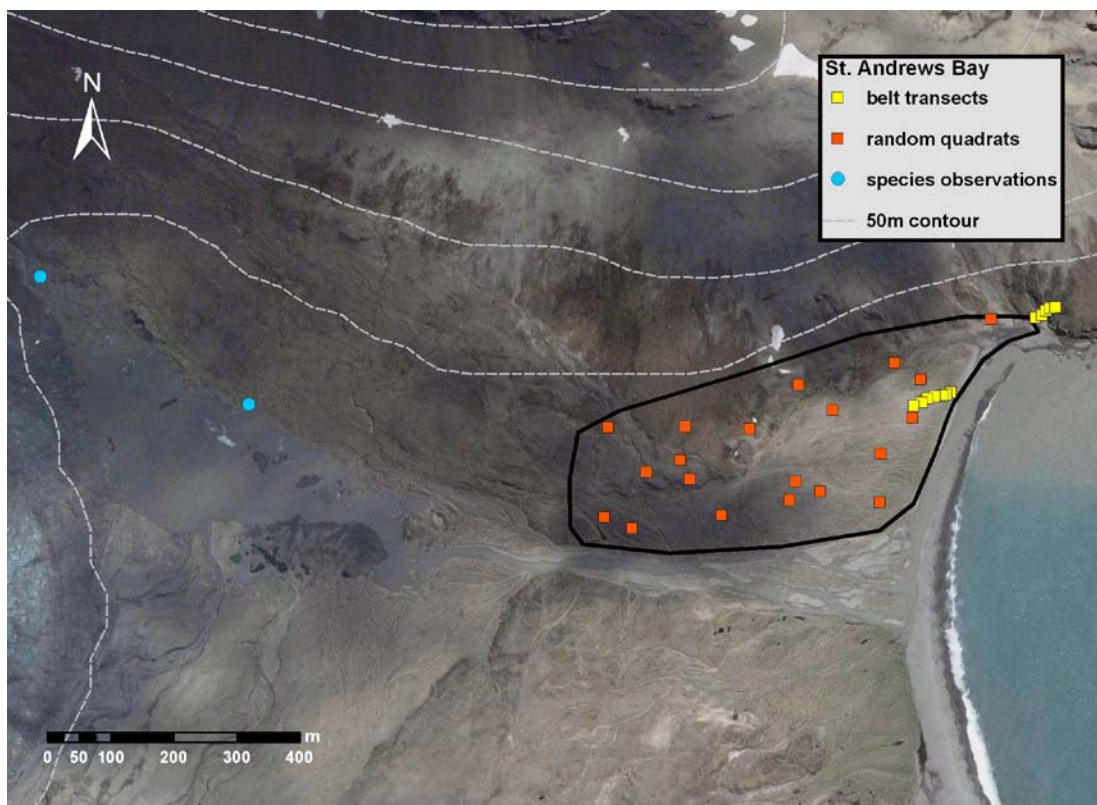
St Andrews Bay is a potential hotspot for new introductions as it is a popular visitor site. There is no historical settlement at this site though there is a small field hut. More details about the site can be found in the South Georgia Government's Visitor Management plan for St Andrews Bay (GSGSSI, 2009).

### Vegetation survey:

One day of survey was carried out at St Andrews Bay. Weather conditions were fine.

21 random 1x1 m quadrat samples were recorded from the area to the north of the Heaney Glacier melt-water river, including the outwash plain and lower slopes to the south of Mount Skittle. Two short belt transects were surveyed, one 70 m long running from the edge of the beach along the flat plain and the second 50 m long running from the edge of the beach up a steep slope on Clark Point. General searching and recording was carried out around the site, walking up to the edge of the Heaney Glacier. We did not cross the melt-water river into the southern part of the site.





**Figure 24: Survey records at St Andrews Bay**

**Native vegetation:**

The vegetation at St Andrews Bay has been mapped in detail by Scott and Poncet (2003). There is an area of ‘short mixed grassland’ behind the beach that is dominated by introduced *Poa annua*. The glacial outwash plain is dominated by ‘sparse lowland fellfield’ with some areas of ‘moist lowland fellfield’. On the slopes to the north of the outwash plain ‘*Festuca*-fellfield’ mosaic is dominant. There is very little ‘tussac’ vegetation at this site apart from tussock and moss on the steep slopes at Clark Point.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at St Andrews Bay
Poaceae	<i>Poa annua</i>	Widespread and abundant
Caryophyllaceae	<i>Cerastium fontanum</i>	Widespread and occasional

Two introduced species, *Poa annua* and *Cerastium fontanum*, were recorded at St Andrews Bay. Both are widespread throughout the site. Dense lawns of *Poa annua* were recorded at the bottom of the glacial outwash plain near the beach, growing with the native *Deschampsia antarctica* in ‘short mixed grassland’ vegetation. These lawns are maintained by reindeer grazing and trampling by fur seals. *Poa annua* was found throughout the survey area, with individual plants occurring almost to the edge of the Heaney Glacier. *Cerastium fontanum* is found across much of the survey area but is not abundant. It also occurs quite far inland towards the glacier. It is likely that these two introduced species are dispersed around the site by movements of both king penguins and reindeer.

## Site 15: Moltke Harbour



### Site features:

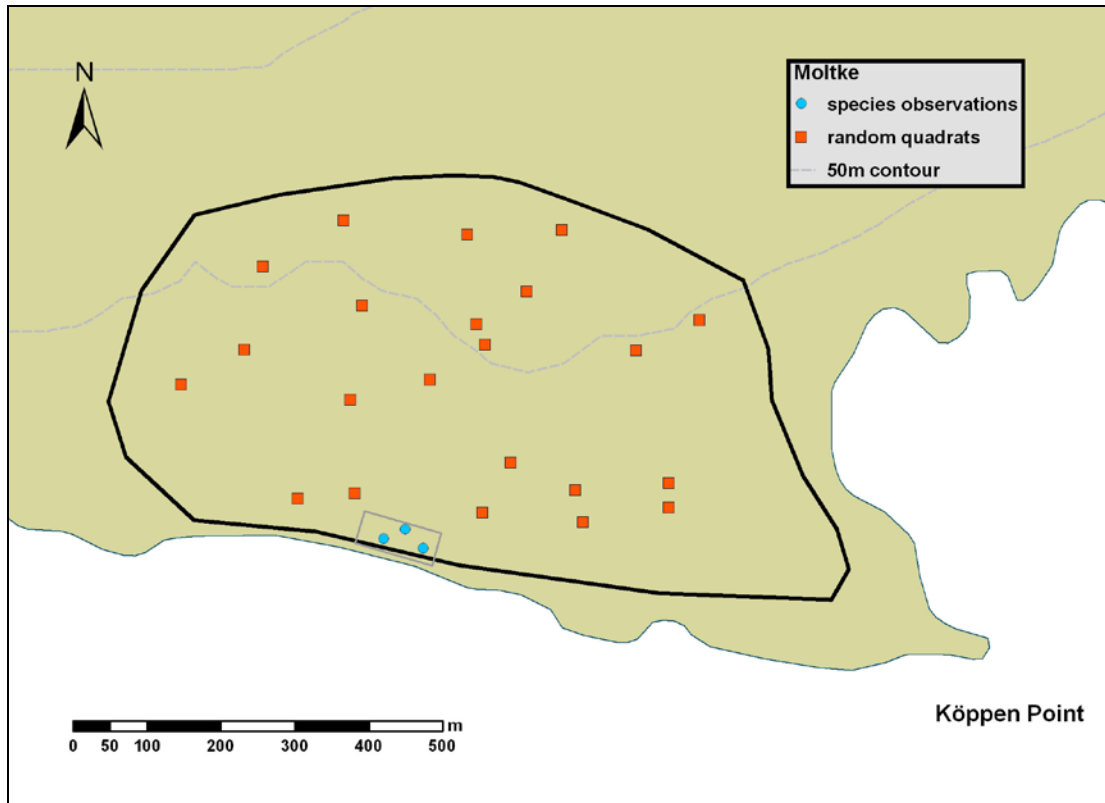
- German Research Station ruins
- Reindeer grazing

Moltke Harbour is a historic hotspot for plant introductions due to the former German Research Station based there from 1882 to 1883. The research station included an 'experimental garden' and a 'mixed garden' and many crop plants were introduced here including potatoes and salad vegetables (Poncet and Crosbie, 2005). Domestic animals were also introduced including sheep, goats and oxen and it is likely that fodder would have been transported with these animals, bringing in the seed of fodder plants. Moltke Harbour is also a potential hotspot for new introductions as it is a popular visitor site.

### Vegetation survey:

One day of survey was carried out at Moltke Harbour, landing at research station ruins near Köppen Point. Weather conditions were fine but strong swells in the afternoon made it necessary to return to the support vessel. Exiting from the rocks to the dinghy was wet and difficult and some equipment was lost.

22 random 1x1 m quadrat samples were recorded from the area around the research station ruins. No belt transects were surveyed due to time limitation. General searching and recording were carried out around the site, and the area around the research station ruins was searched thoroughly.



**Figure 25: Survey records at Moltke Harbour**

**Native vegetation:**

The research station ruins lie on a flat terrace gently sloping up to another terrace to the north. The area around the ruins is dominated by 'tussac, moss and *Poa annua*', and the ground is heavily impacted by fur and elephant seals, which have eroded the vegetation leaving bare mud in many places. Some impressive cushions of the native *Colobanthus subulatus* were observed growing over the ruins. The terrace above the research station ruins is dominated by large areas of *Rostkovia*-dominated 'mire and bog' and large areas of 'Festuca-fellfield mosaic'. In places the ground is distinctively patterned with shallow, stony terraces bordered by lines of *Festuca contracta* and moss.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Moltke Harbour
Poaceae	<i>Poa annua</i>	Restricted and abundant locally around ruins
Poaceae	<i>Poa pratensis</i>	Restricted and common locally within the ruins

Two introduced species were recorded at Moltke Harbour. *Poa annua* was found in abundance throughout and research station ruins and spreading into the area around the ruins. *Poa pratensis* was only found growing within the ruins. This area is heavily grazed by reindeer and both of these grasses were grazed to form a short sward. There was no sign of any of the crop plants or other introduced species from 1882 when the German Research Station was in use. The areas that were used as gardens according to a site plan of the research station (Poncet and Crosbie, 2005), are now muddy elephant seal wallows with very little vegetation.

## Site 16: Larsen Harbour



### Site features:

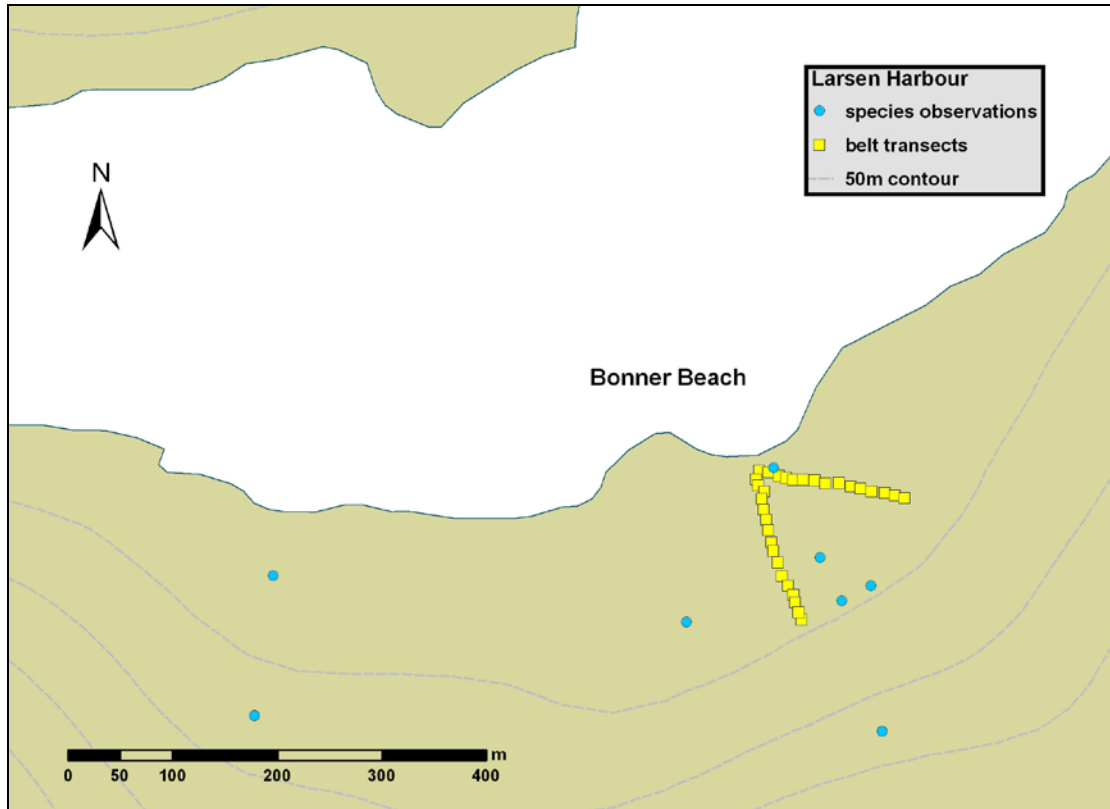
- Rat-free site
- Reindeer-free site
- Specially Protected Area (SPA)
- Weddell Seal breeding site

Larsen Harbour was selected for survey as a comparative less-visited area, where fewer introduced plant species are expected to occur. In the past this harbour in the Drygalski Fjord was used as a safe anchorage by sealers and whalers (Poncet and Crosbie, 2005) but no settlement was built here. It is a popular visitor site as it is the most northerly recorded breeding site for Weddell seals (Poncet and Crosbie, 2005). The area was designated as an Environmentally Sensitive Area in 2000 (McIntosh and Walton, 2000). It is now designated as a Specially Protected Area (Pasteur and Walton, 2006) and entry is prohibited unless a Government permit has been granted.

### Vegetation survey:

The survey was carried out over two days at Larsen Harbour though the time ashore was limited due to adverse weather conditions and only five hours of field survey were carried out in total. Weather conditions were changeable with fine patches, heavy rain, sleet and strong winds.

No random quadrat samples were taken at this site due to time limitation. Two belt transects (150 m and 160 m long) were surveyed, one running perpendicular to the shore and the other at an angle to the shore. General searching and recording were carried out in the area around Bonner Beach including the slopes above the beach up to approximately 120 m altitude.



**Figure 26: Survey records at Larsen Harbour**

**Native vegetation:**

The vegetation at Larsen Harbour has been mapped in detail by Scott and Poncet (2003). The harbour has steep sides consisting of rocky outcrops, cliffs and scree slopes, and the vegetation forms only a thin band at lower altitudes. The area around Bonner Beach is dominated by 'moist lowland fellfield' and 'short mixed grassland'. There are also small areas of 'tussac', 'Acaena herbfield' and 'Festuca-fellfield' mosaic. Large stands of the native fern *Polystichum mohrioides* were observed on the slopes above the beach. This was the only site where the native fern *Grammitis poeppigiana* was recorded during this survey. It was found at higher altitudes above the vegetated zone growing on bare rock face with mosses, lichens and the native filmy fern *Hymenophyllum falklandicum*.

**Introduced vascular plant species:**

Family	Introduced Species	Distribution and Abundance Summary at Larsen Harbour
Poaceae	<i>Poa annua</i>	Widespread and abundant

*Poa annua* was the only introduced species recorded at Larsen Harbour. It is abundant in the flatter areas near the shore, spreading up the slopes to approximately 15 m altitude and 200 m inland from the shoreline. Breeding fur seals were prevalent throughout this area and their movements may have helped to disperse seed around the site.



**Figure 27: Patches of *Poa annua* near the shore at Larsen Harbour**

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## ***Achillea millefolium* L.**

common yarrow

Introduced plant category: Restricted naturalised

## **Compositae (Asteraceae)**



**Global Distribution:** Native to Eurasia but widely naturalised in temperate regions of both hemispheres; introduced on the Falkland Islands (Moore, 1968).

### **Historical records from South Georgia:**

*Achillea millefolium* was first recorded on South Georgia in 1957 in Grytviken on the bank of the stream in front of church (Walton and Smith, 1973). It was also recorded at Husvik in 1961 (Greene, 1964). By 1971 the stand in Grytviken measured 2x1 m with 20-30 inflorescences and was observed to be successfully competing with *Acaena magellanica*. A second, small non-flowering colony was located nearby in 1968 and by 1971 measured 0.3 m in diameter (Walton and Smith, 1973). There are records of this species growing against the east wall of the manager's villa at Husvik in 1979 and 1981 (BAS, 2008).

### **Records from the current survey:**

In this survey we searched the area in Grytviken described by Walton and Smith (1973) and two stands of *Achillea millefolium* were found on southern stream bank, alongside the path below the church (see Appendix 10, map 8.2). The larger one was 2x5 m and smaller 0.5 m in diameter. Both were flowering and fruiting. They were found to be growing in a humid area of '*Acaena* herbfield' on a northwest facing slope. The patches recorded in the current survey have increased in size since previous records. Few flower heads were seen at the time of survey and seed viability is not known. The area around the manager's villa at Husvik was thoroughly searched but the plants recorded in 1979 and 1981 were not seen.

**Habitat:** Disturbed ground around buildings and in wetter areas of '*Acaena* herbfield'. In the UK this herb is common in short grassland and on banks and waysides (Stace, 1997).





**Figure 28: Map showing the proportion of sample sites where *Achillea millefolium* was recorded in this baseline survey, 2009**

**Key field characters:**

- Leaves feathery (finely and very deeply dissected)
- Inflorescences dense, flat-topped, white (or pinkish)
- Inflorescences each with 25-50 flower heads

For a detailed description see Stace (1997).

Most likely to be confused with:

- *Achillea ptarmica*, which has been recorded as sterile populations from three sites on South Georgia (Leith, Stromness and Husvik). *Achillea ptarmica* has leaves that are linear to linear-lanceolate and shallowly toothed. In flower the inflorescence has fewer flower heads (10-15).

**Invasive potential:** *Achillea millefolium* has demonstrated a low rate of spread since 1957. It has not colonised other areas in Grytviken and has not been recorded at any new site on South Georgia in the current survey. It appears to have a low invasive potential under the current conditions.

**Recommendations:** The small population at Grytviken should be removed. Although *Achillea millefolium* does not currently appear to be invasive, it may become invasive with climate change.

***Agrostis capillaris* L.**  
Syn. *Agrostis tenuis* Sibth.  
common bent

**Poaceae**

Introduced plant category: Widespread naturalised



**Global Distribution:** Native to Eurasia but widely naturalised in temperate regions of both hemispheres; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Agrostis capillaris* was first recorded on South Georgia in 1949 from Grytviken, Husvik and Stromness (Walton and Smith, 1973). By 1971 it had been recorded in five squares across the 5km grid square map published by Walton and Smith (1973), who noted that it was one of the most successful introduced plants on South Georgia, competing with the native vegetation at all its known localities. By this time it had been recorded up to 140 m altitude and over 0.5 km inland usually forming circular patches, sometimes over 20 m in diameter. Walton and Smith (1973) observed this grass invading both wetter *Acaena* herbfield and *Rostkovia*-dominated vegetation and drier *Festuca* grassland though it was not known whether viable seed was set. Subsequently, this grass was also collected at Prince Olav Harbour by Smith in 1981, where it was found on waste ground near the buildings.

**Records from the current survey:**

In this survey *Agrostis capillaris* was recorded at four of the 16 survey sites: Stromness, Husvik, Grytviken and Ocean Harbour (see Appendix 10, maps 5.1, 6.1, 8.1, and 13.1), and was found to be abundant in some places. As noted by Walton and Smith (1973), we also observed numerous circular patches of this grass, sometimes coalescing to form larger patches, often bright green or reddish-green and conspicuous against the native vegetation. The patches were dense, preventing native vegetation from re-colonising. Most patches were flowering prolifically, mainly having immature inflorescences at the time of survey. At Grytviken, extensive colonies were found on the slopes behind the whaling station. At Ocean Harbour, it was found in abundance both on the flat plain behind the ruins of the whaling station and on the slopes to the south of the plain. At Husvik, it was found in three areas, one patch behind the whaling station and two other colonies in the Karrakatta valley (one of these consisting of numerous patches). At Stromness a single patch was recorded, growing in dry '*Festuca* grassland' with *Alopecurus antarcticus* along the braided river in the Shackleton Valley.

We were unable to check the previous records within Husvik and Stromness whaling stations as these were restricted areas at the time of survey.

This grass was mainly found in large discrete patches that appear to have spread out vegetatively from the original point of colonisation. A few smaller satellite patches observed around larger patches at Husvik in the Karrakatta valley suggest that this grass is also spreading by seed.



**Figure 29: Map showing the proportion of sample sites where *Agrostis capillaris* was recorded in this baseline survey, 2009**

**Habitat:** On disturbed ground in and around the whaling stations and in native vegetation including wetter 'Acaena herbfield' and 'mire and bog', and drier 'Festuca grassland'.

**Key field characters:**

- Leaf apex flat and pointed
- Ligules shorter than broad
- Spikelets single-flowered, very small (2-3.5 mm long)
- Often forming discrete circular patches

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Poa pratensis*, which has a distinctive boat-shaped leaf apex.
- *Agrostis vinealis*, which has a ligule that is longer than broad and often pointed. These two species can be difficult to tell apart in the field. Using a x10 hand lens and by dissecting a floret the following character can be used: *Agrostis capillaris* has a palea that is half to two thirds the length of the lemma, while *Agrostis vinealis*, (which was also found at Husvik during this survey) has a minute palea (often indistinguishable).
- *Agrostis stolonifera*, which has leafy, creeping stolons (*A. capillaris* has creeping, underground rhizomes but these are not leafy). (*Agrostis stolonifera* was not found during this survey but has been recorded on South Georgia).
- *Festuca rubra*, which has tubular, fused leaf sheaths and long spikelets (to 15 mm long), that are many flowered and awned.

**Invasive potential:** This grass is highly invasive, spreading by creeping rhizomes and successfully competing with native 'Festuca grassland', 'Acaena herbfield' and *Rostkovia*

dominated 'mire and bog' vegetation. It poses a threat to the native vegetation, out-competing and displacing the native species. The rate of vegetative spread is not known and would require patches to be measured and monitored over time. It is also not known whether this species is setting viable seed. However, some small satellite patches around larger patches suggest that it is spreading by seed.

**Recommendations:** It is recommended that this grass is controlled while it is still manageable and eradicated as soon as possible. Further survey is needed to map the full extent of the population around the island and feasibility studies for control methods are recommended. As it tends to occur in discreet, dense and conspicuous patches, control of this grass should be possible without damaging large areas of the native vegetation. If immediate control is not possible due to limited resources, it is recommended that further survey and mapping of the population is carried out and the rate of spread is monitored.

***Agrostis vinealis* Schreb.**

**Poaceae**

Syn. *Agrostis canina* L. ssp. *montana* (Hartm.) Hartm.

brown bent

Introduced plant category: Restricted naturalised



**Global Distribution:** Eurasia (Clayton *et al.*, 2006-).

**Historical records from South Georgia:**

*Agrostis vinealis* was first recorded on South Georgia in 1971 at Ocean Harbour (BAS, 2008). Subsequently this species was collected by Smith in 1981 both at Husvik, growing near the manager's villa, and at Prince Olav Harbour, growing on a gravel track. This species was listed as 'widespread' (cited as *Agrostis canina*) in the handwritten notes on an annotated plan of Husvik whaling station (BAS, date unknown).

**Records from the current survey:**

In this survey *Agrostis vinealis* was recorded only at Husvik, where it was found in two localities, one directly in front of the manager's villa and another in the flat plain behind the manager's villa (see Appendix 10, map 6.2). It was found in flower in both localities. In front of the manager's villa two patches were found, each approximately 0.75x0.5 m across. In the flat plain behind the manager's villa a single small clump was found. The whole area is grazed by reindeer and heavily impacted by breeding fur seals.



**Figure 30: Map showing the proportion of sample sites where *Agrostis vinealis* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed ground growing with *Poa annua*. Also found in native 'Deschampsia grassland'. In the UK *Agrostis vinealis* grows in a wide range of habitats including damp meadows, marshes, heaths, and hill and mountain grassland (Hubbard, 1984).

**Key field characters:**

- Leaf apex flat and pointed
- Ligules longer than broad, often pointed
- Spikelets single-flowered, very small (2-3 mm long)

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Agrostis capillaris*, which has a ligule that is shorter than broad. These two species can be difficult to tell apart in the field. Using a x10 hand lens and by dissecting a floret the following character can be used: *Agrostis capillaris* has a palea that is half to two thirds the length of the lemma, while *Agrostis vinealis*, has a minute palea (often indistinguishable).
- *Agrostis stolonifera*, which has more dense panicles and a larger palea (similar to *A. capillaris* above). *Agrostis stolonifera* was not found during this survey but has been recorded on South Georgia (BAS, 2008).
- *Poa pratensis*, which has a distinctive boat-shaped leaf apex.
- *Festuca rubra*, which has tubular, fused leaf sheaths and long spikelets (to 15 mm long) that are many flowered and awned.

This grass can be difficult to distinguish from other introduced *Agrostis* species and may be under-recorded.

