

New Island Botanical Survey 2010/2011

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Photos: R. Upson



New Island Botanical Survey

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SUMMARY

Situated in the far west of the archipelago, New Island is topographically varied (0-226 m a.s.l.) and supports a range of habitats. Of particular note are the excellent examples of native coastal (saline) grasslands which have formed along the top of exposed west-facing cliffs. In general coastal cushion heath and coastal (saline) grasslands dominate above high, exposed cliffs. In contrast low-lying coastal slopes and inland areas are dominated by improved grassland and dwarf shrub heath.

Past deleterious human activities, such as the burning and overgrazing of native vegetation, combined with the harsh climate have resulted in the exposure of large eroded areas. Coastal Nassauvia *Nassauvia gaudichaudii* is one of the most important native colonizers of bare ground on New Island. Natural colonization is not however happening fast enough across the island as a whole and therefore soil erosion is a significant concern; there is an urgent need for large-scale restoration projects to begin to tackle the problem in an environmentally sensitive way.

73 native (42 % of the Falkland native flora) and 45 introduced vascular plants have now been recorded on New Island. Six of the 14 national endemics are present on New Island: Lady's Slipper *Calceolaria fothergillii*, Clubmoss Cudweed *Chevreulia lycopodioides*, Vanilla Daisy *Leucheria suaveolens*, Coastal Nassauvia *Nassauvia gaudichaudii*, Woolly Ragwort *Senecio littoralis* and Smooth Ragwort *Senecio vaginatus*. In addition there are unusually large populations of the near endemic species Falkland Cudweed *Gamochaeta malvinensis*. One species of orchid, the Yellow Orchid *Gavilea littoralis* is found on New Island and there is also a population of *Calandrinia* cf. *axilliflora*. The latter species is most likely native and may be endemic however its status is currently uncertain and awaits further taxonomic research.

As a study site for recovery of native plant communities after removal of grazing New Island is extremely valuable. Without grazing livestock, native plants, including coastal grass species such as Fuegian Couch *Elymus magellanica* and Tussac *Poa flabellata*, are expanding their cover. At present New Island does not, however, qualify as an international Important Plant Area. This is primarily because there are no significant populations of threatened plant species present or extensive areas covered by threatened habitats. Over time, a substantial expansion in the extent of recovering Bluegrass coastal grassland and Boxwood scrub would increase the value of New Island from a national and international plant conservation perspective.

Yorkshire Fog *Holcus lanatus* is the introduced species which has most impacted on the plant community structure of the Island as a whole, having been extensively spread over the Island by air between 1949 and 1970. There are now, however, large areas of die-back, both natural and as a result of attack by the larvae of a native weevil. The invasive species of most concern at the time of surveying was Gorse *Ulex europaeus*. Removal of outliers away from the main settlement is advised where possible. Marram grass *Ammophila arenaria* has also been planted extensively on eroded sandy sites across the Island and now covers large areas. Any control of the latter species is not advised in the short term and if attempted would need to be followed up immediately with careful re-vegetation of these particularly erosion-prone sites.

SURVEY AIMS

The aim of this survey is to provide baseline information on the current status of the vascular plants and the communities they form on New Island.

METHODS

Field mapping method

Aids to field mapping were as follows:

1. No complete aerial imagery of New Island was available prior to this project (Ian Strange pers. com.), however GoogleEarth imagery was available from 2004. This covered the whole island except for sections of the South End which were obscured by cloud. GoogleEarth imagery printed out on A4 sheets
2. The DOS map with 50 ft contours and geomorphological features marked.
3. One hand-held personal digital assistant (PDA) (Fujitsu-Siemens LOOX N560) with an in-built Global Positioning System (GPS) used to record survey data in the field. Polygon map produced from GoogleEarth imagery and loaded onto PDA – habitat units distinguished by visually assessed differences in colour.

The vegetation field mapping method was as follows:

1. Climb to a high point which gives good visibility of the area to be mapped. Compare view with printed GoogleEarth image and check the appropriateness of currently mapped 'habitat polygons'. Plant communities were distinguished by visually assessed differences in colour.
2. Choose a walking route through the area in order to cover all polygons in previously produced map. Take 5 m² vegetation assessment points (VAPs) within representative communities as well as target notes for un-mappable but interesting communities (e.g. marginal vegetation). The rationale was that a large area of each survey site could be covered. A digital photograph of each quadrat was taken from the centre of one side, depending on terrain.
3. Walk the pre-determined route with PDA, carrying out general searching and recording along the way, checking habitat types and plant communities. Walking around the survey sites provides an opportunity to record species falling outside of the VAPs. This latter method was particularly aimed at species with restricted distributions where small populations may have been present, but did not occur within the VAPs. Widespread species that fell within VAPs were not exhaustively recorded outside.
4. Return to initial viewpoint, and note any additions/ alterations to the original polygon map. Detailed shapes of the plant communities/map units were completed back at the office with a combination of any vertical airphotos that could be opportunistically taken during inward and outward bound helicopter flights (see below) and the GoogleEarth images. Take appropriate panoramic photos at GPSed locations with target notes (TNs) based on day's survey.

A series of digital images were taken out of the helicopter upon approach to the Island. There was only time available to cover the area of the island south of Rookery Hill. Weather conditions prevented a similar series of photos being taken of

the northern part of the island and this was also not possible later in the season (Ian and Georgina Strange pers. com.).

Vegetation assessment points (VAPs)

Standardized recording sheets were used to provide geo-referenced target notes on the vegetation of New Island. These representative locations were chosen based on the patterned arrangement of species over the ground and any vertical layering (JNCC, 2006). The target notes included a description of the plants present, their relative abundance in the community, aspect, soil, disturbance level etc and any general observations on habitat condition (Hamilton, 2008). Where possible a photograph was taken at each recording site (images stored on Falklands Conservation photodatabase) and on selected sites panoramic views were photographed (see vegetation transect report). Relative abundance was estimated using % ground cover (to the nearest 5 %; JNCC, 2006) for at least 3 examples of each of the dominant habitat types and for 46 quadrats in total.

323 further detailed vegetation notes were made using the same standardized recording sheets (including photographs of each site) but with community composition described using the DACFOR scale (Dominant, Abundant, Common, Frequent, Occasional, Rare) of abundance. Although a qualitative measure of abundance this method was used for the majority of assessment points to enable greater ground coverage of the survey in the limited time available and therefore better habitat mapping capability. These data could then also be combined with the former to produce species frequency tables for the different habitat types.

725 rapid geo-referenced vegetation assessments were also made to aid mapping by noting the habitat type in the given location and the dominant components of the vegetation within a stated survey plot. Photo records were not made for these rapid assessments unless there was a noteworthy feature.

Habitat types were identified in accordance with the updated habitat classification for the Falkland Islands (Upson and Broughton, unpublished).

Where the identification of plant species was uncertain, samples were collected and dried for later identification (unless it was suspected that these were rare species in which case only photographs and detailed notes were taken).

Species assessment points (SAPS)

As for VAPs, standardized recording sheets were used to provide geo-referenced target notes on individual populations of any rare or threatened species occurring on New Island. In addition to recording the same basic site data as described above, standardized data were gathered on habit, flowering, fruiting and where possible on the number of mature individuals and any signs of recruitment.

See Appendix 1 for a summary of the Important Plant Area (IPA) selection criteria.

OVERVIEW

125 vascular plant species have been recorded on New Island since the first botanist, G.H. Snyder, visited the Island in 1852 (Appendix 2). Of these, three records are now thought to be erroneous (Andean Pearlwort *Colobanthus quitensis*, Whitegrass *Cortaderia pilosa*, Brown Rush *Rostkovia magellanica*), one to have gone extinct (Snakeplant *Nassauvia serpens*) and three misidentifications (Spiked Cudweed *Gamochaeta spiciformis*, Ladle-leaved Buttercup *Ranunculus trullifolius*, Sticky Groundsel *Senecio viscosus*). Full garden surveys were not carried out during the current survey and therefore further introduced species are likely to be present on the island.

21 new records were made during the current survey; 11 native species, 10 introduced species. Prior to the current survey, botanical records existed for 15 of the 47 1 km grid squares across which New Island occurs (Figure 1). The current survey has visited 42 1 km grid squares with those missed being inaccessible owing to difficult terrain (Figure 1). Moss, liverwort and lichen samples have also been sent away for identification and will no doubt shed further light on the ecology of New Island.

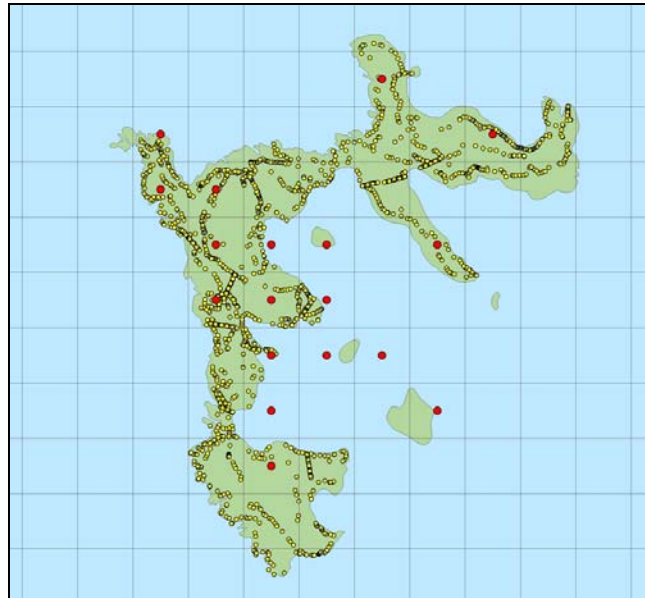


Figure 1: DOS map of New Island showing previously surveyed 1km grid squares (red) and data points collected during the current survey (yellow).

Whitegrass *Cortaderia pilosa* is one of the most abundant native grasses in the Falklands, although interestingly it is not present on New Island. It is likely that it has never formed a significant component of the vegetation on the Island as it was not recorded by Snyder in 1852. New Island appears to hold particularly large subpopulations of the near endemic Falkland Cudweed *Gamochaeta malvinensis* and the native Falkland Strawberry *Rubus geoides*. This trend cannot currently be explained and awaits more in-depth analyses into determinates of species distributions across the Falkland Islands.

