St Helena National Trust

St Helena Airport north runway invertebrate, plant and endemic lichen survey

Commissioned by the Air Access Office, St Helena

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1 INTRODUCTION

1.1 RATIONALE

As a result of the St Helena Airport development a large area of natural land surface is due to be lost in order to construct the runway, an associated cleared and graded area (CGA) and either the batter rising back up to the natural land surface or because of fill built up to create the required levels. Prosperous Bay Plain itself, along with a scattering of sites across the Eastern Arid Area (EAA) was thoroughly surveyed entomologically prior to the Airport development (Ashmole & Ashmole, 2004). The southern ridge and Dry Gut were thoroughly surveyed for plants and lichens in June and July 2012 (Cairns-Wicks & Lambdon, 2012). Invertebrates were surveyed at the same time but as specialist sampling techniques were not employed and only limited identification resources were available this will not have been as comprehensive as it could have been.

As the construction moves northwards along the runway the natural land surface will be lost at an increased rate as there is less material to be levelled in this area. In order to record the invertebrates present in the area and to get a better understanding of the distribution of endemic, native and invasive non-native plant species the Air Access Office commissioned the St Helena National Trust to conduct a survey of the area prior to its loss as a part of the Landscape and Ecology Mitigation Programme (LEMP). Particular emphasis was to be placed on the fringes of Prosperous Bay Plain that were to be lost as this area is of particularly high ecological value.

1.2 CONSTRAINTS

While the whole survey took place over a two month period the main trapping period for invertebrates and the bulk of the plant survey work occurred between 20th February and 20th March, consequently this survey will be a snapshot of the species present at this time of year. The previous year had been particularly dry with drought conditions across much of the island; however, over the previous four months there had been a return to more normal levels of rainfall. Any legacy effects of this drought will be impossible to quantify.

It was not possible to identify all invertebrate taxa to species level as specialist knowledge, skills and experience are needed for some groups (*e.g*. many of the smallest hymenoptera). While further endemic species would almost certainly be found in these groups this information would add little to the overall survey as almost nothing is known of their ecology or wider distribution on the island. The plant survey was undertaken from south to north; in the early stages of the survey many grass species had only just started growing and were difficult to identify. This becomes evident when looking at the maps of some species where they appear to be much more common at the north than in the south.

One potential constraint is that the arid region is one of the most intensively surveyed portions of the island as a result of the airport development. In the King's and Queen's Rocks area there are also stands of endemic Scrubwood (*Commidendrum rugosum*) and St Helena Tea Plant (*Frankenia portulacifolia*) that will have attracted further attention. It is possible that invertebrate species are

more widespread away from the area in question but as relatively little survey work has been undertaken elsewhere our knowledge of their wider distributions is not as clear.

1.3 SITE DESCRIPTION

The area to be occupied by the north end of the runway consists of a ridge aligned north-south, it is bounded on the west by Prosperous Bay Plain and on the east by sea cliffs and the massif of King's and Queen's Rocks. At its northernmost end the site descends steeply into Fisher's Valley and Signal House Ravine; here it is in the form of a broad, near semi-circular promontory. Prior to the construction work at the southern end of the runway the ridge carried on southwards, dividing around the valley separating off Gill Point; prior to the airport construction the western arm of the ridge curved around to join the southern ridge of Prosperous Bay Plain. A map of the area marked with the 104 vegetation survey points to show the extent of the survey is given in Figure 1.

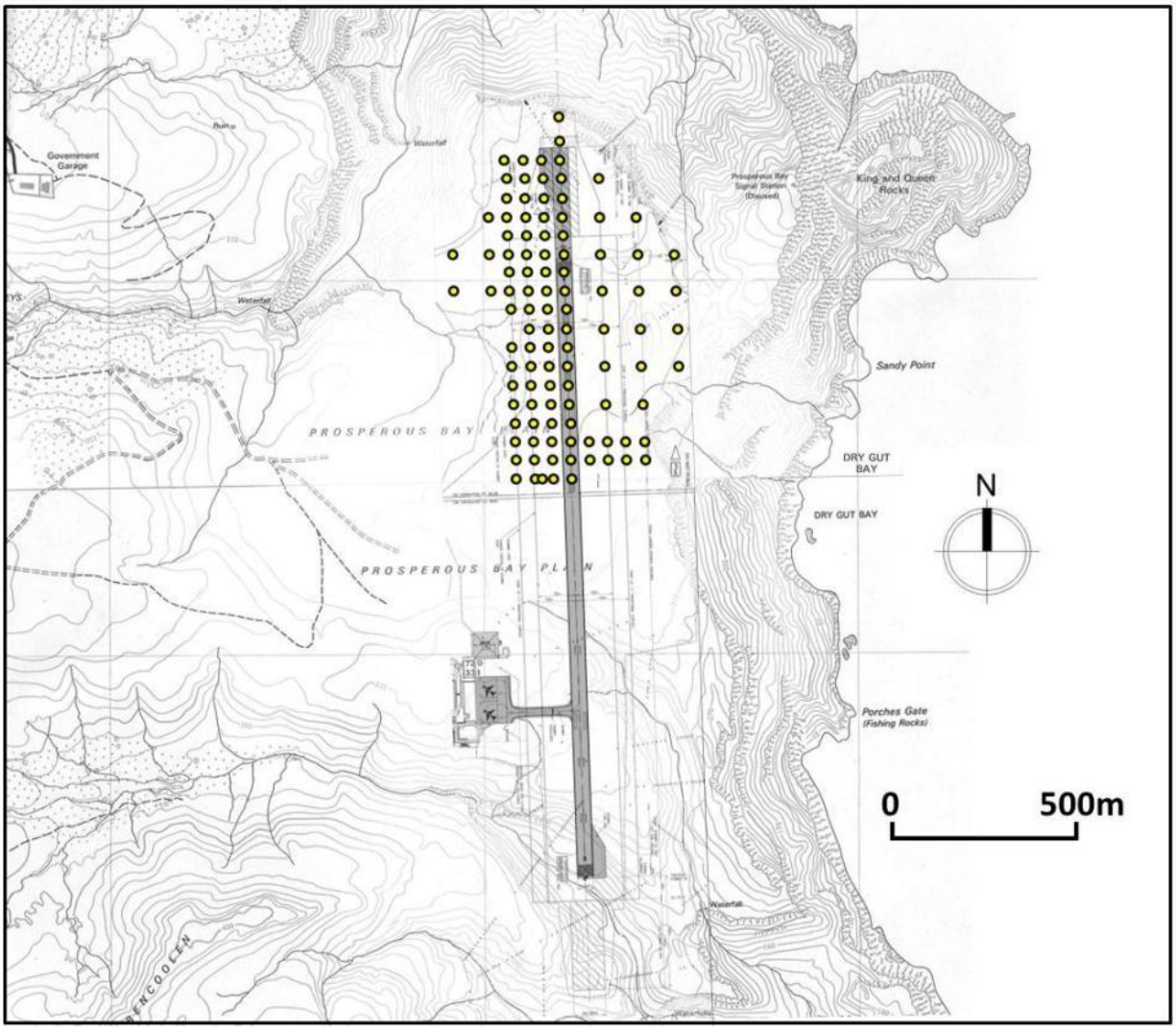

FIGURE 1 Map of the airport site with vegetation survey points (yellow dots) to illustrate extent of survey.

The ridge is much dissected by gullies along its edges and erosion along the summit of the ridge has created a series of small, low, flat-topped hills capped by harder layers of rock, these have a mesa-like appearance; the highest of these, which will be lost to the construction work has been called 'Table Hill'. The gullies are a mixture of solid rock intermixed with areas of marl with the most barren area immediately to the west of Table Hill being christened 'The Dark Side of the Moon'.

The area lies almost entirely within the Prosperous Plain land unit (Ordnance Survey, 1979b) with small areas in the easternmost parts being in the Sea Cliffs unit. As far as vegetation is concerned the entire site is classified as desert with the exception of land in the Sea Cliffs unit that is classified as Barren Sea Cliffs (Ordnance Survey, 1979d).

The geology consists of a basal lower basalt of upper shield rocks (southern volcano) which are overlain by near-horizontal trachyandesite lavas that poured into the void created by a cataclysmic landslide (Ordnance Survey, 1979a; Baker, 2010). Erosion has exposed the lower basalts in a complex pattern across the site; Figure 2 shows schematically how the vegetation surface points (yellow circles) fall with respect to the lower basalt (white, labelled 'Lb') and the trachyandesite (green) bedrock as currently exposed. The soils present across the site are predominantly haplic xerosols with scattered haplic xerosols of the lithic phase (or lithosols) which form the steep cliffs surrounding the north-west, north and east of the site (Ordnance Survey, 1979c).

2 METHODOLOGY

2.1 INVERTEBRATE SURVEY

The survey was undertaken over a 61 day period from 20th February to 21st April 2014. The bulk of invertebrate sample collection (90.9% of invertebrate specimens collected) and most of the plant and lichen survey was undertaken over the 28 day period from 20th February to 20th March. Invertebrates were surveyed using the following techniques:

- **Casual observation** of easy to identify species, particularly around flowers. Details of invertebrates observed during an earlier site visit with Rebecca Cairns-Wicks on 6th December 2013 have been included as a separate sample as this will go some way to addressing the time constraint issue. This visit was to the area of the runway centre-line and approximately up to 50 metres west from chainage 1100 to 800.
- **Malaise traps.** Two of these flight intercept traps were set up in a barren area at the outermost edge of the ADA at approximate runway chainage 1000 and 900 on 20th February 2014; they were taken down on 27th February as the catch was found to be poor. The two traps were re-erected on the same day in the gully at chainage 650, 100m west of the runway centre line. Vegetation consisted of frequent Saltbush, occasional Samphire, Creeper and Tropical Finger Grass and a few Wild Coffee bushes. They were left in place for three weeks, each week's catch from each trap being classed as a separate sample. Photographs of the Malaise traps *in situ* are given in Figure 4B, C and D.

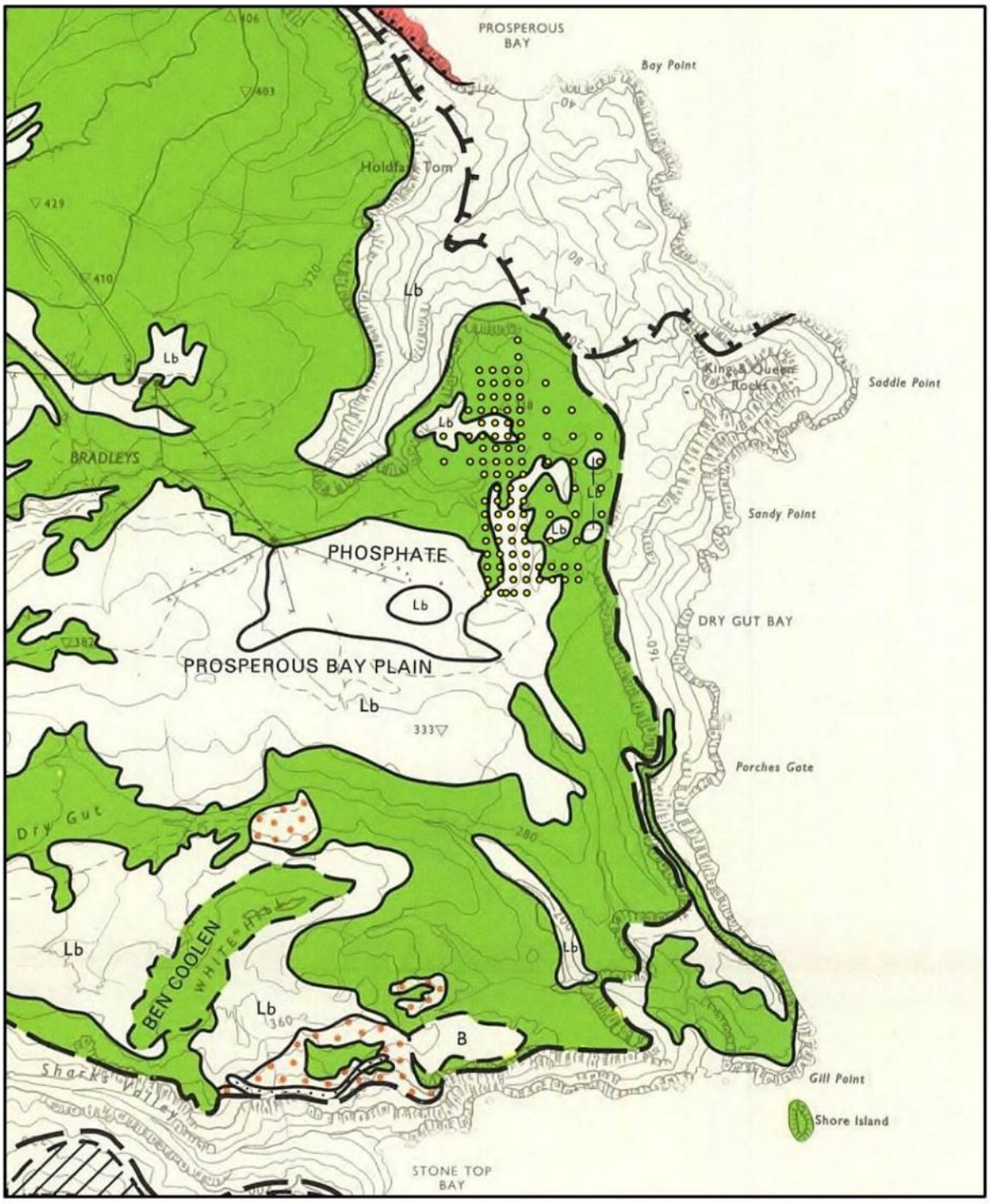

FIGURE 2 Geology of the Prosperous Bay Plain area with respect to the extent of the survey (yellow dots); white areas labeled 'Lb' are lower basalts of the upper shield, green areas are trachyandesite.