**Invasive potential:** In this survey *Agrostis vinealis* was found growing in native 'Deschampsia grassland' suggesting that it may compete with native vegetation. However, in the area where it was found, the 'Deschampsia grassland' was heavily impacted by seals and grazed by reindeer, which may reduce the ability of this introduced grass to colonise locally. No seedlings were observed. It does not appear to have spread very far since first recorded near the manager's

villa at Husvik in 1981 and it was not found any other site on South Georgia during this survey. This grass currently has a low invasive potential.

**Recommendations:** The patches of *Agrostis vinealis* at Husvik should be removed while the population is still manageable. Although this grass does not currently appear to be invasive, it may become invasive with climate change.

***Anthriscus sylvestris* (L.) Hoffm.**

cow parsley

Introduced plant category: Persistent

**Umbelliferae (Apiaceae)**



**Global Distribution:** Native to Europe and temperate Asia; introduced in Iceland, North America, New Zealand and South Africa (Magnússon, 2006).

**Historical records from South Georgia:**

*Anthriscus sylvestris* was first recorded on South Georgia in 1964 at Husvik (Walton and Smith, 1973) but was not seen there again until 1979 when it was found on the northern side of the accommodation building near the slipway. It was also recorded in the whaling station at Grytviken in 1967 and by 1972 had persisted there for five years as a single large plant, flowering each year but not setting seed (Walton and Smith, 1973). In 1995 MacAlister noted that this species had become more established at the Grytviken site, forming a group of 'several distinct plants'. A group of 'several clumps' was recently observed on the east side of the barracks (Shanklin, 2006). *Anthriscus sylvestris* has not been recorded at any other sites on South Georgia.

**Records from the current survey:**

During the current survey we located the site described by Walton and Smith (1973), to the east of the former barracks' kitchens (see Appendix 10, map 8.3). At this site we found a population





**Figure 31: Map showing the proportion of sample sites where *Anthriscus sylvestris* was recorded in this baseline survey, 2009**

of three mature clumps of *Anthriscus sylvestris* and numerous seedlings spreading in a linear patch 15x1 m along the edge of the building. The plants were in flower at the time of survey and immature fruits were observed on two of the plants. We were unable to monitor the record from within Husvik Whaling Station as this was a restricted area at the time of survey.

**Habitat:** Disturbed ground around buildings. In the UK *Anthriscus sylvestris* is common in grassy areas, along hedgerows and woodland edges (Stace, 1997).

**Key field characters:**

- Tall herb with flowering stems up to 1.5 m
- Flowers white, in umbels
- Leaves soft and feathery, 3-pinnate

For a detailed description see Stace (1997).

This tall herb is unlikely to be confused with any other plant found on South Georgia. It is very conspicuous in flower and the dried remains of the flowering stems can persist for some time. The feathery, pinnate leaves of young plants are also quite distinctive.

**Invasive potential:** Since 1972 the single persistent plant of *Anthriscus sylvestris* has expanded to form a small population that appears to be producing viable seed. Since the number of mature plants is small and there are numerous seedlings, it is likely this has occurred only in recent years. This herb is not currently invading the native vegetation but there is likely to be a significant area of suitable habitat on South Georgia and this species therefore has a high invasive potential.

**Recommendations:** The small population of *Anthriscus sylvestris* in Grytviken should be removed as soon as possible while this species still has a restricted distribution on South Georgia. The site at Husvik Whaling Station should also be surveyed and any plants of this species removed. As it appears to be producing viable seed, dormant seed may remain in the ground for many years. The areas surrounding the mature plants should be monitored and any seedlings removed each year before they have a chance to flower and set seed.

***Cardamine flexuosa* With.**

wavy-leaved bittercress

Introduced plant category: Widespread naturalised

**Cruciferae (Brassicaceae)**



**Global Distribution:** Native to Europe and found throughout much of Asia; naturalised in North and South America, South Africa and Australia.

**Historical records from South Georgia:**

*Cardamine flexuosa* was first recorded on South Georgia in 2001 at King Edward Point having been accidentally introduced during rebuilding works in 2000 (Summers, 2009). Since then it has spread rapidly around King Edward Point and to Hope Point and has now also been found on the south side of King Edward Cove, to the east of the cemetery. Attempts to control this plant by spraying with herbicides began in 2004 and continue up to the present. These are detailed in a report by Summers (2009). To help control the spread of this plant, biosecurity policies have been put in place so that people walking on the track between Gryviken and KEP are required to use a boot washing facility to prevent seed from being dispersed on footwear.

**Records from the current survey:**

In this survey *Cardamine flexuosa* was recorded in the areas where it is currently being controlled by spraying at King Edward Point (main area approximately 18x9 m) and in the recently discovered patch on the south side of King Edward Cove (approximately 5x5 m). Two new patches were also located including a small patch along the track between KEP and Grytviken growing amongst building materials, and a small patch invading native vegetation in a wet flush at Hope Point (see Appendix 10, map 8.4).

All the populations that had not been sprayed were flowering and fruiting prolifically at the time of survey. In the previously sprayed areas some re-growth was observed including a few plants with flowers and immature fruits.

Since this survey was undertaken, further spraying and monitoring has been carried out and all new sites marked for future monitoring (Summers, 2009).



**Figure 32: Map showing the proportion of sample sites where *Cardamine flexuosa* was recorded in this baseline survey, 2009**

**Habitat:** This species colonises disturbed ground and invades native vegetation including 'tussac and *Festuca*', and wet flush vegetation with *Acaena magellanica*. In the UK this species grows in marshes, along stream-sides and on cultivated ground (Stace, 1997).

**Key field characters:**

- Flowers white with four petals
- Leaves pinnate with 5-15 leaflets
- Fruits long and narrow, opening explosively

For a more detailed description see Stace (1997).

This herb is quite distinctive and unlikely to be confused with anything else on South Georgia.

**Invasive potential:** *Cardamine flexuosa* has spread rapidly from King Edward Point since it was first recorded in 2001 and is now found to be invading native vegetation as well as disturbed ground around the settlement. It flowers and fruits prolifically, producing viable seed that is easily dispersed by humans and wildlife. It has a high invasive potential on South Georgia.

**Recommendations:** *Cardamine flexuosa* should be eradicated on South Georgia while the population is manageable and restricted. While the current control program is undoubtedly slowing the spread of this species, the spraying regime has not been frequent enough to prevent it from setting seed and spreading this year. It is recommended that a more intensive program of monitoring and control is put in place in 2009/2010. This should be continued in subsequent years as there is likely to be dormant seed remaining in the ground for many years.

***Carex aquatilis* Wahlenb.**

water sedge

Introduced plant category: Persistent

**Cyperaceae**



**Global Distribution:** Northern, Central & Eastern Europe to Siberia; Eastern Canada to U.S.A. Govaerts *et al.* (2006).

**Historical records from South Georgia:**

*Carex aquatilis* was first recorded on South Georgia at Husvik behind the manager's villa (Walton and Smith, 1973). Only sterile plants were found and living material was sent to Birmingham (UK) where it was cultivated for identification (Longton, 1965). By 1972 this species had formed a stand approximately 12x9 m (Walton and Smith, 1973). More recently, a larger patch size of approximately 15x30 m was marked by hand on an annotated plan of Husvik whaling station (BAS, date unknown). This sedge has not been recorded at any other site on South Georgia.

**Records from the current survey:**

In this survey we re-visited the site where *Carex aquatilis* had previously been recorded, and found that it now covers an area approximately 40x16 m behind the manager's villa and to the north and west of the radio shack (see Appendix 10, map 6.3). The site is heavily impacted by seals and patches of the vegetation have been eroded leaving bare mud. Only sterile plants were found.

**Habitat:** Bare ground and disturbed wet ground. In the UK this sedge grows in marshes and swampy areas (Stace, 1997).



**Figure 33: Map showing the proportion of sample sites where *Carex aquatilis* was recorded in this baseline survey, 2009**

**Key field characters:**

- Leaves 3-5 mm wide
- Leaves bright green beneath
- Grows in wet ground

For a detailed description see Jermy *et al.* (1982).

Only sterile plants have been recorded on South Georgia to date.

Most likely to be confused with:

- *Carex nigra*, of which there is a single fertile population at Ocean Harbour. *Carex nigra* has leaves that are glaucous above and beneath. These two sedges are difficult to tell apart in the field but can be separated on South Georgia by their location.
- *Uncinia macrolepis*, which grows in dry grassland and has distinctive hooked fruits.

**Invasive potential:** *Carex aquatilis* has demonstrated a slow rate of vegetative spread since 1972. It has not colonised other areas at Husvik and has not been recorded at any new site on South Georgia in the current survey. *Carex aquatilis* appears to have a low invasive potential under the current conditions.

**Recommendations:** The single population at Husvik should be removed. Although *Carex aquatilis* does not currently appear to be invasive, it may become invasive with climate change.

***Carex nigra* (L.) Reichard**

common sedge

Introduced plant category: Restricted naturalised

Cyperaceae



**Global Distribution:** Temperate regions throughout the Northern Hemisphere (Govaerts *et al.*, 2006).

**Historical records from South Georgia:**

*Carex nigra* was first recorded on South Georgia in 1971 when seven circular patches were found at Ocean harbour (Walton and Smith, 1973). It was found to be invading *Rostkovia*-dominated native vegetation on wet ground. The largest patch recorded at this time was 7.05 m x 6 m and patches were all within 100 m distance of each other. Walton and Smith (1973) suggest that this sedge would have been introduced before 1920, while the whaling station was still operating. In 1981 *Carex nigra* was recorded at Husvik by Smith, who collected it from patches to the north and south of the manager's villa. These locations are marked by hand on an annotated plan of Husvik whaling station (BAS, date unknown). It has not been recorded at any other site on South Georgia.

**Records from the current survey:**

In this survey *Carex nigra* was only recorded at Ocean Harbour where we found a single irregular-shaped and slightly broken patch approximately 22 m x 10 m in the same area described by Walton and Smith (1973) (see Appendix 10, map 13.3). It was found growing in wet 'short mixed grassland' vegetation heavily impacted by fur seals, especially along channels of standing water. This species was not found in the *Rostkovia*-bog further to the north-west of the ruins of the whaling station. The area around the manager's villa at Husvik was thoroughly searched but the patches recorded in 1981 were not seen.

It is likely that the large patch recorded at Ocean Harbour in the current survey is the result of expansion of one or more of the original patches recorded in 1971. If this is the case, it is interesting to note the change in vegetation in this area from *Rostkovia*-dominated vegetation in

1971 to wet grassland. The other patches may not have survived due to the heavy trampling and erosion by fur seals or to changes in the hydrology at the site.



**Figure 34: Map showing the proportion of sample sites where *Carex nigra* was recorded in this baseline survey, 2009**

**Habitat:** Wet ground including *Rostkovia*-bog and wet grassland.

**Key field characters:**

- Stems solid and triangular in section
- Leaves glaucous
- Inflorescence of 2-6 dense spikes
- Fruits not hooked at apex
- Grows in wet ground

For a detailed description see Jermy *et al.* (1982).

Most likely to be confused with:

- *Carex aquatilis*, of which there is a sterile population at Husvik. *Carex aquatilis* has leaves that are glaucous above but bright green beneath. These two sedges are difficult to tell apart in the field but can be separated on South Georgia by their location.
- *Uncinia macrolepis*, which grows in dry grassland and has distinctive hooked fruits.

**Invasive potential:**

*Carex nigra* has demonstrated a slow rate of vegetative spread since 1971. It has not colonised other areas within the Ocean Harbour site (in fact the number of patches has reduced) and has not been recorded at any new site on South Georgia in the current survey. *Carex nigra* appears to have a low invasive potential under the current conditions.

**Recommendations:**

The single small population at Ocean Harbour should be removed. Although *Carex nigra* does not currently appear to be invasive, it may become invasive with climate change.

***Cerastium fontanum*** Baumg.

**Caryophyllaceae**

common mouse-ear

Introduced plant category: Widespread naturalised



**Global Distribution:** Native to Europe but naturalised in temperate regions around the world; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Cerastium fontanum* was first recorded on South Georgia in 1949, both at Grytviken and at Husvik where it was noted to be thriving, producing seed and seedlings (Walton and Smith, 1973). In 1964 Greene already considered this species to be naturalised when he published *The Vascular Flora of South Georgia*, in which he describes it as being 'locally frequent'. By 1972 *Cerastium fontanum* had been recorded up to 230 m altitude and at 11 sites across the 5km grid square map published by Walton and Smith (1973).

**Records from the current survey:**

In this survey *Cerastium fontanum* was recorded at 11 of the 16 survey sites (see Appendix 10, maps 4.1, 5.2, 6.4, 7.1, 8.5, 9.1, 10.1, 11.1, 12.1, 13.2, and 15.1). At most of these sites it was found to be widespread but present at low densities.

**Habitat:** Common on bare ground and sparsely vegetated stony and gravelly areas. Frequent in *Festuca* grassland. Occasional throughout most other native vegetation apart from the wettest bog.





**Figure 35: Map showing the proportion of sample sites where *Cerastium fontanum* was recorded in this baseline survey, 2009**

**Key field characters:**

- Small herb with densely hairy leaves and stems
- Leaves in opposite pairs
- Flowers white with 5 deeply cleft petals
- Fruit an elongated papery capsule opening at the apex

For a more detailed description see Stace (1997).

This small herb with distinctive hairy leaves and stems is unlikely to be confused with any of the other plants found on South Georgia.

**Invasive potential:** *Cerastium fontanum* is widespread on South Georgia. It produces lots of viable seed and readily colonises suitable habitat. However, although it can be found growing throughout much of the native vegetation, it has a straggling growth form, grows at low densities and does not appear to displace the native species. As *Cerastium fontanum* has such a wide distribution and high seed viability it is inevitable that this species will eventually spread to all suitable habitat across South Georgia (Professor D. Walton, pers. comm.).

**Recommendations:** Although widespread, this introduced species does not appear to threaten any of the native vascular plant species or vegetation types. Control or eradication of this species may currently be unrealistic and the cost prohibitive.

***Deschampsia cespitosa*** (L.) Beauv.  
Syn. *Deschampsia caespitosa* (L.) Beauv.  
tufted hair grass  
Introduced plant category: Widespread naturalised

**Poaceae**



**Global Distribution:** Found throughout much of the world including Europe, Asia, Africa, Australasia, North and South America (Clayton *et al.*, 2006-).

**Historical records from South Georgia:**

*Deschampsia cespitosa* is a widespread introduced species first recorded on South Georgia in 1961 by Greene (1964) who found it at Grytviken, Stromness and Husvik. By 1971 it had also been recorded at Ocean Harbour and Leith and was noted to have become well established at each of these sites, invading native vegetation on fairly dry ground (Walton and Smith, 1973). At this time the largest stands measured 15-20 m<sup>2</sup> at Grytviken and 4 m in diameter at Ocean Harbour, no seedlings were found and only vegetative spread was observed. The location of a patch beside the manager's villa at Husvik is marked by hand on an annotated plan of Husvik whaling station (BAS, date unknown).

**Records from the current survey:**

In this survey *Deschampsia cespitosa* was found at two of the 16 survey sites: Grytviken and Ocean Harbour (see Appendix 10, maps 8.2 and 13.3). At Grytviken a small patch 2x3 m across was recorded on the east bank of the stream below the church. At Ocean Harbour a large population was found on slopes to the South of the harbour. This population consisted of frequent circular patches approximately 2 m in diameter within an area 20x20 m in a broad, damp gully between raised areas of hard moss-bank. Another small clump (0.3 m diameter) was recorded at Ocean Harbour in the flat area to the north-west of the hut, growing along a stream. We were unable to check the previous records within Husvik and Stromness whaling stations as these were restricted areas at the time of survey. The area around the manager's villa at Husvik was thoroughly searched but the patch recorded in 1979 was not seen.



**Figure 36: Map showing the proportion of sample sites where *Deschampsia cespitosa* was recorded in this baseline survey, 2009**

**Habitat:** Damp ground, stream-sides. In the UK this grass is commonly found on marshy fields, rough grassland and moorland (Hubbard, 1984).

**Key field characters:**

- Dense, tussock-forming grass (flowering shoots to 75 cm tall)
- Leaves ribbed on upper surface, rough on ribs and margins (smooth beneath)
- Ligule long, narrow and pointed, up to 15 mm long
- Panicles often appearing silvery-purple
- Spikelets 2-flowered

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Poa pratensis*, which can be distinguished by its smooth leaves, rounded ligule and 3-5 flowered spikelets.
- *Elymus repens*, which has an unbranched flowering spike and leaves that are usually smooth on ribs and margins.
- *Deschampsia antarctica*, which is a much smaller grass with flowering shoots to 20cm long. It forms low dense mats rather than tussocks. The leaves are ribbed on the upper surface but not rough.

**Invasive potential:** Since 1971 *Deschampsia cespitosa* does not appear to have spread on South Georgia. At Ocean Harbour the largest closed stand in 1971 measured 4 m in diameter while in the current survey the largest recorded patches at this site were 2 m in diameter (though it should be noted that in this survey the vegetation has been sampled rather than extensively mapped so there may be other existing patches of the grass that have not been recorded). No seedlings were seen in the current survey suggesting only vegetative spread. The invasive potential appears to be low under the current conditions.

**Recommendations:** As only a few populations of this grass were recorded in the current survey it is recommended that this introduced grass is removed while it is manageable. Although it does not currently appear to be invasive, it may become invasive with climate change. As this grass was recorded in 1971 as widespread at Grytviken, Husvik, Leith, Stromness and Ocean

Harbour, further survey is recommended to ensure that all patches are mapped so they can be removed.

***Elymus repens* (L.) Gould**

Poaceae

Syn. *Elytrigia repens* P.Beauv.

*Agropyron repens* (L.) Nevski

**couch grass**

Introduced plant category: Restricted naturalised



**Global Distribution:** Native to Eurasia but widely naturalised in temperate regions of both hemispheres; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Elymus repens* was first recorded on South Georgia in 1961 in Grytviken (Greene, 1964), growing on the south side of the whaling station (BAS, 2008). By 1971 this population had spread into the surrounding vegetation to cover an area of over 15 m<sup>2</sup> (Walton and Smith, 1973) and in 1977 it was recorded again from this locality. In 1980 a specimen was also collected from the other side of Grytviken whaling station near the power house. *Elymus repens* has also been recorded at Husvik, Leith Harbour and Prince Olav Harbour. At Husvik it was found in 1981 growing against the wall of the manager's villa and also forming a large patch within Husvik whaling station (BAS, 2008). The exact locality of the first of these sites was noted by hand on a plan of Husvik (BAS, date unknown). At Leith Harbour it was found in 1979, growing adjacent to the villa and at Prince Olav Harbour it was found on a slope below the manager's house (BAS, 2008).

**Records from the current survey:**

In this survey *Elymus repens* was found at Husvik growing in a narrow strip by the east wall of manager's villa, as recorded in 1981 (see Appendix 10, map 6.3). The strip was approximately 4 m long and the plants were mature and just coming into flower at the time of survey. This species was not seen around the whaling station at Grytviken. We were unable to monitor records within the whaling stations at Husvik, Leith and Prince Olav Harbour as these areas were restricted at the time of survey.



**Figure 37: Map showing the proportion of sample sites where *Elymus repens* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed ground around buildings. In the UK this grass occurs in rough grassland, on waste ground and roadsides and is a bad weed of cultivated land (Hubbard, 1984).

**Key field characters:**

- Tall grass (approx. 60 cm tall in South Georgia)
- Leaf blades flat and broad (3-10 mm wide)
- Leaves finely pointed at apex
- Leaf sheaths with small clasping auricles at the apex
- Inflorescence a single spike with one spikelet per node
- Spikelets in two rows, flattened broadside onto the rachis
- Creeping rhizomes

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Poa pratensis*, which can be distinguished by its branched panicles and leaves that are boat shaped at the apex.
- *Deschampsia cespitosa*, which is tussock-forming, has branched panicles and leaves that are strongly ribbed on the upper surface and rough on ribs and margins.
- *Festuca rubra*, which has narrow infolded leaves and branched panicles.
- *Parodiochloa flabellata*, which is a native tussock-forming plant easily distinguished by growth habit and by the dense, ovoid or cylindrical flowering spikes.

**Invasive potential:** *Elymus repens* does not appear to have spread since 1981 and has not colonised other areas in Husvik. It was recorded in flower during the current survey but the seed viability of this population is unknown. It has not been recorded at any new site on South Georgia in the current survey. This species appears to have a low invasive potential under the current conditions.

**Recommendations:** The single small population by the manager's villa at Husvik should be removed along with any plants subsequently located within the whaling stations at Husvik, Leith and Prince Olav Harbour. Although *Elymus repens* does not currently appear to be invasive, it may become invasive with climate change.

## *Festuca rubra* L.

red fescue

Introduced plant category: Restricted naturalised

Poaceae



**Global Distribution:** Native to Eurasia and North America but widely introduced in southern temperate regions, introduced on the Falkland Islands (Moore, 1968).

### **Historical records from South Georgia:**

*Festuca rubra* was first recorded on South Georgia in 1961 on waste ground in the whaling stations at Husvik and Stromness (Walton and Smith, 1973). Subsequently, two flowering populations were recorded in and around Grytviken whaling station in 1970 (Walton and Smith, 1973) and it was collected at King Edward Point in 1981 by Smith (BAS, 2008). In a recent study of the vascular flora of King Edward Point and Grytviken, Shanklin (2006) also describes two localities for *Festuca rubra* at King Edward Point. This grass has not been recorded at any other sites on South Georgia.

### **Records from the current survey:**

In this survey *Festuca rubra* was recorded only at Husvik as a single clump growing along the wall of a small hut to the southwest of the manager's villa (see Appendix 10, map 6.2). The location had been previously marked by hand on an annotated plan of the whaling station (BAS, date unknown) and the clump may be the remnants of a small population recorded in this area in 1979. The site is grazed by reindeer and heavily impacted by breeding fur seals. In places, the vegetation has been eroded to bare ground, which may have reduced the population size of this grass.

At Grytviken and King Edward Point, previously recorded populations were not found. This grass appears to have been eradicated from the two locations recorded by Shanklin (2006) at King Edward Point, where extensive searches were carried out during this survey. At Grytviken, general searches were carried out in and around the whaling station but coverage of the area was not exhaustive due to time limitation and it is possible that small populations may have been overlooked.

We were unable to check the previous records within Husvik and Stromness whaling stations as these were restricted areas at the time of survey.



**Figure 38: Map showing the proportion of sample sites where *Festuca rubra* was recorded in this baseline survey, 2009**

**Habitat:** On waste ground and in native *Acaena* herbfield. In the UK this grass is common across a wide range of habitats including dunes, moorland, woodland and mountain slopes (Hubbard, 1984).

**Key field characters:**

- Leaf sheaths tubular and fused to the apex
- Basal outer leaf sheaths densely hairy (downward pointing hairs)
- Leaves narrow, infolded
- Rhizomes creeping
- Spikelets with awns (on the lemmas)
- Spikelets long (to 15mm), 4-10 flowered

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Poa pratensis*, which has no awns, flat or keeled leaves and boat-shaped leaf tips.
- *Elymus repens*, which has flat leaf blades and an unbranched flowering spike.
- *Agrostis* spp., which have very small, single-flowered spikelets 2-3.5 mm long.

This grass is not conspicuous and may easily be overlooked.

**Invasive potential:** In this survey only one small, persistent clump of *Festuca rubra* was found and no seedlings were observed. The distribution and abundance of this grass appears to have reduced since previous records and it was not found growing within the native vegetation. The invasive potential appears to be low.

**Recommendations:** The single clump of *Festuca rubra* at Husvik should be removed along with populations previously recorded within the Husvik and Stromness whaling stations, if these have survived. The area within and around Grytviken and King Edward Point should be monitored regularly and any persistent clumps found should be removed. Although this grass does not currently appear to be invasive, it may become invasive with climate change.



***Nardus stricta* L.**

mat grass

Introduced plant category: Persistent

Poaceae



**Global Distribution:** Eurasia, Africa, North and South America and Australasia (Clayton *et al.*, 2006-).

**Historical records from South Georgia:**

*Nardus stricta* was first recorded on South Georgia in 1970 at Leith Harbour (Walton and Smith 1973). It had been known only from a single plant at the outskirts of the whaling station.

**Records from the current survey:**

Leith Harbour was not one of the survey sites selected for this baseline survey (due to safety restrictions at this site). However, during the current survey we found another previously unrecorded single clump of *Nardus stricta* on the hillside to the southeast of Maiviken (see Appendix 10, map 7.2). This small clump was approximately 0.25 m in diameter.

**Habitat:** Edge of boggy flush in *Festuca contracta* grassland growing with *Rostkovia magellanica*, *Juncus scheuchzerioides* and moss. In the UK this grass is common on heaths and moors on poor soils (Hubbard, 1984).



**Figure 39: Map showing the proportion of sample sites where *Nardus stricta* was recorded in this baseline survey, 2009**

**Key field characters:**

- Tough, densely tufted grass
- Leaves in-rolled, narrow and wiry
- Flowering spikes one-sided
- Spikelets narrow and fine pointed, single flowered

For a detailed description see Hubbard (1984).

Most likely to be confused with:

- *Festuca contracta*, which also has narrow, wiry leaves but can be distinguished by having spikelets that contain 3-5 flowers.