New Island has a low annual rainfall; the average rainfall between 1998 and 2006 was 454 mm (NICT report, 2007). Amongst other things, this will most likely decrease the rate of recovery of vegetation after removal of grazing.

NATIONALLY THREATENED HABITATS

The list of globally threatened habitats found in the Falkland Islands must be considered preliminary at this stage as it is based on our current limited knowledge of the extent of these habitat types both nationally and regionally (Upson, 2011a). Individual species have to date received more attention than particular habitats because of the greater knowledge base we have in this area. Two globally threatened habitats occurring/ in recovery on New Island are Bluegrass grasslands and Native Boxwood scrub (Upson, 2011a).

Bluegrass was assessed by Hooker (1847) as being 'most abundant' whereas over 60 years later, Skottsberg (1913) states that he found this species only once – 'West Falkland Fox Island, among rocks near the shore.' It is clear from such early records and present day survey data on several un-grazed areas that the introduction of livestock has had a great impact on the extent of Bluegrass-dominated grasslands (Upson, 2011a). On New Island stands of Bluegrass grassland are recovering at several sites - due west of the settlement above cliffs (Figure 2), on the south side of Cliff Peak above cliffs and at the south end of Grand Cliff, again above steep west-facing cliffs (Figure 3).



Figure 2: Recovering Bluegrass grassland north of Cliff Peak, VAP190.

Native Boxwood is recovering on the south-facing coastal slope of Rookery Hill above Barnard's Cove (Figure 3). Boxwood scrub is a nationally threatened habitat so as this stand expands it may become important. The lichen community found on the bark of Native Boxwood may also be important within the Falklands (A. Orange pers. comm.) and samples from the stand on New Island have been sent away for identification. In terms of the overall distribution of the Native Boxwood on New Island, a single shrub also grows in the south of the settlement within a stone wall. There is a further record of Native Boxwood within Pond Paddock but this was not relocated during the current survey.

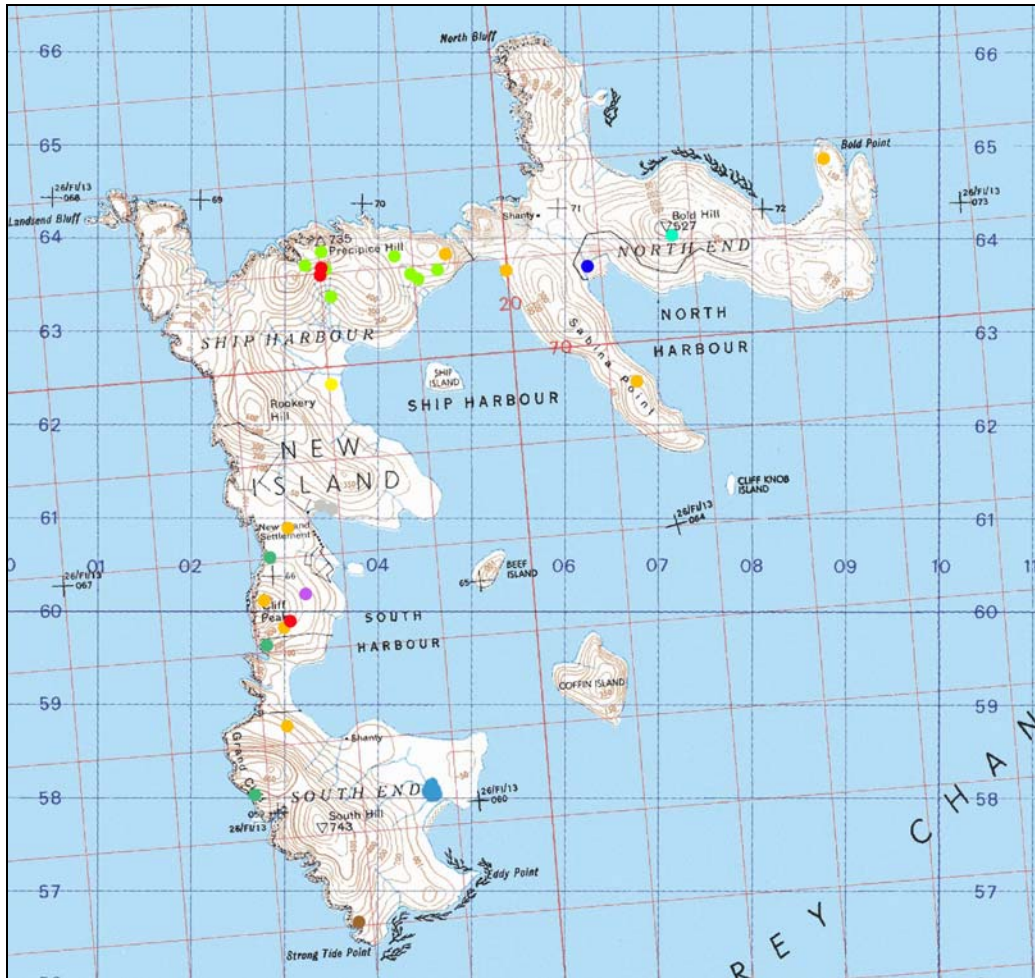


Figure 3: DOS map of New Island with coloured dots showing the locations of nationally threatened habitats, Bluegrass coastal grassland (teal) and Boxwood scrub (grey). Also shown are populations of Falkland endemic species *Calceolaria fothergillii* (orange), *Chevreulia lycopodioides* (yellow, R. Woods unpublished data), *Leucheria suaveolens* (red), *Senecio littoralis* (turquoise) and *Senecio vaginatus* (lime green). New Island populations of two species with uncertain taxonomic status, *Calandrinia* cf. *axilliflora* (navy blue) and *Plantago* cf. *moorei* (brown) are also indicated. Populations of the endemic *Nassauvia gaudichaudii* are not shown as this species is widespread across New Island.

DISTRIBUTION DATA FOR THREATENED AND PROTECTED SPECIES

Calandrinia cf. *axilliflora* is a rare species within the Falklands with uncertain taxonomic status. The ribosomal and chloroplast DNA data regarding this species are conflicting, with one possible explanation being that the species is in fact a hybrid between *Calandrinia axilliflora* and either *Calandrinia compressa* or *Calandrinia ciliata* (Hershkovitz, 2006). Further taxonomic study is needed to elucidate the species. In the absence of further research the species is currently regarded as native owing to the fact that it has been recorded on uninhabited islands in natural habitats.

The only New Island record for *Calandrinia* cf. *axilliflora* is for the population growing on sand along the strandline at the south end of North Harbour beach (Figure 4). Formally this population was recorded on the hillside to the south of the beach on a

northeast-facing slope (R. Woods, pers. comm.). It appears therefore that the population has undergone a reduction in size. Herbarium vouchers and dried leaf samples collected during the current survey can be used for further taxonomic study of the species once funds are available.



Figure 4: *Calandrinia* cf. *axiliflora* population growing with *Rumex acetosella* along the strandline on the south side of North Harbour beach. The population extent is indicated by the foremost and furthest marker posts (left). A close-up image shows the leaves and bud of *Calandrinia* cf. *axiliflora* (right).

Appropriate sites were searched for three globally threatened species thought likely to occur on New Island (*Nastanthus falklandicus*, *Plantago moorei* and *Erigeron incertus*) but none were found. However a record was made for a particularly hairy *Plantago barbata* plant, from which a herbarium voucher was taken and leaves collected for genetic analysis (Figure 3, Figure 5). Molecular analyses are awaited to confirm whether this is in fact the globally threatened Moore's Plantain *Plantago moorei*. The identity of the specimen has been cast into doubt by recent results from molecular analyses on similar material collected from Port Stephens, West Falkland (Stevens *et al.*, in prep.). Pending further research on the *Plantago* and *Calandrinia* samples there are no threatened species present on New Island.



Figure 5: Possible *Plantago moorei* at Strong Tide Point, New Island.

Two protected (listed under the Conservation of Wildlife and Nature Ordinance) species occur on New Island – the Yellow Orchid *Gavilea littoralis* and the Common Violet *Viola maculata*. *Gavilea littoralis* is found on the east side of Cliff Peak at roughly 60 m a.s.l. (Figure 3). There are currently only four individuals and these are growing within *Empetrum rubrum*-dominated dwarf shrub heath with a local increase in the occurrence of *Hierochloa redolens* and *Blechnum penna-marina* where the orchid is found.

Viola maculata is given protected status not because it is rare or threatened but because it is believed to be the larval food plant of the rare and protected Queen-of-the-Falklands Fritillary *Yramea cytheris*. On New Island the largest (451-500 individuals) population of this species occurs on a south-facing slope of Precipice Hill within dwarf shrub heath – improved/reseeded grassland mosaic vegetation.

DISTRIBUTION DATA FOR ENDEMIC SPECIES

Of the endemic species occurring on New Island, *Nassauvia gaudichaudi* is by far the most common. As mentioned above it is one of the main colonists recorded on the Island. In contrast the population of *Chevreulia lycopodioides* previously recorded somewhere within Pond Paddock by R. Woods could not be relocated during the current survey.

The largest populations of *Calceolaria fothergillii* occur on Cliff Peak however time restrictions did not allow a total count to be carried out. There are also scattered individuals/ populations of less than 10 individuals across at least six other sites and at least 61-70 mature individuals recorded on Almond-flower Hill (Figure 3). On New Island *Calceolaria fothergillii* is predominantly found within dwarf shrub heath but two small populations have also been recorded within coastal cushion heath.

Roughly 50 mature *Leucheria suaveolens* individuals are found in *Blechnum penna-marina* fern beds on the south side of Precipice Hill (Figure 3). Another similarly sized population occurs within *Empetrum rubrum* – *Nassauvia gaudichaudii* – *Blechnum penna-marina* dwarf shrub heath on Cliff Peak. Unfortunately time did not allow a full population count. Other records are for scattered individuals.