- **Pitfall trapping**. Five pitfall traps were installed on 27th February around the two Malaise traps and operated for three weeks; each week's combined catch was classed as a single sample. Pitfall trap number 1 (adjacent to Malaise trap 3) had to be removed after the first week as it was found to have been flooded by the adjacent intermittent water channel. The remaining four were all installed in bare ground with adjacent Samphire and Saltbush.

- **Berlese extraction**. Three samples of dead twigs and leaf litter were removed from the site. These were placed in a funnel system with a bag of mothballs placed at the top in order to create a chemical gradient of naphthalene vapour, thus causing any invertebrates present to self-extract into a tube of alcohol below. The samples were taken from Samphire on the flat plain 200m west of the runway centre line at chainage 600, from beneath a large Wild mango bush at chainage 600 (25 m west), and from beneath a Scrubwood on the eastern cliffs.
- **Suction sampling**. Two areas of grasses with adjacent vegetation were suction-sampled on 6th April 2014 with a modified Makita EH025 petrol-powered garden leaf vacuum (BugVac); each sample was 0.25m². The areas sampled were immediately adjacent to Malaise trap 1 and an area with grasses 150 metres west of the runway centre line at chainage 450.

A map showing the relative locations of the fixed sampling points with respect to the runway is given in Figure 3; a general site overview and pictures of the Malaise trap locations is given in Figure 4; GPS coordinates for the fixed sample sites are given in Appendix 1.

Invertebrates were preserved in 70% ethanol and identified to species level (where possible) using a binocular zoom microscope at magnifications of 7 to 90x. Identifications were made using Ashmole & Ashmole (2000b, 2004), Basilewsky (1970, 1972, 1976, 1977) and Karisch (2001, 2003, 2007).

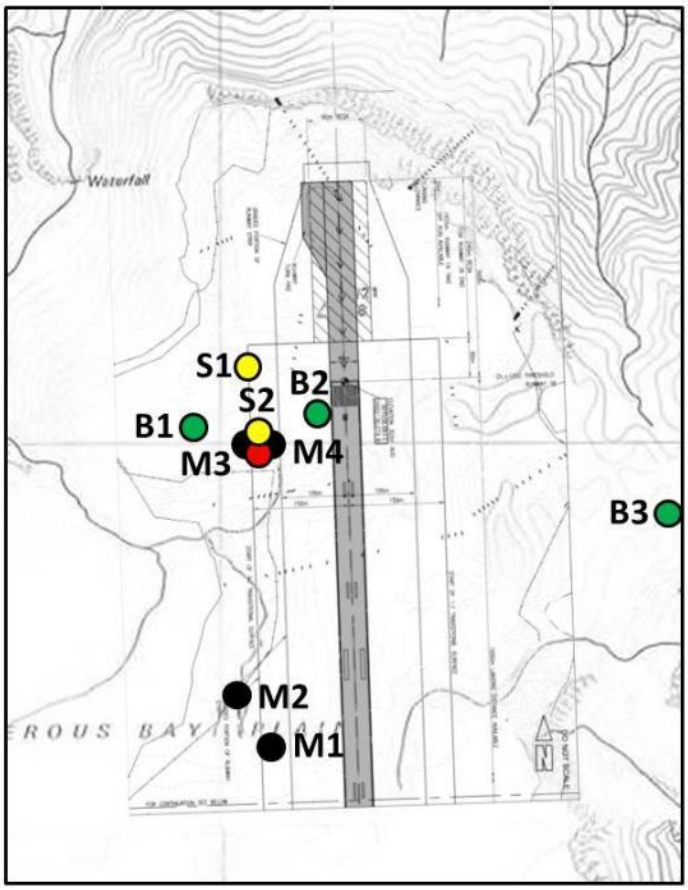

FIGURE 3 Map of the northern runway area with the fixed sampling points approximately located; Malaise traps 1-4 (black dots), pitfall traps (red dot), Berlese samples 1-3 (green dots), suction samples 1 and 2 (yellow dots).

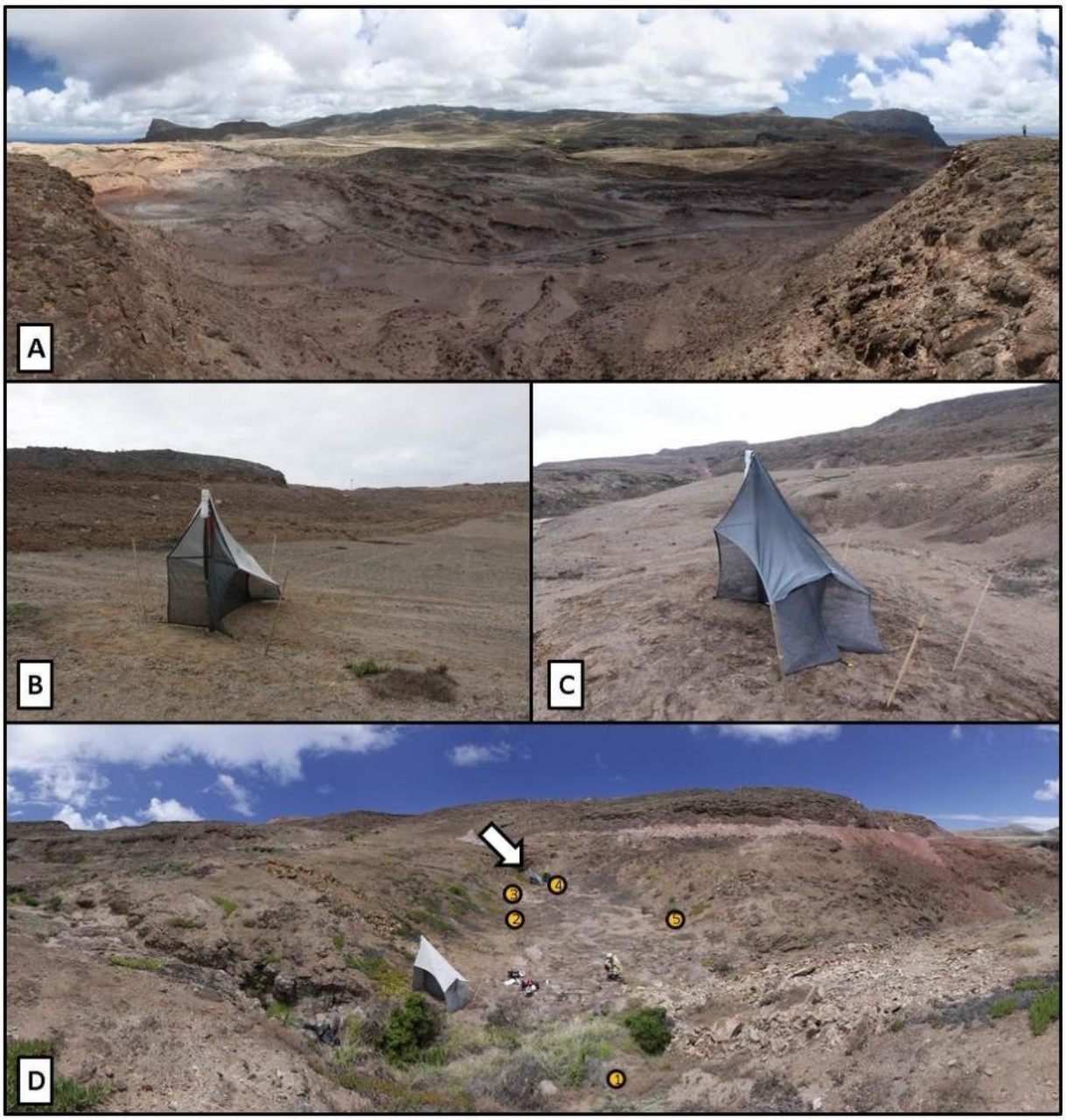

FIGURE 4 Sample sites.
A – General overview of the site, a panoramic view from south (left) to north (right) looking westward from 'Table Hill', the area known as 'The Dark Side of the Moon' in centre. B – Malaise trap 1, looking south-east. C – Malaise trap 2, looking north. D – Panoramic view of Malaise traps 3 (foreground) and 4 (white arrow) looking east with pitfall trap locations (numbered yellow circles); the grass and Wild Coffee bushes in the foreground were the location of suction sample 2.

2.2 PLANT AND LICHEN SURVEY

Plants and endemic lichens were surveyed across the site at the points indicated in Figure 1, generally from south to north. Each west-to-east transect was given a letter from A in the south to T in the north and a number starting at 1 in the west, increasing stepwise eastwards to a maximum of

9 (see Appendix 2a for a list of site locations and Appendix 2b for a diagrammatic representation of their numbers). Along the runway centre line and to the west the sites were surveyed on a 50 metre grid out to 150 metres, the approximate extent of the ADA, with extra points added beyond if the ADA extended markedly beyond this point. An extra point at 80 metres west was added into the southernmost transect as construction work in this area meant that much of this area had already been lost. The 150 metre west point at chainage 700 could not be surveyed due to health and safety considerations. The southernmost transect is at runway chainage 1100 and the northernmost at chainage 100.

The main aim of the survey was to assess any impact to the edge of Prosperous Bay Plain as this has been highlighted as one of the most important areas for biodiversity on St Helena. Surveying to the east of the runway centre line was started off at a 50 metre grid, but it quickly became apparent that this would involve considerable extra time, consequently it was postponed to concentrate on the runway centre line and western side, the eastern area was surveyed afterwards using a 100 metre grid.

Hand held GPS set to the UTM coordinate system was used to locate the precise 50 metre chainage points; it was then possible to measure outwards due east or due west. As the runway is orientated approximately 2° off a due north alignment and the east-west transects are on a 90-270° alignment there is a slight skew to the survey grid.

After navigating to a survey point a marker was placed on the ground. The species of plant and identifiable lichens (paying particular attention to endemic species) occurring within 20 metres of the marker were noted and their abundance recorded using the semi-quantitative DAFOR scale (Dominant, Abundant, Frequent, Occasional, Rare). A key aim of the survey was to quantitatively record the density of the scarce endemic lichen *Dimelaena triseptata*. The first time this species was found at a survey point a circular 1m² quadrat was placed over it; the greatest length of each colony present was then measured using a calliper and recorded. Four further quadrats were then surveyed in the same manner by pacing 10 metres north, east south and west from the initial point of discovery. A schematic representation of this methodology, to scale, is given in Figure 4.

Three minor problems were encountered during the survey. Firstly, annual grasses were growing during the survey; at the start it was not possible to identify small plants to species level; these only became possible to identify as the survey moved northwards. Secondly, English Tungi (*Opuntia ficus-indica*) may have been overlooked in the southern area in very small specimens as its presence was first noted only when large specimens were encountered. Thirdly, it is possible that Green Saltbush (*Atriplex suberecta*) was overlooked, some small plants that could have been this species being recorded as Common Saltbush (*Atriplex semibaccata*).

Where identification was not immediately apparent higher plants were identified using Lambdon (2012), bryophytes with Wigginton (2012) and lichens with Aptroot (2012).

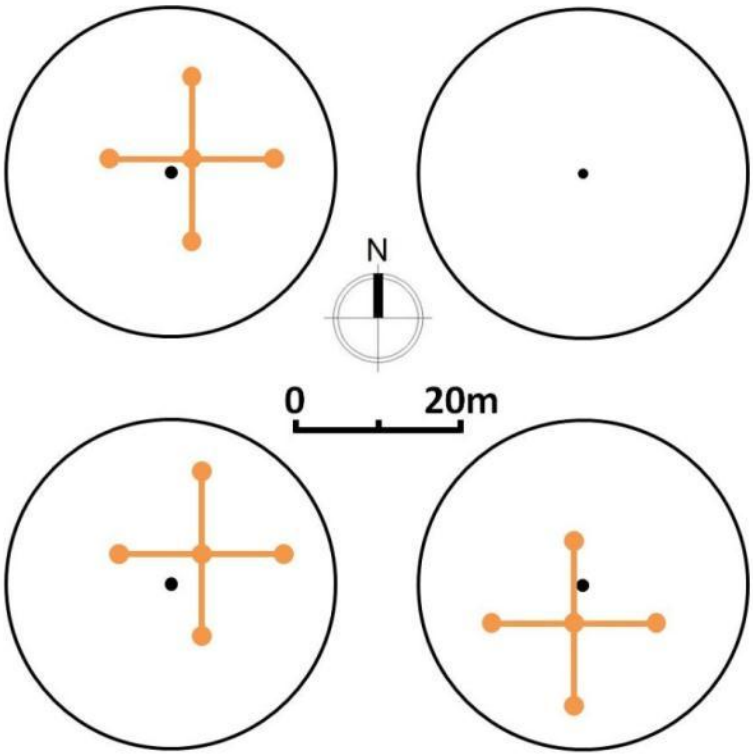

FIGURE 5 Schematic illustration of the plant and lichen survey coverage (to scale) with site centroids (black dots), 20 metre search zone around them and *Dimelaena triseptata* survey (orange cross) from first point of observation, when present, (centre of cross) and observations 10 metres N, E, S and W.

3 RESULTS

3.1 INVERTEBRATE SURVEY

A total of 2820 specimens were collected or observed during the survey, these were referable to 125 species of which 27 (21.6%) were endemic species, with 8 of these (6.30%) being from endemic genera. Additional endemic species may well be present among the unidentified species (chiefly small parasitic wasps and mites) but these would have required specialist knowledge and skills to identify. A complete species list, including details of their island status, scarcity, the number of specimens recovered and the number of samples they were present in is presented in Appendix 3. The most important invertebrates found are discussed separately below.

3.1.1 *LIMNOPHORA HELENAE* PONT, 1977 (HELENIAN MUSCID)

This endemic fly, originally described after the Belgian expeditions of the mid- to late-1960s (Basiliewsky, 1977) was by far the commonest species encountered; a total of 1124 specimens (39.86% of all specimens) were collected in Malaise traps during the survey period. The total number collected each week during the survey (assuming no effect resulting from moving the traps after week one) rose steadily:

Week 1 – 140.
Week 2 – 227.
Week 3 – 292.
Week 4 – 482.