**Invasive potential:** A single clump of *Nardus stricta* was seen during the current survey. The clump had several flower heads at the time of survey but there was no evidence of seedlings in the surrounding area. This grass appears to have a low invasive potential.

**Recommendations:** The single clump of *Nardus stricta* at Maiviken should be removed along with the clump recorded at Leith Harbour in 1970, if this has survived. Although this grass does not currently appear to be invasive, it may become invasive with climate change.

## ***Poa annua* L.**

annual meadow grass

Introduced plant category: Widespread naturalised

Poaceae



**Global Distribution:** Worldwide; introduced on the Falkland Islands (Moore, 1968).

### **Historical records from South Georgia:**

*Poa annua* is currently the most abundant and widespread introduced plant on South Georgia and was the first introduced plant to be recorded here. In 1964 Greene already considered this grass to be naturalised when he published *The Vascular Flora of South Georgia*. He suggested that it had probably been present continuously since 1902 when it was first collected by Skottsberg at Grytviken. The most recent distribution map of *Poa annua* was published by Walton and Smith (1973) and shows the distribution of all records of *Poa annua* on South Georgia up to 1972 by 5 km grid squares. By this time *Poa annua* had been recorded at all the former whaling stations and many other sites around the island. Although most commonly found at lower altitudes around the coast and whaling stations *Poa annua* has been recorded at 300 m altitude and up to 4 km inland (Walton and Smith 1973). *Poa annua* has now also been recorded on Bird Island (Shanklin 2006a).

*Poa annua* forms a significant component of vegetation units in two of the most recent plant community classifications for South Georgia. In the Environmental Management Plan for South Georgia, Walton and McIntosh (2000) describe a community of 'introduced grasses' that consists primarily of *Poa annua*, which forms extensive lawns in areas impacted by reindeer grazing (sometimes growing with *Poa pratensis*). In the recent South Georgia Environmental Mapping Report, Scott and Poncet (2003) define a category of 'short mixed grassland' where *Poa annua* is often the dominant species. They also describe 'Tussac, moss and *Poa annua*' as a visually distinct map unit arising from degraded tussac grassland.

### **Records from the current survey:**

In this survey *Poa annua* was found at 14 of the 16 survey sites (see Appendix 10, maps 3.1, 4.2, 5.3, 6.5, 7.2, 8.4, 9.2, 10.2, 11.2, 12.2, 13.4, 14.1, 15.1 and 16.1) and often in abundance. Our results include a new record and range extension for *P. annua* at Larsen Harbour in Drygalski Fjord at the southern end of the island.



**Figure 40: Map showing the proportion of sample sites where *Poa annua* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed ground; areas heavily trampled and eroded by seals and penguin colonies; moraines; stream-sides. Not usually found in bogs or on dry peat. In the UK this species occurs across a wide variety of habitats (Hubbard, 1984).

**Key field characters:**

- Small grass (flowering shoots to 15 cm tall)
- Branched panicle with 1-2 branches at the lowest nodes of the inflorescence
- Spikelets 3-5 mm long with 3-5 florets
- No awns
- Short rounded ligule
- Leaves flat or keeled, hairless, boat shaped at apex
- No creeping rhizomes (though it does sometimes root at the nodes)

For a detailed description see Greene (1964) or Hubbard (1984).

Most likely to be confused with:

- *Poa pratensis*, which usually has more branches (2-5) at the lowest nodes of the inflorescence. Although *P. pratensis* tends to be taller than *P. annua* there is often overlap. Where the two grasses are growing together in a heavily grazed sward, *P. annua* tends to appear more yellow-green with softer, less robust leaves than *P. pratensis*, which appears more glaucous-green.
- *Deschampsia antarctica* can be a similar size to *P. annua* but has awns, spikelets with only two florets, a long, narrow pointed ligule, and panicles with distinctive spreading branches.

**Invasive potential:** *Poa annua* tends to colonise bare and degraded areas rather than directly invading native vegetation. However, in some areas it was found to be invading patches of damp moss (see Figure 41). As it is tolerant to grazing, it is maintained in dense lawns where reindeer are present and may prevent the native vegetation from re-colonising. It is also highly tolerant of trampling so populations are maintained in areas heavily impacted by people and wildlife, along pathways and in fur seal breeding areas. Although usually referred to as an annual, *Poa annua* behaves as a perennial under the climatic conditions on South Georgia (Walton and Smith, 1973). It flowers and sets seed continually throughout the summer months. The seed is highly

viable and may be dispersed by both wind and wildlife. Its viability was evident from the numerous seedlings seen. Reindeer are likely to be a significant vector for the spread of *Poa annua*, distributing seeds across their range in their dung (see Figure 42). Since *Poa annua* already has such a wide distribution and high seed viability it is inevitable that this grass will eventually spread to all suitable habitat across South Georgia (Professor D. Walton, pers. comm.).

**Recommendations:** Control or eradication of this species would currently be unrealistic and the cost prohibitive.



**Figure 41: *Poa annua* invading damp moss at Stromness**



**Figure 42: *Poa annua* growing out of reindeer dung in an area of *Rostkovia magellanica* bog at Stromness. As *Poa annua* does not invade bog vegetation it was particularly conspicuous here.**

***Poa pratensis* L.**

smooth meadow grass

Introduced plant category: Widespread naturalised

Poaceae



**Global Distribution:** Native to Eurasia but widely introduced in temperate regions of both hemispheres; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Poa pratensis* is a widespread introduced species that was first collected at Grytviken in 1927 (Walton and Smith 1973). In 1964 Greene already considered this grass to be naturalised when he published *The Vascular Flora of South Georgia*, in which he describes it as being 'locally frequent'. By 1972 *Poa pratensis* had been recorded at 10 sites across the 5 km grid square map published by Walton and Smith (1973) including a site on the southwest coast. It was recorded as 'locally abundant' at many of these sites.

**Records from the current survey:**

In this survey *Poa pratensis* was found at six of the 16 survey sites (see Appendix 10, maps 5.1, 6.1, 6.3 (part), 8.6, 11.3, 13.5 and 14.1) where it was often widespread and abundant. It was not recorded at any new sites since Walton and Smith's 1973 distribution map. In addition, we did not find *Poa pratensis* at Prince Olav Harbour where it had formerly been recorded. However, the grass may still be present within the whaling station, which was a restricted area at the time of survey.



**Figure 43: Map showing the proportion of sample sites where *Poa pratensis* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed ground and heavily grazed areas, seepage areas, 'Acaena herbfield'. In the UK this species occurs across a wide variety of habitats (Hubbard, 1984).

**Key field characters:**

- Medium height grass (flowering shoots to 50 cm tall)
- Panicle branched with 2-5 branches at the lowest nodes of the inflorescence
- Spikelets 3-5 mm long with 3-5 florets
- No awns
- Ligule very short, rounded
- Leaves flat or keeled, hairless, boat shaped at apex
- Rhizomes creeping

For a detailed description see Greene (1964) or Hubbard (1984).

Most likely to be confused with:

- *Poa annua*, which usually has fewer branches (1-2) at the lowest nodes of the inflorescence and no creeping rhizomes. Although *P. pratensis* tends to be taller than *P. annua* there is often overlap. Where the two grasses are growing together in a heavily grazed sward, *P. annua* tends to be more yellow-green in appearance with softer, less robust leaves than *P. pratensis*, which can appear more glaucous-green.
- *Deschampsia antarctica*, which has awns, spikelets with only two florets, a long, narrow pointed ligule, and panicles with distinctive spreading branches.
- *Elymus repens*, which has leaves that are finely pointed at the apex and an unbranched inflorescence.

**Invasive potential:** *Poa pratensis* does invade native vegetation, especially in damp seepage areas where it can be found with the native *Acaena magellanica*. It forms large, dense patches spreading by creeping rhizomes. It is also tolerant of grazing by reindeer and forms discreet patches amongst the grazed *Poa annua* sward.

This grass is considered to be naturalised and widespread and is abundant at a number of sites on South Georgia. However, within the 16 sites sampled during this survey it does not appear to have colonised new sites since the early 1970's. This could be due either to low seed viability or

limited seed dispersal. During this survey we frequently observed *Poa pratensis* in flower and Walton and Smith (1973) also noted that it produced copious inflorescences. However, the seed viability is not known and the seedlings are difficult to distinguish from those of *Poa annua*. Where this grass is maintained as a grazed sward by reindeer, very few inflorescences were seen and it appears to be less capable of flowering under grazing pressure than *Poa annua*. Within each site we do not have comparative historical distribution data to assess the rate at which *P. pratensis* has colonised or the rate of vegetative spread of each patch.

**Recommendations:** *Poa pratensis* is widespread and abundant. It is an invasive grass and ideally should be eradicated on South Georgia. However, control or eradication of this species may currently be unrealistic and the cost prohibitive.



***Pratia repens* Gaudich.**

berry-lobelia

Introduced plant category: Restricted naturalised

**Campanulaceae**



**Global Distribution:** Native to the Falkland Islands, Fuegia and Patagonia (Moore, 1968).

**Historical records from South Georgia:**

*Pratia repens* was first recorded on South Georgia in 1979 at Grytviken, growing on the north side of the whaling station behind the coffee grindery, near the slop chest. This population was recorded again in 1981. In 1991 *Pratia repens* was recorded at Husvik, where it was found growing in a moist, sheltered depression approximately 300 m upstream from Block Lake, on the south side of the stream in Karrakatta Valley. The population was abundant, covering an area of 10x5 m. It was recorded again at this location at Husvik in 1993 by MacAlister (1995) who noted that the plants were expanding into *Festuca* grassland and also that while most growth was vegetative it was regularly producing flowers and even 'viable seedpods' in some years.

**Records from the current survey:**

During the current survey we located the site in Husvik described by MacAlister (1995), upstream from Block Lake, on the south side of the stream. At this site we found a patch of *Pratia repens* covering an area of approximately 10x5 m population, as recorded by Smith in 1991 (BAS, 2008). We also located the patch at Grytviken behind the coffee grindery (near the museum). This patch was approximately 6x8 m. The plants in both localities were in flower and fruit at the time of survey. (see Appendix 10, maps 6.4 and 8.2).

**Habitat:** *Pratia repens* was found growing in two different habitats on South Georgia. At Husvik it was found in *Festuca*-fellfield mosaic while at Grytviken it was found on a degraded area of boggy ground in the whaling station. In the Falkland Islands this species grows in moist habitats and is common (Moore, 1968).



**Figure 44: Map showing the proportion of sample sites where *Pratia repens* was recorded in this baseline survey, 2009**

**Key field characters:**

- Creeping herb up to 3cm tall
- Petals purplish white, inside of corolla tube yellow-purple
- Leaves almost circular with crenate margin, shiny
- Fruit a round whitish berry (may also be green or purplish)

For a detailed description see Moore (1968).

This herb is unlikely to be confused with any other plant found on South Georgia. It is very conspicuous in flower and its round shiny leaves are fairly easy to spot.

**Invasive potential:** Since 1991 the patch of *Pratia repens* at Husvik does not appear to have expanded. We have no information on size of the population of *Pratia repens* at Grytviken from historical records. Although MacAlister (1995) noted that this species does produce viable seed pods there was no evidence of seedlings in the areas within or around the two recorded patches. Seed was collected during the current survey and will be tested for viability at the Millenium Seed Bank, Wakehurst Place. *Pratia repens* appears to have a low invasive potential under the current conditions.

**Recommendations:** *Pratia repens* is native to the Falkland Islands and it is not known whether it was introduced on South Georgia as a result of human activity or arrived by natural means. Therefore treatment of this species as an 'introduced plant' should be considered carefully. Colonisation of islands by new species is a natural process and management policy should allow for this. However, the occurrence of this species within the whaling station at Grytviken suggests that it was introduced. The patches of *Pratia repens* at Grytviken and at Husvik should be removed as soon as possible while this species still has a restricted distribution on South Georgia. As it may be producing viable seed, dormant seed may remain in the ground for many years. The areas should be monitored and any seedlings removed each year before they have a chance to flower and set seed.

## ***Ranunculus repens* L.**

creeping buttercup

Introduced plant category: Restricted naturalised

## **Ranunculaceae**



**Global Distribution:** Native to Eurasia but widely naturalised in temperate regions throughout the world, introduced on the Falkland Islands (Moore, 1968).

### **Historical records from South Georgia:**

*Ranunculus repens* was first recorded on South Georgia at Leith Harbour in the whaling station in 1949 (Walton and Smith, 1973). In 1957 it was recorded at Grytviken and Ocean Harbour and in 1961, at Husvik and Prince Olav Harbour (BAS, 2008). Greene considered this species to be naturalised when he published *The Vascular Flora of South Georgia* in 1964 and it was classified as a naturalised and restricted alien by Walton and Smith in 1973.

At Grytviken there are a number of records of *Ranunculus repens* around the whaling station. By 1973, when Walton and Smith published *The Status of the Alien Flora of South Georgia*, they noted two persistent plants at Grytviken. The first was recorded in front of the power station growing in a stand of *Acaena magellanica* and the second beside the piggery (the second plant measured 75 cm diameter in 1971). These two plants were recorded again in 1980, when another locality at King Edward Point (outside Shackleton House) was also recorded (BAS, 2008). In 1985 a further locality was recorded behind the theatre in Gryviken (BAS, 2008).

At Ocean Harbour Walton and Smith (1973) recorded a patch of 'many very small plants' growing amongst *Poa annua* in an area of approximately 5x3 m. They noted that this population was heavily grazed by reindeer.

At Husvik *Ranunculus repens* was recorded on waste ground within the whaling station in 1961 and later as 'several grazed plants' on a grassy mound behind the piggery in 1981 (BAS, 2008).

At Prince Olav Harbour it was found 'between buildings at shore level and those on upper terrace, south shore of North bay' in 1961. It was recorded again at this site in 1980 when

'several populations' of 'very large plants up to 35 cm tall' were recorded, and again in 1981 (BAS, 2008).

#### Records from the current survey:

In this survey *Ranunculus repens* was found at Grytviken and Prince Olav Harbour (see Appendix 10, maps 3.1 and 8.7). Around Grytviken it was persisting at the four sites recorded in the 1970's and 80's and the population appears to have increased since then. Three flowering patches up to 0.7x0.5 m were growing about 70 m south of the church. The patches consisted of numerous small plants. This locality corresponds with the record in 1985 from 'behind the theatre'. One small plant was also recorded on the north side of the fuel oil tanks, a clump 20 cm wide and fruiting. At the site behind the former piggery (northwest from Morrison Camp) approximately ten plants were recorded in an area 1 m in diameter. Another small clump (approximately 0.3 m diameter) was recorded in front of the hydro-power station. At King Edward Point a patch approximately 1 m in diameter was recorded growing on a steep, west facing slope near the track towards Hope Point. This locality is near the site of the former Shackleton House corresponding with the record of *Ranunculus repens* in 1980 (BAS, 2008).

At Prince Olav Harbour a clump of *Ranunculus repens* in flower was observed with binoculars growing within the whaling station at the south side of the station. As this area was restricted (for safety reasons) at the time of survey we did not collect a specimen but have added a record of the locality on the map. This corresponds to the locality recorded from 1961-1981 (BAS, 2008). A specimen from this population has recently been collected during an archaeological expedition to Prince Olav Whaling Station. This specimen will be appended to the records from the current survey.

We searched for, but did not find this species at Ocean Harbour. At Husvik we were unable to monitor the historical records within the whaling station as this was a restricted area at the time of survey.



Figure 45: Map showing the proportion of sample sites where *Ranunculus repens* was recorded in this baseline survey, 2009

**Habitat:** Disturbed ground around buildings, 'Festuca grassland' and 'Acaena herbfield'. In the UK this species grows in wet grassland, streamsides and marshes, and is also abundant as a weed (Stace, 1997).

**Key field characters:**

- Perennial herb with creeping stems rooting at nodes
- The middle lobe of basal leaves with long stalk
- Flowers bright yellow
- Sepals not reflexed

For a detailed description see Stace (1997).

The *Ranunculus repens* found on South Georgia is unusual because the creeping stems that are usually a conspicuous character of this species were not seen. The plants collected at different locations also demonstrated a variable degree of pubescence with some specimens having very few hairs.

This species is unlikely to be confused with any of the other plants found on South Georgia. However, there are historical records from Grytviken of *Ranunculus acris*, which can be distinguished as follows:

- *Ranunculus acris* has leaves deeply 3-5 lobed, lobes deeply toothed and middle lobe not stalked.

**Invasive potential:** The distribution and abundance of this herb appears to have increased since previous records and though vegetative spread has been slow, several plants were observed in fruit. The viability of seed is not known but a new record from within the whaling station (north side of the fuel oil tanks) may indicate that this species is producing viable seed. It should also be noted that plants have been weeded out from the area around Grytviken whaling station (Darren Christie, pers. comm.) so evidence of seedlings may have been removed. *Ranunculus repens* has a high invasive potential as there is likely to be a large area of suitable habitat on South Georgia.

**Recommendations:** The existing populations of *Ranunculus repens* should be removed as soon as possible while this species still has a restricted distribution on South Georgia. As it may be producing viable seed, dormant seed may remain in the ground for many years. The areas should be monitored and any seedlings removed each year before they have a chance to flower and set seed.

***Rumex acetosella* L.**

sheep's sorrel

Introduced plant category: Widespread naturalised

**Polygonaceae**



**Global Distribution:** Found throughout temperate regions around the world; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Rumex acetosella* was first collected on South Georgia at Grytviken in 1927 (Greene, 1964). In 1959 Bonner made a collection of this species at Husvik and in 1961 the first collection at Stromness was made by Greene on waste ground in Stromness whaling station. Longton recorded this species at Ocean Harbour in 1964 and in 1970 two populations were found at Leith Harbour (Walton and Smith, 1973). By 1971 Walton and Smith (1973) also noted two large populations in Grytviken and many scattered plants in Ocean Harbour where the species occurred up to approximately 75 m above sea level.

Greene considered this species to be a transient alien when he published *The Vascular Flora of South Georgia* in 1964. However, by 1973 *Rumex acetosella* had been recorded in four squares across the 5 km grid square map published by Walton and Smith, who classified it as widespread and naturalised and noted that numerous seedlings were seen at each site. Since then, in 1981 Smith recorded this species at Husvik on the southwest side of the bay and also at Grytviken, where a large patch 25x25 m was found growing in 'Festuca grassland' to the west of the football pitch.

### Records from the current survey:

In this survey *Rumex acetosella* was found at three sites: Grytviken, Husvik and Ocean Harbour (see Appendix 10, maps 6.6, 8.1 and 13.3). It was found in flower at each of these sites. At Grytviken it was found to be widespread and abundant, forming large patches on slopes to the north and west of the whaling station, spreading more than 500 m inland and over 100 m altitude. It was observed to be particularly prevalent on north and east facing slopes. *Rumex acetosella* was also found in abundance beside the church and on the football pitch.

At Husvik three separate populations were recorded and it was found growing as far as 750 m inland in the Karrakatta Valley. On the stony outwash plain behind the whaling station numerous patches up to 4 m diameter were recorded over an area approximately 50x50 m, with further occasional patches occurring outside this area. A second population consisting of a single patch 10x30 m was recorded growing in 'Festuca grassland' in a stream gully northwest of the whaling station. A third population consisting of a single patch 20x20 m was recorded in 'Festuca grassland' in the Karrakatta Valley, below and to the east of Block Lake on the south side of the outflow stream.

At Ocean Harbour we found three separate populations of *Rumex acetosella* and it was recorded up to 400 m inland. On the south side of the flat plain it was found growing at low density forming large, spreading patches in 'sparse lowland fellfield' vegetation. On the steep slopes to the south of the plain two large patches of 10 m diameter and 10x15 m were recorded growing in 'Festuca grassland'.

We did not find *Rumex acetosella* at Stromness where it had formerly been recorded. However, it may still be present within Stromness whaling station, which was a restricted area at the time of survey.



**Figure 46: Map showing the proportion of sample sites where *Rumex acetosella* was recorded in this baseline survey, 2009**

**Habitat:** Well-drained areas in a range of habitats from degraded ground around buildings and bare stony ground through 'sparse lowland fellfield' to 'short mixed grassland' and 'Festuca grassland'. This species grows in flat areas and also often on north or east facing slopes. In the UK *Rumex acetosella* grows in open heathland, short grassland and on cultivated land, mostly on acid sandy soils (Stace, 1997).

**Key field characters:**

- Deep red, upright inflorescences to 25cm tall
- Small arrowhead-shaped leaves with lateral or forward-pointing basal lobes

Note that this herb is dioecious so only all-male or all-female flowers will be seen on any one plant.

For a detailed description see Stace (1997).

*Rumex acetosella* is unlikely to be confused with any other plant found on South Georgia. It is very conspicuous in flower and large patches add a red tinge to the landscape. Two other species of *Rumex* have been recorded on South Georgia: *Rumex crispus* at Grytviken and *Rumex alpinus* at Leith. These can be distinguished as follows.

- *Rumex crispus* is a much taller plant (to 1 m tall) and has large narrowly oblong leaves that are undulate or 'crisped' at the margins. This species has bisexual flowers.
- *Rumex alpinus* is also a taller plant (to 70 cm tall) with broad leaves that are cordate at the base.

**Invasive potential:** *Rumex acetosella* does invade native vegetation, especially on well-drained substrate in 'Festuca grassland', 'Acaena herbfield' and 'sparse lowland fellfield'. It forms large patches spreading vegetatively by horizontal roots and also smaller patches, which suggests that it may set viable seed. During this survey we observed *Rumex acetosella* in flower quite frequently. It appears to tolerate reindeer grazing at Husvik and Ocean Harbour. This species has a high invasive potential.

**Recommendations:** It is recommended that *Rumex acetosella* is controlled to prevent further spread and eradicated as soon as possible. Further survey is needed to map the full extent of the population around the island and feasibility studies for control methods are recommended. If immediate control is not possible due to limited resources, it is recommended that further survey and mapping of the population is carried out and the rate of spread is monitored.



***Rumex crispus* L.**

Curled dock

Introduced plant category: Persistent

**Polygonaceae**



**Global Distribution:** Native to Europe but widely naturalised in temperate regions around the world; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Rumex crispus* was first recorded on South Georgia in 1949 at Husvik and then in 1958 at Grytviken (Walton and Smith, 1973). It has not been seen at Husvik since 1964 but a few isolated plants were recorded in Grytviken in 1971 (Walton and Smith, 1973).

**Records from the current survey:**

In this survey we searched for all the plants listed by Walton and Smith (1973) and found only a single plant at Grytviken in front of the church, along the gravel track beside the stream (see Appendix 10, map 8.3). At the time of survey only the dry remains of flowering stems were seen, with several small new leaves at the base.



**Figure 47: Map showing the proportion of sample sites where *Rumex crispus* was recorded in this baseline survey, 2009**

**Habitat:** *Rumex crispus* is commonly found on waste ground, cultivated land and in marshy areas (Stace, 1997).

**Key field characters:**

- Herbaceous plant to 1m tall
- Large basal leaves with strongly undulate margins
- Leaf apex acute

For a more detailed description see Stace (1997).

Most likely to be confused with:

- *Rumex alpinus*, which has been recorded at Leith Harbour. *Rumex alpinus* has broad leaves that are deeply cordate at the base, obtuse at the apex and with flat or slightly undulate margins.
- *Rumex acetosella* is a much smaller plant (to 25 cm tall) with dark red inflorescences and small arrowhead-shaped leaves with lateral or forward-pointing basal lobes.

**Invasive potential:** *Rumex crispus* shows no signs of becoming invasive on South Georgia. The small number of plants recorded has diminished since 1972. No fruits were seen on the dried flowering stems and no seedlings were found during the current survey.

**Recommendations:** The plant in front of the church at Grytviken and any others that are found should be removed. Although *Rumex crispus* does not currently appear to be invasive, it may become invasive with climate change.

## ***Sagina procumbens* L.**

procumbent pearlwort

Introduced plant category: Persistent

## **Caryophyllaceae**



**Global Distribution:** Native to Europe and Asia, introduced and common in temperate regions around the world. Introduced on the Falkland Islands (Moore, 1968).