A single population of 18 *Senecio littoralis* plants occurs near the summit of Bold Hill (Figure 3) within *Empetrum rubrum*-dominated dwarf shrub heath. The population is found on a south-facing slope within a 73 x 41 m area and on its western side several *Senecio littoralis* plants grow within widely scattered Tussac – dwarf shrub heath mosaic vegetation.

Large numbers of *Senecio vaginatus* plants can be found on the upper slopes of Precipice Hill between Tussac stands and between Precipice and Almond-flower hills within fern beds (e.g. Figure 6). The latter population of 401-450 mature individuals occurs within an area of roughly 60 x 200 m. There are an additional 8 individuals found close to this area on the west side of Almond-flower Hill. The uppermost population of *Senecio vaginatus* occurs near the summit of Precipice Hill in clearings within Tussac dominated by *Luzula alopecurus* and *Festuca magellanica* as well as amongst Tussac bogs. 151-175 mature individuals are found here within an area of c. 40 x 40 m. South-west of this site a further 451-500 mature individuals of *Senecio vaginatus* grow within an area of 90 x 100 m amongst mosaic vegetation of

scattered Tussac – *Blechnum penna-marina* fern beds – dwarf shrub heath. Further outlying clusters of *Senecio vaginatus* occur downslope. The New Island population of *Senecio vaginatus* therefore totals over 1000 mature individuals. It must be remembered that unlike the other endemic species occurring on New Island, *Senecio vaginatus* is biennial rather than perennial.



Figure 6: *Senecio vaginatus* growing within fern beds between Precipice and Almond-flower Hills, NI_SAP5.

NEW ISLAND HABITATS

In total 22 broad habitats are found on New Island: acid grassland, bare ground, scrub (recovering Boxwood and Gorse), coastal (saline) grassland, coastal cushion heath, coastal feldmark, coastal rock/boulders/slope, dwarf shrub heath, fern beds, garden, improved/ reseeded grassland, inland rock, introduced vegetation, littoral sediment, maritime cliff, marshy grassland, neutral grassland, pond, springs and streams, strandline vegetation, Tussac. There are also mosaic communities with the most common being acid grassland – dwarf shrub heath mosaics and acid grassland – semi-improved grassland mosaics.

DOMINANT HABITATS FOUND ON NEW ISLAND

Coastal cushion heath

Cushion heath is characterized by cushion plants covering over 25 % of the ground although cushion plants, mosses or lichens can dominate this habitat. Coastal cushion heath forms on coastal sites and has a high ground cover. On New Island this habitat covers large areas and is generally dominated by *Nassauvia gaudichaudii*. There is also a subset of sites dominated by *Azorella lycopodioides*, *Azorella filamentosa* or *Colobanthus subulatus*. On the Rabbit's Ears (east and west) *Bolax gummifera* becomes locally co-dominant on a small scale (Figure 7). The largest

Bolax gummifera cushions were found at the Rabbit's Ears and at the southern end of Grand Cliff (up to 5 x 4 m). The substrates upon which this habitat is found are sand, sandy peat or peat and there are also two examples of coastal cushion heath beginning to establish on eroded clay areas.



Figure 7: *Nassauvia gaudichaudii*-dominated coastal cushion heath on the Rabbit's Ears. In the distance is an area where *Bolax gummifera* cushions have increased in density.

Nassauvia gaudichaudii, *Colobanthus subulatus* and *Festuca magellanica* are all constant (occurred in 81-100% of the VAPs) components of coastal cushion heath on New Island. Frequent (occurred in 41-60% of the VAPs) components are *Trisetum phleoides*, *Azorella filamentosa*, *Luzula alopecurus* and *Aira praecox*.

In moist areas *Juncus scheuchzerioides* and, to a lesser extent, *Lilaeopsis maclovianum* become significant components of coastal cushion heath.

Deschampsia parvula is a rare grass across the Falklands, with the largest populations recorded in the SW of the archipelago. This species was recorded for the first time on New Island during the current survey. It occurs predominantly as a component of coastal cushion heath, becoming locally dominant over small scales.

The Falkland endemic *Nassauvia gaudichaudii* is an important colonist on New Island showing high recruitment rates at many sites, with high densities of seedlings (Figure 8). Studies into the rates of growth and peat formation of this important New Island cushion plant would be extremely informative.



Figure 8: Landsend Bluff provides an example of *Nassauvia gaudichaudii* colonizing bare ground, VAP226.



Figure 9: On the south side of Cliff Peak *Nassauvia gaudichaudii* is colonizing an area where *Holcus lanatus* has died back.

Now that livestock have been removed, this habitat appears to be able to encroach on former *Holcus lanatus* grassland (e.g. Figure 9). Survey data suggests however that in some areas, coastal cushion heath may not be the climax community. The long term vegetation transects will shed further light on this. It appears to be a good first colonizer of bare areas but may eventually be grown over by various coastal grasses, including *Poa flabellata*, at appropriate sites. At present it seems that within

coastal cushion heath *Poa flabellata* is predominantly colonizing eroded patches as seen on Landsend and North Bluff (Figure 10).



Figure 10: *Poa flabellata* colonizing eroded sections of *Nassauvia gaudichaudii* coastal cushion heath on North Bluff.

Improved/ reseeded grassland

Owing to past management practices, the majority of grassland on low-lying areas of New Island has at some point been subject to intensive grazing and multiple reseeded, therefore falling into this category. *Holcus lanatus* seed was spread by plane over New Island by J.J. Davis between 1949 and 1970 with the aim of benefiting grazing livestock (NICT, 2007). Improved grassland is characterized by vegetation with over 30 % cover of introduced grasses, less than 10 % cover of native herbs and is overall species-poor.

As expected, the majority of improved grassland on New Island is dominated by *Holcus lanatus*, however there are also examples where *Poa pratensis* (e.g. Figure 11), *Agrostis stolonifera* or *Festuca rubra* dominate. *Anthoxanthum odoratum* dominates over an area greater than 20 x 20 m just below the vehicle track on the south side of Precipice Hill. Around the settlement there are also stands dominated by *Dactylis glomerata* and to a lesser extent *Lolium perenne*. The introduced grass *Vulpia bromoides* is widely distributed across the island but only forms small stands and generally on eroded/ disturbed sites.



Figure 11: Thin-billed prion burrows within *Poa pratensis* improved grassland on the east side of South Hill.

An analysis of the VAP data gathered shows *Holcus lanatus* and *Poa pratensis* to be constant (occurred in 81-100% of the VAPs) components of improved grassland on New Island. Frequent (occurred in 41-60% of the VAPs) components are *Rumex acetosella*, *Aira praecox*, *Senecio sylvaticus* and *Festuca magellanica*.

There is evidence that without grazing, the dominant grasses in this category are losing their competitive advantage against some of the native plant species (e.g. Figure 12). Long term studies will shed light on whether areas dominated by *Poa pratensis*, as on the north side of Grand Cliff, where there is continued grazing by geese and nutrient input, will remain more resistant to change than other sites. It also remains to be seen whether the rate at which native species are colonizing *Holcus lanatus*-dominated grassland (e.g. Figure 13) can keep pace with the rate of bare ground exposure caused by natural dieback of this grass and attack by the larvae of the weevil *Malvinus compressiventris* (NICT, 2007).



Figure 12: Native grass *Elymus magellanicus* colonizing *Poa pratensis* improved grassland within the valley south of Rookery Hill, VAP199.



Figure 13: *Elymus magellanicus* beginning to colonize an area formerly dominated by *Holcus lanatus* on the south side of Rookery Hill, VAP255. Note the large areas of *H. lanatus* die-back.

The highly palatable *Acaena magellanica* is another native species which appears to be overgrowing areas of improved grassland now that livestock have been removed.

Dwarf shrub heath

On New Island the majority of dwarf shrub heath areas are dominated by *Empetrum rubrum*. There are also more restricted areas where *Gaultheria pumila* comes to dominate this habitat, for example at a few sites out on the South End and on a section of Almond-flower Hill. This habitat is characterized by dwarf shrubs covering over 25 % of the ground.

Constant components of dwarf shrub heath on New Island are *Empetrum rubrum*, *Gaultheria pumila*, *Festuca magellanica*, *Colobanthus subulatus*, *Nassauvia gaudichaudii* and two species of macrolichen - the black and white foliose *Hypogymnia lugubris* and an unidentified fruticose lichen, which is probably a *Cetraria* species (A. Orange pers. comm.). *Holcus lanatus* is also currently a constant component of New Island heath, growing in the spaces between dwarf shrubs.

The majority of heath is species-poor, occurring on low and mid-altitude sites and coastal slopes that were most likely formally vegetated with Tussac. There are, however, several areas of heath that have a good number of species. Cliff Peak and Almond-flower Hill both have examples of heath with a greater number of native species, including reasonable populations of the endemic *Calceolaria fothergillii* along with *Oxalis enneaphylla*, *Olsynium filifolium* (e.g. Figure 14). On Cliff Peak the endemic *Leucheria suaveolens* is also recovering well within dwarf shrub heath. *Poa alopecurus* is colonizing dwarf shrub heath on Cliff Peak and stands of *Hierochloa redolens* also occur scattered across heath areas at these and other sites. Survey work around the Falklands indicates that increases in all these species are a good

sign of recovery from grazing. Although currently scarce across this habitat on New Island, the appearance of *Apium australe* within dwarf shrub heath is also a sign of recovery from grazing as this is a species which is very palatable to livestock.

The only known population of *Senecio littoralis* occurs within dwarf shrub heath on Bold Hill (see above).

The largest population of the protected species *Viola maculata* occurs within dwarf shrub heath – improved/reseeded grassland mosaic vegetation (see above).



Figure 14: A section of *Empetrum rubrum* dwarf shrub heath with a high density of *Oxalis enneaphylla*, VAP284, Almond-flower Hill.

Coastal (saline) grassland

Coastal (saline grassland) occurs on seaspray-influenced coastal cliff sites on the west coast of New Island, with the largest stands occurring on New Island South. This habitat displays a variety of facies, alternately dominated by *Poa robusta*, *Elymus magellanicus* or *Poa alopecurus*. Areas once dominated by *Holcus lanatus* have since been colonised by coastal (saline) grassland species (I. Strange, unpublished data). The current survey also recorded evidence of *Elymus magellanicus* and *Poa alopecurus* beginning to colonise such sites and with the latter species also increasing in prominence within some areas of dwarf shrub heath and coastal cushion heath as seen on Cliff Peak, for example.