It is interesting to note that over this period, while numbers increased, the number of females decreased as a proportion of the population as a whole (Figure 6). This is quite an important observation as there is very little data indicating seasonality among the invertebrate fauna on St Helena; however, it is also possible that this is an artefact of differences in behaviour between the sexes rather than seasonality.

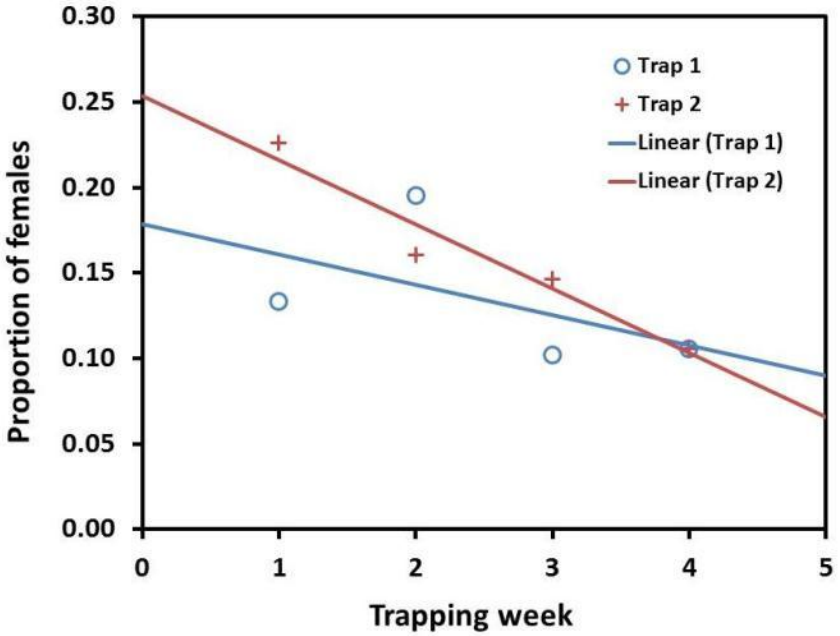

FIGURE 6 Decrease in the proportion of females in the population of *Limnophora helenae* over a four week period, an indicator of seasonality on St Helena?

3.1.2 CURCULIONIDAE (WEEVILS)

Five species of weevil were detected during the survey, four of which are endemic at the generic level. Two endemic species (*Acanthinomerus armatus* and *Microxylobius westwoodi*) are very common and widespread being found chiefly on Samphire (*Suaeda fruticosa*). The other two endemic species are scarcer although not rare; they are both in the genus *Acanthinomerus*. *A. angustus* has been found from Flagstaff and The Barn, through Peak Dale to Joan Hill on Gumwood (*Commidendrum robustum*) and Scrubwood (*Commidendrum rugosum*). During this survey two specimens were found in a piece of dead Scrubwood and a further specimen was extracted from Berlese sample 3. *A. similis*, which is slightly more common than *A. angustus*, has been found primarily on Gumwood and less frequently on Scrubwood; two records from the Peaks survey (Mendel *et al*., 2008) are from Cabbage Tree road and Mount Actaeon so it is presumably also able to utilise other species.

One interesting non-native species of weevil trapped during the survey in Malaise traps 3 and 4 deserves to be put on record as it appears to be very poorly known, this is the ceuthorhnchine *Pericartius aequatorialis* (Hustache, 1934) of which there appear to be no known images on the internet; a photograph of three males is given in Figure 7A. This species was first recorded during the Belgian expeditions (Basilewsky, 1972) with 23 specimens being collected from lower Rupert's Valley, Prosperous Bay Plain and the lower valley near Sandy Bay; Ashmole & Ashmole (2008) found it at Lower House Plain below Peak Dale Gumwoods.

3.1.3 *TARPHIOPHASIS LELELUPI* ARDOIN, 1972 (LELELUP'S DARKLING BEETLE) AND *CTENOLEPISMA SANCTAEHELENAE* WYGODZINSKY, 1970 (VIOLET-MARKED SILVERFISH)

These two scarce endemic species were found to be moderately common during the Dry Gut Open Channel invertebrate survey (Pryce, 2013a); they were found twice during the current survey and were both present together each time. While conducting the initial site walk-over along the western edge of the site it was noted that an area of the endemic lichen *Dimelaena triseptata* was about to be covered by fill; a selection of these colonies were removed to safety at the edge of the ADA. During a later visit it was noted that the final edge of the fill had been marked by posts and that this lichen would again be at risk of being covered. While lifting the material to take it outside the marked area five female *T. leleupi* and a single male and female *C. sanctaehelenae* were found underneath.

After completion of the main survey a site visit was made to map the Scrubwood populations along the eastern edge of the site; while turning over stones to see if any further species could be found these two species were again found together. As they were found nowhere else across the site it is important to record their precise locations:

Western site:	WGS84 UTM 0216616 8234087, 15°57.384'S 005°38.837'W, 307m alt.
Eastern site:	WGS84 UTM 0217037 8234253, 15°57.298'S 005°38.600'W, 313m alt.

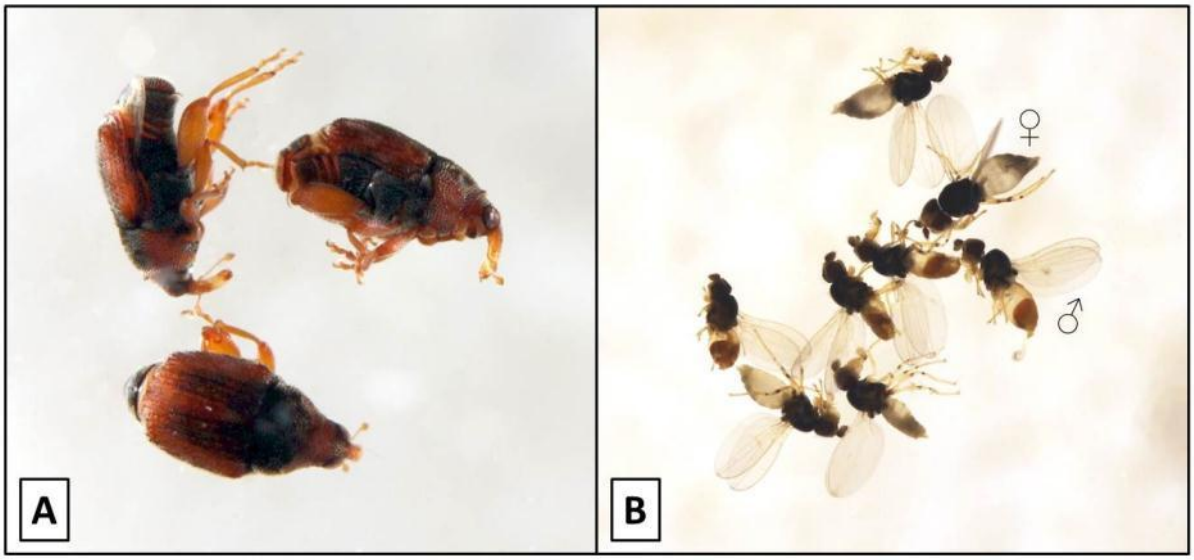

FIGURE 7 A – the non-native Short-winged Weevil *Pericartius aequatorialis*; B – the endemic asteiid fly *Anarista vittata*, male and female indicated.

3.1.4 *ANARISTA VITTATA* SABROSKY, 1977 (ST HELENA GRASS FLY) (FIGURE 7B)

A total of 33 specimens of this species were collected during the survey. The first female was collected in Malaise trap 2 between 20th and 27th February. In Malaise trap 3 a single female was collected between 27th February and 6th March; a further four males and four females were collected between 13th and 20th March. In Malaise Trap 4 one male and one female were collected between the 6th and the 13th March with a further 6 males and 8 females caught between the 13th and 20th March. It was only in this last week when significant comparative male and female material was available that the earlier material could be assessed and specimens assigned to their relevant sexes. During the suction sampling on 6th March both samples yielded specimens of this species, a single male from suction sample 1, three males and three females from suction sample 2.

Prior to 2013 this species was known from only two specimens collected during the second Belgian expedition to the island: one male from the irrigated area of Fisher's Valley on 26th January 1967 and one adult of indeterminate sex from lower Rupert's Valley on 13th May 1967 (Basilewsky, 1977). During the invertebrate and lichen survey for the Dry Gut Open Channel a third female specimen was collected from an area of rough grass by suction sampling on 20th May 2013 (Pryce, 2013a). A further female was collected on Rupert's Hill from a Malaise trap near an area of Fountain Grass tussocks between 25th December 2013 and 4th January 2014 (Pryce, 2014).

Following completion of the previous surveys in this region (Pryce 2013a, 2014) the precise habitat of this species was in some doubt as this particular group of flies is rather obscure and poorly studied. It is believed that the asteiid flies are primarily scavengers on the frass (pelletized excretia) of other invertebrates (Sabrosky, 1987). From the data known of this species to date we can tentatively conclude the following:

- It is often associated with or extracted from patches of grass in a desert environment.
- The full range of grasses preferred is unknown; while being caught in a Malaise trap near African Fountain Grass (*Pennisetum setaceum*) (Pryce, 2014) it was not suction sampled from nearby Crooked Awn Grass (*Bothriochlora radicans*). The grass this species was suction sampled from is not recorded in Pryce (2013a).
- The main grasses this species was encountered near or extracted from during this survey were Tropical Finger Grass (*Digitaria ciliaris*), Slender Finger Grass (*Digitaria violascens*), Fishbone Grass (*Eragrostis cilianensis*) and Bur Grass (*Tragus berteronianus*). The *Eragrostis* and *Tragus* plants encountered were generally quite small and so are unlikely to be the preferred habitat. The Tropical Finger Grass (possibly native) was well established at one site and the other species of this genus (naturalised) was present at the other.
- Being that fly larvae (maggots) are generally thin-skinned it is probable that this species prefers a particular humidity regime or substrate structure which seems to be provided by non-native species, consequently this species is probably less threatened than its apparent rarity suggests.

It should be noted that neither the Belgians (Basilewsky, 1977) nor Ashmole & Ashmole (2004a) used either Malaise traps or suction sampling in this part of the island.

3.1.5 *SCENOPINUS* SP. (PROSPEROUS WINDOWFLY)

This probable new species was first detected by Philip and Myrtle Ashmole (Ashmole & Ashmole, 2004a, 2004b); it is superficially similar to the familiar household windowfly *Scenopinus glabrifrons* (Meigen, 1824) but actually belongs to a different group and is closer to *Scenopinus canarius* Kelsey, 1969. It can easily be distinguished by its orange legs (black in *S. glabrifrons*). The Ashmoles found the species at eight sites, two of which have been lost to the airport development; the other sites include several on Prosperous Bay Plain, the edge of Tungi Flats and Horse Point.

Very little is known of the ecology of this group of insects, although the larvae are all believed to be predacious with records of them feeding on the larvae of dermestid beetles, lice and the larvae of fleas in bird's nests, bark infesting beetle larvae and one record from a termite nest (Kelsey, 1969). Ashmole & Ashmole (2004b) speculate that that it is probably a predator on the larvae of tineid moths or possibly beetle larvae.

3.1.6 *HOLEPYRIS ATLANTICUS* BENOIT, 1977 (ATLANTIC CURVE-VEIN WASP)

This bethylid wasp (Figure 8A) was originally described by the Belgians having been found during the second expedition. One male was collected at Prosperous Bay Plain (with no further details as to precise locality) on 25th February 1967 and a female was collected near South West Point at an approximate altitude of 520m on 8th March 1967. Ashmole & Ashmole (2004) encountered this species at their site numbers 8 ('Samphire Plain' in the west central basin) and 11 ('Government Garage Flat'), the number of specimens not being recorded.

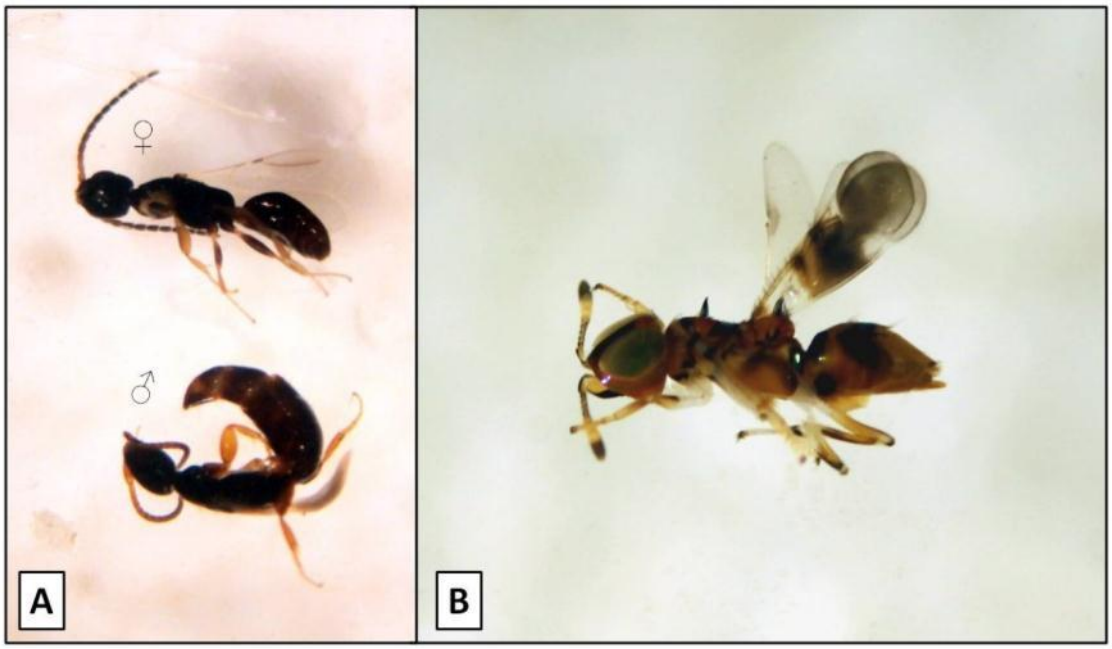

FIGURE 8 A – the bethylid wasp *Holepyris atlanticus*, male and female indicated, note antennal differences; B – the encyrtid wasp *Diversinervus elegans*.