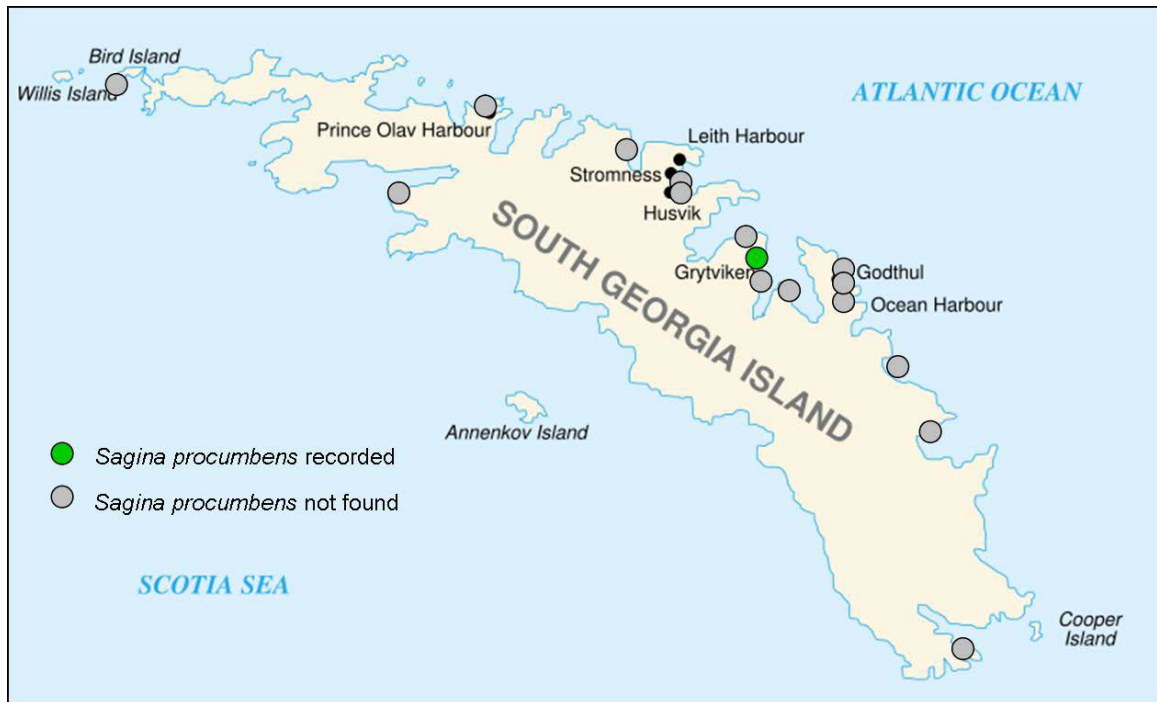
### **Historical records from South Georgia:**

*Sagina procumbens* was first recorded on South Georgia in 1963 at Husvik, growing within the whaling station. In 1967 it was also recorded at Grytviken in two localities, beside the bakery (old bakery) and by the steps of the barracks next to the kitchens. In 1968 the population beside the bakery consisted of several small plants and by 1971 this had increased to between 30 and 40 plants and numerous seedlings in an area of approximately 10m<sup>2</sup> (Walton and Smith, 1973). At the second site by the steps to the barracks only a single plant was observed in 1971 and it was noted that this plant was being out-competed by the native *Acaena magellanica* (Walton and Smith, 1973). Since then, the population of *Sagina procumbens* at Husvik was recorded in 1992, growing close to the railway track on the west side of Husvik laundry, where plants were noted to be small and straggly and producing flowers (MacAlister, 1995).

### **Records from the current survey:**

During the current survey we found *Sagina procumbens* at Grytviken, where two populations were recorded (see Appendix 10, map 8.3). A large population of approximately 80-90 circular clumps was recorded over a flat, 20x25 m gravel area in the whaling station, in the flensing plan area between the meat cookery and blubber cookery. The plants were in flower and fruit at the time of survey. In front of the old bakery site a single clump 20x30 cm was recorded in flower. This species was not found near the steps of the barracks where it was last recorded in 1971 (Walton and Smith, 1973).

We were unable to monitor the record at Husvik whaling station as this area was restricted at the time of survey. This species was not seen in the area surrounding Husvik whaling station.



**Figure 48: Map showing the proportion of sample sites where *Sagina procumbens* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed ground with sparse vegetation in former whaling station area. In the UK this species is common on paths, lawns, ditch sides and short turf (Stace, 1997).

**Key field characters:**

- Herb 1-2.5 cm tall, mat-forming
- Patches bright yellow-green
- Stems procumbent and spreading, rooting at nodes
- Peduncles narrow, often reflexed
- Leaves linear with a minute point <0.1mm

For a detailed description see Stace (1997).

Most likely to be confused with:

- *Colobanthus quitensis*, which is a loosely compacted cushion-forming plant. This species can be distinguished by having upright shoots with leaves in a star-like arrangement at the apex and stout upright peduncles, compared to the straggling procumbent shoots and narrow peduncles of *Sagina procumbens*.

**Invasive potential:** Since 1968 the population of *Sagina procumbens* has increased and spread within the whaling station at Grytviken. Numerous small clumps were observed during the current survey indicating that it is producing viable seed. This herb appears to colonise bare ground rather than invading the native vegetation. However, there is likely to be a large area of suitable habitat on South Georgia (including 'sparse lowland fellfield' vegetation) and this species therefore has a high invasive potential.

**Recommendations:** The population of *Sagina procumbens* in Grytviken should be removed as soon as possible while this species still has a restricted distribution on South Georgia. As it is producing viable seed, dormant seed may remain in the ground for many years. The area should be monitored and any seedlings removed each year before they have a chance to flower and set seed.

***Taraxacum officinale* Weber sensu lato\***  
dandelion

Introduced plant category: Widespread naturalised

**Compositae (Asteraceae)**



**Global Distribution:** Native to the northern hemisphere, introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Taraxacum officinale* was first collected on South Georgia in 1949 at both Husvik and Grytviken (Walton and Smith, 1973). In 1964 Greene already considered this species to be naturalised when he published *The Vascular Flora of South Georgia*, in which he describes it as 'occasional', growing on storm beaches and on bare ground around the whaling stations. By 1971-72 thriving colonies had become established around Grytviken, at Hestesletten, Ocean Harbour, Husvik and Leith and this species had been recorded up to 100 m altitude and within four squares on the 5km grid square map (Walton and Smith, 1973). It was also noted to be grazed by reindeer at Ocean Harbour (Walton and Smith, 1973).

**Records from the current survey:**

In this survey *Taraxacum officinale* was recorded at nine of the 16 survey sites (see Appendix 10, maps 5.4, 6.3 (part), 6.6, 7.3, 8.8, 9.3, 10.2, 11.3, 12.1 and 13.2) and was often found to be abundant. Plants were observed to be flowering and fruiting prolifically, and numerous seedlings were observed, particularly around Grytviken and on Greene Peninsula. There was a marked difference in the frequency and abundance of this species between sites with reindeer and sites without reindeer. Where *Taraxacum officinale* was recorded at reindeer grazed sites, there were only occasional, scattered, individual plants and a few small colonies in areas inaccessible to the reindeer.

The effect of reindeer grazing on the vegetation (including the introduced *Taraxacum officinale*) is strikingly demonstrated by an area fenced off from reindeer at Husvik as part of a long-term exclusion experiment. Inside the fenced area we observed lush growth of the native *Acaena magellanica* and invasive *Taraxacum officinale*. Outside the fenced area the vegetation has been completely modified to *Rostkovia*-dominated bog. Results from the exclusion experiment

and the influence of reindeer on the vegetation are discussed by Leader-Williams *et al.* (1987) and further monitoring was carried out in 2008 (Upson, unpublished).



**Figure 49: Map showing the proportion of sample sites where *Taraxacum officinale* was recorded in this baseline survey, 2009**

**Habitat:** Found across a wide range of habitats on South Georgia, growing on bare and disturbed ground as well as invading native vegetation. This species is common in 'Acaena herbfield' and also found in 'Festuca grassland', 'Festuca-fellfield mosaic', 'mixed grassland' and 'tussac'.

**Key field characters:**

- Flower heads bring yellow
- Leaves and stems exuding milky sap when broken
- Leaves hairless
- Seeds wind-dispersed with white, feathery pappus

For a more detailed description see Clapham *et al.* (1962).

*Taraxacum officinale* is unlikely to be confused with any other species found on South Georgia. Note that different growth forms occur according to habitat. Very lush, upright plants with flowering stems to 30cm tall were observed in sheltered areas, while in exposed and reindeer grazed areas small, flat, rosette plants were observed flowering close to the ground on stems only a few cm tall.

\* Nomenclatural note: The genus *Taraxacum* is apomictic, setting seed without sexual reproduction to produce seedlings that are genetically identical to the parent. As a result, many botanists do not classify the genus into species but recognise numerous microspecies. In the 'New Flora of the British Isles' for example, Stace (1997) aggregates 229 recognised microspecies of *Taraxacum* into nine sections, though he notes that these are ill-defined and can be difficult to determine. For practical purposes we refer to the *Taraxacum* on South Georgia as *T. officinale* Weber *sensu lato* and have not attempted to identify microspecies. However, DNA samples from two specimens collected during the survey may be useful for future research and classification. This could provide information on the original provenance of *Taraxacum* on South Georgia and indicate whether there were multiple introductions of this plant.

**Invasive potential:** *Taraxacum officinale* readily colonises suitable habitat, competing with the native vegetation. As the seed is wind dispersed it is easily spread over large distances and therefore has a high invasive potential. When the reindeer have been eradicated from South Georgia, as proposed in the *Environmental Management Plan* (McIntosh and Walton, 2000), there is likely to be a rapid increase in *Taraxacum officinale* at previously grazed sites where the reindeer were selectively grazing it out.

**Recommendations:** *Taraxacum officinale* is widespread on South Georgia and has a high invasive potential. However, control or eradication of this species would currently be unrealistic and the cost prohibitive.



**Figure 50:** *Taraxacum officinale* at Stromness. The small, flat rosette form and bitten leaves are the result of grazing by reindeer.

***Trifolium repens* L.**

white clover

Introduced plant category: Persistent

Leguminosae



**Global Distribution:** Native to Eurasia but introduced in many temperate regions around the world; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Trifolium repens* was first recorded on South Georgia in 1957 at Grytviken, growing and flowering in the whaling station by the fuel storage tanks. In 1961 it was also recorded at Husvik, growing on waste ground in the whaling station.

At Grytviken four clumps were recorded beside the barracks adjacent to the kitchens in 1967. However, by 1971 only one colony was seen here (Walton and Smith, 1973).

At Husvik *Trifolium repens* was observed in flower in 1990 (MacAlister, 1995).

This species was also recorded at Leith Harbour Whaling Station in 1979 and in 1991 (BAS, 2008).

**Records from the current survey:**

During the current survey we found *Trifolium repens* only at Grytviken, where two clumps were recorded from around the whaling station (see Appendix 10, map 8.2). The first was found growing by the chute in the flensing plan area in a circular patch approximately 0.5 m diameter. Another colony 1 m diameter was found on the east side of the Morrison Camp building. Both clumps were flowering at the time of survey. This species was not found from the area beside the barracks adjacent to the kitchens, where it was last seen in 1971. We were unable to monitor the record from within Husvik Whaling Station as this was a restricted area at the time of survey.





**Figure 51: Map showing the proportion of sample sites where *Trifolium repens* was recorded in this baseline survey, 2009**

**Habitat:** Disturbed, stony ground around buildings. In the UK *Trifolium repens* is common in grassland and on rough ground (Stace, 1997).

**Key field characters:**

- Herb with procumbent stems rooting at nodes
- Flower heads globose with many white flowers (occasionally pink)
- Leaves with 3 obovate leaflets

For a detailed description see Stace (1997).

Most likely to be confused with:

- *Trifolium hybridum*, which has been recorded at Grytviken and Husvik. *Trifolium hybridum* can be distinguished by having erect to ascending stems, not rooting at nodes and having flowers that are usually white ageing to pink.

**Invasive potential:** *Trifolium repens* has persisted at Grytviken since 1957 though very few plants have been recorded. The two clumps seen in the current survey are not in the same locations given in historical records. These clumps may have grown from seed produced by plants growing on South Georgia or may have arisen from seed that was introduced (in soil or livestock fodder for example) and has lain dormant in the soil. The latter is more likely as until recently there was thought to be no suitable native insect pollinators on South Georgia. However, results from the invertebrate survey carried out in parallel with this survey, suggest that there is now an introduced hover fly that could be a potential pollinator (Roger Key, pers. comm.), which indicates potential for seed to be produced in the future. *Trifolium repens* was not found growing within the native vegetation and no seed or seedlings have been reported on South Georgia to date. The invasive potential is low under current conditions.

**Recommendations:** The two clumps of *Trifolium repens* in Grytviken should be removed while this species still has a restricted distribution on South Georgia. The sites of historical records at Husvik and Leith Harbour should be surveyed and any clumps found there should also be removed. As the position of the two clumps seen in the current survey suggests they may have arisen from dormant seed, the area should be monitored each year and any seedlings removed before they have a chance to flower. Although it does not currently appear to be invasive,

*Trifolium repens* may become more invasive with climate change. Pollination by the introduced hoverfly could also allow this species to set seed, increasing its invasive potential.

***Trisetum spicatum* (L.) K.Richt.**

**Poaceae**

spike trisetum

Introduced plant category: Widespread naturalised



**Global Distribution:** Native to Eurasia, North and South America (including Tierra del Fuego), Australia, New Zealand and the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Trisetum spicatum* has not previously been recorded on South Georgia.

**Records from the current survey:**

During the current survey we found an extensive population of *Trisetum spicatum* at Stromness (see Appendix 10, map 5.4). It was recorded from just outside the exclusion zone west of the whaling station to over 1 km inland. At all localities it was growing and flowering in either 'Festuca grassland' or 'short mixed grassland', often at fairly high densities.

**Habitat:** 'Festuca grassland' and 'short mixed grassland'.

**Key field characters:**

- Grass to 30 cm tall
- Peduncles densely white hairy
- Ligule <1 mm long
- Leaves flat or folded, up to 3 mm wide
- Lemmas awned

For a detailed description see Clayton *et al.* (2006-).



**Figure 52: Map showing the proportion of sample sites where *Trisetum spicatum* was recorded in this baseline survey, 2009**

Most likely to be confused with:

- *Festuca contracta*, which can easily be distinguished by its glabrous peduncles and narrow bristle-like leaves (1 mm wide).

*Trisetum spicatum* is not conspicuous and does not stand out from *Festuca contracta* in 'Festuca grassland'.

**Invasive potential:** This species is currently growing over a large area at one site on South Georgia, where it is invading the native vegetation. It grows at fairly high densities in both 'Festuca grassland' and 'short mixed grassland', and is likely to affect the species composition. As we do not have any previous records of *Trisetum spicatum* we cannot compare the population size or assess its rate of spread. The large number of plants at Stromness indicate that this herb is producing viable seed. *Trisetum spicatum* grows well here and there is a large area of suitable habitat on South Georgia. It therefore has a high invasive potential.

**Recommendations:**

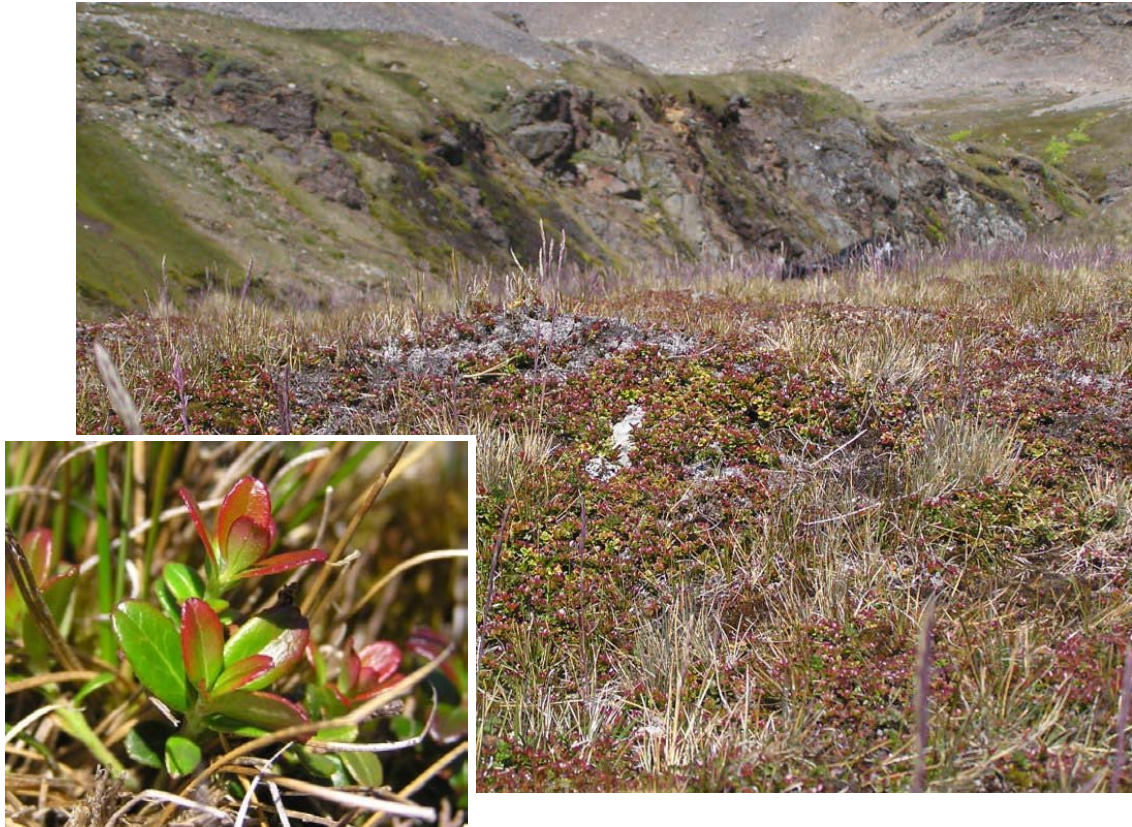
*Trisetum spicatum* is native to the Falkland Islands and it is not known whether it was introduced on South Georgia as a result of human activity or arrived by natural means. Therefore treatment of this species as an 'introduced plant' should be considered carefully. Colonisation of islands by new species is a natural process and management policy should allow for this. However, the occurrence of this species within a few hundred metres of the whaling station suggests that it was introduced. As this species is widespread at Stromness and growing at high densities in 'Festuca grassland' and 'short mixed grassland', control would be difficult without damaging large areas of native vegetation. It is recommended that further survey is carried out to map the extent of the population at Stromness and that the population is monitored to assess the rate of spread.

***Vaccinium vitis-idaea* L.**

**Ericaceae**

cowberry

Introduced plant category: Restricted naturalised



**Global Distribution:** Native to Eurasia and North America.

**Historical records from South Georgia:**

*Vaccinium vitis-idaea* was first recorded on South Georgia in 1991 at Husvik in Husdal Valley (MacAlister, 1995). At this time it covered an area of several square meters and was not seen in flower, though vegetative expansion was apparent (MacAlister, 1995). It has not been recorded at any other sites on South Georgia.

**Records from the current survey:**

During the current survey we located the site in Husvik described by MacAlister (1995), half way up Husdal Gorge on the north side, after the narrowing in the gorge, above the waterfall (see Appendix 10, map 6.5). At this site we found a patch of *Vaccinium vitis-idaea* 10x10 m in size. No flowers or fruits were seen.

**Habitat:** 'Festuca-fellfield mosaic'. In the UK this species grows on moors and in open, peaty woods (Stace, 1997).



**Figure 53: Map showing the proportion of sample sites where *Vaccinium vitis-idaea* was recorded in this baseline survey, 2009**

**Key field characters:**

- Evergreen shrub, low-growing
- Leaves shiny, red-tinged
- Leaves with minute, orange gland dots on the underside
- Leaf margins serrate
- Plants connected by a tough network of underground roots

For a detailed description see Stace (1997).

This shrub is unlikely to be confused with any other plant found on South Georgia.

**Invasive potential:** The population (or possibly individual) of *Vaccinium vitis-idaea* at Husvik appears to have expanded vegetatively since 1991 when it occupied an area of only 'several square meters' (MacAlister, 1995). No flowers or seedlings have been observed. Under the current conditions this species has a low invasive potential.

**Recommendations:** The patch of *Vaccinium vitis-idaea* at Husvik should be removed as soon as possible while this species has a restricted distribution on South Georgia. Although this species does not currently appear to be invasive, it may become more invasive with climate change.

***Veronica serpyllifolia* L.**  
thyme-leaved speedwell  
Introduced plant category: Persistent

**Scrophulariaceae**



**Global Distribution:** Native to Eurasia but widely naturalised in temperate regions of both hemispheres; introduced on the Falkland Islands (Moore, 1968).

**Historical records from South Georgia:**

*Veronica serpyllifolia* was first recorded on South Georgia in 1967 at Grytviken and by 1971 several small populations had been recorded around the whaling station (Walton and Smith, 1973). In 2006 Shanklin recorded a number of plants growing opposite the whale catchers at the entrance to Grytviken and a single plant near the small barracks west of the bath house. It has not been recorded at any other sites on South Georgia.

**Records from the current survey:**

During the current survey we found a fairly extensive population of *Veronica serpyllifolia* in flower and fruit growing at a low density in a patch approximately 25x15 m to the east of the main barracks at Grytviken. A few smaller patches and seedlings were found outside the main patch. A second population was found in an area approximately 10x10 m at the shore near the whale catchers. (see Appendix 10, map 8.3).



**Figure 54: Map showing the proportion of sample sites where *Veronica serpyllifolia* was recorded in this baseline survey, 2009**

**Habitat:** In gravel on dry, disturbed ground. In the UK this species occurs in open grassland, along woodland rides, on mountains, waste and cultivated ground and along paths (Stace, 1997).

**Key field characters:**

- Small, upright herb approximately 8cm tall
- Flowers white with blue veins and a yellow centre
- Leaves hairless
- Fruit a capsule opening by two valves

For a detailed description see Stace (1997).

This small herb is unlikely to be confused with any other plant found on South Georgia. It is quite inconspicuous and can be difficult to spot.

**Invasive potential:** Since 1971 the population of *Veronica serpyllifolia* has increased from ‘a small group of plants’ recorded by Walton and Smith to the two large patches recorded in this survey. It is not known whether the increase has been at a slow and steady rate since 1971 or whether there has been a sudden increase in recent years. The two patches at Grytviken include numerous seedlings suggesting that this herb is producing viable seed. Currently the distribution is restricted to the whaling station at Grytviken and does not threaten the native vegetation. However, as this herb grows well on dry gravel there are numerous areas of suitable habitat on South Georgia. It therefore has a high invasive potential.

**Recommendations:** The two populations in Grytviken should be removed while this species still has a restricted distribution on South Georgia. As *Veronica serpyllifolia* appears to produce viable seed there is likely to be dormant seed remaining in the ground for many years. The area should be monitored and any plants removed each year before the seed has a chance to ripen.