On New Island, *Elymus magellanicus*, *Apium australe* and *Galium antarcticum* are all constant components of coastal (saline) grassland. The former two species, in particular, are known to increase in prominence at ungrazed coastal sites.

The largest stands of *Poa robusta* grassland occur above cliffs west of the settlement (Figure 15) and on Landsend Bluff. Hiking boots are quickly covered in a layer of salt when walking through these areas. *Poa robusta*-dominated grassland also occurs above the similarly exposed western cliffs of Weddell and Beaver Islands as well as along the Port Stephens coast of West Falkland. *Elymus magellanicus*-dominated grassland has, to the best of my knowledge, only otherwise been recorded on smaller offshore islands and could warrant further investigation as a threatened habitat type. The spread of this species across New Island is therefore particularly

noteworthy (e.g. Figure 16). *Poa alopecurus* grassland is also restricted across the Falklands and recognised as a nationally threatened habitat – see above for a discussion of this.



Figure 15: *Poa robusta*-dominated grassland above cliffs west of New Island settlement, VAP191.



Figure 16: *Elymus magellanicus*-dominated grassland recovering in the valley south of Rookery Hill, VAP203.

NOTES ON ALL OTHER HABITATS FOUND ON NEW ISLAND

Grasslands

Tussac

It can be hypothesized that Tussac would have once been the dominant habitat on New Island. Current distribution patterns, signs of regeneration, evidence of past burning and the vegetation of neighbouring islands all provide a subset of clues to its past extent on New Island prior to the first human disturbances from the late 1700s (Figure 17).

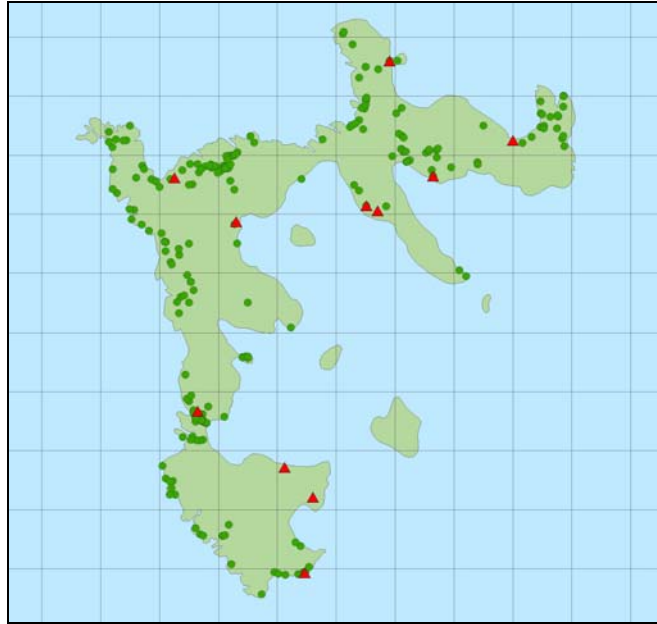


Figure 17: A map of New Island showing recent (9 records from 1999/2000, 222 records from 2010/2011) records of Tussac grass *Poa flabellata* (green circles) and exposed red ash deposits below peat layers (red triangles). Ash deposits indicate past peat fires, most likely where former stands of Tussac were burnt.

At present the largest dense stands of Tussac are above Settlement Rookery on Rookery Hill, Precipice Hill, at South End Tussac and on the Rabbit's Ears (e.g. Figure 18). *Poa flabellata* plants can be found close to the highest point on New Island, on South Hill and overall this species occurs within 86 % of the 1 km grid squares surveyed (Figure 17). In some cases there may be only lone mature plants with associated seedlings, such as on the south side of Sabina Point at c. 100 m a.s.l, but these areas still represent signs of regeneration and give an indication of what might have been the past extent of this habitat.



Figure 18: Dense Tussac on the Rabbit's Ears (west) taken from VAP109. Individual Tussac plants reach over 2 m in this stand.

Tussac is generally a species-poor habitat, but in areas without grazing where there are reasonable gaps between plants, several characteristic co-occurring species can be found such as *Stellaria debilis*, *Callitriche antarctica* and *Apium australe*. These latter species are all found, for example in Tussac stands surrounding The Settlement Rookery. On Precipice Hill a subpopulation of the endemic species *Senecio vaginatus* occurs within Tussac. The endemic *Senecio littoralis* is partially found within widely scattered Tussac – Dwarf shrub heath mosaic on Bold Hill.

On New Island the introduced *Rumex acetosella* is a constant associate of dense to scattered Tussac and a frequent associate is *Holcus lanatus*. The latter is a reflection of the fact that *Holcus lanatus* appears in the majority of habitats on New Island and is the most frequently recorded species across all VAPs in the current study. Occasional vascular components of the Tussac habitat are *Apium australe* along with the introduced species *Aira praecox* and *Senecio sylvaticus*.

The interaction between stands of Tussac and stands of introduced grasses such as *Ammophila arenaria* and *Agrostis stolonifera* (Figure 19) is not fully understood. There are, for example, conflicting views as to whether Tussac is able to eventually overgrow stands dominated by *Ammophila arenaria*. The vegetation transect set up on Bold hill will allow one such site to be studied.



Figure 19: *Poa flabellata* colonizing an area of North Bluff dominated by *Agrostis stolonifera*, VAP144.

It was formally thought that Tussac was unable to establish in areas of coastal dwarf shrub heath but this is now known to be a fallacy with numerous examples to the contrary around the Falkland Islands, including on New Island (e.g. Bold Hill). As mentioned above the interaction between Tussac and coastal cushion heath also requires long term study and this can also be addressed in part by the vegetation transects set up on New Island.

Acid grassland

There are no areas of acid grassland that reach 0.25 ha (c. 50x50 m) in size on New Island. The original description of this habitat in the Falkland Islands (Broughton, 2000) encompassed only *Cortaderia pilosa* dominated grassland, of which there is none on New Island. More recently, however, it has become clear that Bluegrass grassland can also form on acid soils as well as sand/ sandy peat so this vegetation has been incorporated into this category. In addition stands dominated by *Deschampsia flexuosa* or *Festuca magellanica* on acid soils should also be included within this broad habitat. In all cases these grasslands have less than 25 % dwarf shrub cover.

Although only covering small areas on New Island, their occurrence has been target noted and so is mentioned here.

Only one stand of *Deschampsia flexuosa* is currently recorded on New Island, on a west-facing slope on the south side of South Hill. This stand is semi-improved, with *Poa pratensis* co-dominant in the sward. Unusually, *Ranunculus biternatus* occurs frequently across this area suggesting moister ground other times of the year. On ungrazed Keppel Island *Deschampsia flexuosa* is one of the two dominant grasses and its increase is another sign of recovery from heavy grazing (Upson, 2008c). The stand on New Island is near to an area where *Poa flabellata* is recovering (to the north) and large stands of *Hierochloa redolens* also occur (to the south).

Festuca magellanica stands rarely have continuous grass cover on New Island and do not fit well into the category of acid grassland as they also occur on mineral soils and sandy sites. *Festuca magellanica* appears to be a good colonizer of bare ground (e.g. Figure 23) and longer term studies of the vegetation will shed light on whether this is actually a transient community that will become dominated by other native species in time. *Aira praecox*, *Colobanthus subulatus* and *Holcus lanatus* are all constant associates of *Festuca magellanica* grassland. This community may be better associated with the broader habitat of bare ground; *Festuca magellanica* is mentioned elsewhere as a good colonist of eroded sites in the Falkland Islands (e.g. Wilson *et al.* 1993).



Figure 23: Open *Festuca magellanica* grassland on north side of Bold Hill at VAP116.

Neutral grassland

Neutral grassland includes all semi-neutral and unimproved grassland occurring on circumneutral soils or in areas of nutrient flushing on otherwise acid soils (Broughton, 2000). *Hierochloa redolens* stands occur across New Island with several particularly extensive stands occurring on the south-east side of South Hill and on the north side of Cliff Peak (Figure 28). As mentioned above, *Hierochloa redolens* appears to be one of the native grasses which most rapidly re-colonize heath and fern bed sites after removal of grazing.



Figure 28: *Hierochloa redolens*-dominated grassland growing over *Nassauvia gaudichaudii*-dominated coastal cushion heath, west of New Island settlement, VAP185.

On New Island, constant associates of this habitat are *Hierochloa redolens* and *Galium antarcticum*. Frequent associates are *Blechnum penna-marina*, *Empetrum rubrum*, *Gunnera magellanica* and the ubiquitous *Holcus lanatus*. Good populations of *Oxalis enneaphylla* can occasionally be found in this habitat.

Marsippospermum grandiflorum occurs at several locations across New Island with the largest stands found along the ridge between Rookery and Precipice Hills.

Marshy grassland

Marshy grassland is herb-rich, grass-poor vegetation found in damp locations such as valleys near streams. Constant components of this habitat on New Island are *Apium australe*, *Juncus scheuchzerioides*, *Festuca magellanica*, *Poa pratensis*, *Nassauvia gaudichaudii* and *Galium antarcticum*. Frequent components are *Poa alopecurus*, *Poa robusta*, *Lilaeopsis macloviana*, *Trisetrum phleoides*, *Elymus magellanicus* and *Aster vahlii*.

On New Island the majority of marshy grassland is semi-improved. This community is generally composed of *Gunnera magellanica* dominating the ground and a semi-continuous cover of *Holcus lanatus* or *Poa pratensis*. Constant associates of this vegetation are these three species along with *Apium australe*.

One of the two records for *Carex trifida* on New Island is of a single mature individual growing near the coast in Ship Harbour Valley within *Holcus lanatus* semi-improved marshy grassland. It is difficult to explain why one single mature individual of *Carex trifida* should survive within this previously grazed site. It might be useful to split it up into clones and replant it across the site to try and encourage spread.