In the present survey three females were initially collected in Malaise trap 1. When the Malaise traps were relocated, specimens were collected by both traps in each of the three weeks they were operational; a breakdown of the specimens trapped is:

Week	Malaise 3	Malaise 4
2	3 females	3 females
3	8 females	2 males, 12 females
4	2 males, 7 females	1 male, 11 females

As the numbers of specimens collected in weeks one and two was so low (a fact that could be put down to the effects of weather) it is impossible to say if any seasonal effects are operating.

3.1.7 HYMENOPTERA AND ACARI (MITES)

The parasitic hymenoptera recovered during this survey were particularly diverse, a fact accounted for by the use of Malaise traps which are particularly good at trapping this group which is often missed using other collection techniques due to their small size. It was possible to put names to some species like the Spike-backed Wasp *Diversinervus elegans* (Silvestri, 1915) (Figure 8B) and it was also possible to determine a few others to generic level like *Anagyrus* sp. which appears to match the very brief description by the Belgians ('*scape noir*, *blanchi distalement*; *pédicelle et une funicule blancs* (*jaunissant dans la potasse*); *massue jaunâtre*', Basilewsky, 1977). There are, however, a total of 15 species where it has been possible to assign them to a family at best, most being recorded as morphotypes (*e.g.* 'Trichogrammatidae sp. – hairy antennae, rounded wings with small spot'). There will undoubtedly be undescribed endemic species amongst this rump of unidentified material and entomologically it should be considered a priority to work on this group.

There is a similar situation with the mites. The discovery of the large, easily identified endemic Sculptured Black Mite *Liodes lanceosetosus* Wallwork, 1977 in Berlese sample 3 (Scrubwood) indicates that more endemics should be present. This species has since also been found at 'Tea Plant Gully' by Lourens Malan, on Scrubwoods at the base of The Barn by Mikko Paajanen and by the primary author on Samphire in lower Bank's Valley. One other species present looks very like *Scheloribates deficiens* Wallwork, 1977, a species described from the 'High Central Ridge', Mount Actaeon and High Peak; as a result of the extreme difference in habitat this could well represent another undescribed endemic species.

3.2 PLANT AND LICHEN SURVEY (BY MIKKO PAAJANEN)

3.2.1 GENERAL PLANT AND LICHEN SURVEY

A total of 104 points were surveyed for their plants and lichens; 35 taxa were recorded although the true figure is probably higher as the lichens *Ramalina* and *Roccella* were only recorded at generic level, both of which have endemic and native species. Of these species three were endemic: Babies'-toes (*Hydrodea cryptantha*) and the lichens *Dimelaena triseptata* and *Dermasticum pusillum*. A total of five species were native, two probably native, five possibly native and 18 non-native (51.4% of the species found). The most important species are discussed separately below.

Endemic species

These species, unique to the island of St Helena, and thus of great national and international importance, should be prioritized in mitigation and remediation work.

Babies'-toes (*Hydrodea cryptantha*)

Rare and scattered. An annual species restricted mainly to the southern and western semi-desert and coastal areas of the island. It would be very good in restoration but has been difficult to grow in nurseries.

St Helena Tea Plant (*Frankenia portulacifolia*)

Extremely rare. Not actually found during the strict part of the survey but noted at various sites on the sea cliffs, especially at 'Tea Plant Gully' where approximately 35 plants are present (WGS84 0216977 8234096, 15°57.382'S 005°38.634'W, 317m alt.). The small population at Prosperous Bay Plain is one of the few remaining wild populations of this species and is thus of great importance. It is good for restoration in the dry areas and is not too hard to grow in nurseries situated in dry locations. It could be used as an ornamental species in airport landscaping although the stems are very fragile and break easily.

Old-father-live-forever (*Pelargonium cotyledonis*)

Very rare. Not found during the survey in the strict sense but known from the adjacent sea cliffs. Good for remediation, could be used as an ornamental species in airport landscaping.

Scrubwood (*Commidendrum rugosum*)

Scattered populations on the south, west and north side of the island, mostly on cliffs and dry sparsely vegetated areas. Very good for restoration, easy to grow and ornamental. High ecological importance. Stems are fragile and break off easily. One specimen on 'Table Hill' that fell between survey points has since been lost to airport construction.

Dimelaena, *Dermasticum* and *Ramalina*

The endemic and native lichens can have a great ecological role in their habitats and in some parts of the site form the principal vegetation. They appear to support several species of the endemic tineid moths of the genus *Opogona* (Pryce, 2013a).

Native species

These species are native to St Helena and are thus good for remediation work.

Ramalina, *Roccella* and Golden Hair Lichen (*Telochistes flavicans*)

These species have a big ecological role in their habitat and also appear to support tineid moths of the genus *Opogona* (Pryce, 2013a). These species are important in airport remediation work, in addition Golden Hair Lichen is very ornamental. One important outcome of the airport development is that quite large areas of new rock face have been created along with banks of fill, essentially putting back portions of the landscape to a 'blank slate' state. An important part of

future monitoring work will be to record the natural regeneration and how well the lichen remediation works.

Samphire (*Suaeda fruticosa*)

This native species is a good ground cover. It harbours a fairly good endemic invertebrate fauna. This is one of the most important and useful native species for the revegetation of the airport site.

Purslane (*Portulaca oleracea*)

An annual species. Perhaps an endemic variety to St Helena, it is very widely distributed on the island in open and disturbed areas. It has a very wide distribution world-wide. A good plant for remediation and a known food source to the native diadem butterfly *Hypolimnas misippus*.

Lily fern (*Ophioglossum polyphyllum*)

Potentially present on most dry coastal slopes, this is an ephemeral species that sprouts when optimal growth conditions occur. While not encountered during the plant survey in its strict sense a colony of 54 plants was noted at the top of the eastern sea cliffs towards the north of the site (WGS84 0216885 8234813, 15°56.992'S 005°38.681'W, 312m alt., see Figure 9 for map). It is an interesting species that is probably rather hard to cultivate.

Probably native species

These species are probably native and can be used in remediation

Pagoda plant (*Cotula coronopifolia*)

An annual. It has a rather wide world distribution and grows mostly in marshy situations but on St Helena it is special in that here it seems to prefer dry rocky situations. Germinating after heavy rains, mostly in the winter time. It could be a good plant for temporary gullies.

Fish-bone grass (*Eragrostis cilianensis*)

An annual species with a world-wide distribution in the tropical and warm-temperate regions of the Old World. It grows in sparsely vegetated dry areas, germinating after rainy periods, mostly during the winter time.

Possibly native species

The following species might or might not be native. These shouldn't be prioritized in remediation work as many of these can potentially outcompete endemic and native plant species that have a higher ecological and conservation value. Most of these species have a wide distribution on the island and will most probably find their way to restoration sites by themselves.

Ice Plant (*Mesembryanthemum crystallinum*);
Field Sedge (*Cyperus polystachyos*);
Tropical Finger Grass (*Digitaria ciliaris*);
Coastal Cup Grass (*Eriochloa procera*);

Cape Grass (*Sporobolus africanus*).

Invasive species

The following species are particularly invasive and should be considered as a priority for removal from the site.

Lantana (*Lantana camara*);
Red Tungi (*Opuntia elatior*);
White Tungi (*Opuntia ficus-indica*);
Wild Coffee (*Chrysanthemoides molinifera*);
Wild Mango (*Schinus terebinthifolius*);
Willow (*Acacia longifolia*).

3.2.2 SEA CLIFF ENDEMIC PLANT SURVEY

Populations of endemic plants along the eastern edge of the survey area were mapped using hand-held GPS and the number of individuals present was counted; a list of the site coordinates and numbers counted is given in Appendix 4D.

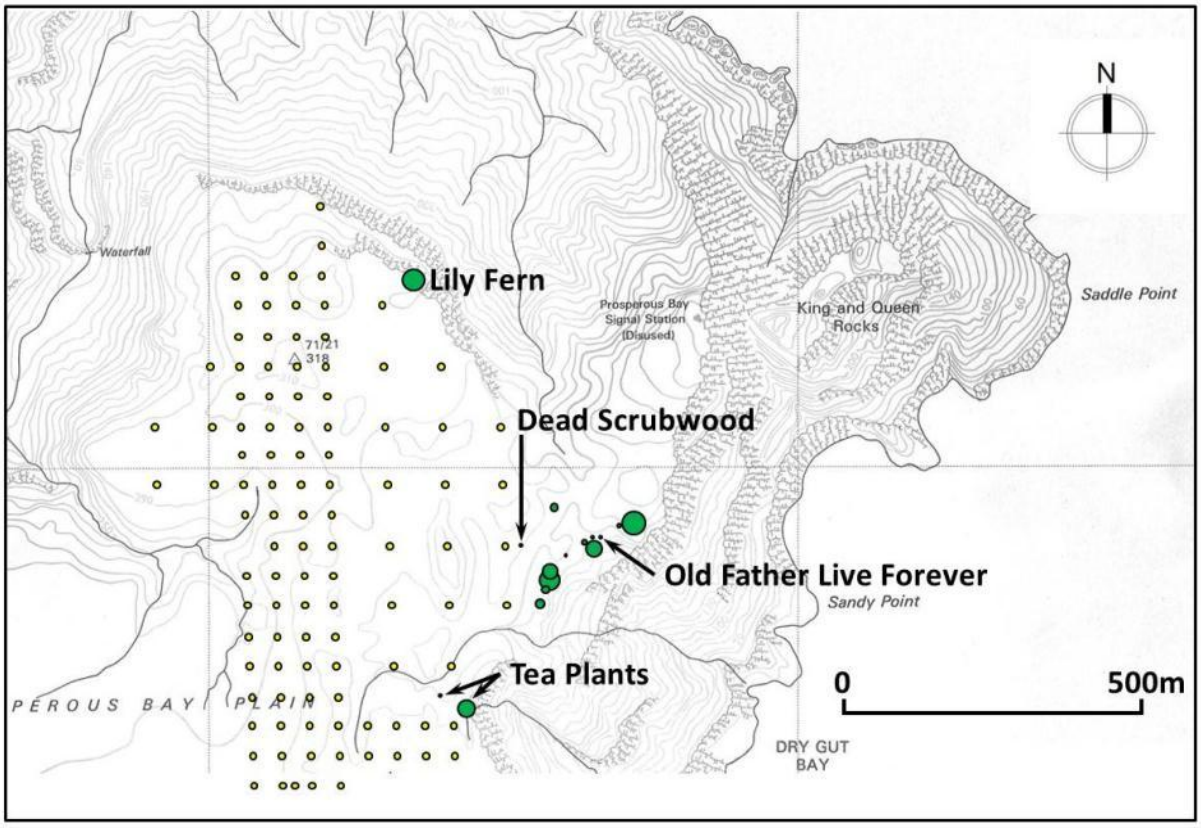

Figure 9 Locations of endemic plants along the eastern sea cliffs in relation to the vegetation survey sites with Scrubwood (*Commidendrum rugosum*) mapped in green and other species indicated; number of plants in each population represented by the area of the circle.

The most common endemic plant along the cliffs is Scrubwood (*Commidendrum rugosum*) with 193 living plants being counted; these are shown as green circles on Figure 9, the area of the circle being proportional to the number of plants found. A single dead specimen away from and separate to the main stands was also mapped. Plans are already in place to minimize damage to the Tea Plants (*Frankenia portulacifolia*) in the south of the survey area, although the poor condition rock above these plants, particularly on the southern side, has meant that a number of rock falls have already occurred and several plants have been damaged. The single accessible Old Father Live Forever (*Pelargonium cotyledonis*) known from the area was found to have died.

3.2.3 *DIMELAENA TRISEPTATA* SURVEY

The lichen *Dimelaena triseptata* was found to be common across the site with a total of 2246 colonies being measured as a part of the quantitative survey (an average of 21.60 colonies per site or 4.32 per quadrat). The species was found to be present at 79 and absent from 25 of the 104 sites.

Figure 10 shows the recorded *Dimelaena triseptata* information plotted in four separate ways:

A, the number of quadrats per site;
B, the total number of colonies per site;
C, the average number of colonies per quadrat;
D, the average colony size.

It can be seen that while there is a degree of clustering in the data there are no obvious survey-wide trends. On the ground it seemed that there was less *Dimelaena* present at the extreme southern end of the survey, however, this could not be quantified as a result of the large amount of disturbance that had already taken place. In graph C it is suspected that the apparent trend for there to be a higher number of colonies per quadrat along the 100 metres east line is an artefact of the data. *D. triseptata* was only found at one of the four easternmost sites and it was noted that this species was either very scarce or absent beyond this point.

Taken together the data suggests that nearly the entire site is prime habitat for this species, however the survey would have to be extended into Prosperous Bay Plain in order to demonstrate this clearly. As variation over short distances can be so great this would have to be done on a 50 metre grid; as can be seen here the 100 metre grid employed on the eastern side of the runway is too coarse to capture the spatial variation that is visible in the west.

An interesting finding was the growth of *D. triseptata* as a soil crust in the area known as 'The Dark Side of The Moon' (Figure 11A, orange speckling approximately 30 cm to the right of the radio, close-up Figure 11B). This proved particularly easy to rescue as the soil crust with lichen could simply be scraped off with a spade. The rocks in this area are particularly acidic and bearing in mind the difference in microhabitat, substrate and form it is possible that this may constitute a previously unrecognised taxon.