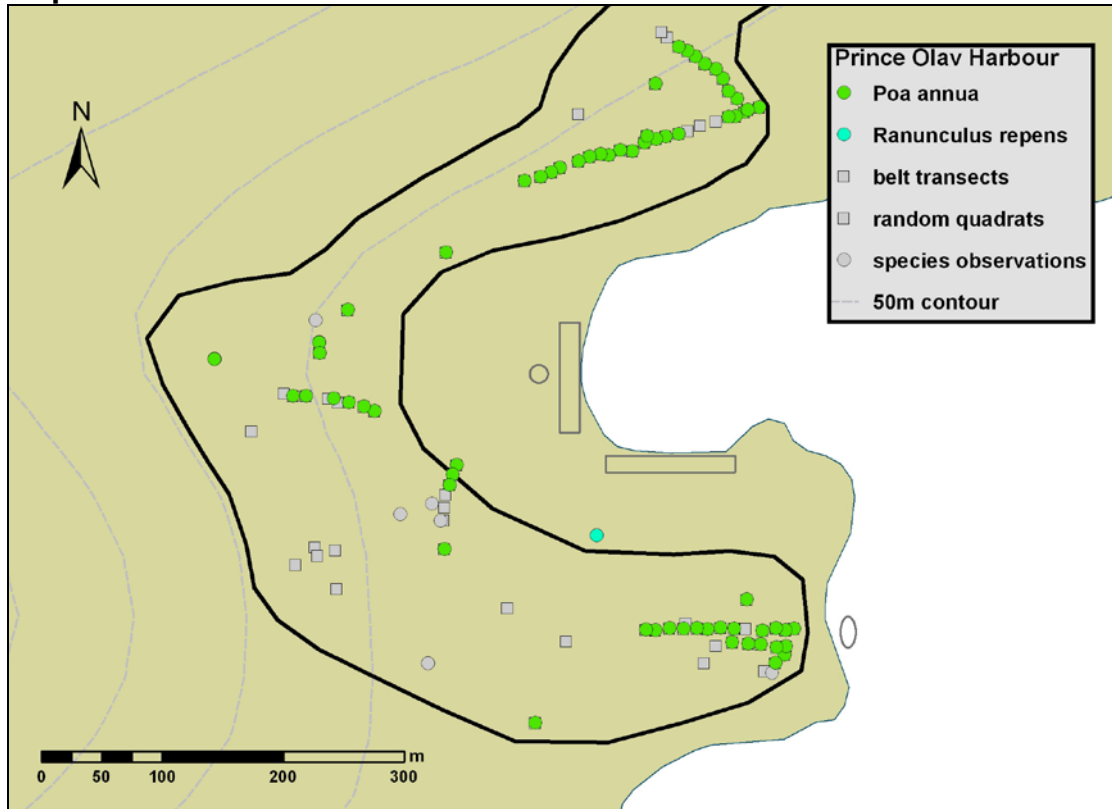
## Appendix 10: Maps of introduced species records

Table 9: Map index table

Site Number	Survey Site	Map Number	Species
1.	Cape Rosa	-	-
2.	Bird Island	-	-
3.	Prince Olav Harbour	3.1	<i>Poa annua</i> <i>Ranunculus repens</i>
4.	Fortuna Bay	4.1	<i>Cerastium fontanum</i>
		4.2	<i>Poa annua</i>
5.	Stromness	5.1	<i>Agrostis capillaris</i> <i>Poa pratensis</i>
		5.2	<i>Cerastium fontanum</i>
		5.3	<i>Poa annua</i>
		5.4	<i>Taraxacum officinale</i> <i>Trisetum spicatum</i>
6.	Husvik	6.1	<i>Agrostis capillaris</i> <i>Poa pratensis</i>
		6.2	<i>Agrostis vinealis</i> <i>cf. Deschampsia flexuosa</i> <i>Festuca rubra</i>
		6.3	<i>Carex aquatilis</i> <i>Elymus repens</i> <i>Poa pratensis</i> (part) <i>Taraxacum officinale</i> (part)
		6.4	<i>Cerastium fontanum</i> <i>Pratia repens</i>
		6.5	<i>Poa annua</i> <i>Vaccinium vitis-idaea</i>
		6.6	<i>Rumex acetosella</i> <i>Taraxacum officinale</i>
7.	Maiviken	7.1	<i>Cerastium fontanum</i>
		7.2	<i>Nardus stricta</i> <i>Poa annua</i>
		7.3	<i>Taraxacum officinale</i>
8.	Grytviken	8.1	<i>Agrostis capillaris</i> <i>Rumex acetosella</i>
		8.2	<i>Achillea millefolium</i> <i>Deschampsia cespitosa</i> <i>Pratia repens</i> <i>Trifolium repens</i>
		8.3	<i>Anthriscus sylvestris</i> <i>Rumex crispus</i> <i>Sagina procumbens</i> <i>Veronica serpyllifolia</i>
		8.4	<i>Cardamine flexuosa</i> <i>Poa annua</i>
		8.5	<i>Cerastium fontanum</i>
		8.6	<i>Poa pratensis</i>
		8.7	<i>Ranunculus repens</i>
		8.8	<i>Taraxacum officinale</i>
9.	Hestesletten	9.1	<i>Cerastium fontanum</i>
		9.2	<i>Poa annua</i>
		9.3	<i>Taraxacum officinale</i>
10.	Greene Peninsula	10.1	<i>Cerastium fontanum</i>
		10.2	<i>Poa annua</i>

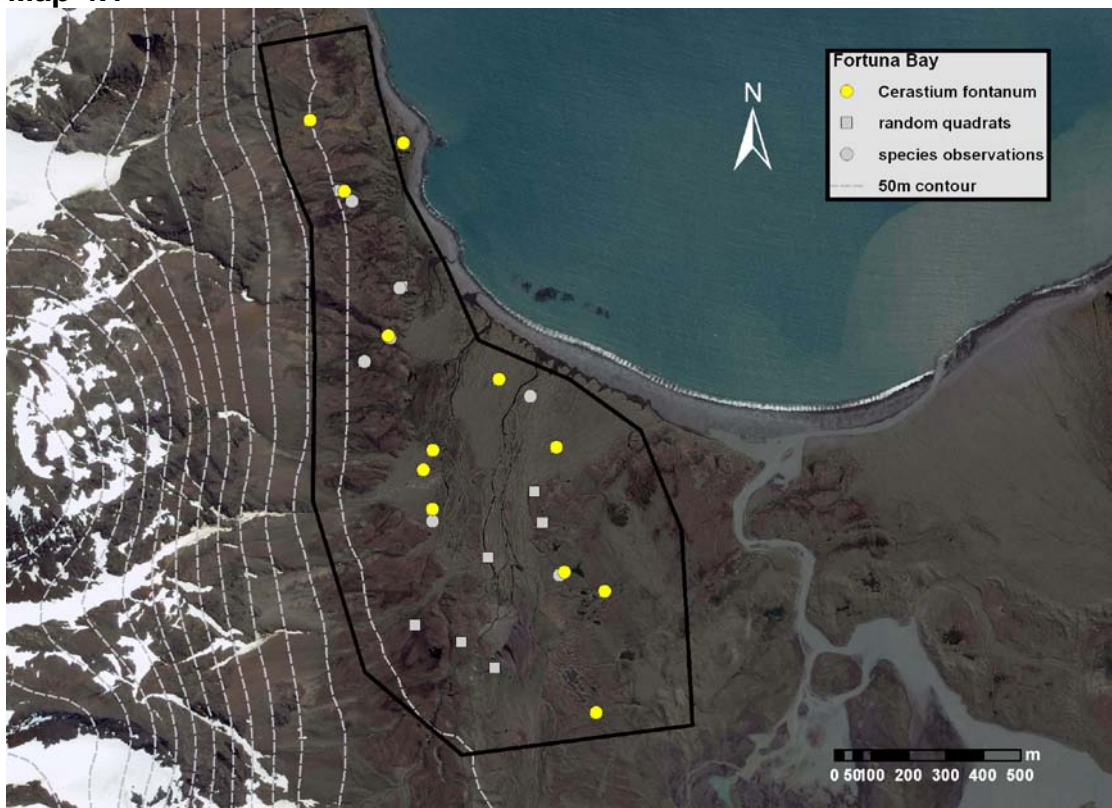
Site Number	Survey Site	Map Number	Species
			<i>Taraxacum officinale</i>
11.	Godthul	11.1	<i>Cerastium fontanum</i>
		11.2	<i>Poa annua</i>
		11.3	<i>Poa pratensis</i> <i>Taraxacum officinale</i>
12.	Cobblers Cove	12.1	<i>Cerastium fontanum</i> <i>Taraxacum officinale</i>
		12.2	<i>Poa annua</i>
13.	Ocean Harbour	13.1	<i>Agrostis capillaris</i>
		13.2	<i>Cerastium fontanum</i> <i>Taraxacum officinale</i>
		13.3	<i>Carex nigra</i> <i>Deschampsia cespitosa</i> <i>Rumex acetosella</i>
		13.4	<i>Poa annua</i>
		13.5	<i>Poa pratensis</i>
14.	Moltke Harbour	14.1	<i>Poa annua</i> <i>Poa pratensis</i>
15.	St. Andrews Bay	15.1	<i>Cerastium fontanum</i> <i>Poa annua</i>
16.	Larsen Harbour	16.1	<i>Poa annua</i>