Although not recorded in the current study, there is a herbarium specimen of *Carex fuscula* which Jeanne Verssal collected near the old whaling station. As a result of the removal of grazing, it can be expected that sedge populations will increase in damp areas around the island and may eventually recover as bank side vegetation of some streams.

Possibly the most undisturbed example of marshy grassland can be found on the east side of Precipice Hill on a steep south-east facing slope above a deep sink hole. This provides an example of *Elymus magellanicus* – *Apium australe* – *Gunnera magellanica* marshy grassland. Even here, though, there is still frequent *Holcus lanatus* and *Poa pratensis*.

Fern beds

Extensive fern beds dominated by *Blechnum penna-marina* occur on several hillsides across New Island, for example on the south side of Precipice Hill and on the south-east side of South Hill. An extensive, gently east-sloping area roughly 200 x 60 m between Precipice and Almond-flower Hills is also dominated by *Blechnum penna-marina* fern beds.

In contrast *Blechnum magellanicum* has a much more restricted occurrence on New Island with no large stands present. It is not known whether this species was formerly burnt on New Island or whether it is naturally rarer here.

The *Leucheria suaveolens* populations on Precipice Hill are all found within *Blechnum penna-marina* fern beds. The *Senecio vaginatus* population between Precipice Hill and Almond-flower Hill is also found predominantly within *Blechnum penna-marina* fern beds.

This habitat most likely expanded in areas that were overgrazed in the past but also *Blechnum penna-marina* appears to be another native species which can colonize bare peaty ground. Surveys of Keppel Island suggest that at many sites this is unlikely to be a climax community (Upson, 2008c).

Open water

Standing water

There are two large freshwater ponds on New Island: one at the north end, behind North Harbour beach, and one at South End.

South End pond is fed by run-off from South Hill and there is a peaty hue to the water (Figure 29). At the pond margins there are floating patches of the aquatic herb *Callitriche antarctica*. *Lilaeopsis maclovianum* forms the only emergent vegetation at the pond margins. *Ranunculus acaulis* occurs on moist sand at the southern bank but introduced grasses *Holcus lanatus* and *Agrostis stolonifera* dominate the goose-grazed banks of this pond. At the time of the current survey, gentoo penguins were bathing in the western part of the pond. Since the current survey this pond has been

partially drained by site managers and it would therefore be useful to monitor water levels over the coming seasons (I. Strange pers. comm.).

North Harbour pond is fed by a stream on its northwest side and has a peaty hue. This pond also has goose-grazed margins dominated by introduced grasses, in this case *Poa pratensis* and *Agrostis stolonifera*. *Gunnera magellanica* and *Holcus lanatus* are also common and there are scattered patches of *Poa annua*. Several floating mats of *Callitriche antarctica* occur at the margins but there is no emergent vegetation. Magellanic penguins swim in the pond.



Figure 29: A view of the east side of South End pond, VAP052. The pond margins are goose-grazed and dominated by introduced grasses.

Behind the old whaling station there is a small (c. 10 x 10 m) man-made pool built by widening of the stream – the remains of a retaining wall are still visible.

There is a dried-up seasonal pool on the Rabbit's Ears and also on Rookery Hill eastern coastal flats. The seasonal pool on the Rabbit's Ears has a reasonable stand of *Deschampsia antarctica* at its margin, mixed predominantly with *Agrostis stolonifera*.

The dried up pool on Rookery Hill coastal flats has algal mats and *Spergularia marina* growing at its base and *Juncus scheuchzerioides* and *Poa annua* at its margins.

There are several, probably brackish, seasonal pools within *Poa robusta* coastal (saline) grassland west of the settlement and on Landsend Bluff. These pools have muddy bases and probably fill from a combination of sea spray, rainfall and run-off from nearby hill sides.

Running water

There are no rivers on New Island although there are small (< 50 cm wide) springs and streams collecting run-off from the hillsides with several of these opening out into wider (1-3 m) streams in valleys. For example wider streams occur south of the main settlement, the valley behind the Barnard Building and Ship Harbour Valley. Streams have been target-noted where possible using VAP forms. Bank tops are generally dominated by *Gunnera magellanica* and introduced grasses. Leafy

liverworts, mosses and algae are found on at least some section of the bank sides of most streams. *Callitriche antarctica* and *Montia fontana* are the only floating vegetation currently recorded and emergent vegetation where present is formed by *Lilaeopsis macloviana*, *Juncus scheuchzerioides* and, less frequently, *Isolepis cernua*.

One of the largest streams is found in the valley behind the Barnard Building. The bank sides/ margins of this stream contain the only record of *Ranunculus pseudotrullifolius* found on New Island (Figure 30).



Figure 30: Stream within *Holcus lanatus*-dominated improved grassland in valley south of Rookery Hill, VAP206. *Ranunculus pseudotrullifolius* forms part of the marginal community (right).

On the north side of Grand Cliff there are two small streams that join to form a single channel which flows over the western cliff edge. The bank tops of these are dominated by *Elymus magellanicus* and *Apium australe* and various mosses and liverworts grow on the bank sides and within the stream, such as a *Drepanocladus* moss species. Emergent vegetation is formed of *Lilaeopsis macloviana* (Figure 31).



Figure 31: Stream on northern slope of Grand Cliff within *Elymus magellanicus* coastal grassland; extensive bryophyte growth within stream.

At the South End, several streams run down the east and southeast side of South Hill. Bank vegetation is dominated by *Holcus lanatus* in this area. Of these, the small

stream on the southeast side of South Hill was extensively surveyed for roughly 400 m (Figure 32). The basal substrate is mud and running water was muddy at the time of survey. This stream flows out to sea. *Gunnera magellanica* dominates the bank top and the bank sides are well vegetated with liverworts and mosses interspersed with several stands of *Ranunculus biternatus*. Three moss species, three leafy liverwort species and one thaloid (*Riccardia* sp) liverwort were collected and have been sent to the U.K. for identification. The stream runs underground at some points and on slightly level ground there is standing water in the surrounding vegetation with mats of *Montia Fontana* occurring.



Figure 32: Upper section of South Hill Spring, VAP047. The bank tops are dominated by *Gunnera magellanica* and a range of bryophytes grow on the sheltered, moist bank sides.

Coastland

Littoral sediment

On New Island the intertidal zone includes boulder beaches and rock shelves at the base of gulches and cliffs on the more exposed western coastline. On the eastern coastlines sand and shingle beaches occur as well as rock shelves and boulders. No vascular plants are found in the intertidal zone on New Island.

Coastal rock/boulders/slope above high tide mark

Characteristic white, black (*Verrucaria* spp) and orange (*Caloplaca* spp) crustose lichens grow on rocks and boulders in the spray zone above the high tide mark (e.g. Figure 25). Also found on rocks in this habitat are two species of Strap Lichen (*Ramalina* spp).

In rock crevices and on coastal slopes within the splash zone, characteristic native species include *Isolepis cernua*, *Juncus scheuchzeroides*, *Lilaeopsis macloviana*, *Colobanthus subulatus*, *Crassula moschata*, *Poa flabellata* and *Apium australe*. Characteristic introduced species include *Rumex acetosella*.



Figure 25: Characteristic white, black and orange crustose lichens growing on boulders in the spray zone along an east-facing coast of the South End.

Strandline vegetation

Senecio candidans is a constant component of strandlines on New Island (e.g. Figure 24) but associated species are predominantly introduced in this habitat; *Senecio sylvaticus*, *Holcus lanatus* and *Poa annua* are also constant components of strandline vegetation.



Figure 24: Strandline vegetation at North Harbour beach, VAP166.

Sand dunes

Restricted sand dunes are found behind Barnard's Cove beach, on Burnt Island, behind North Harbour beach and the promontory on the east side of North Bluff. *Ammophila arenaria* has been planted at all these sites, to stabilize mobile sand. It is likely that all these sites would have formally been vegetated with Tussac prior to erosion of a peat layer.

Coastal feldmark

Coastal feldmark habitat is cushion, moss or lichen dominated areas on coastal sites at low altitudes with low ground cover. On New Island this vegetation occurs on mineral substrates and constant components are crustose lichens (unidentified), *Colobanthus subulatus*, *Nassauvia gaudichaudii* and a species of the Strap Lichen *Ramalina*.

The extent of the lichen cover at such sites provides an indication of the age of the site. Several areas have a feldmark-like community but cannot be included in this category as the exposed bedrock lacks a well-developed lichen community. These sites are clearly the result of relatively recent exposure by erosion processes and have instead been included within the category of bare ground.

The majority of examples of coastal feldmark on New Island are narrow bands above cliff tops such as on the Rabbit's Ears. The largest area covered by coastal feldmark is at the southernmost tip of the island above Strong Tide Point.

Inland rock

Outcrop, cliff, scree

There are no species which are restricted to inland rock habitats on New Island. The majority of exposed inland rock is the result of erosion and therefore has little cover by lichens. This includes the scree present on one section of Precipice Hill. Only *Festuca magellanica* and *Rumex acetosella* currently colonise the unstable mineral soil between rocks and the rocks themselves have minimal crustose lichen cover and scattered occurrence of an *Usnea* lichen.

In general inland rock outcrops, such as on a south-facing slope of Precipice Hill above Ship Harbour, are vegetated with scattered individuals of the same species forming the surrounding community along with additional lichen and sometimes bryophyte species.

There are two inland cliffs with exposed wet rock faces in sink holes. One, east of Precipice Hill, opens out to the sea via a tunnel at its base. The north-facing cliff has a population of 91-100 *Carex trifida* plants – the largest stand of this species on New Island. Associated species are *Apium australe*, *Poa alopecurus*, *Oxalis enneaphylla*, *Elymus magellanicus*, *Nassauvia gaudichaudii*, *Holcus lanatus* and *Aster vahlii*.

The second inland cliff is north of Sabina Point, close to the vehicle track. Its south-facing low cliff is wet and colonized extensively by bryophytes, along with *Juncus scheuchzerioides*, *Isolepis cernua* and mats of *Callitriche antarctica* (Figure 26). Seven *Poa flabellata* plants are also growing on the cliff along with the ubiquitous *Holcus lanatus*.



Figure 26: A sink hole with a well-vegetated sheltered cliff, VAP137.