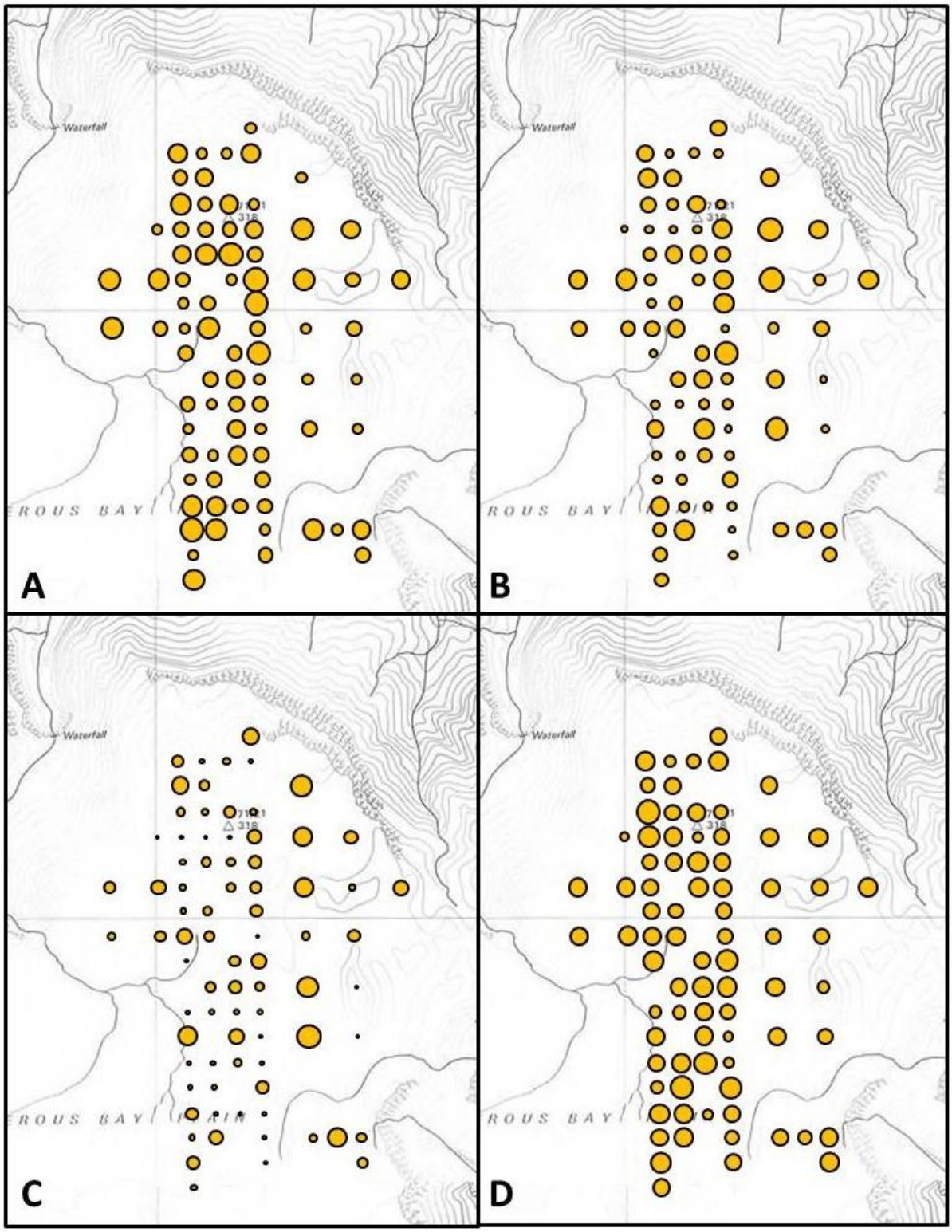

Figure 10 *Dimelaena triseptata* quantitative survey results.
A – number of quadrats in which *Dimelaena* was found (range: 1-5); B – Total number of *Dimelaena* colonies per site, note: represented by the *area* of the circle (range: 1-151); C – average number of colonies per quadrat (range: 1-56.5); D – average size of colony (range: 3.40-25.22 mm).

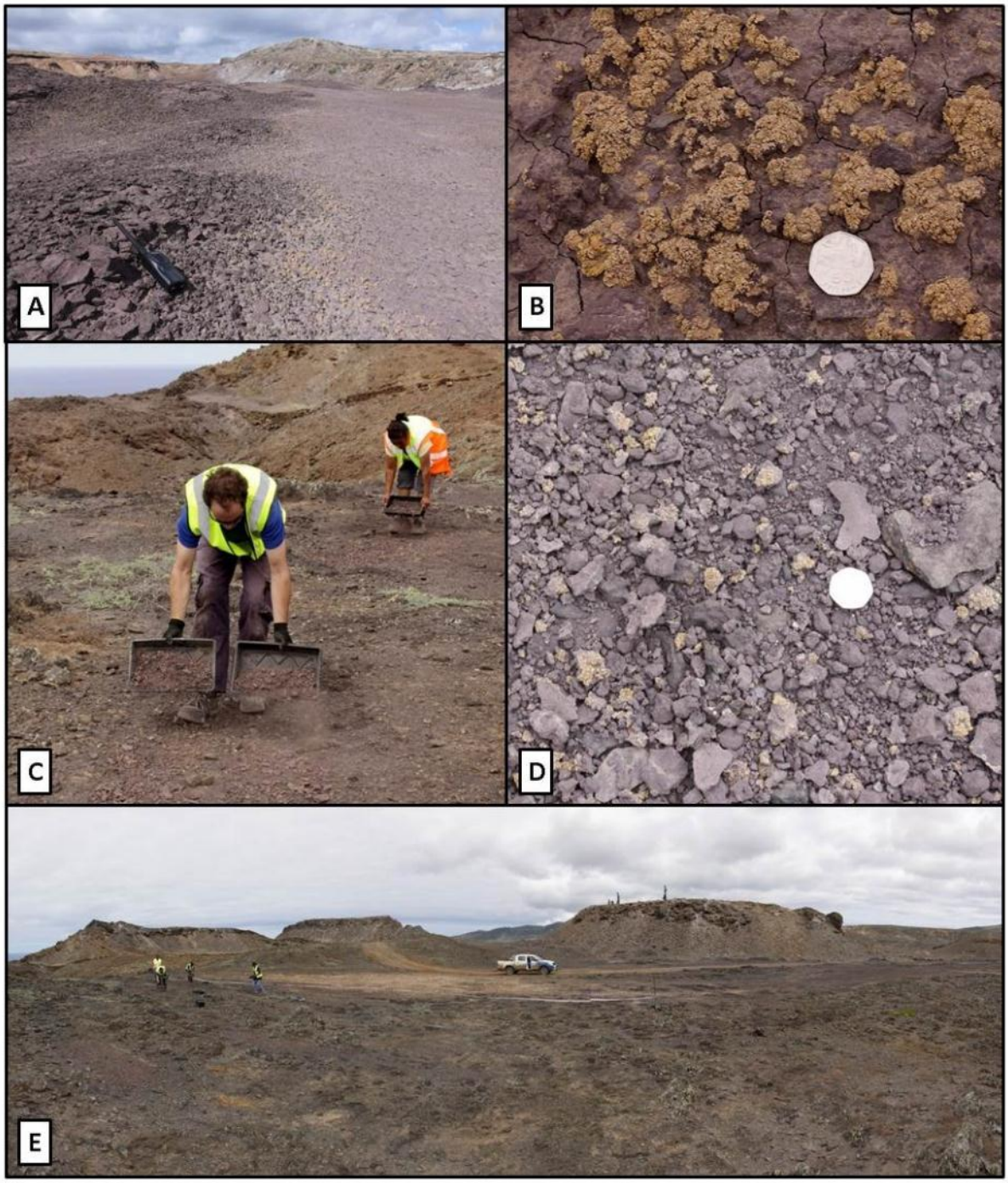

Figure 11 *Dimelaena triseptata* translocation.
A – *D. triseptata* soil crust at 'The Dark Side of The Moon'; B – close-up of soil crust; C – scattering soil crust at the storage site; D – close-up of soil crust at the storage site; E – panoramic view of the storage site.

3.3 OTHER COMMENTS

An interesting point noted during the survey was the low number of invertebrate predators present in the area; no evidence was found of the Blue-headed Centipede (*Scolopendra morsitans*) or the Lesser Brown Scorpion (*Isometrus maculatus*) and only two specimens of the large spider *Xeropigo*

tridentiger were found under the ring of stones surrounding the triangulation point near chainage 400, 50 metres east. The only significant vertebrate predator found was the Java Gecko (*Hemidactylus frenatus*) with three being found within about a 100 metre radius of the same location.

One interesting archaeological find consisted of two joining fragments of six-inch shell that would have been fired from Ladder Hill Fort at WGS84 0216720 8233997, 15°57.433'S 005°38.779'W in an area where the soil had been raked over by machine; these have been passed to Rob Kleinjan.

Near the triangulation point at WGS 0216695 8234674, 15°57.066'S 005°38.789'W is apparently the only remaining *in situ* cable support and insulator from the Signal Station wire from King's and Queen's Rocks. This should be documented and removed carefully, preferably in consultation with Museum staff.

3.4 ANALYSIS OF SAMPLING EFFECTIVENESS

Sampling effectiveness was assessed using EstimateS v.9.1.0 statistical software for analysis of species richness and shared species (Colwell, 2013). This program produces a synthetic species accumulation curve from the data collected. It is then possible to take the generated curve and fit a trendline in Microsoft Excel and, using the associated R^2 and trendline equation, estimate the effectiveness of the survey.

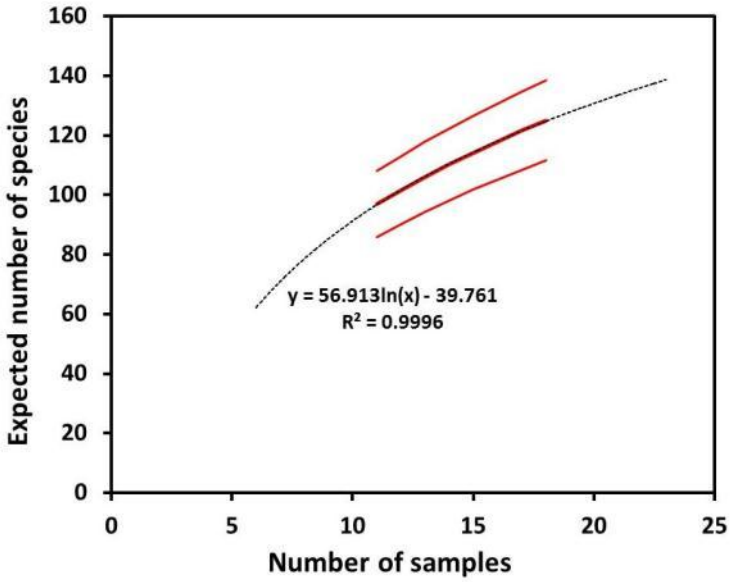

FIGURE 12 Invertebrate survey synthetic species accumulation curve and 95% confidence limits generated by EstimateS with logarithmic trendline, associated equation and R^2 value.

The synthetic species accumulation curve generated from the invertebrate data collected in this survey is shown in Figure 12 (thicker red line) with 95% confidence limits (thinner red lines) with the associated logarithmic trendline generated from the last eight of the 18 data points.

The formula for the trendline can now be used to predict the number of taxa that would be recovered if additional work were undertaken. If a 'survey' is defined as 18 samples, the calculated figures for the number of taxa that should be recovered by repeating this survey with identical methodology multiple times is given in Table 1.

It can be seen that the amount of effort necessary to double the number of taxa recovered would have been just over nine surveys (approximately 163 samples). This is considerably higher than that of the Dry Gut Open Channel survey (Pryce, 2013a) where it would have been necessary to repeat just over four surveys of 22 samples each (approximately 90 samples) in order to obtain the same increase and the Rupert's Hill survey where between six and seven surveys of nine samples each (approximately 56 samples) would have been required to achieve the same. This indicates that this survey was quite effective as it would require a lot more effort to significantly increase the number of taxa found. This is explained mainly by the use of Malaise traps which are particularly effective at trapping flying insects and, being present on site continuously, trap species that may be active when the surveyor is not present.

NO. SURVEYS	PREDICTED NO.TAXA	% INCERASE
2	164.19	31.35
3	187.26	49.81
4	203.64	62.91
5	216.34	73.07
6	226.71	81.37
7	235.49	88.39
8	243.09	94.47
9	249.79	99.83
10	255.79	104.63

TABLE 1 EstimateS prediction of taxon diversity increase for the invertebrate survey by multiplying survey effort.

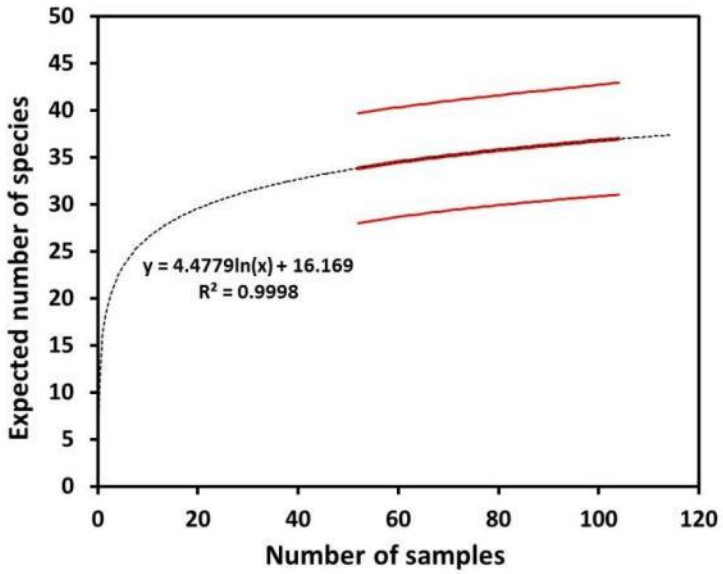

FIGURE 13 Plant and lichen survey synthetic species accumulation curve and 95% confidence limits generated by EstimateS with logarithmic trendline, associated equation and R^2 value.