Map 3.1



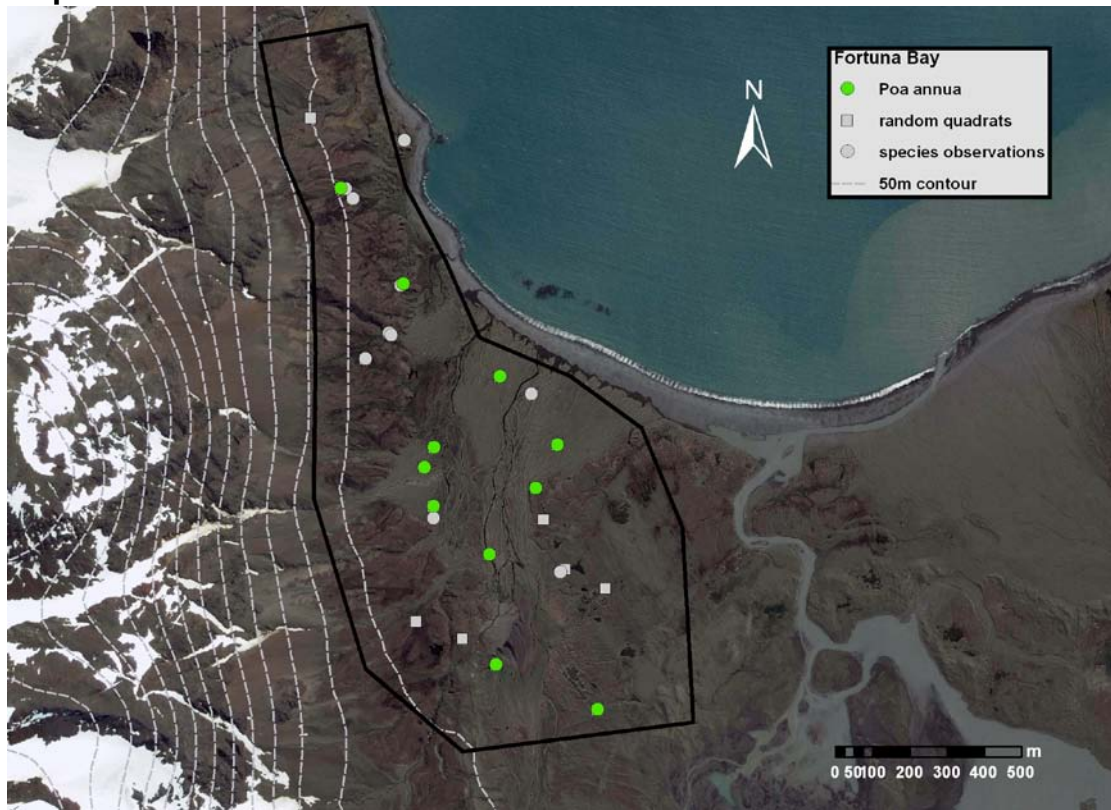
Map source BAS

Map 4.1



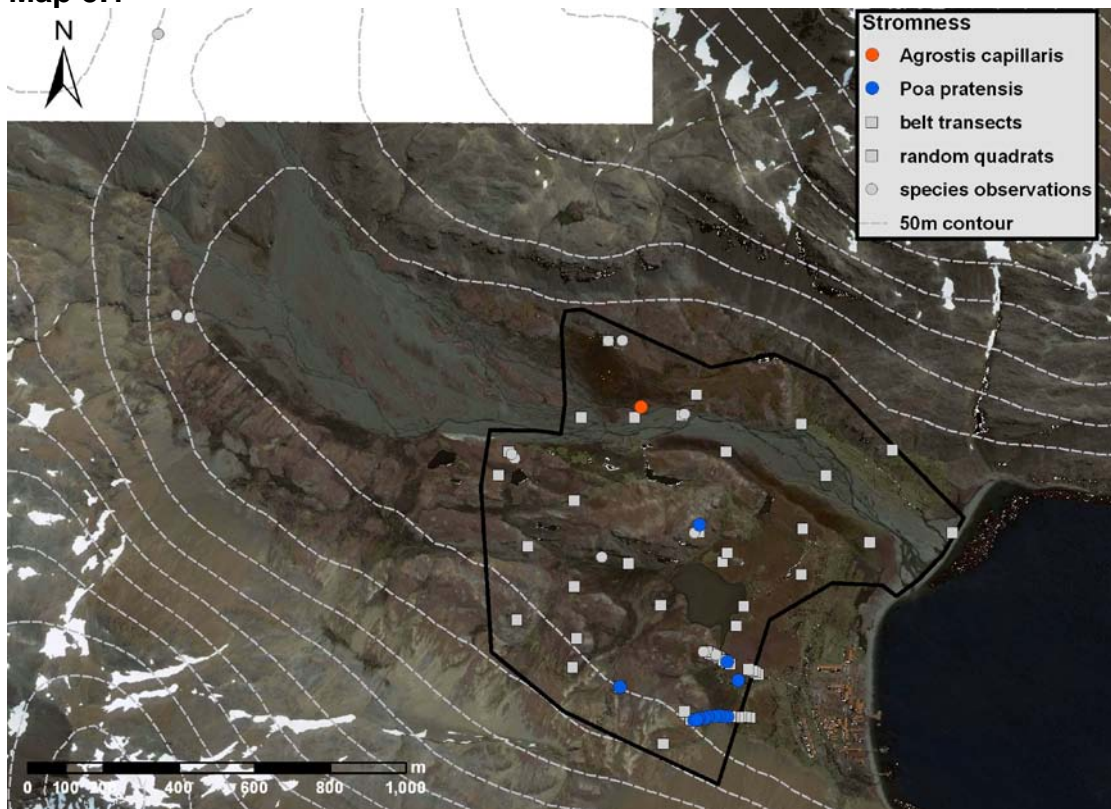
Map source Google Earth

Map 4.2



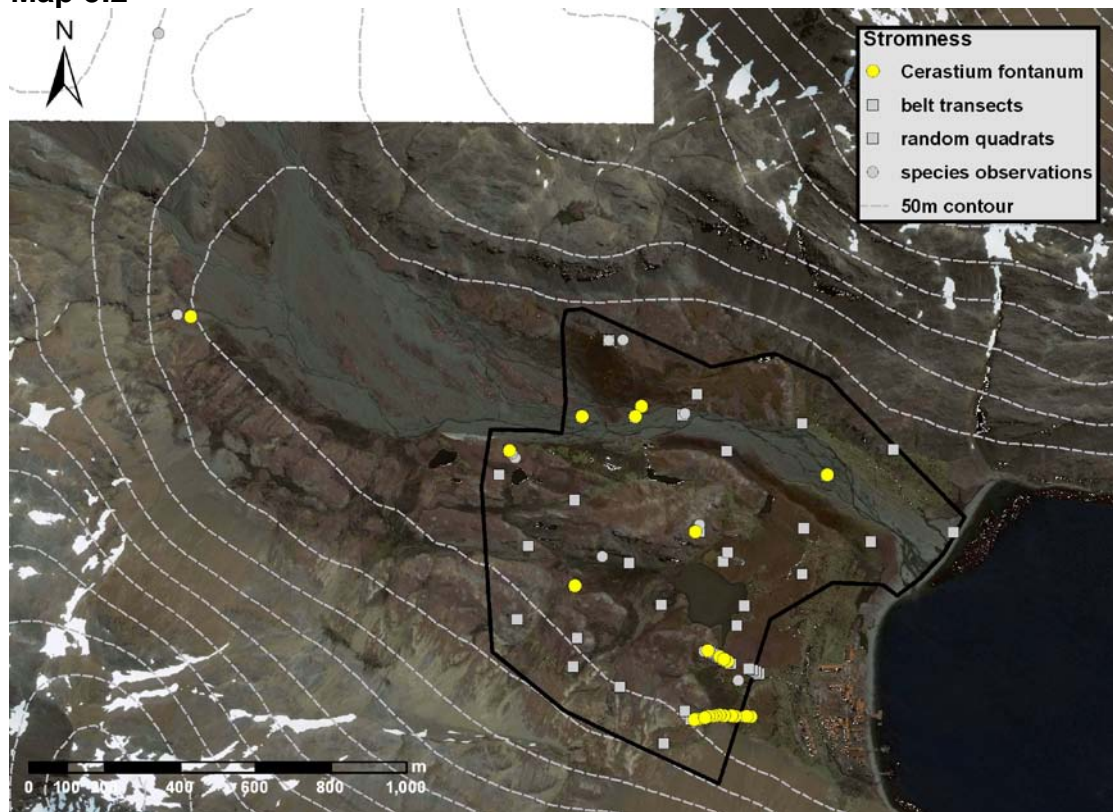
Map source Google Earth

Map 5.1



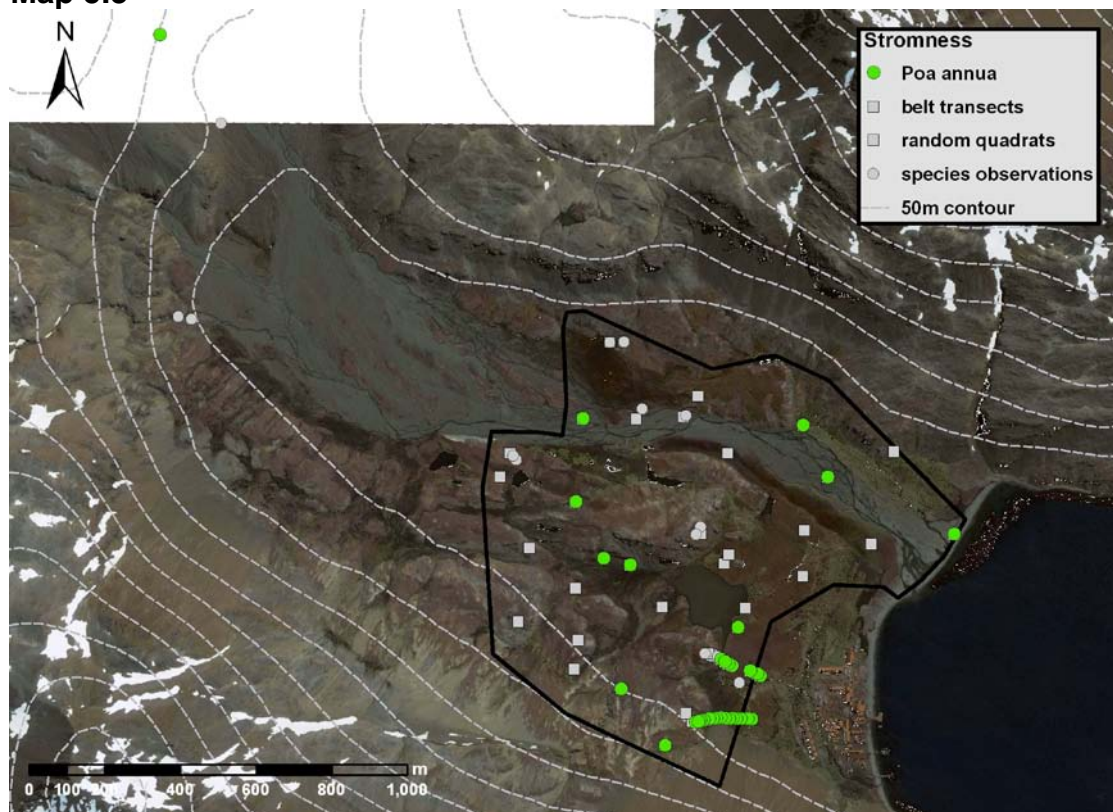
Map source Google Earth

Map 5.2



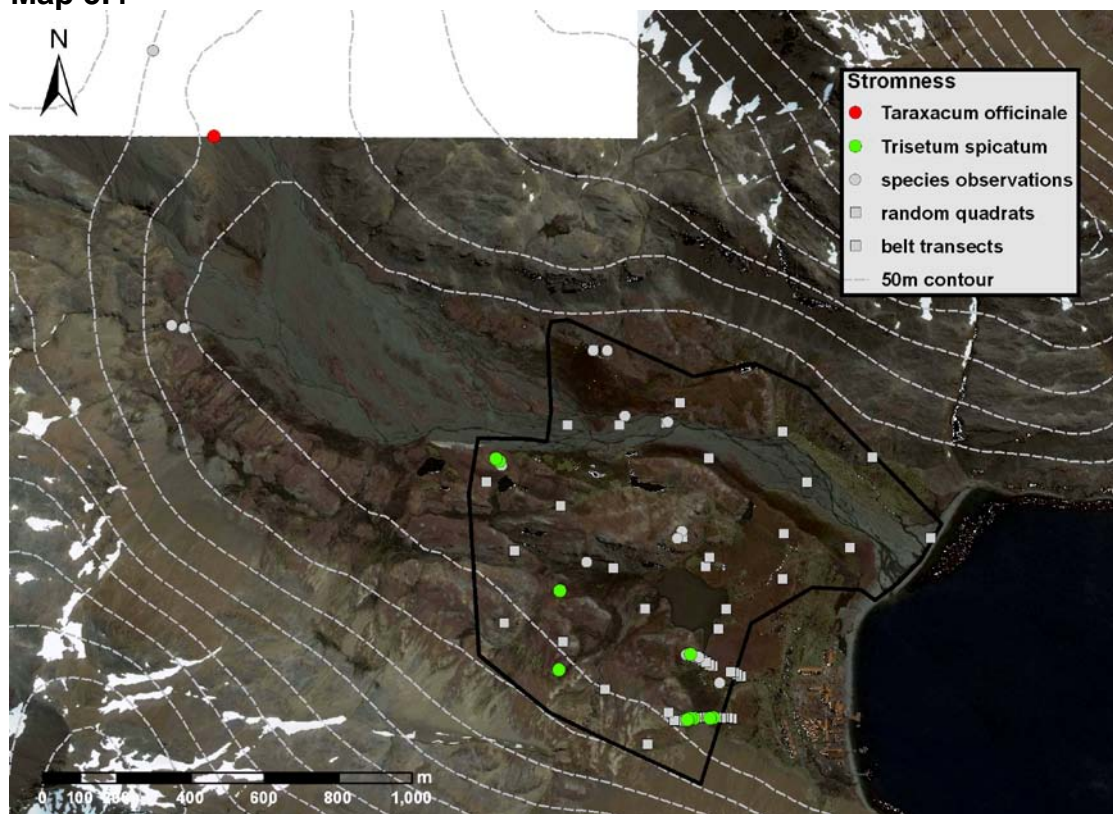
Map source Google Earth

Map 5.3



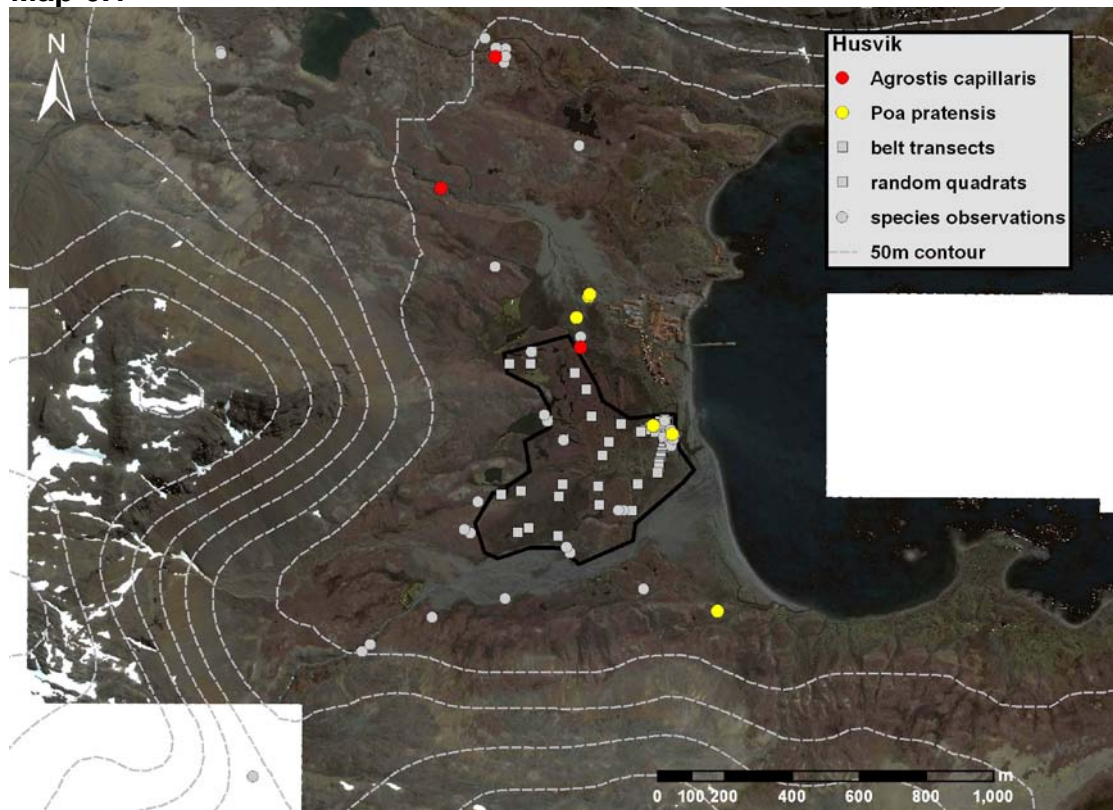
Map source Google Earth

Map 5.4



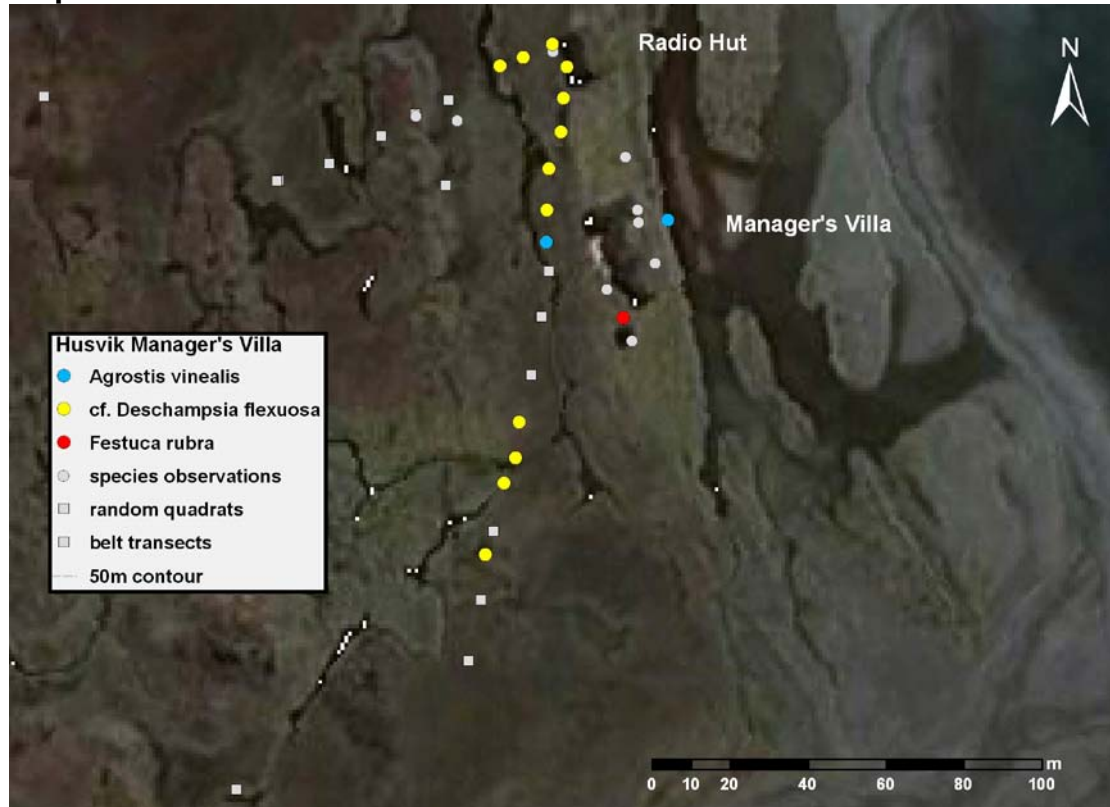
Map source Google Earth

Map 6.1

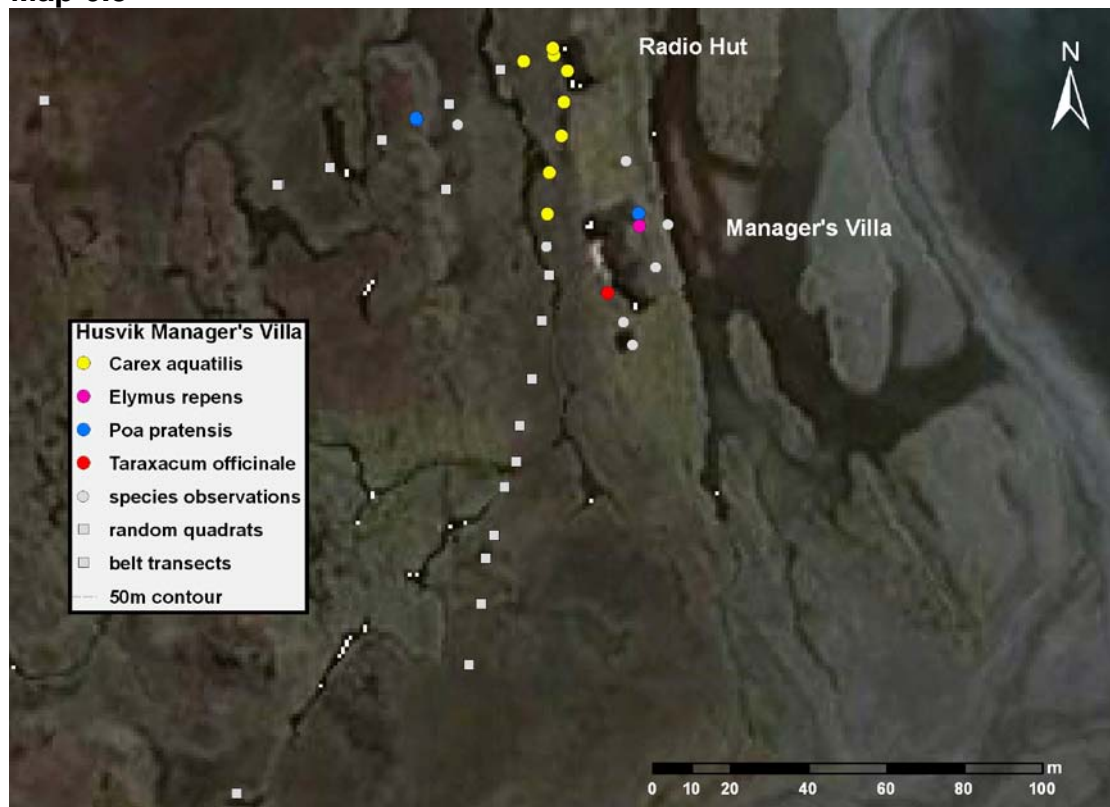


Map source Google Earth

Map 6.2

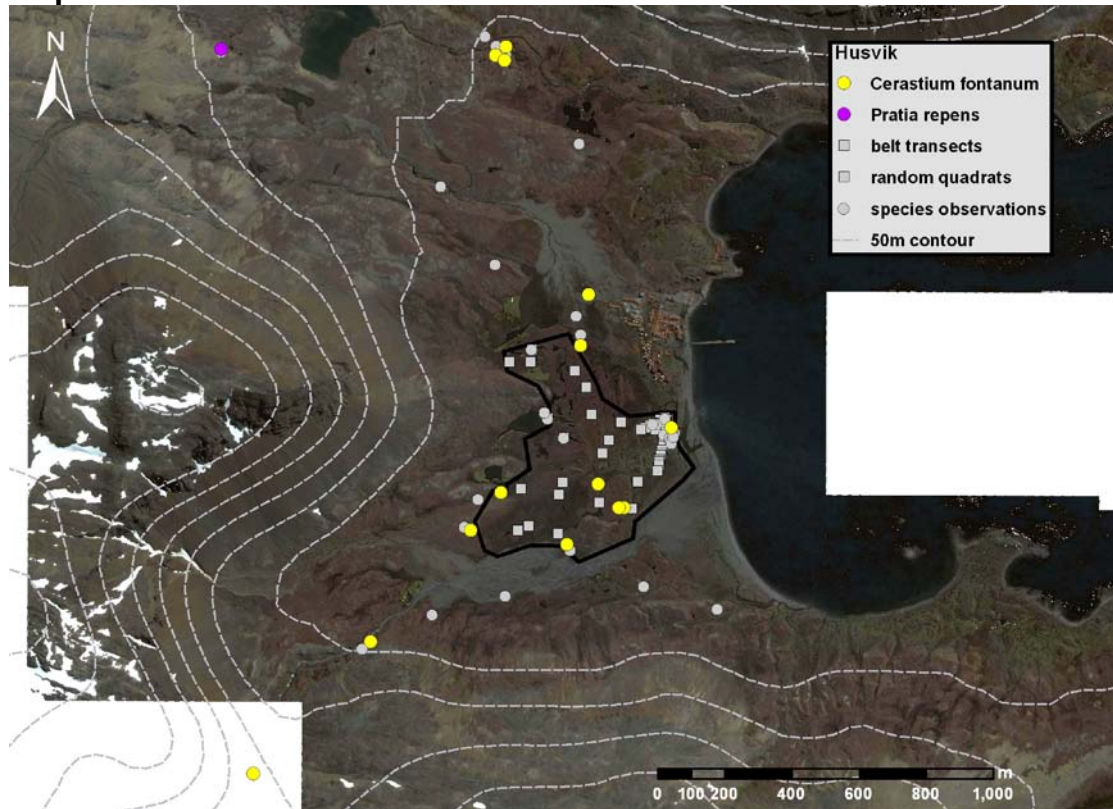


Map 6.3



Please note that further records of *Poa pratensis* and *Taraxacum officinale* can be found on maps 6.1 and 6.6 respectively.

Map 6.4



Map source Google Earth

Map 6.5



Map source Google Earth

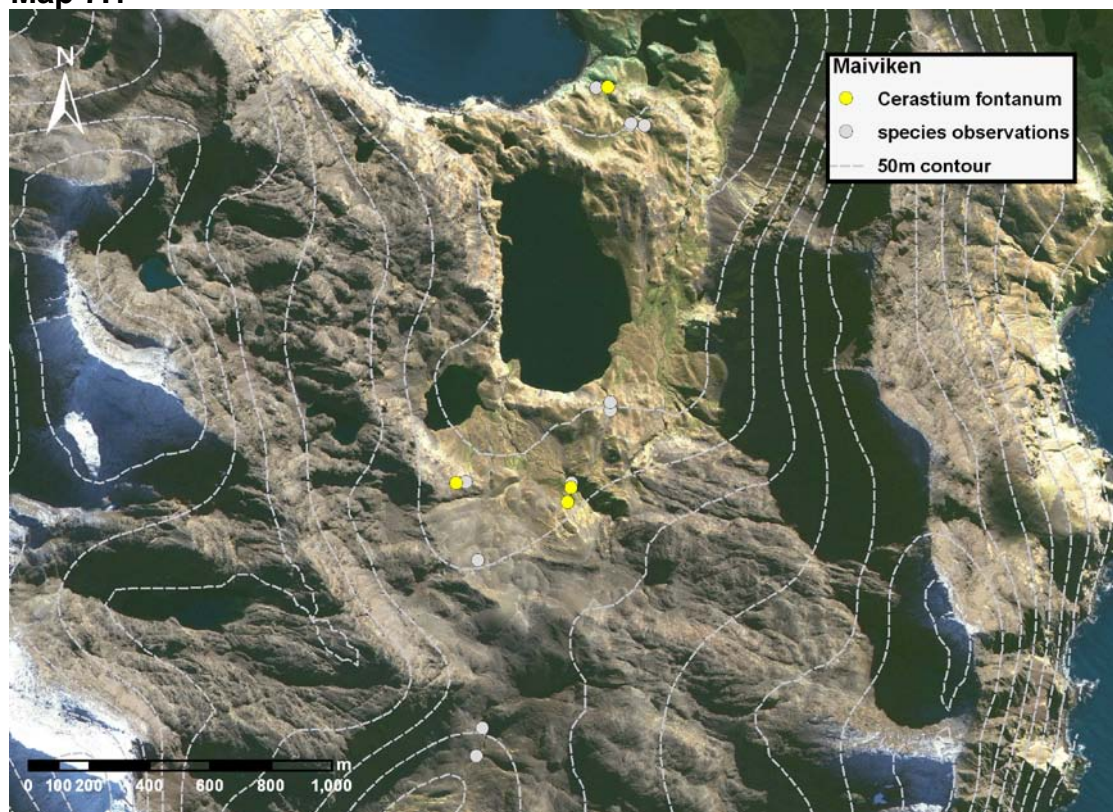


Map 6.6



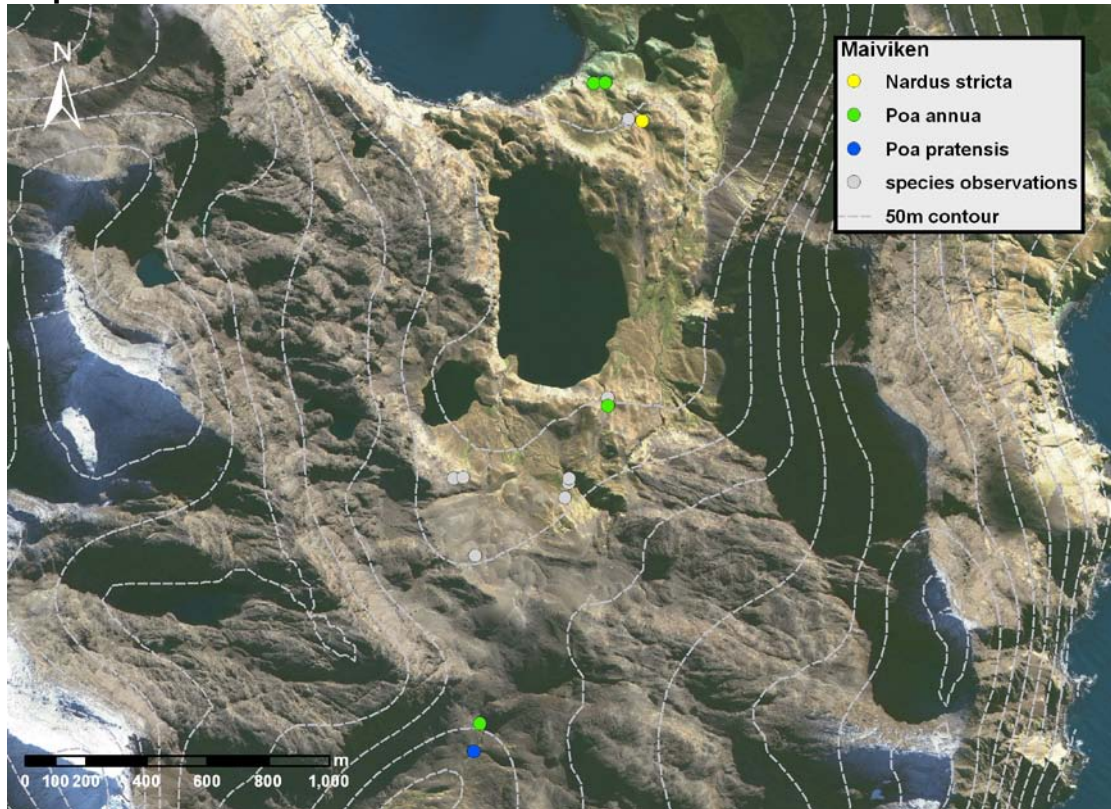
Map source Google Earth

Map 7.1



Map source BAS

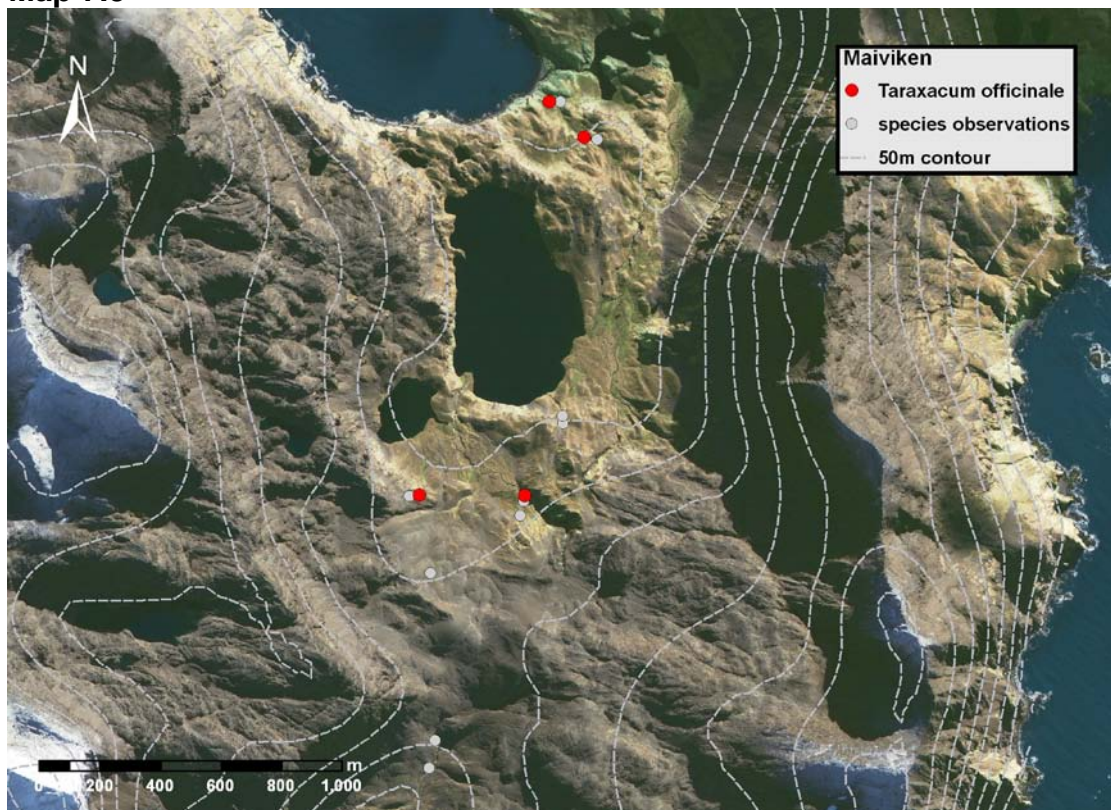
**Map 7.2**



Map source BAS

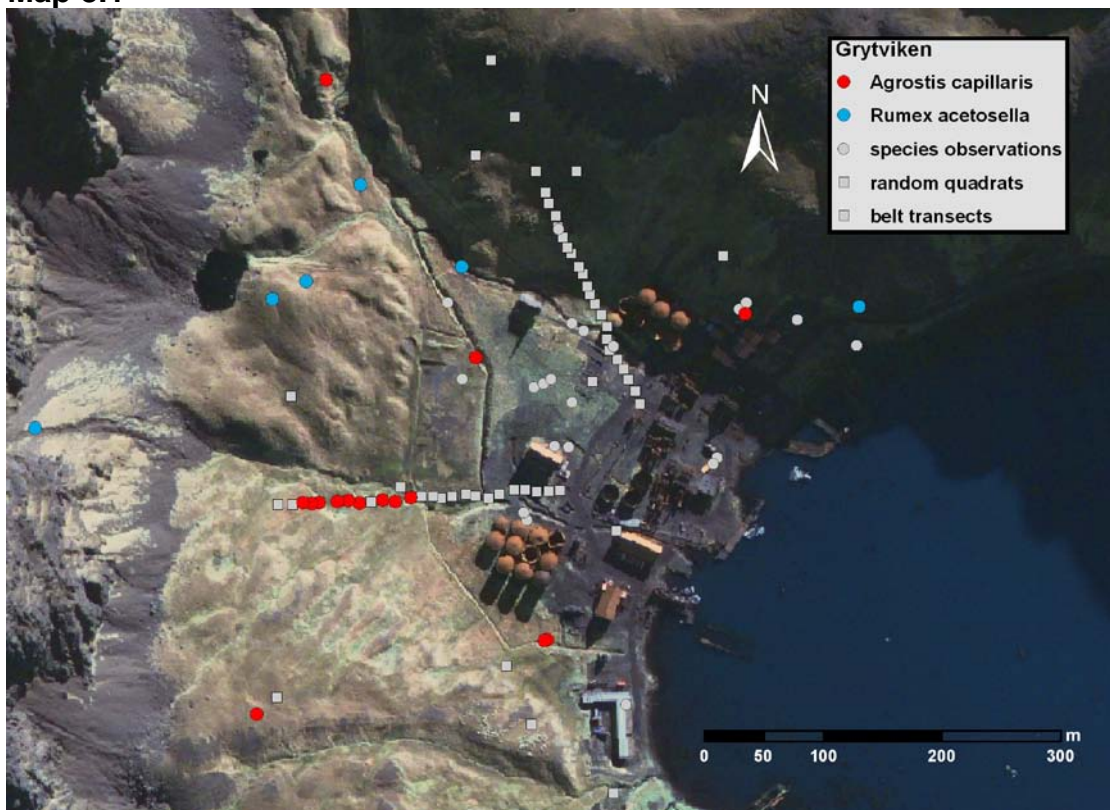
Please note that *Poa pratensis* occurs on the Grytviken side of the saddle and is therefore not considered to be recorded at Maiviken.