Other

Bare, eroded ground

Soil erosion is one of the biggest threats to the terrestrial ecosystem on New Island today. Indirect effects of past overgrazing as well as the direct impact of past burning and many years of livestock trampling on vulnerable habitats have all led to the exposure of bare peat, mineral soil or the underlying sand, clay or bedrock. These areas of bare ground are now left vulnerable to the natural forces of wind and water erosion.

The removal of livestock has allowed re-colonization of some sites and others are currently being re-vegetated. In contrast in some areas bare ground is becoming exposed where *Holcus lanatus* is dying back and blowing away at a faster rate than re-colonization. The natural processes of colonization can also not keep pace with natural erosion working on other bare sites, leading to further loss of soil. In other sites re-vegetation simply will not occur naturally and therefore continue to erode without intervention. In these cases active, environmentally sensitive re-vegetation of sites is urgently needed (see discussion below). Grand Cliff and the east side of Almond-flower Hill provide warning examples where the soil has now eroded away and large areas of clay have become exposed. Erosion gullies have formed within the clay and are further hastening the deterioration of these and other sites.

There are no constant colonists of bare ground, reflecting the different species that colonize depending on the surrounding vegetation. The introduced *Rumex acetosella* and native *Festuca magellanica* are however frequently colonizers of eroded sites on New Island. *Juncus scheuchzerioides* is also often seen colonizing bare peat, spreading out from the margins via rhizomes that help to stabilize the soil. As mentioned above, *Nassauvia gaudichaudii* also appears to be an important colonist on New Island.

In some locations the top layers of peat have eroded away and exposed red peat ash accumulations (Figure 17, Figure 20). These accumulations indicate past burning events, most likely during the period between 1774 and 1854 when the Island was intermittently occupied by Whalers and Sealers. Peat core studies to enable dating of these ash deposits would provide a better understanding of the past burning history of New Island.



Figure 20: Exposed peat ash accumulations on the south side of Cliff Peak below eroding peat bank (left). Eroded section of *Nassauvia gaudichaudi* dominated coastal cushion heath near NI_VAP181 west of New Island Settlement (right).



Figure 21: Formation of an erosion gully on Landsend Bluff.

A more detailed description of individual bare peat areas was not possible within the time period available for this study but may be useful for planning future restoration programs. Overall, across New Island there are examples of peat pans, oxidized dry bare peat, micro-eroded sites, erosion gullies (e.g. Figure 21 and 22) vegetated hags (e.g. Figure 20) and eroded hags.



Figure 22: An area near the summit of Cliff Peak where underlying clay has become exposed and erosion gullies are forming.

Introduced vegetation

This category was added for the purposes of habitat mapping to cover non-dune sites dominated by *Ammophila arenaria* and eroded sites that have been well colonized by introduced species such as *Aira praecox* and *Rumex acetosella*. This category does not cover improved or semi-improved grassland and should perhaps in the future be merged with bare and eroded ground.

Ammophila arenaria has been planted extensively across New Island and is currently found in 20 (48%) of the 1 km grid squares surveyed. It was planted to stabilize eroded sandy ground.

Although introduced, *Rumex acetosella* is one of the most common colonizers of bare peat in the Falkland Islands and on New Island large areas are dominated by this single species (e.g. Figure 27). Constant associates of *Rumex acetosella* on New Island are *Aira praecox*, *Senecio sylvaticus* and *Holcus lanatus*. The native colonist *Festuca magellanica* is a frequent associate of these degraded sites.

The introduced herb *Matricaria discoidea* has a limited distribution across New Island however at North End it forms large stands, up to 20 m across, around the nutrient-enriched ground near gentoo colonies.



Figure 27: *Rumex acetosella* is one of the dominant colonizers of bare ground on New Island, forming large predominantly single-species stands. This photo shows an area colonized by *R. acetosella* on one of the eastern peaks of Bold Hill, VAP089.

Garden

Except for an abandoned garden in Ship Harbour valley, the gardens on New Island were not surveyed owing to time restrictions. Now that all properties on New Island are owned by NICT this would be a worthwhile project for later surveys as there may be species present with the potential to become invasive. Two species identifications are still awaited for this section and can be combined with the upcoming survey of the recently extended runway.

Three-cornered Garlic *Allium triquetrum* is found on the east side of Georgina's house in the settlement. It should be removed to prevent further spread (see below). *Veronica x franciscana* Hebe is found as hedging in the settlement, in the abandoned garden in Ship Harbour and along the coast beside the settlement.

The abandoned garden in Ship Harbour contains Monterey Cypress *Cupressus macrocarpa*, Lodgepole Pine *Pinus contorta*, *Cordyline australis*, New Zealand Flax *Phormium tenax*, Magellanic Currant *Ribes magellanicum* and at least two other species awaiting identification. It was not possible to enter the garden at the time of survey as it was too overgrown to get in to. *Cupressus macrocarpa* trees have also been planted at several other locations in Ship Harbour valley.

After completing the current survey, information came to light that the *Cupressus macrocarpa* trees found on New Island have at least two distinct sources (I. Strange pers. comm.). Younger *Cupressus macrocarpa* trees growing by the jetty, in the fenced garden by Prion House and a single tree c. 150 m southwest of Prion House are grown from seed sourced from naturally growing trees found at East Grove Point, Lobos, Monterey, California (I. Strange pers. comm.). All other *Cupressus macrocarpa* trees on New Island are from commercial stock (I. Strange, pers. comm.).

LOWER PLANTS

46 moss, 31 liverwort and 22 lichen collections were made during the 2010/ 2011 surveys. These have been sent to contacts in the U.K. for identification. The results will be used to amend all appropriate VAP and SAP forms.

INVASIVE SPECIES

Gorse *Ulex europaeus*

Gorse *Ulex europaeus* scrub occurs primarily around New Island settlement and on the east side of Grand Cliff southwest of the old whaling station. There are also outliers in Ship Harbour and on the north side of Bold Hill. Removal of outlier Gorse shrubs is needed, along with a continuation of control of hedges around the settlement in order to prevent excessive re-growth and re-seeding (Whitehead, 2008). See Belton (2008) for a comprehensive management strategy for Gorse.

Marram grass *Ammophila arenaria*

Marram grass *Ammophila arenaria* has been widely planted on sandy sites, including sand dunes, across New Island. Marram grass is able to invade other communities (e.g. Upson, 2008a) and tends to form monocultures, decreasing the overall biodiversity value of a site. At this time it would however be ill-advised to remove the current populations as they are now performing a valuable soil stabilization function.

In the long term the most sensitive approach to dealing with this species would be to carry out planting/ seeding trials with native species in order to investigate which are able to overgrow *Ammophila arenaria*. To the best of the author's knowledge, the only recorded evidence of a native species naturally overgrowing a stand of *Ammophila arenaria* in the Falklands is that of *Hebe elliptica* at Dyke Point on Weddell Island (Upson, 2008b).

There are conflicting views as to how *Ammophila arenaria* and *Poa flabellata* interact and this can be monitored through the vegetation monitoring being carried out and advised for the future.

Spiny Sow Thistle *Sonchus asper*

The American botanist G.H. Snyder recorded Spiny Sow Thistle *Sonchus asper* during his visit in 1852/ 1853. Apart from this first record, the location of which is uncertain, all other records show this to be an invader of disturbed sites in coastal habitats along the eastern side of New Island. It would be worth making it a policy that if anyone comes across this species they dig it up or mark the site and come back to dig it up/ pour boiling water on the plant. The removed plant should be placed in an airtight container and burnt back at the settlement so as to prevent the spread of seed. A comprehensive thistle management plan is available for the Falklands (Lewis, 2011).

Three-cornered Garlic *Allium triquetrum*

A native of west and central Mediterranean, *Allium triquetrum* is a known invasive weed and is considered noxious in parts of the USA and Australia. It is a bulbous perennial herb which can spread rapidly within a localised area but needs human assistance to reach new areas at a distance. This species should be removed from New Island to protect against future accidental spread by movement of contaminated soil or garden refuse etc. *Allium triquetrum* is best pulled up once it has produced flower spikes. At this time the bulbs have given up all their food and shriveled, making plants easy to pull up. It is best to pull up whole clusters of plants so as to have the remove as many bulbs as possible. Check the area again the following season and remove any remaining plants that were missed the first time.

Common Stork's-bill *Erodium cicutarium*

The introduced herb *Erodium cicutarium* is found within strandline vegetation on Barnard Building beach and on coastal slopes around the coast east of Rookery Hill. It occurs again as part of the strandline community of Ship Harbour Beach and a single plant is also found on the vehicle track on the north side of Rookery Hill. A total of 91-100 mature individuals were counted across these sites. It would therefore be possible to eradicate this species through hand removal over the course of one or two seasons.

Lesser Trefoil *Trifolium dubium*

Trifolium dubium was recorded at two sites on New Island. It grows amongst *Dactylis glomerata* – *Lolium perenne* improved grassland in the New Island settlement and within *Poa pratensis* – *Aira praecox* improved grassland near North End gentoo colonies. With its nitrogen fixing nodules it may be having a significant impact on the soil nutrient status of the area but it is difficult to see how it could be brought under control as it is so small and covers a large area at the latter site.

Strawberry Clover *Trifolium fragiferum*

A specimen of this species was collected by Jeanne Verssal for the New Island herbarium and it is apparently found at only one location. This site is known by the island manager and she has agreed to remove and burn the plants.

Hebe *Veronica x franciscana*

The cultivar *Veronica x franciscana* 'Lobeloides' is present on New Island along with back-crosses with the native *V. elliptica*. The general name *Veronica x franciscana* covers both. There is a risk that *Veronica x franciscana* may naturalise on New Island and cause genetic erosion of *Veronica elliptica* through hybridization.

RECOMMENDATIONS - TACKLING SOIL EROSION

Simple action that can be taken now

Tussac tillers can be planted on areas of coastal peat including areas on South End where *Holcus lanatus* has died back. Landowners have in the past already carried out this activity but it is suggested that the program is expanded so that there is a concerted annual effort to plant Tussac tillers at appropriate sites. More detailed information on Tussac restoration, including the propagation of seedlings, will not be provided here but can be sought from the author at Falklands Conservation along with access to useful planting guides etc.