NO. SURVEYS	PREDICTED NO.TAXA	% INCERASE
2	40.07	8.30
3	41.89	13.20
4	43.17	16.69
5	44.17	19.39
6	44.98	21.29
7	45.68	23.46
8	46.28	25.07
9	46.81	26.50
10	47.28	27.78

TABLE 2 EstimateS prediction of taxon diversity increase for the plant and lichen survey by multiplying survey effort.

If we complete the same analysis for the plant and lichen survey (Figure 13) it can be seen that a much flatter curve is produced. Indeed, by increasing the effort expended tenfold to 1040 samples it is predicted that an increase in the number of taxa found would only be 27.8% bringing the total to between 44 and 45 species. We can conclude therefore that this survey has been very thorough. The number of species would have been increased considerably if all lichen species had been included, however, the time implications of this would have made the survey as a whole untenable.

4 IMPACT OF WORKS ON ENDEMIC SPECIES

A - invertebrates

The impact of the works on endemic invertebrates in this area should generally be quite low. The species that are present have all been found at other sites and it appears that there will be no loss of unique habitat that would be of particular importance to them. While scarce and unusual species were found during the survey (*e.g. Anarista vittata*, *Holepyris atlanticus* and *Scenopinus* sp.) these all appear to occupy habitat that is scattered widely across this portion of the island. A key watching brief should be maintained to avoid the potential loss of Mole Spider habitat that lies immediately adjacent to the south-east point of the survey area.

While present across the site the larval and pupal cases of the undescribed tineid moths of the genus *Opogona* were found to be less common than in other areas of the island and no significantly different looking cases were found, as was the case during the Dry Gut Open Channel survey (Pryce, 2013a).

B – Plants and lichens

Nearly the whole of the surveyed area has been found to be good habitat for the scarce endemic lichen *Dimelaena triseptata*. While some material has been placed in storage for later remediation it

would be worth spending some more time removing further colonies into safe areas for later re-seeding.

The greatest risk during the construction phase at the north end of the runway is of damage to the populations of Scrubwood and Tea Plant along the eastern cliffs. When blasting in this area it is very important that the blasts are engineered as carefully as possible to minimize fly rock ejection to the east; the prevailing wind should usually keep dust from impacting these plants. If it is possible to use smaller but more frequent blasts in this area this should be encouraged in order to keep shock damage to a minimum.

5 MITIGATION AND REMEDIATION

5.1 MITIGATION

A small amount of the scarce endemic lichen *Dimelaena triseptata* was placed in storage to the west of the site at WGS84 UTM 0216614 8234087, 15°57.383'S 005°5'38.838'W, 311m alt. A total of 64 trays of soil crust bearing this species were removed from a roughly rectangular area in the part of the site known as 'The Dark Side of the Moon' at:

SW corner	0216797 8234247, 15°57.299'S 005°5'38.733'W, 317m alt.
SE corner	0216810 8234238, 15°57.302'S 005°5'38.727'W, 316m alt.
NE corner	0216865 8234357, 15°57.239'S 005°5'38.695'W, 314m alt.
NW corner	0216816 8234326, 15°57.255'S 005°5'38.724'W, 314m alt.

A further 16 trays of the same species growing on rocks were removed from around runway chainage 400, 100m east of the runway centre line. All of this material has been placed in storage to the east of the site in an area that will be unaffected by the works and where *Dimelaena triseptata* was found to be already present at 0217036 8234557, 15°57.081'S 005°5'38.598'W, 316m alt. Further collection of this species is to be encouraged should the opportunity arise.

The collection of seeds from endemic and native plant species across the site is also to be encouraged as and when individual species produce them.

5.2 REMEDIATION

The main endemic species to consider for replanting when undertaking remediation work in this part of the site are:

Scrubwood (*Commidendrum rugosum*);
Tea Plant (*Frankenia portulacifolia*);
Old Father Live Forever (*Pelargonium cotyledonis*);
Babies'-toes (*Hydrodea cryptantha*).

The stored *Dimelaena triseptata* lichen should be seeded onto the eastern part of the site only. This species has a preference for near-flat areas with a small amount of shelter; in Figure 11A which is facing due south the species can be seen to prefer the western side of the low ridge where it is sheltered from the prevailing south-easterly wind. The most hospitable area of the completed works for this species will be the newly created land surface immediately to the east of the cleared and graded area (CGA). When placing the lichen it is recommended that an experimental approach be taken similar to that proposed in Pryce (2013b). It is critical that this work is fully documented in order to assess its success, or otherwise, in the long term.

Other plants suitable for remediation work are the endemic, native and probably native plant species listed above in the vegetation survey results (Section 3.2.1). One of the best native species is Samphire (*Suaeda fruticosa*) as this has been established on the island for a long time and has several endemic invertebrate species associated with it.

It is also recommended that the wood from the single dead Scrubwood (*Commidendrum rugosum*) at WGS84 0217072 8234369, 15°57.234'S 005°38.579'W be collected and placed around other living plants, preferably around the larger nearby colonies. This material has previously been shown to contain flightless endemic weevils; translocation to a site with mature living trees will ensure that any genetic variation present in this isolated population will be retained within the population as a whole. This work is best undertaken by contractors with ecological experience in order to maximise the success of the work.

6 CONCLUSIONS

Despite the barren and inhospitable nature of the site it holds a diverse invertebrate fauna including many endemic species, some of which are apparently quite scarce. It is probable that these species are more widespread in the area as they are poorly studied and little is known of their ecology. Further endemic species are almost certainly present amongst the taxa that could not be identified to species level.

The scarce endemic lichen *Dimelaena triseptata* is present across the site in good numbers; there are fluctuations in density, probably associated with topographical differences, but there are no overall trends in density observable across the site other than a decrease at the far eastern edge of the survey area. Further lichen rescue work is recommended if possible.

The most important area for endemic plants is the upper portion of the eastern sea cliffs where Scrubwood (*Commidendrum rugosum*) and Tea Plant (*Frankenia portulacifolia*) are present. Care should be taken when engineering works are being undertaken in this area to minimize any impact on the populations that are present here.

The primary focus of remediation should be replanting with endemic and native species. The replacement of *Dimelaena triseptata* lichen should be conducted in a scientific manner with the work being carefully recorded to ensure that it can be monitored in the future.

ACKNOWLEDGEMENTS

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APPENDIX 1 DETAILS OF INVERTEBRATE SAMPLES TAKEN

Sample no.	Date	Methodology and location
1	06/12/2013	Hand searching from chainage 1100 to 800, 0-50m west
2	20/02-14/04	Casual observation and hand searching across site
3	20/02-27/02	Malaise trap 1
4	20/02-27/02	Malaise trap 2
5	27/02-06/03	Malaise trap 3
6	06/03-13/03	Malaise trap 3
7	13/03-20/03	Malaise trap 3
8	27/02-06/03	Malaise trap 4
9	06/03-13/03	Malaise trap 4
10	13/03-20/03	Malaise trap 4
11	27/02-06/03	Pitfalls around Malaise traps
12	06/03-13/03	Pitfalls around Malaise traps
13	13/03-20/03	Pitfalls around Malaise traps
14	27/02	Berlese extraction 1: Samphire
15	20/03	Berlese extraction 2: Wild Mango
16	27/03	Berlese extraction 3: cliff Scrubwood
17	20/04	Suction sample of grass and Samphire at chainage 450, 150 m west
18	20/04	Suction sample of vegetation around Malaise trap 3

Locations (GPS readings with WGS84 spheroid):

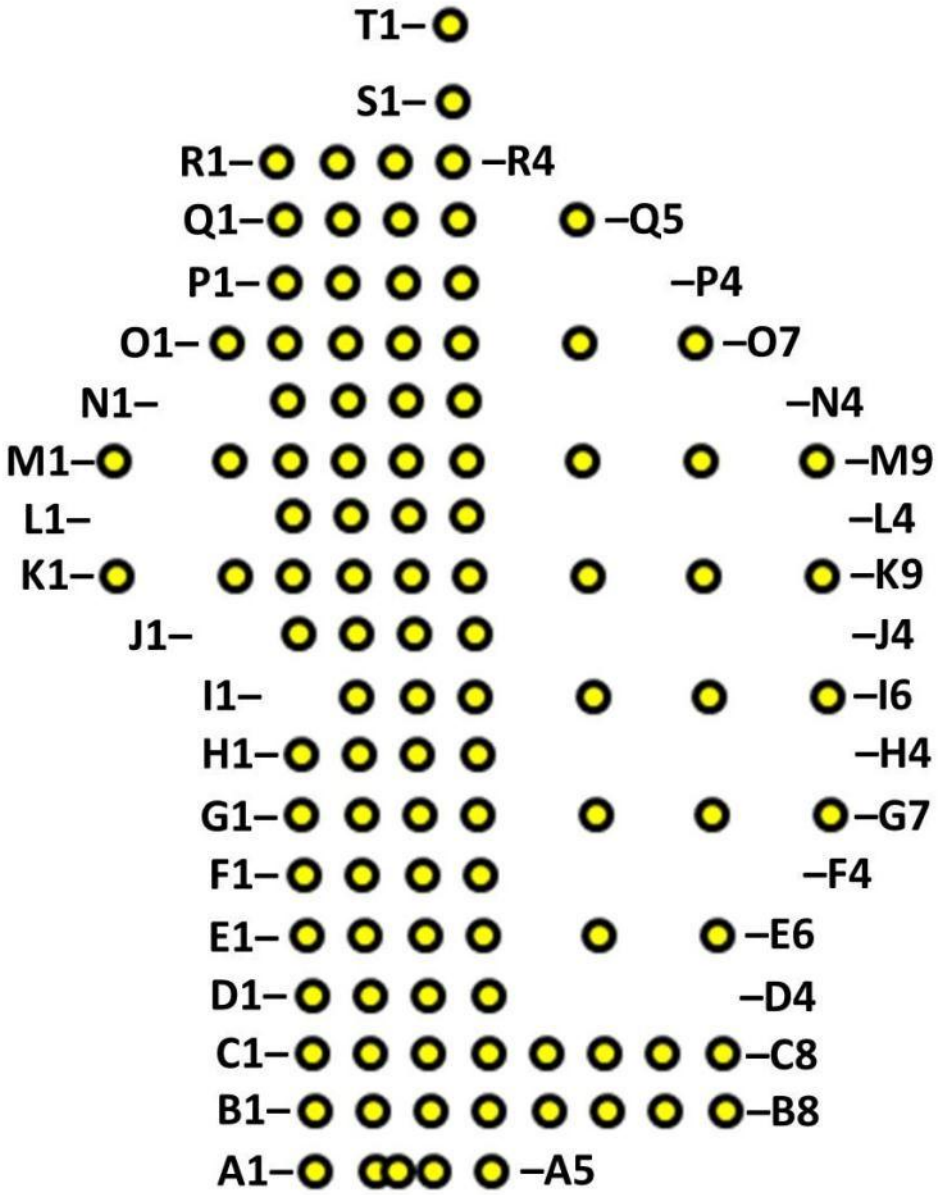
Sample	UTM	dd mm.mmm	Altitude
Malaise trap 1	0216632 8234053	15°57.402'S 005°38.827'W	309m
Malaise trap 2	0216675 8234147	15°57.351'S 005°38.860'W	297m
Malaise trap 3	0216625 8234440	15°57.193'S 005°38.830'W	299m
Malaise trap 4	0216649 8234428	15°57.199'S 005°38.815'W	299m
Pitfall trap 1	0216617 8234436	15°57.194'S 005°38.833'W	299m
Pitfall trap 2	0216633 8234434	15°57.196'S 005°38.824'W	299m
Pitfall trap 3	0216640 8234433	15°57.197'S 005°38.821'W	299m
Pitfall trap 4	0216651 8234424	15°57.202'S 005°38.814'W	299m
Pitfall trap 5	0216627 8234425	15°57.201'S 005°38.828'W	299m
Berlese 1	0216543 8234448	15°57.187'S 005°38.875'W	304m
Berlese 2	0216738 8234448	15°57.178'S 005°38.765'W	304m
Berlese 3	0217166 8234299	15°57.272'S 005°38.555'W	300m
Suction sample 1	0216632 8234053	15°57.402'S 005°38.827'W	309m
Suction sample 2	0216618 8234439	15°57.193'S 005°38.833'W	299m