**Map 7.3**



Map source BAS

Map 8.1



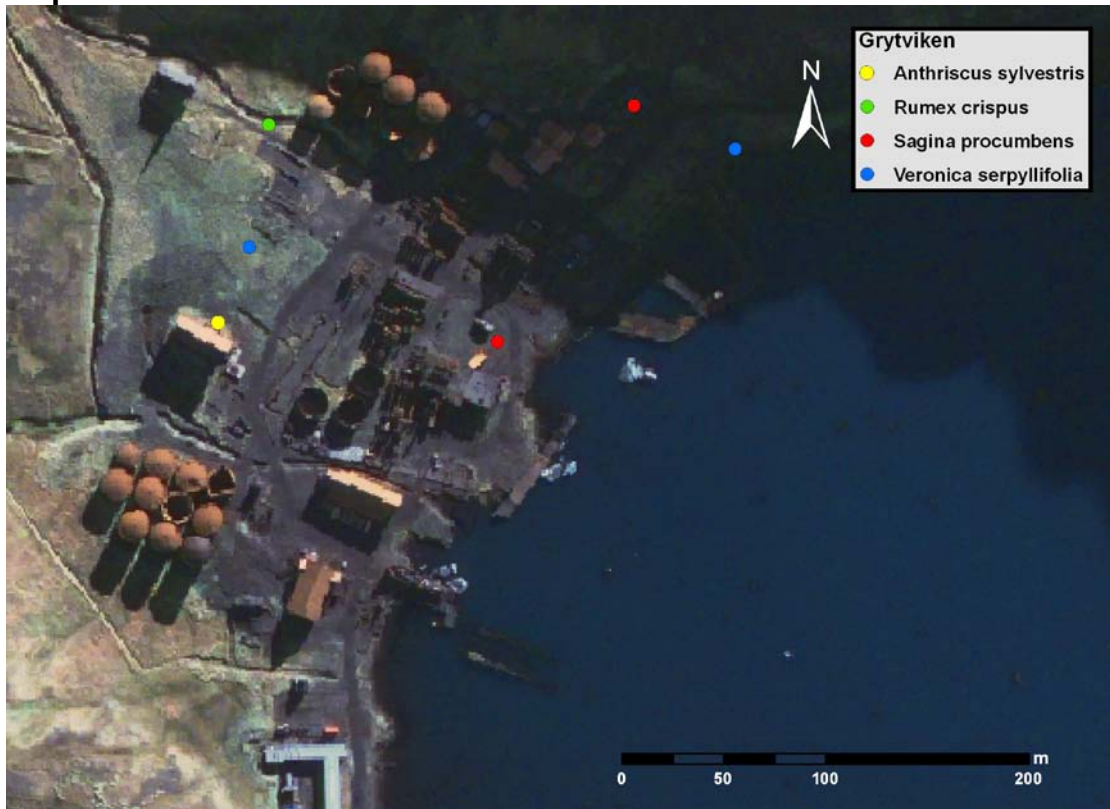
Map source BAS

Map 8.2



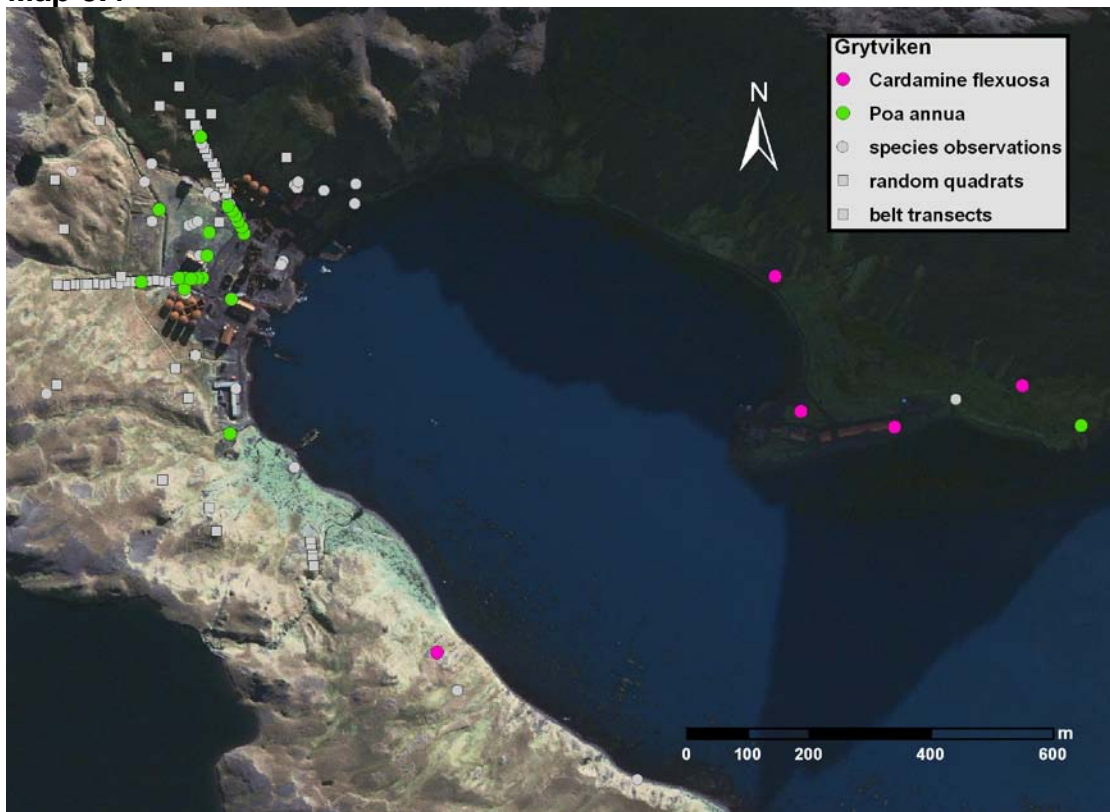
Map source BAS

Map 8.3



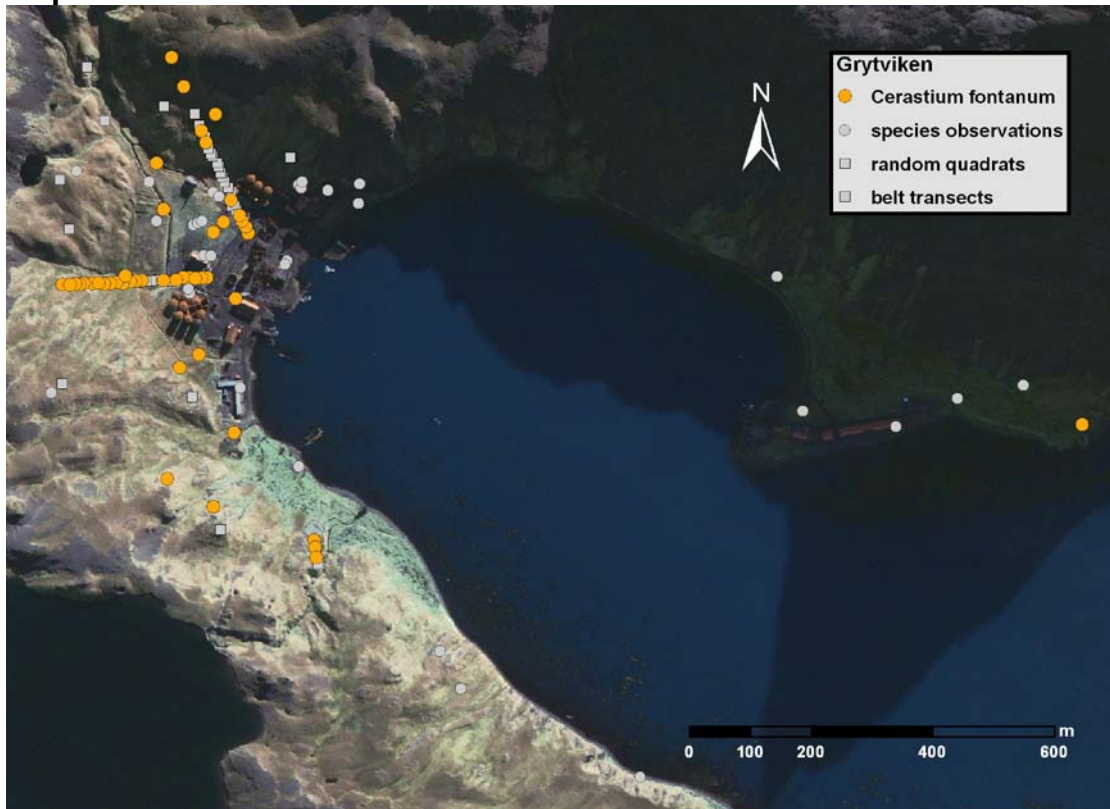
Map source BAS

Map 8.4



Map source BAS

Map 8.5



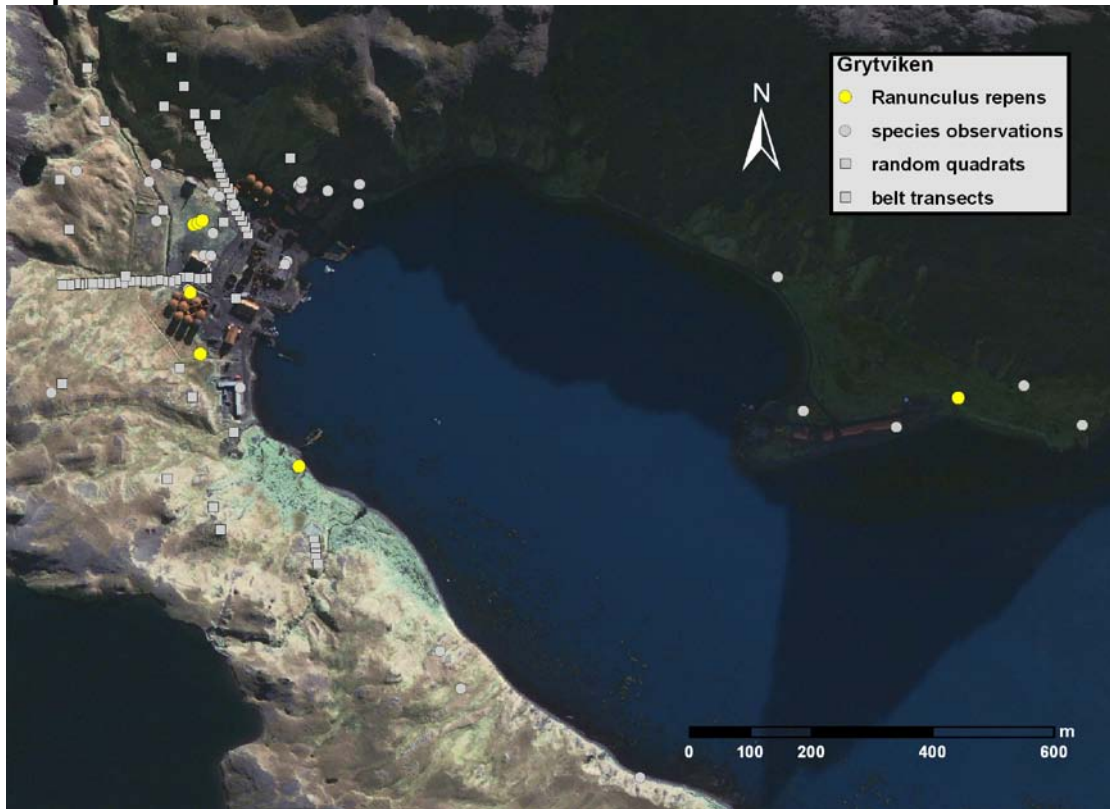
Map source BAS

Map 8.6



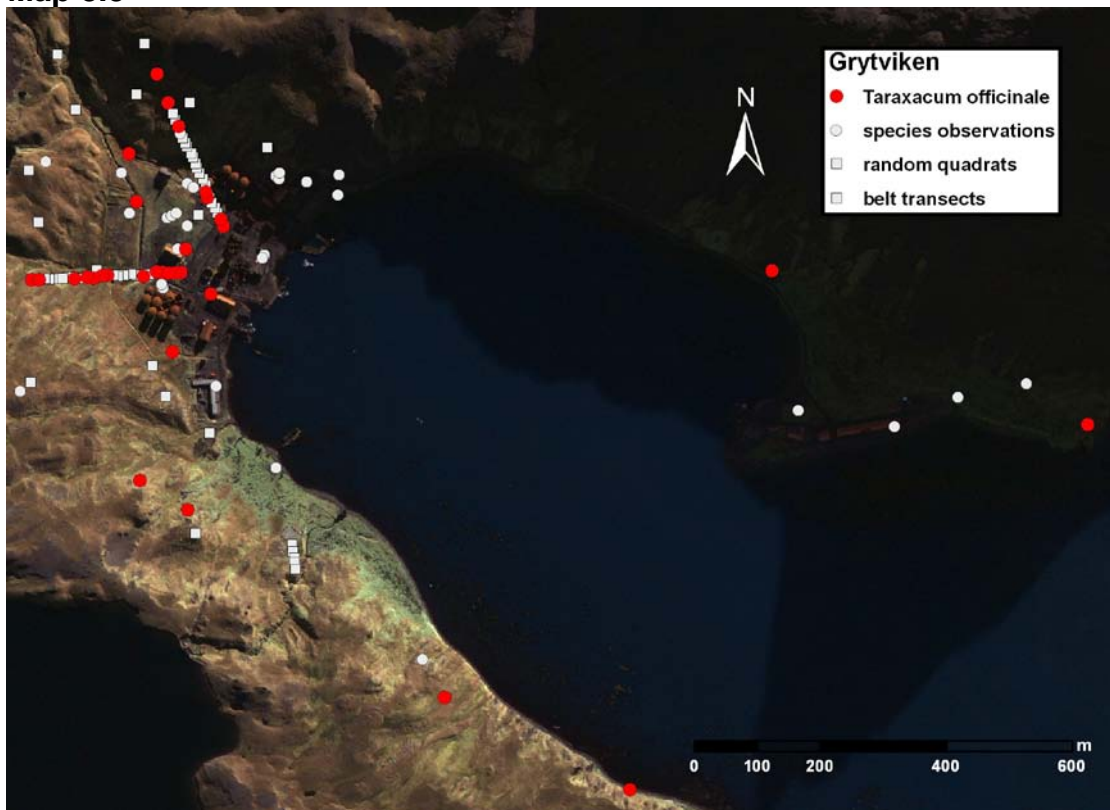
Map source BAS

Map 8.7



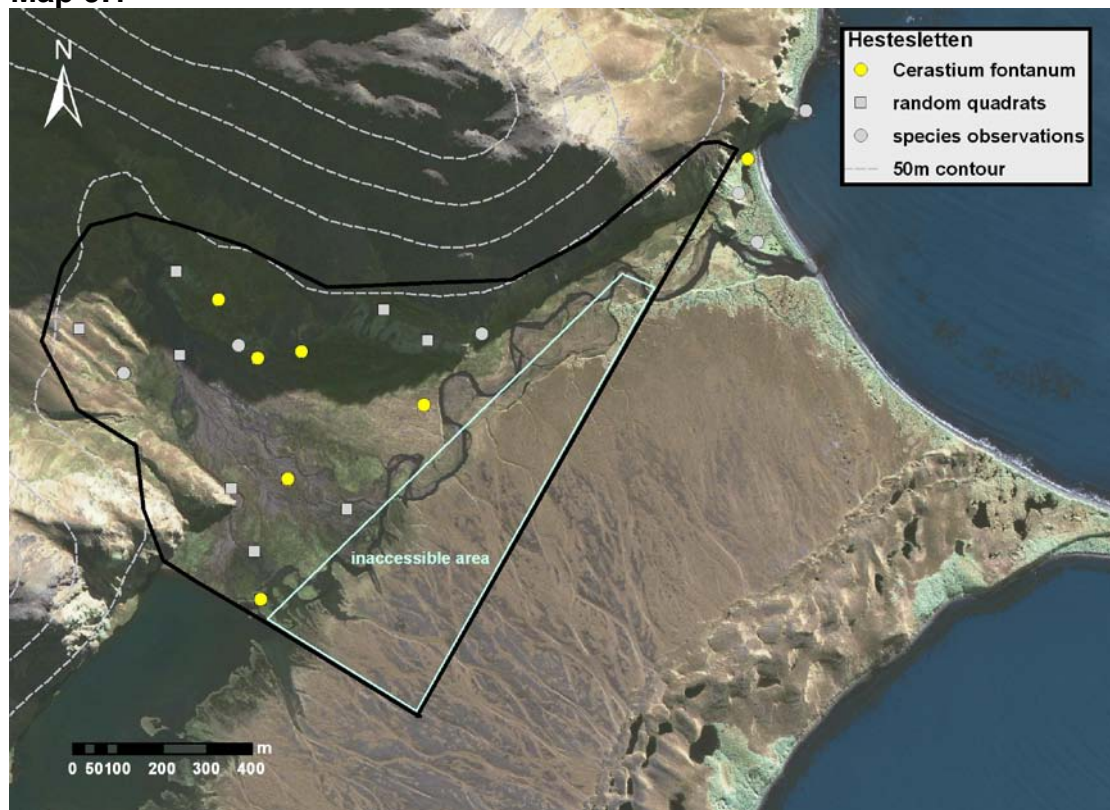
Map source BAS

Map 8.8



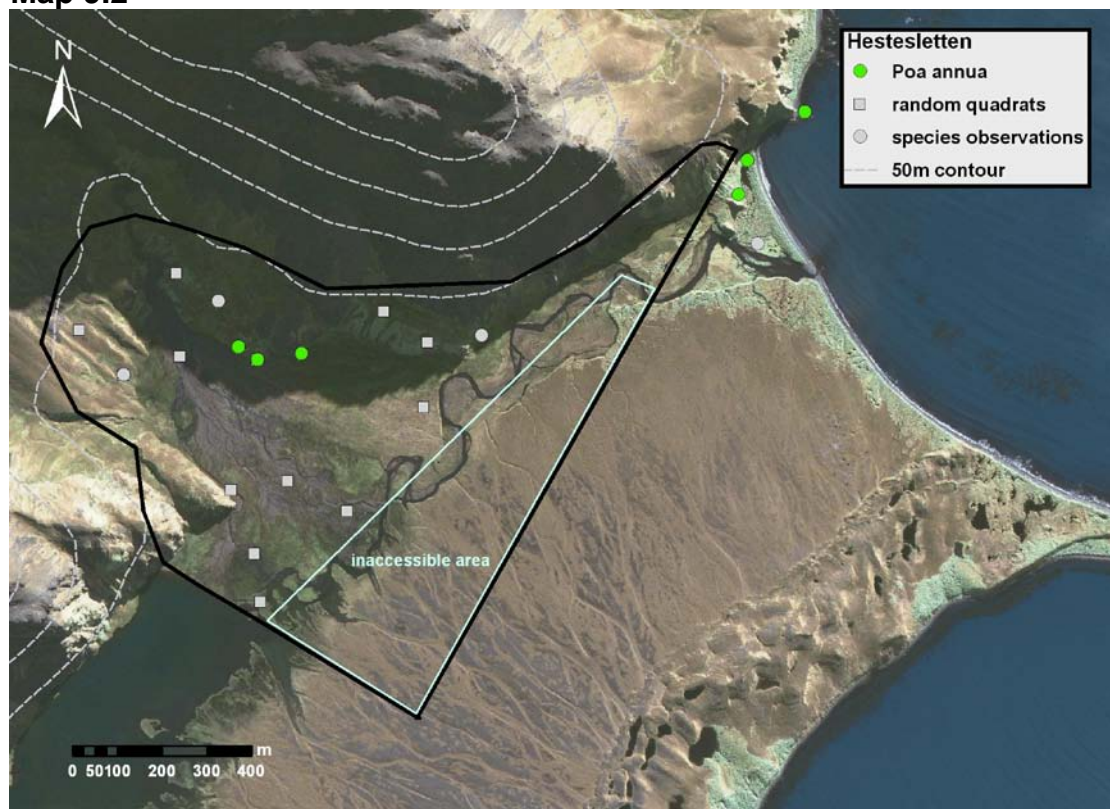
Map source BAS

Map 9.1



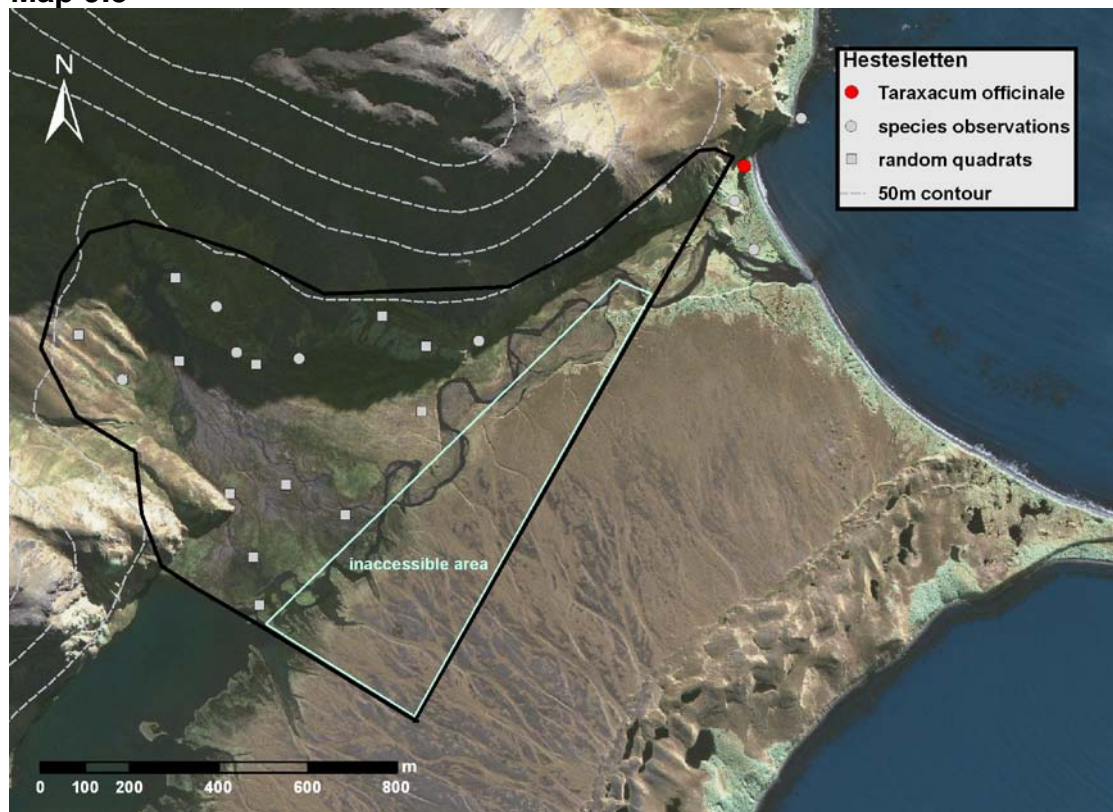
Map source BAS

Map 9.2



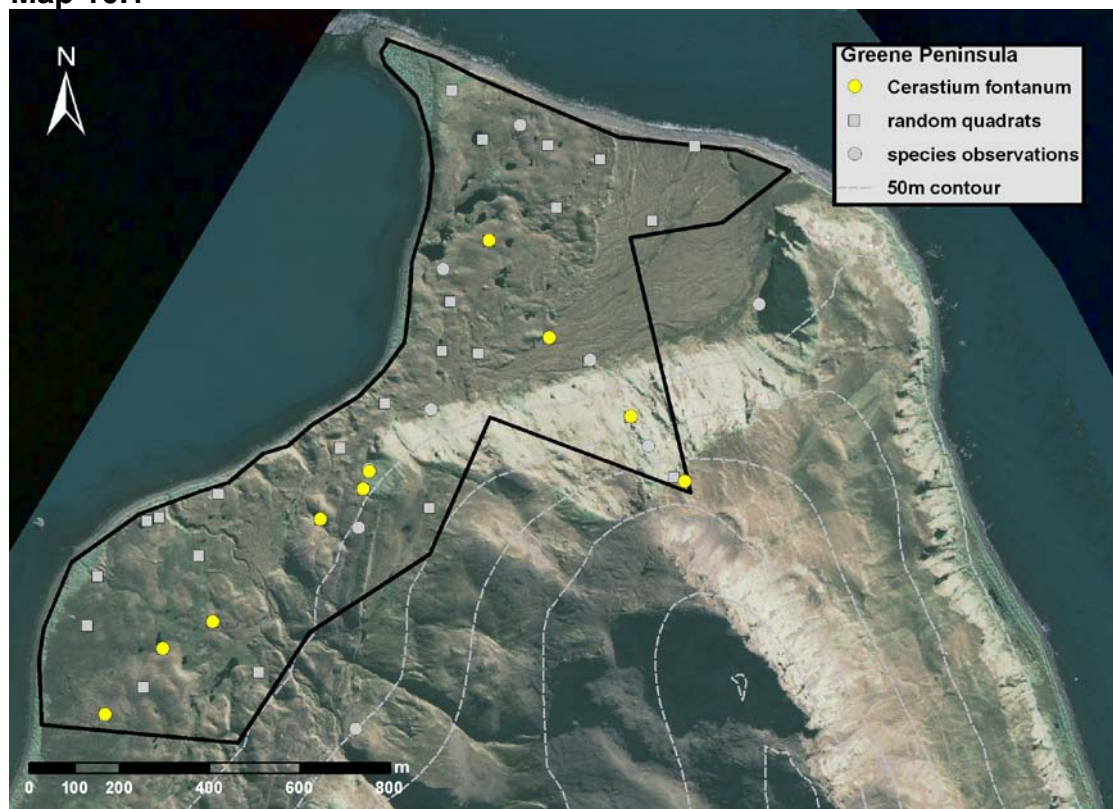
Map source BAS

Map 9.3



Map source BAS

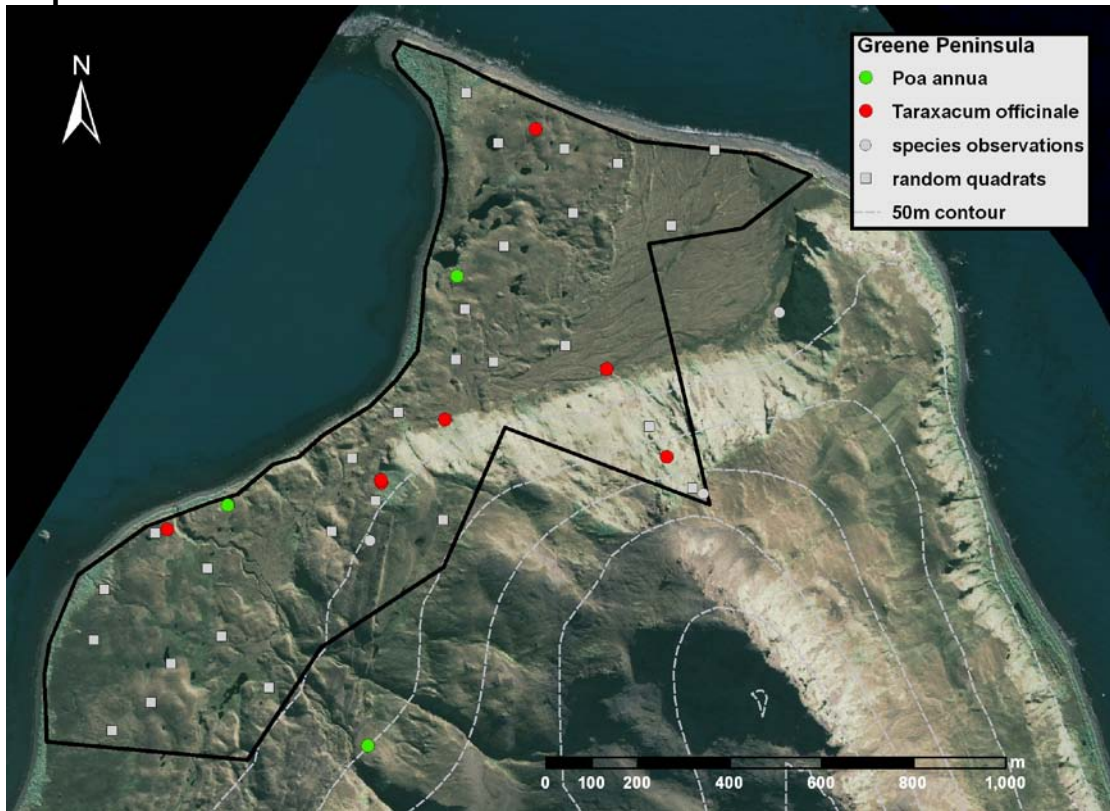
Map 10.1



Map source BAS