One issue in relation to restoration work which has, to the best of our knowledge, not been encountered so far in the Falklands is the need to consider the interaction between restoration activities and populations of key animal species, such as the thin-billed prions. Where Thin-billed prion burrows occur in high densities, strategic planting of Tussac tillers around the margins should speed up natural colonization of the area through seedling establishment. It may, however, be that restoration work will impact on the suitability of sites for nesting of key species on New Island, such as the thin-billed prion (Catry et al., 2003). It is therefore important that experts are consulted in relation to these considerations. At some sites, such as South End coastal flats, there are no foreseeable negative impacts with planting as much Tussac as possible across the area and this would therefore be a useful place for work to begin immediately.

Other methods of stabilizing bare peat

For flat areas, trials using *Empetrum rubrum* brash, cut in winter, could be carried out. This material laid onto the eroded site should help prevent further peat blowing away and also aid in the capture of propagules from surrounding vegetation. The restoration trials currently being carried out on recently cleared minefields at Sapper Hill and Surf Bay will help to inform the usefulness of this approach in the Falkland Islands (R. Upson, unpublished data).

Other re-vegetation techniques could be trialed such as the translocation of plant plugs from surrounding plant communities to the eroded area. In addition other native plant species can be used for planting up areas where Tussac is not appropriate.

Sites that are not appropriate for *Poa flabellata* are most likely appropriate for *Elymus magellanicus* or *Poa alopecurus*, both of which occur on New Island. The bare area on the south side of Rookery Hill could, for example, be planted up with tillers of *Elymus magellanicus* as there are signs that this is the dominant native grass re-colonizing this hillside. Winter is the best time to carry out such planting activities especially as New Island has such low rainfall.

In eroded sand areas *Poa alopecurus* tillers are recommended as this species forms part of the Falkland Island native dune community. A trial at Surf Bay has shown that *P. alopecurus* tillers can be successfully established in sand when planted in winter/early spring (Upson, 2011b).

Clay sites will be the most difficult to deal with. Survey work on Weddell Island indicates that *Veronica elliptica* is able to establish on clay (Upson, 2008b) and so this could be trialed on New Island. This species readily propagates from cuttings.

In other countries geo-textiles are sometimes used to halt erosion and promote re-vegetation of eroded slopes. On exposed slopes such as the north side of Rookery Hill where the peat has dried extensively and is blowing away, the use of a biodegradable geo-textile such as geo-jute could be trialed.

FURTHER RECOMMENDATIONS

1. Vegetation transect monitoring

- See separate report.

2. Population assessments

- Annual population assessments should be carried out for *Calandrinia* cf. *axilliflora* and the *Plantago* cf. *moorei* until further information is available on their taxonomic status. Neither of these surveys will take very long and simply require the completion of a species assessment form included in Appendix 3.
- The majority of endemic species occurring on New Island have populations so large that re-assessments would be very time consuming. It would be worth monitoring the population of *Senecio littoralis* on Bold Hill as this is a small enough population for the work to be manageable and will provide an insight into regeneration of this species. The species assessment form in Appendix 3 should be used.

3. Invasive plant control

- See recommendations within the invasive plants section above.

4. Botanical surveys

- To carry out a full botanical survey of the settlement area and vegetable plot in Ship Harbour valley to identify any potentially invasive species.
- An introduced species survey on and around the site of the extended runway.

ACKNOWLEDGEMENTS

We are grateful to the New Island Trust for funding the current survey. Many thanks to Georgina Strange for her help in organising logistics and in making us so welcome on New Island and to Ian Strange for useful discussions prior to the field work. Thanks also to volunteers Neil Anders and Margaret Carr for their invaluable assistance with survey work.

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APPENDIX 1: IPA Selection Criteria. Table taken from 'Identifying and Protecting the World's Most Important Plant Areas'. 2004. Plantlife International.

CRITERION	DESCRIPTION	THRESHOLD	NOTES
A(i) (threatened species)	Site contains globally threatened species	All sites known, thought or inferred to contain 5% or more of the national population can be selected, or the 5 'best' sites, whichever is the most appropriate.	Species listed as 'threatened' * on IUCN global red lists
A(ii) (threatened species)	Site contains regionally threatened species	(In exceptional cases, for example where there are less than 10 sites in the entire country or there are between 5-10 large populations of a species, up to 10 sites can be selected)	Species listed as 'threatened' * on regional IUCN red lists or regionally approved lists
A(iii) (threatened species)	Site contains national endemic species with demonstrable threat not covered by A(i) or A(ii)	(Populations must be viable or there is a hope that they can be returned to viability through conservation measures)	Species listed as national endemic (on any recognized list or publication) and 'threatened' * on national red lists
A(iv) (threatened species)	Site contains near endemic/restricted range species with demonstrable threat not covered by A(i) or A(ii)		Species listed as near endemic/ restricted range (on any recognised list or publication) and 'threatened' * on national red lists
B (botanical richness)	Site contains high number of species within a range of defined habitat or vegetation type	Up to 10% of the national resource (area) of each habitat or vegetation type, or 5 best sites; whichever is the most appropriate. (In exceptional cases, for example there are between 5 and 10 exceptionally rich sites for a particular habitat, up to 10 sites can be selected for each level 2 habitat type)	Species richness can be based on a nationally created list of indicator species developed for each habitat or vegetation type. For example characteristic species and/or endemic species and/or nationally rare and scarce species (where the endemic and rare and scarce species are numerous and/or are characteristic for the habitat) Defined habitat or vegetation type taken from or based upon a regionally accepted classification
C (threatened habitat or vegetation type)	Site contains threatened habitat or vegetation type	All sites known, thought or inferred to contain 5% or more of the national resource (area) of priority threatened habitats can be selected, or a total of 20-60% of the national resource, whichever is the most appropriate.	Threatened habitats or vegetation taken from a regionally recognised list.

*Criterion A, threatened species must be listed as **Critically Endangered (CR)**, **Endangered (EN)** or **Vulnerable (VU)** using the new IUCN criteria, or **Extinct/Endangered (Ex/E)**, **Endangered (E)** or **Vulnerable (V)** using the original IUCN categories

APPENDIX 2: Species records for New Island

FAMILY	SPECIES	LOCNAME	Status	1852/ 1853	1907/ 1908	1937/ 1938	1999/ 2001	2001	New Island Herbarium	2010/ 2011
Asteraceae	<i>Abrotanella emarginata</i>	Notched Moss-bog	n				1		0	1
Rosaceae	<i>Acaena lucida</i>	Native Yarrow	n				1	1	0	1
Rosaceae	<i>Acaena magellanica</i>	Prickly-burr	n		1		1	1	1	1
Asteraceae	<i>Achillea millefolium</i>	Yarrow	i						1	0
Asteraceae	<i>Agoseris coronopifolium</i>	Fuegian Hawk's-beard	n	1			1		0	1
Poaceae	<i>Agrostis magellanica</i>	Fuegian Bent	n			1		1	0	0
Poaceae	<i>Agrostis stolonifera</i>	Creeping Bent	i					1	0	1
Poaceae	<i>Aira praecox</i>	Early Hair-grass	i				1	1	1	1
Alliaceae	<i>Allium triquetrum</i>	Three-cornered Garlic	i						0	1
Poaceae	<i>Alopecurus geniculatus</i>	Marsh Foxtail	i						1	0
Poaceae	<i>Ammophila arenaria</i>	Marram	i				1	1	0	1
Primulaceae	<i>Anagallis alternifolia</i> var. <i>repens</i>	Pimpernel	n				1		1	1
Asteraceae	<i>Anthemis cotula</i>	Stinking Chamomile	i						1	0
Poaceae	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	i					1	1	1
Apiaceae	<i>Apium australe</i>	Wild Celery	n	1			1	1	1	1
Asteraceae	<i>Aster vahlII</i>	Marsh Daisy	n				1	1	1	1
Apiaceae	<i>Azorella filamentosa</i>	Wiry Azorella	n		1		1		0	1
Apiaceae	<i>Azorella lycopodioides</i>	Clubmoss Azorella	n					1	1	1
Apiaceae	<i>Azorella monantha</i>	Tufted Azorella	n		1		1	1	1	1
Asteraceae	<i>Baccharis magellanica</i>	Christmas-bush	n				1	1	1	1
Asteraceae	<i>Bellis perennis</i>	Daisy	i					1	1	1
Blechnaceae	<i>Blechnum magellanicum</i>	Tall-fern	n	1			1		1	1
Blechnaceae	<i>Blechnum penna-marina</i>	Small-fern	n	1			1	1	1	1
Apiaceae	<i>Bolax gummifera</i>	Balsam-bog	n	1			1	1	0	1
Poaceae	<i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	Soft Brome	i					1	1	0
Portulacaceae	<i>Calandrinia</i> cf. <i>axilliflora</i>	unidentified species	n				1		0	1
Calceolariaceae	<i>Calceolaria fothergillii</i>	Lady's Slipper	e	1			1	1	0	1
Callitrichaceae	<i>Callitriche antarctica</i>	Water-starwort	n				1	1	0	1
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's-purse	i				1		0	1
Brassicaceae	<i>Cardamine glacialis</i>	Bitter-cress	n	1					0	0
Cyperaceae	<i>Carex fuscula</i>	Dusky Sedge	n						1	0
Cyperaceae	<i>Carex trifida</i>	Sword-grass	n						0	1
Caryophyllaceae	<i>Cerastium arvense</i>	Field Mouse-ear	n					1	0	1
Caryophyllaceae	<i>Cerastium fontanum</i>	Common Mouse-ear	i					1	0	1
Chenopodiaceae	<i>Chenopodium macrospermum</i> ssp. <i>macrospermum</i>	Goosefoot	n					1	1	1
Asteraceae	<i>Chevreulia lycopodioides</i>	Clubmoss Cudweed	e				1		0	0