APPENDIX 2

A – PLANT SURVEY COORDINATES

Site no.	Chainage	Offset	Astrodos		WGS84		Site no.	Chainage	Offset	Astrodos		WGS84	
A1	1100	150W	0216075	8234469	0216609	8233967	**J1**	650	150W	0216059	8234922	0216593	8234420
A2	1100	100W	0216125	8234469	0216659	8233967	**J2**	650	100W	0216109	8234922	0216643	8234420
A3	1100	80W	0216145	8234469	0216679	8233967	**J3**	650	50W	0216159	8234922	0216693	8234420
A4	1100	50W	0216175	8234469	0216709	8233967	**J4**	650	0	0216209	8234922	0216743	8234420
A5	1100	0	0216225	8234469	0216759	8233967	**K1**	600	300W	0215906	8234972	0216440	8234470
B1	1050	150W	0216073	8234519	0216607	8234017	**K2**	600	200W	0216006	8234972	0216540	8234470
B2	1050	100W	0216123	8234519	0216657	8234017	**K3**	600	150W	0216056	8234972	0216590	8234470
B3	1050	50W	0216173	8234519	0216707	8234017	**K4**	600	100W	0216106	8234972	0216640	8234470
B4	1050	0	0216223	8234519	0216757	8234017	**K5**	600	50W	0216156	8234972	0216690	8234470
B5	1050	50E	0216273	8234519	0216807	8234017	**K6**	600	0	0216206	8234972	0216740	8234470
B6	1050	100E	0216323	8234519	0216857	8234017	**K7**	600	100E	0216306	8234972	0216840	8234470
B7	1050	150E	0216373	8234519	0216907	8234017	**K8**	600	200E	0216406	8234972	0216940	8234470
B8	1050	200E	0216423	8234519	0216957	8234017	**K9**	600	300E	0216506	8234972	0217040	8234470
C1	1000	150W	0216071	8234569	0216605	8234067	**L1**	550	150W	0216054	8235022	0216588	8234520
C2	1000	100W	0216121	8234569	0216655	8234067	**L2**	550	100W	0216104	8235022	0216638	8234520
C3	1000	50W	0216171	8234569	0216705	8234067	**L3**	550	50W	0216154	8235022	0216688	8234520
C4	1000	0	0216221	8234569	0216755	8234067	**L4**	550	0	0216204	8235022	0216738	8234520
C5	1000	50E	0216271	8234569	0216805	8234067	**M1**	500	300W	0215902	8235069	0216436	8234567
C6	1000	100E	0216321	8234569	0216855	8234067	**M2**	500	200W	0216002	8235069	0216536	8234567
C7	1000	150E	0216371	8234569	0216905	8234067	**M3**	500	150W	0216052	8235069	0216586	8234567
C8	1000	200E	0216421	8234569	0216955	8234067	**M4**	500	100W	0216102	8235069	0216636	8234567
D1	950	150W	0216071	8234616	0216605	8234114	**M5**	500	50W	0216152	8235069	0216686	8234567
D2	950	100W	0216121	8234616	0216655	8234114	**M6**	500	0	0216202	8235069	0216736	8234567
D3	950	50W	0216171	8234616	0216705	8234114	**M7**	500	100E	0216302	8235069	0216836	8234567
D4	950	0	0216221	8234616	0216755	8234114	**M8**	500	200E	0216402	8235069	0216936	8234567
E1	900	150W	0216067	8234669	0216601	8234167	**M9**	500	300E	0216502	8235069	0217036	8234567
E2	900	100W	0216117	8234669	0216651	8234167	**N1**	450	150W	0216051	8235120	0216585	8234618
E3	900	50W	0216167	8234669	0216701	8234167	**N2**	450	100W	0216101	8235120	0216635	8234618
E4	900	0	0216217	8234669	0216751	8234167	**N3**	450	50W	0216151	8235120	0216685	8234618
E5	900	100E	0216317	8234669	0216851	8234167	**N4**	450	0	0216201	8235120	0216735	8234618
E6	900	200E	0216417	8234669	0216951	8234167	**O1**	400	200W	0215999	8235170	0216533	8234668
F1	850	150W	0216065	8234718	0216599	8234216	**O2**	400	150W	0216049	8235170	0216583	8234668
F2	850	100W	0216115	8234718	0216649	8234216	**O3**	400	100W	0216099	8235170	0216633	8234668
F3	850	50W	0216165	8234718	0216699	8234216	**O4**	400	50W	0216149	8235170	0216683	8234668
F4	850	0	0216215	8234718	0216749	8234216	**O5**	400	0	0216199	8235170	0216733	8234668
G1	800	150W	0216063	8234771	0216597	8234269	**O6**	400	100E	0216299	8235170	0216833	8234668
G2	800	100W	0216113	8234771	0216647	8234269	**O7**	400	200E	0216399	8235170	0216933	8234668
G3	800	50W	0216163	8234771	0216697	8234269	**P1**	350	150W	0216048	8235220	0216582	8234718
G4	800	0	0216213	8234771	0216747	8234269	**P2**	350	100W	0216098	8235220	0216632	8234718
G5	800	100E	0216313	8234771	0216847	8234269	**P3**	350	50W	0216148	8235220	0216682	8234718
G6	800	200E	0216413	8234771	0216947	8234269	**P4**	350	0	0216198	8235220	0216732	8234718
G7	800	300E	0216513	8234771	0217047	8234269	**Q1**	300	150W	0216047	8235273	0216581	8234771
H1	750	150W	0216062	8234820	0216596	8234318	**Q2**	300	100W	0216097	8235273	0216631	8234771
H2	750	100W	0216112	8234820	0216646	8234318	**Q3**	300	50W	0216147	8235273	0216681	8234771
H3	750	50W	0216162	8234820	0216696	8234318	**Q4**	300	0	0216197	8235273	0216731	8234771
H4	750	0	0216212	8234820	0216746	8234318	**Q5**	300	100E	0216297	8235273	0216831	8234771
I1	700	100W	0216110	8234870	0216644	8234368	**R1**	250	150W	0216042	8235322	0216576	8234820
I2	700	50W	0216160	8234870	0216694	8234368	**R2**	250	100W	0216092	8235322	0216626	8234820
I3	700	0	0216210	8234870	0216744	8234368	**R3**	250	50W	0216142	8235322	0216676	8234820
I4	700	100E	0216310	8234870	0216844	8234368	**R4**	250	0	0216192	8235322	0216726	8234820
I5	700	200E	0216410	8234870	0216944	8234368	**S1**	200	0	0216192	8235372	0216726	8234870
I6	700	300E	0216510	8234870	0217044	8234368	**T1**	100	0	0216189	8235438	0216723	8234936

B – PLANT SURVEY SITE NUMBERING



APPENDIX 3 INVERTEBRATE SPECIES LIST

For each species the up-to-date taxonomic name is given along with the species authority and common name where appropriate.
The species status is defined as follows:

- \- Non-endemic species (either non-native or indigenous);
- * Endemic species;
- ** Endemic genus and species;
- ? Indicates uncertainty.

The scarcity status is defined as follows:

- Common Widespread on the island (5 or more sites in different areas);
- Scarce Either less than 5 sites, or all sites restricted to one portion of the island;
- Rare Only known from one or two sites or less than 10 individuals;
- ? Indicates uncertainty.

	Species	Author	St Helena common name	Status	Scarcity	No. samples	No. specimens
Collembola							
Entomobryomorpha							
Entomobryidae	*Entomobrya multifasciata*	(Tullberg, 1871)	Zebra-striped Springtail	-	Common	5	31
Entomobryidae	*Lepidocyrtus ?languinosus*	(Gmelin, 1788)	-	-	Scarce	1	1
Poduromorpha							
Poduridae	*Xenylla yucatana*	Mills, 1938	Yucatan Springtail	-	Scarce	4	16
Insecta							
Blattodea							
Blattidae	*Periplaneta australasiae*	(Fabricius, 1775)	Australian Cockroach	-	Common	1	4
Ectobiidae	*Balta longicercata*	(Bolívar, 1924)	Ghost Cockroach	-	Common	3	4
Coleoptera							
Anobiidae	*Sphaericus gibboides*	(Boieldieu, 1854)	Humped Spider Beetle	-	Common	1	27
Anobiidae	*Xyletomerus insulanus*	Español, 1972	Samphire Woodworm	*	Scarce	1	2
Cerambycidae	*Curtomerus flavus*	(Fabricius, 1775)	Orange Longhorn	-	Common	2	2
Coccinellidae	*Cheilomenes lunata*	(Fabricius, 1775)	Lunate Ladybird	-	Common	1	1

Coleoptera contd.							
Coccinellidae	*Exochomus flavipes*	(Thunberg, 1781)	Orange-cheeked Ladybird	-	Common	1	1
Curculionidae	*Acanthinomerus angustus*	(Wollaston, 1871)	Straight Weevil	**	Common	2	3
Curculionidae	*Acanthinomerus armatus*	Boheman, 1859	Common Samphire Weevil	**	Scarce	2	4
Curculionidae	*Acanthinomerus similis*	Wollaston, 1877	Similar Weevil	**	Scarce	1	4
Curculionidae	*Microxylobius westwoodi*	Chevrolat, 1836	Westwood's Weevil	**	Common	1	141
Curculionidae	*Pericartius aequatorialis*	(Hustache, 1934)	Short-winged Weevil	-	Scarce	2	4
Tenebrionidae	*Hemasodes batesi*	Waterhouse, 1890	Bates' Darkling Beetle	-	Scarce	1	2
Tenebrionidae	*Tarphiophasis leleupi*	Ardoin, 1972	Lelelup's Darkling Beetle	**	Scarce	1	5
Diptera							
Asteiidae	*Anarista vittata*	Sabrosky, 1977	Helenian Frass Fly	*	Scarce	7	33
Calliphoridae	*Chrysomya putoria*	(Wiedemann, 1830)	African Latrine Blowfly	-	Common	1	1
Calliphoridae	*Sarcophaga redux*	Walker 1849	Reduced Flesh Fly	-	Common	1	2
Chironomidae	*Chironomus* sp.	-	-	?	?	2	2
Chloropidae	Chloropidae indet.	-	-	?	?	1	1
Dolichopodidae	*Syntormon flexibilis*	Becker, 1922	Flexible Doli-fly	-	Common	2	2
Drosophilidae	*Drosophila punctatonervosa*	Frey, 1954	Spot-winged Fruit Fly	-	Common	6	12
Drosophilidae	*Drosophila repleta*	Wollaston, 1858	Dark-eyed Fruit Fly	-	Common	5	11
Drosophilidae	*Drosophila simulans*	Sturtevant, 1919	Banana Fly	-	Common	2	2
Ephydridae	*Scatella septemfenestrata*	Lamb, 1912	Window-winged Fly	-	Common	4	8
Ephydridae	Ephydridae indet. 1	-	-	?	?	2	3
Ephydridae	Ephydridae indet. 2	-	-	?	?	1	1
Fanniidae	*Euryomma peregrinum*	(Meigen, 1826)	Peregrine fly	-	Common	6	34
Limoniidae	*Symplecta pilipes*	(Fabricius, 1787)	Pale Cranefly	-	Scarce	1	1
Muscidae	*Dasyphora cyanella*	(Meigen, 1826)	Green Cluster Fly	-	Common	1	1
Muscidae	*Limnophora helenae*	Pont, 1977	Helenian Muscid	*	Common	9	1124
Muscidae	*Hydrotaea capensis*	(Wiedemann, 1818)	Cape Muscid	-	Rare	3	6
Muscidae	*Musca autumnalis*	De Geer, 1776	Face Fly	-	Common	1	1
Scatopsidae	*Coboldia fuscipes*	(Meigen, 1830)	Minute Black Scavenger Fly	-	Common	1	1
Scatopsidae	*Scatopsidae indet.*	-	-	?	?	1	1
Scenopinidae	*Scenopinus* sp. n.	-	Prosperous Bay Plain Windowfly	*	Scarce	4	4
Sciaridae	Sciaridae indet.	-	-	-	?	1	1
Syrphidae	*Ischiodon aegyptius*	(Wiedemann, 1830)	Bright Hoverfly	-	Common	1	2
Syrphidae	*Eristalinus aeneus*	(Scopoli, 1763)	Bronze Hoverfly	-	Common	1	1
Diptera indet.	Diptera indet.	-	-	?	?	1	1

Hemiptera							
Aleyrodidae	Aleyrodidae indet.	-	Whitefly	-	?	6	25
Anthocoridae	*Orius thripoborus*	(Hesse, 1940)	-	-	Common	1	1
Aphididae	*Aphis craccivora*	Koch, 1854	Cowpea Aphid	-	Common	1	1
Cicadellidae	*Stirellus* sp.	-	-	-	Common	1	1
Cydnidae	*Aethus pallidipennis*	(Reuter, 1883)	Burrower Bug	-	Common	1	1
Delphacidae	Delphacidae indet.	-	-	-	?	1	1
Lygaeidae	*Nysius ericae*	(Schilling, 1829)	False Chinch Bug	-	Common	1	9
Miridae	*Creontiades pallidus*	(Rambur, 1842)	Shredder Bug	-	Common	2	5
Miridae	*Taylorilygus apicalis*	(Blanchard, 1852)	Broken-backed Bug	-	Common	3	3
Tingidae	*Teleonemia scrupulosa*	Stål, 1873	Lantana Lace Bug	-	Common	1	1
Hymenoptera							
Ampulicidae	*Ampulex compressa*	Jurine, 1807	Cockroach Killer	-	Common	3	5
Apidae	*Apis mellifera*	Linnaeus, 1758	Honey Bee	-	Common	2	11
Bethylidae	*Holepyris atlanticus*	Benoit, 1977	Atlantic Curve-vein Wasp	*	Rare	10	56
Braconidae	*Braconidae* indet.	-	-	-	?	5	15
Encyrtidae	*Anagyrus* sp.	-	Paddle-based-antenna Wasp	?	Rare	1	1
Encyrtidae	*Diversinervus elegans*	(Silvestri, 1915)	Spike-backed Wasp	-	Rare	1	1
Encyrtidae	Encyrtidae indet.	-	-	?	?	1	1
Formicidae	*Cardiocondyla emeryi*	Forel, 1881	Emery's Sneaking Ant	-	Common	9	50
Formicidae	*Paratrechina bourbonica*	(Forel, 1886)	Robust Crazy Ant	-	Common	8	74
Formicidae	*Paratrechina longicornis*	(Latreille, 1802)	Slender Crazy Ant	-	Scarce	1	1
Formicidae	*Pheidole megacephala*	(Fabricius, 1793)	Big-headed Ant	-	Common	7	29
Formicidae	*Plagiolepis alluaudi*	Emery, 1894	Alluaud's Little Yellow Ant	-	Common	1	2
Formicidae	*Solenopsis globularia*	(Smith, 1858)	Fire Ant	-	Scarce	5	97
Formicidae	*Tapinoma melanocephalum*	(Fabricius, 1793)	Ghost Ant	-	Scarce	7	87
Formicidae	*Tetramorium caldarium*	(Roger, 1857)	-	-	Scarce	3	5
Mymaridae	*Anaphes nitens*	(Girault, 1928)	Minute Fringe-winged Wasp	-	Scarce	3	7
Pteromalidae	Pteromalidae indet.	-	-	?	?	2	2
Scelionidae	Scelionidae indet.	-	-	?	?	1	1
Trichogrammatidae	Trichogrammatidae sp. 1	-	-	?	?	7	12
Trichogrammatidae	Trichogrammatidae sp. 2	-	-	?	?	2	2
Hymenoptera indet.	Hymenoptera indet. 1	-	-	?	?	2	3
Hymenoptera indet.	Hymenoptera indet. 2	-	-	?	?	7	58
Hymenoptera indet.	Hymenoptera indet. 3	-	-	?	?	1	1