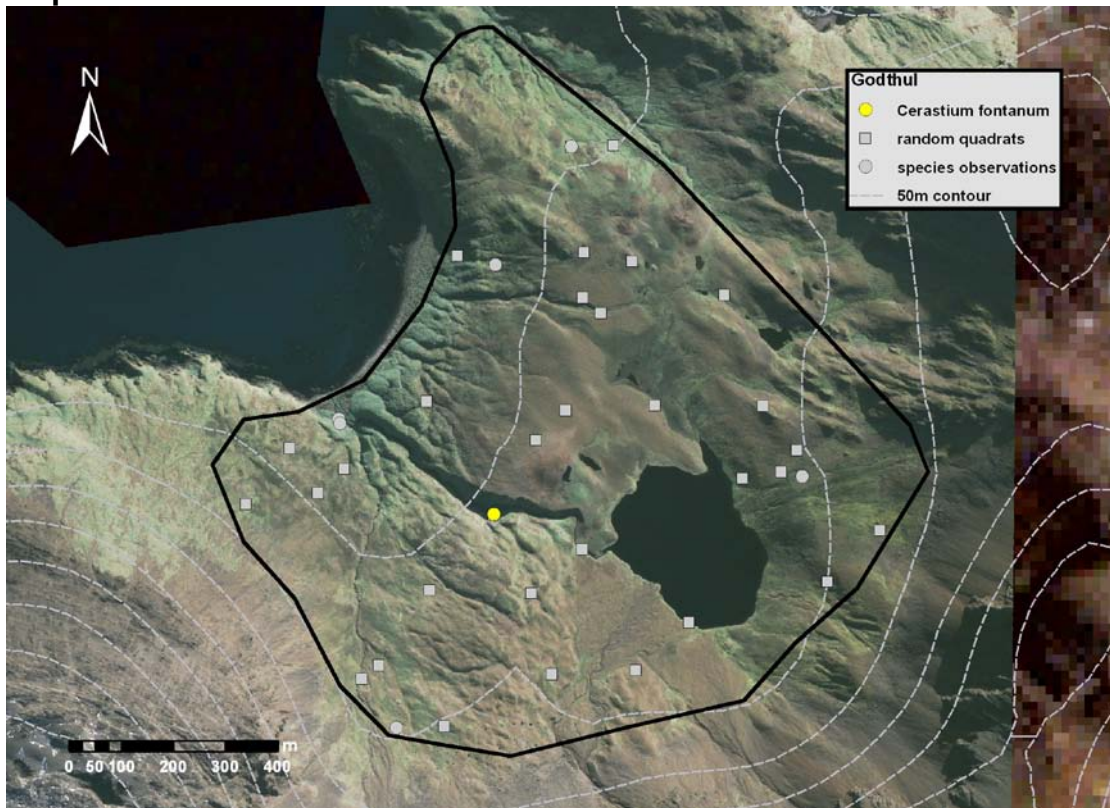


Map 10.2



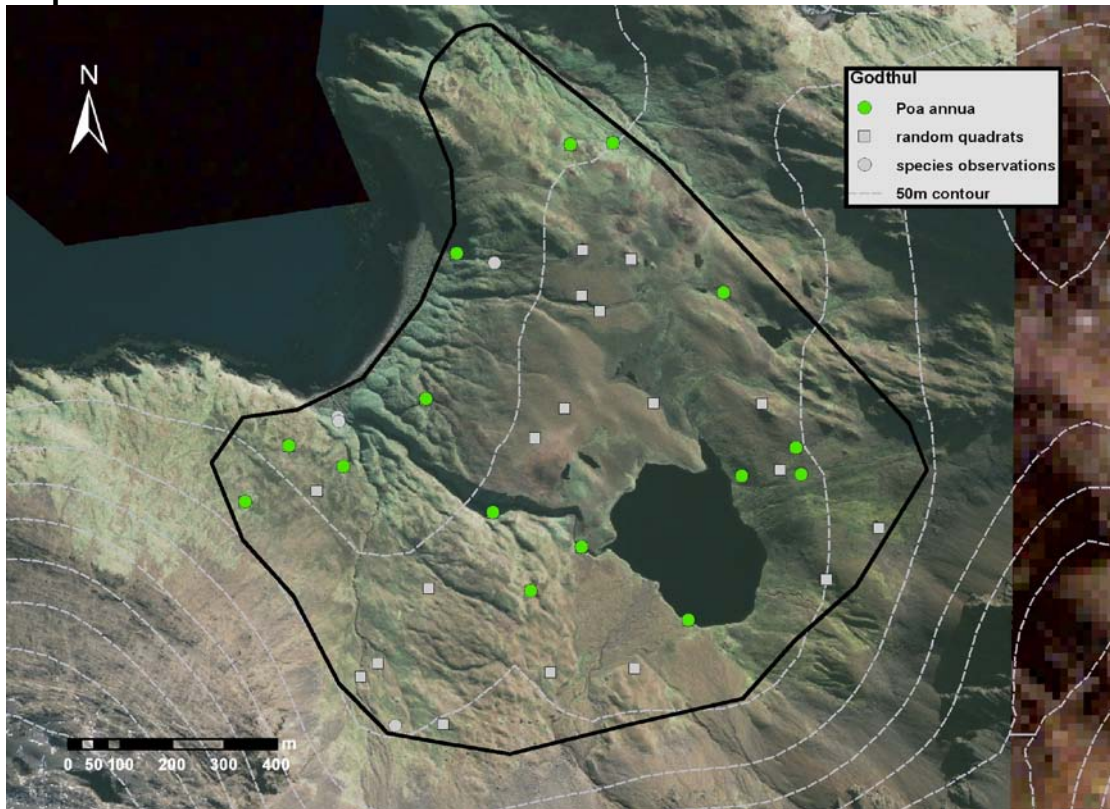
Map source BAS

Map 11.1



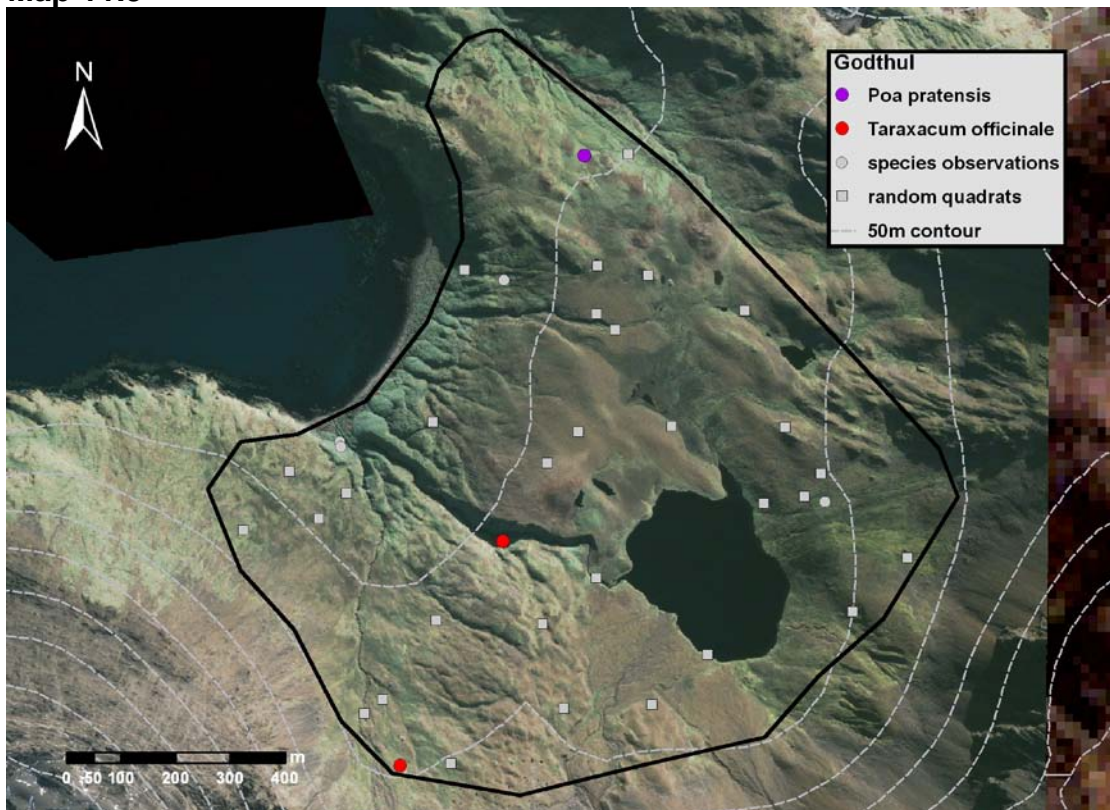
Map source BAS

Map 11.2



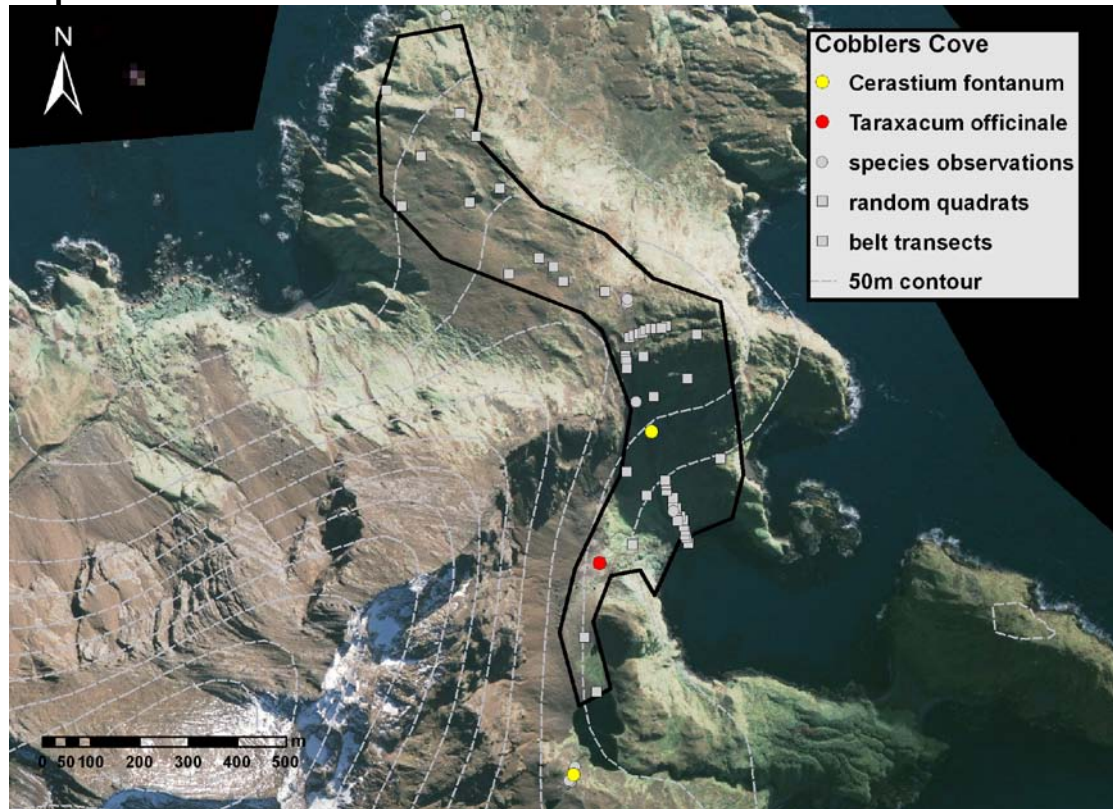
Map source BAS

Map 11.3



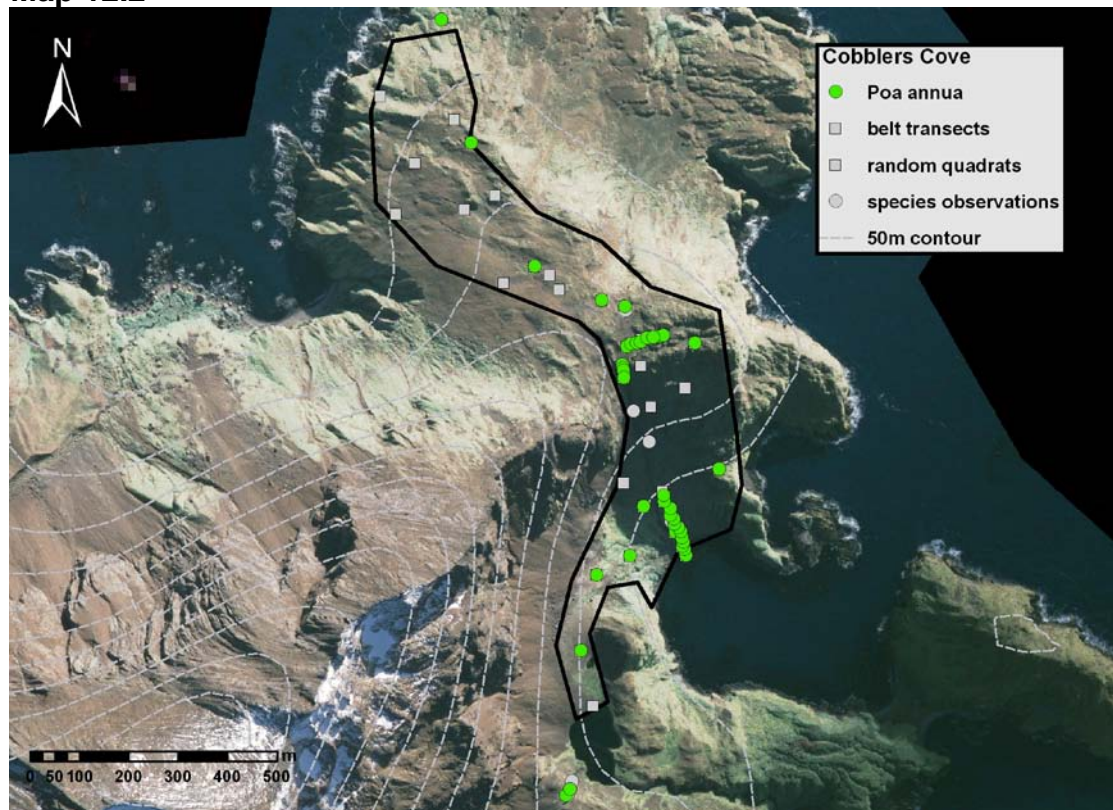
Map source BAS

Map 12.1



Map source BAS

Map 12.2



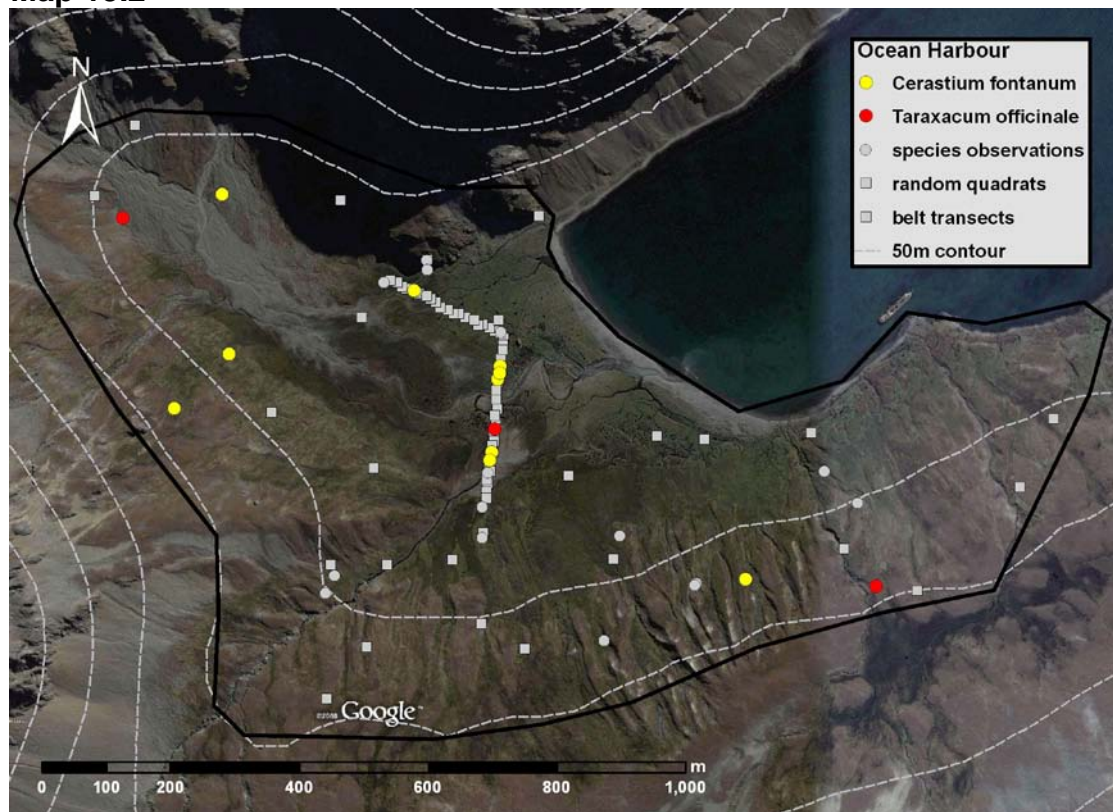
Map source BAS

Map 13.1



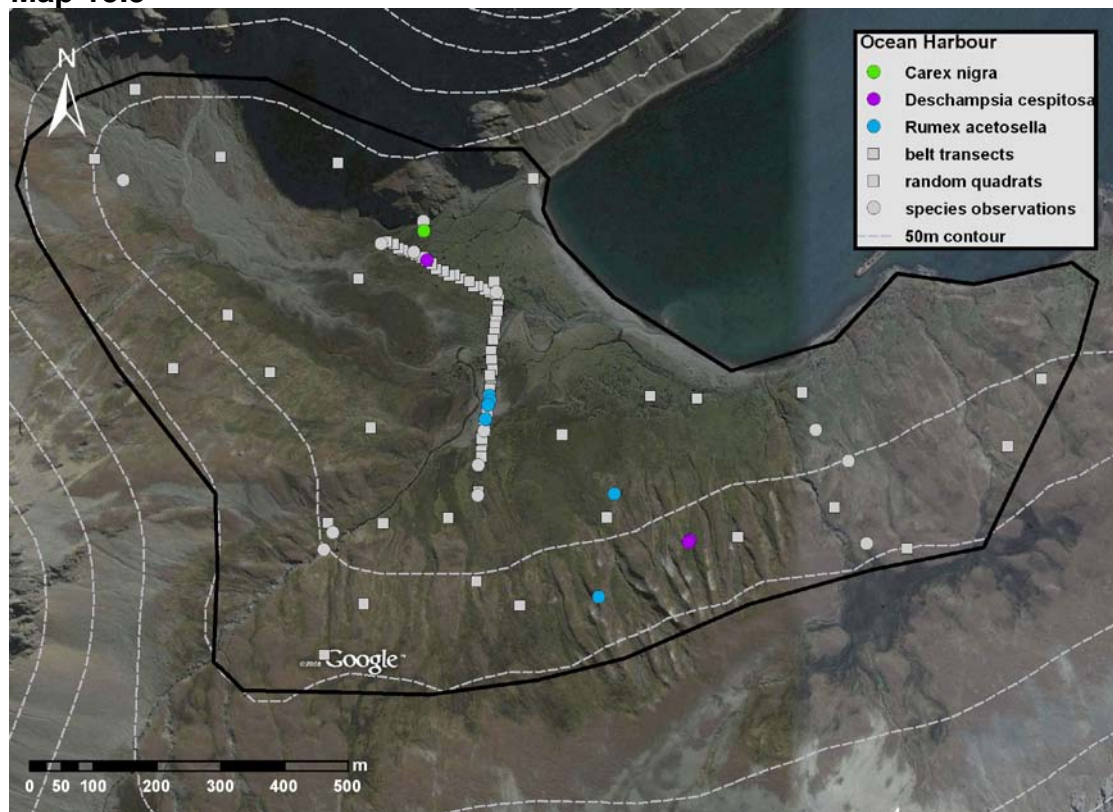
Map source Google Earth

Map 13.2



Map source Google Earth

Map 13.3



Map 13.4

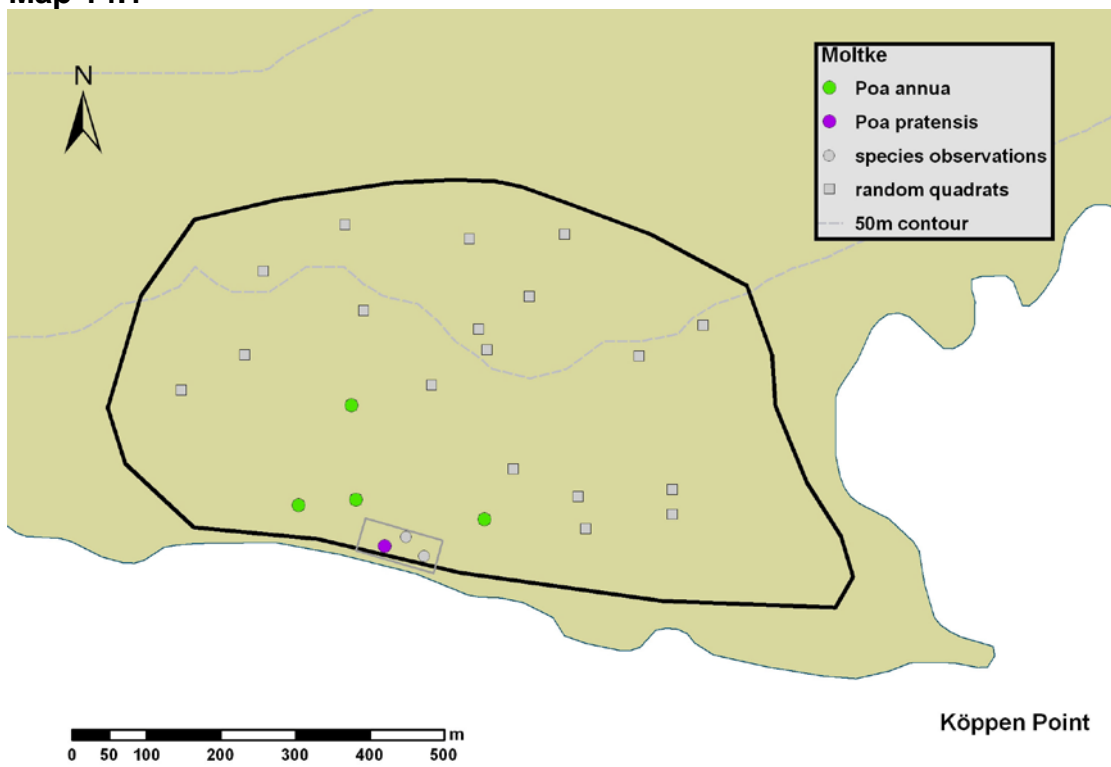


Map 13.5



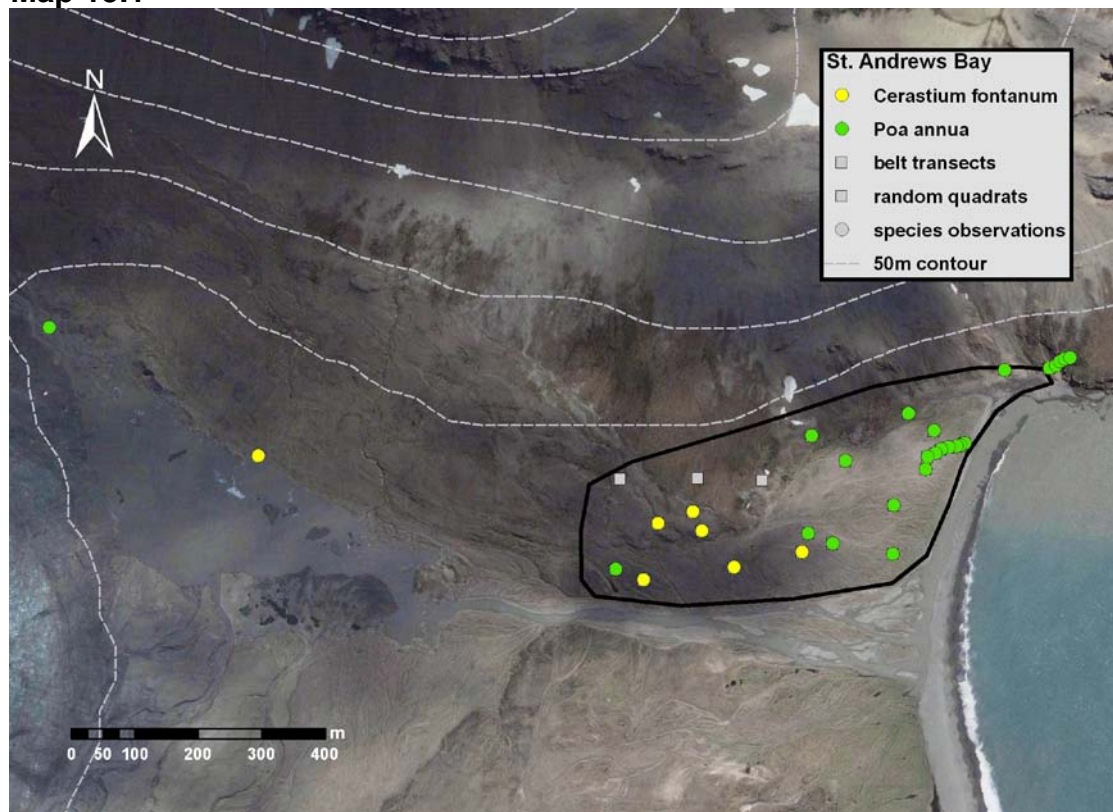
Map source Google Earth

Map 14.1



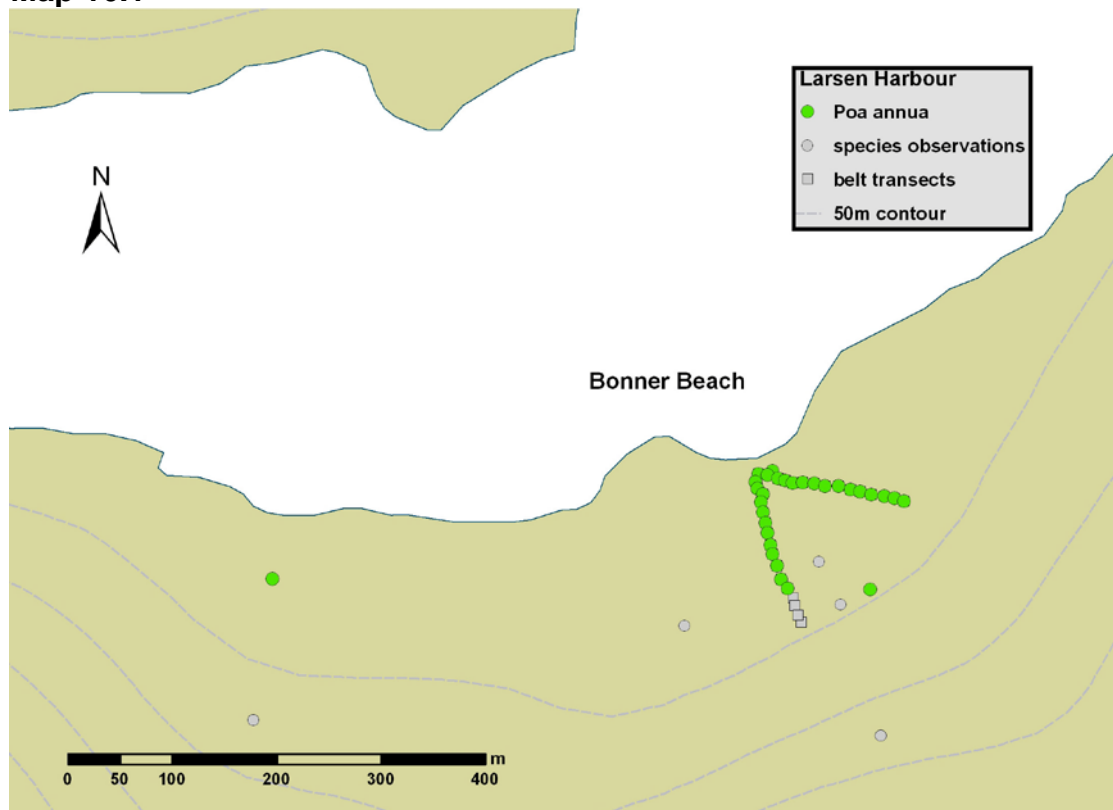
Map source BAS

Map 15.1



Map source Google Earth

Map 16.1



Map source BAS