FAMILY	SPECIES	LOCNAME	Status	1852/ 1853	1907/ 1908	1937/ 1938	1999/ 2001	2001	New Island Herbarium	2010/ 2011
Caryophyllaceae	<i>Colobanthus quitensis</i>	Pearlwort	n					1	0	0
Caryophyllaceae	<i>Colobanthus subulatus</i>	Emerald-bog	n				1		0	1
Agavaceae	<i>Cordylina australis</i>	Cabbage-palm	i						0	1
Brassicaceae	<i>Coronopus didymus</i>	Lesser Swine-cress	n	1			1	1	1	1
Poaceae	<i>Cortaderia pilosa</i>	Whitegrass	n					1	0	0
Crassulaceae	<i>Crassula moschata</i>	Stonecrop	n				1	1	1	1
Cupressaceae	<i>Cupressus macrocarpa</i>	Monterey Cypress	i					1	1	1
Poaceae	<i>Dactylis glomerata</i>	Cock's-foot	i					1	1	1
Poaceae	<i>Deschampsia antarctica</i>	Antarctic Hair-grass	n			1			0	1
Poaceae	<i>Deschampsia flexuosa</i>	Wavy Hair-grass	n						0	1
Poaceae	<i>Deschampsia parvula</i>	Dwarf Hair-grass	n		1				0	1
Brassicaceae	<i>Draba funiculosa</i>	Whitlowgrass	n				1		0	0
Poaceae	<i>Elymus magellanicus</i>	Fuegian Couch	n				1	1	1	1
Ericaceae	<i>Empetrum rubrum</i>	Diddle-dee	n				1	1	1	1
Geraniaceae	<i>Erodium cicutarium</i>	Common Stork's-bill	i					1	0	1
Poaceae	<i>Festuca magellanica</i>	Fuegian Fescue	n				1	1	1	1
Poaceae	<i>Festuca rubra</i>	Red Fescue	i					1	1	1
Rubiaceae	<i>Galium antarcticum</i>	Antarctic Bedstraw	n	1			1	1	1	1
Asteraceae	<i>Gamochaeta americana</i>	American Cudweed	n						0	1
Asteraceae	<i>Gamochaeta malvinensis</i>	Falkland Cudweed	n				1	1	1	1
Asteraceae	<i>Gamochaeta spiciformis</i>	Spiked Cudweed	n				1		0	0
Ericaceae	<i>Gaultheria pumila var. pumila</i>	Mountainberry	n	1			1	1	1	1
Orchidaceae	<i>Gavilea littoralis</i>	Yellow Orchid	n						0	1
Asteraceae	<i>Gnaphalium luteoalbum</i>	Jersey Cudweed	i						1	0
Gunneraceae	<i>Gunnera magellanica</i>	Pigvine	n	1			1	1	1	1
Poaceae	<i>Hierochloa redolens</i>	Cinnamon Grass	n				1	1	1	1
Poaceae	<i>Holcus lanatus</i>	Yorkshire Fog	i				1	1	1	1
Asteraceae	<i>Hypochaeris radicata</i>	Cat's-ear	i					1	0	1
Cyperaceae	<i>Isolepis cernua</i>	Nodding Club-rush	n						1	1
Juncaceae	<i>Juncus scheuchzerioides</i>	Native Rush	n				1		1	1
Asteraceae	<i>Leontodon hispidus</i>	Rough Hawkbit	i						1	1
Asteraceae	<i>Leucheria suaveolens</i>	Vanilla Daisy	e	1			1	1	1	1
Apiaceae	<i>Lilaeopsis macloviana</i>	Lilaeopsis	n				1	1	1	1
Campanulaceae	<i>Lobelia pratiana</i>	Berry-lobelia	n				1	1	1	1
Poaceae	<i>Lolium perenne</i>	Perennial Rye-grass	i					1	1	1
Juncaceae	<i>Luzula alopecurus</i>	Native Wood-rush	n				1	1	1	1
Juncaceae	<i>Luzula multiflora</i>	Heath Wood-rush	i						1	0

FAMILY	SPECIES	LOCNAME	Status	1852/ 1853	1907/ 1908	1937/ 1938	1999/ 2001	2001	New Island Herbarium	2010/ 2011
Luzuriagaceae	<i>Luzuriaga marginata</i>	Almond-flower	n						0	1
Juncaceae	<i>Marsippospermum grandiflorum</i>	Tall Rush	n						1	1
Asteraceae	<i>Matricaria discoidea</i>	Pineappleweed	i					1	0	1
Portulacaceae	<i>Montia fontana</i>	Blinks	n						0	1
Asteraceae	<i>Nassauvia gaudichaudii</i>	Coastal Nassauvia	e		1		1	1	1	1
Asteraceae	<i>Nassauvia serpens</i>	Snakeplant	e	1					0	0
Iridaceae	<i>Olsynium filifolium</i>	Pale Maiden	n	1			1	1	0	1
Apiaceae	<i>Oreomyrrhis hookeri</i>	Hooker's Sweet Cicely	n				1		0	0
Oxalidaceae	<i>Oxalis enneaphylla ssp. enneaphylla</i>	Scurvygrass	n	1			1	1	1	1
Papaveraceae	<i>Papaver dubium</i>	Long-headed Poppy	i						1	0
Asteraceae	<i>Perezia recurvata</i>	Falkland Lavender	n	1				1	1	1
Agavaceae	<i>Phormium tenax</i>	New Zealand Flax	i						0	1
Pinaceae	<i>Pinus contorta</i>	Lodgepole Pine	i						0	1
Plantaginaceae	<i>Plantago barbata</i>	Thrift Plantain	n						0	1
Poaceae	<i>Poa alopecurus ssp. alopecurus</i>	Bluegrass	n			1	1		1	1
Poaceae	<i>Poa annua</i>	Annual Meadow-grass	i						0	1
Poaceae	<i>Poa flabellata</i>	Tussac	n		1		1	1	1	1
Poaceae	<i>Poa pratensis</i>	Smooth-stalked Meadow-grass	i				1		1	1
Poaceae	<i>Poa robusta</i>	Shore Meadow-grass	n		1			1	1	1
Poaceae	<i>Puccinellia pusilla</i>	Dwarf Saltmarsh-grass	n						0	1
Ranunculaceae	<i>Ranunculus acaulis</i>	Skottsberg's Buttercup	n					1	0	1
Ranunculaceae	<i>Ranunculus biternatus</i>	Antarctic Buttercup	n				1		1	1
Ranunculaceae	<i>Ranunculus pseudotrullifolius</i>	False Ladle-leaved Buttercup	n						0	1
Ranunculaceae	<i>Ranunculus trullifolius</i>	Ladle-leaved Buttercup	n					1	0	0
Juncaceae	<i>Rostkovia magellanica</i>	Short Rush/ Brown Rush	n					1	0	0
Rosaceae	<i>Rubus geoides</i>	Falkland Strawberry	n				1		1	1
Polygonaceae	<i>Rumex acetosella</i>	Sheep's Sorrel	i	1			1	1	1	1
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	i						1	0
Caryophyllaceae	<i>Sagina procumbens</i>	Procumbent Pearlwort	i				1	1	1	1
Apiaceae	<i>Schizeilema ranunculus</i>	Buttercup-parsley	n						1	0
Asteraceae	<i>Senecio candidans</i>	Sea Cabbage	n					1	1	1
Asteraceae	<i>Senecio littoralis</i>	Woolly Ragwort	e	1			1		0	1
Asteraceae	<i>Senecio sylvaticus</i>	Heath ragwort	i						0	1
Asteraceae	<i>Senecio vaginatus</i>	Smooth Ragwort	e	1					0	1
Asteraceae	<i>Senecio viscosus</i>	Sticky Groundsel	i				1	1	0	0
Asteraceae	<i>Senecio vulgaris</i>	Groundsel	i	1			1		1	1
Asteraceae	<i>Sonchus asper ssp. asper var. asper</i>	Spiny Sow-thistle	i	1				1	0	1

FAMILY	SPECIES	LOCNAME	Status	1852/ 1853	1907/ 1908	1937/ 1938	1999/ 2001	2001	New Island Herbarium	2010/ 2011
Caryophyllaceae	<i>Spergularia marina</i>	Lesser Sea-spurrey	n				1	1	1	1
Caryophyllaceae	<i>Stellaria debilis</i>	Native Stitchwort	n						1	1
Caryophyllaceae	<i>Stellaria media</i>	Chickweed	i	1					1	1
Asteraceae	<i>Taraxacum officinale</i>	Dandelion	i						1	1
Fabaceae	<i>Trifolium dubium</i>	Lesser Trefoil	i					1	0	1
Fabaceae	<i>Trifolium fragiferum</i>	Strawberry Clover	i						1	1
Poaceae	<i>Trisetum phleoides</i>	Spiked Oat-grass	n						1	1
Fabaceae	<i>Ulex europaeus</i>	Gorse	i				1	1	1	1
Veronicaceae	<i>Veronica elliptica</i>	Boxwood	n					1	1	1
Veronicaceae	<i>Veronica x franciscana</i>	Hedge Veronica	i					1	1	1
Violaceae	<i>Viola maculata</i>	Common Violet	n	1			1		1	1
Poaceae	<i>Vulpia bromoides</i>	Squirreltail Fescue	i						1	1

¹Red lettering indicates a new record for Weddell Island

Appendix 3: Plant species assessment recording form

Collector Name(s)	
Date	
GPS datum	WGS 84 Other
Lat (or Grid Reference)	
Long	
Name of Island	
Location notes	
Estimated slope in degrees (to nearest 5%)	
Aspect	N NE E SE S SW W NW ALL
Estimated altitude (in metres)	
Habitat type	
Common name or Latin name	
Plant description - e.g. what is the maximum height of target species?	
Is it in flower?	
Are fruits or seeds present?	
Signs of recruitment	Seedlings Vegetative spread
Frequency within plot	Common Frequent Occasional Rare
Notes, e.g. What other plants are present? Human land use e.g. peat cutting?	
Sample plot: total area covered by population or a random 5x5m plot within this	metres X metres
No. of mature plants	
% bare ground within sample plot	
Soil Type	Peat Sand Clay Rock Mineral Other:
What is the tallest plant species within plot and what is its height?	
Are there any obvious threats to the target species? E.g. erosion, invasive species	
Photos - who and file name/ no.	