Hymenoptera contd.							
Hymenoptera indet.	Hymenoptera indet. 4	-	-	?	?	1	2
Hymenoptera indet.	Hymenoptera indet. 5	-	-	?	?	3	6
Hymenoptera indet.	Hymenoptera indet. 6	-	-	?	?	3	3
Hymenoptera indet.	Hymenoptera indet. 7	-	-	?	?	2	2
Hymenoptera indet.	Hymenoptera indet. 8	-	-	?	?	1	1
Hymenoptera indet.	Hymenoptera indet. 9	-	-	?	?	1	1
Hymenoptera indet.	Hymenoptera indet. 10	-	-	?	?	1	1
Lepidoptera							
Crambidae	*Helenoscoparia nigritalis*	(Walker in Melliss, 1875)	Dark Grass Moth	**	Common	2	2
Crambidae	*Herpetogramma licarsisalis*	(Walker, 1859)	Grass Webworm	-	Common	5	29
Crambidae	*Spoladea recurvalis*	(Fabricius, 1775)	White-striped Moth	-	Common	1	1
Noctuidae	*Agrotis segetum*	(Denis & Schiffermüller, 1775)	Turnip Moth	-	Common	2	3
Noctuidae	*Aletia ptyonophora*	(Hampson, 1905)	Bar-winged Moth	*	Common	1	1
Noctuidae	*Cardepia subvelata*	(Walker in Melliss, 1875)	Wrapped Moth	*	Scarce	3	8
Noctuidae	*Ctenoplusia limbirena*	(Guenée, 1852)	Scar Bank Gem	-	Common	1	2
Noctuidae	*Hypena helenae*	Berio, 1972	Mottled Snout Moth	*	Common	2	2
Noctuidae	*Hypocala rostrata*	(Fabricius, 1794)	Tendu Defoliator Moth	-	Scarce	3	10
Noctuidae	*Ophiusa tirhaca*	(Cramer, 1773)	Green Drab Moth	-	Common	1	1
Noctuidae	*Pandesma robusta*	Walker, 1858	Robust Tabby	-	Scarce	1	1
Pyralidae	*Cactoblastis cactorum*	(Berg, 1885)	Cactus Moth	-	Common	1	1
Tineidae	Tineidae indet. 1	-	-	*	?	11	185
Tineidae	Tineidae indet. 2		-	*	?	6	17
Tineidae	Tineidae indet. 3		-	*	?	2	12
Orthoptera							
Acrididae	*Primnia sanctaehelenae*	(Stål, 1861)	Dryland Grasshopper	**	Common	2	2
Psocoptera							
Liposcelidae	*Liposcelis bostrychophila*	Badonnel, 1931	Tiny barkfly	-	Scarce	1	4
Myopsocidae	*Myopsocus eatoni*	McLachlan, 1880	Eaton's Barkfly	-	Common	1	2
Psocidae	*Blaste basiliewskyi*	Badonnel, 1977	Large Common Barkfly	*	Common	1	1
Trogiidae	*Cerobasis annulata*	(Hagen, 1865)	Scale-wing Barkfly	-	Common	7	27
Thysanoptera							
Phlaeothripidae	*Haplothrips gowdeyi*	(Franklin, 1908)	Gowdey's Thrips	-	Common	2	2
Thysanura							
Lepismatidae	*Ctenolepisma sanctaehelenae*	Wygodzinsky, 1970	Violet-marked Silverfish	*	Scarce	1	2

Arachnida							
Araneae							
Corinnidae	*Xeropigo tridentiger*	(Pickard-Cambridge, 1869)	-	-	Common	1	2
Lycosidae	*Lycosidae* indet.	-	-	*?	?	1	2
Lycosidae	*Lycosidae* sp. 3	-	Mole Spider	**	Rare	1	2
Oecobiidae	*Oecobius* sp.	-	-	?	?	4	18
Oonopidae	*Gamasomorpha insularis*	Simon, 1907	-	-	Common	4	6
Oonopidae	*Opopaea concolor*	(Blackwall, 1859)	Uniform Goblin Spider	-	Scarce	1	3
Salticidae	*Hasarius adansoni*	(Audouin, 1826)	Adanson's House Jumper	-	Common	4	10
Salticidae	*Pellenes inexcultus*	(Pickard Cambridge, 1873)	Dishonourable Jumper Spider	*	Common	2	3
Thomisidae	*Philodromus signatus*	Pickard-Cambridge, 1869	-	*	Common	2	2
Acari							
Bdellidae	*Bdellodes* ?*parvisetosa*	Atyeo, 1977	-	*	Rare	3	12
Erythraeidae	?*Cavannea cooremani*	(Feider & Chioreanu, 1977)	Cooreman's Mite	*	Rare	3	3
Liacaridae	?*Liacarus coracinus*	(Koch, 1841)	-	-	Scarce	5	284
Liodidae	*Liodes lanceosetosus*	Wallwork, 1977	Sculptured Black Mite	*	Common	1	29
Malaconothridae	*Trimalaconothrus* sp.	-	-	?	?	1	6
Parasitidae	Parasitidae indet. (pale)	-	-	?	?	1	1
Scheloribatidae	*Scheloribates* nr. *deficiens*	Wallwork, 1977	-	*?	?	1	2
Acari indet.	Acari indet. 1	-	-	?	?	2	7
Acari indet.	Acari indet. 2	-	-	?	?	1	3
Acari indet.	Acari indet. 3	-	-	?	?	1	2
Acari indet.	Acari indet. 4	-	-	?	?	2	11
Acari indet.	Acari indet. 5	-	-	?	?	1	4

APPENDIX 4 PLANT AND LICHEN SURVEY RESULTS

A – SPECIES LIST

Group	Family	Species	Common name	Status
Dicotyledon	Aizoaceae	*Carpobrotus edulis*	Creeper	Naturalised
Dicotyledon	Aizoaceae	*Hydrodea cryptantha*	Babies'-toes	Endemic
Dicotyledon	Aizoaceae	*Mesembryanthemum crystallinum*	Ice Plant	Poss. native
Dicotyledon	Aizoaceae	*Tetragonia microptera*	Sea-spinach	Naturalised
Dicotyledon	Anacardiaceae	*Schinus terebinthifolius*	Wild Mango	Naturalised
Dicotyledon	Asteraceae	*Ageratum conyzoides*	Blue Weed	Naturalised
Dicotyledon	Asteraceae	*Chrysanthemoides molinifera*	Wild Coffee	Naturalised
Dicotyledon	Asteraceae	*Conyza bonariensis*	Hairy Fleabane	Naturalised
Dicotyledon	Asteraceae	*Cotula coronopifolia*	Pagoda Plant	Prob. native
Dicotyledon	Asteraceae	*Sonchus oleraceus*	Smooth Sow-thistle	Naturalised
Dicotyledon	Cactaceae	*Opuntia ficus-indica*	White Tungi	Naturalised
Dicotyledon	Cactaceae	*Opuntia elatior*	Red Tungi	Naturalised
Dicotyledon	Chenopodiaceae	*Atriplex semibaccata*	Saltbush	Naturalised
Dicotyledon	Chenopodiaceae	*Suaeda fruticosa*	Samphire	Native
Dicotyledon	Fabaceae	*Acacia longifolia*	Willow	Naturalised
Dicotyledon	Portulacaceae	*Portulaca oleracea*	Purslane	Native
Dicotyledon	Solanaceae	*Lycopersicon esculentum*	Tomato	Naturalised
Dicotyledon	Solanaceae	*Solanum nigrum*	Diddly Dight	Naturalised
Dicotyledon	Verbenaceae	*Lantana camara*	Lantana	Naturalised
Monocotyledon	Cyperaceae	*Cyperus polystachyos*	Field Sedge	Poss. native
Monocotyledon	Poaceae	*Digitaria ciliaris*	Tropical Finger Grass	Poss. native
Monocotyledon	Poaceae	*Eleusine indica*	Fowl's Foot Grass	Naturalised
Monocotyledon	Poaceae	*Eragrostis cilianensis*	Fish-bone Grass	Prob. native
Monocotyledon	Poaceae	*Eriochloa procera*	Coastal Cup-grass	Poss. native
Monocotyledon	Poaceae	*Sporobolus africanus*	Cape Grass	Poss. native
Monocotyledon	Poaceae	*Tragus berteronianus*	Burr Grass	Naturalised
Pteridophyte	Ophioglossaceae	*Ophioglossum polyphyllum*	Lily Fern	Native
Pteridophyte	Polypodiaceae	*Phlebodium aureum*	Phlebodium	Naturalised
Bryophyte	Bryaceae	*Bryum argenteum*	Bryum	Native
Lichen	Physciaceae	*Dermasticum pusillum*	Dermasticum	Endemic
Lichen	Physciaceae	*Dimelaena triseptata*	Dimelaena	Endemic
Lichen	Ramalinaceae	*Ramalina*	Ramalina	Encemic/Native
Lichen	Roccellaceae	*Roccella*	Roccella	Encemic/Native
Lichen	Teloschistaceae	*Telochistes flavicans*	Golden Hair Lichen	Native

B – DISTRIBUTION AND ABUNDANCE

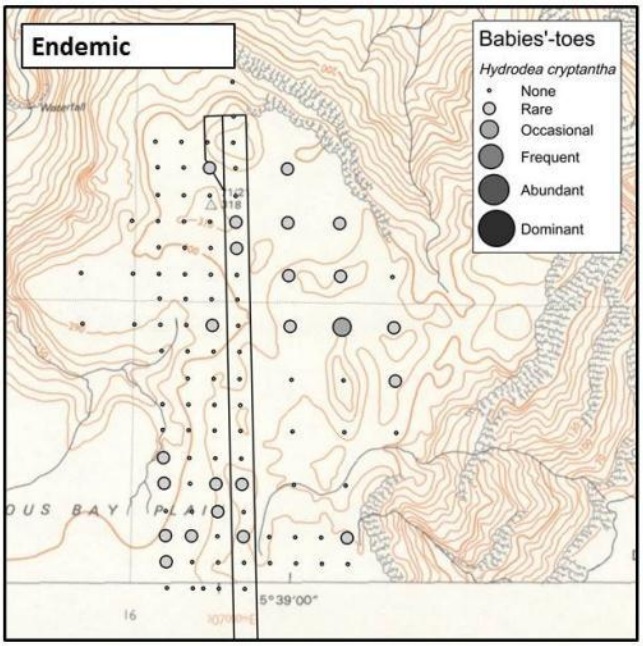
DAFOR abundance categories: 2 – rare, 3 – occasional, 4 – frequent, 5 – abundant, 6 dominant. [1 – present, not used].

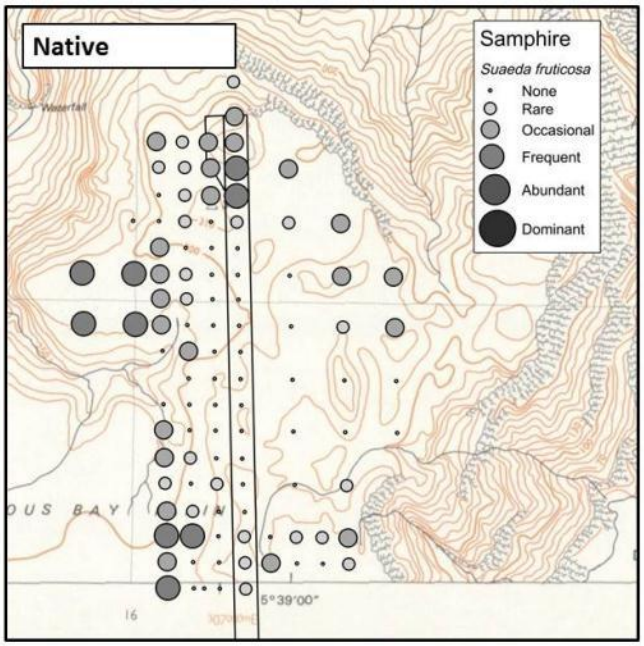
Site	Creeper	Babies toes	Ice plant	Sea-spinach	Wild mango	Blue weed	Wild coffee	Hairy fleabane	Pagoda plant	Smooth sow-thistle	Red tungi	White tungi	Saltbush	Samphire	Willow	Purslane	Tomato	Diddly dight	Lantana	Dermasticum	Dimelaena	Ramalina	Roccella	Golden hair lichen	Field sedge	Tropical finger grass	Fowl's foot grass	Fish-bone grass	Coastal cup-grass	Cape grass	Burr grass	Small finger grass	Bryum	Lily fern	Phlebodium	Disturbed soil	Bare soil
A1	3		2				2						4	4							2	2						2									6
A2																																					
A3			3	2									3			2						4						2							2		6
A4	3		3							2			3		2							4						2									6
A5	4		2										3	2								3													6	3
B1	3	2	2	2							2		3	3							2	2						2									6
B2																																					
B3																																					
B4	3												4	2							2	2						2								4	6
B5			2		2						2		3	3																					6	4
B6																																					
B7																																					
B8	2												2	2							2	2													6	4
C1	4	2									2		4	4							2							2									6
C2	3	2	2										4	4							3							2									6
C3																																					
C4	3	2							2				3	2							2	2													4	6
C5																																					
C6	2		2										3	2							2	2													6	3
C7	3		2										3	2							2	3														
C8	2	2					2						3	3							2	3	2													6
D1	4						2		2		2		5	3		2					2	2						3									6
D2	3		2								2		4	2		2					2	3	2					3									6
D3	4	2	2								2		4			2					2	2	2												3	6
D4	4			2			2			2	2		4			2					2	3						2									6
E1	3	2											3	2					2		2	2	2														6
E2	4			2							2		4			2			2		2	3						2									6
E3	3	2	2								2		4	2		2						2													3	6
E4	4	2											4			2					2	2						2							3	6
E5																																			6	4
E6	2												2	2																					6	4
F1	3	2	2					2			2		4	3					2		2	3	2					2									6

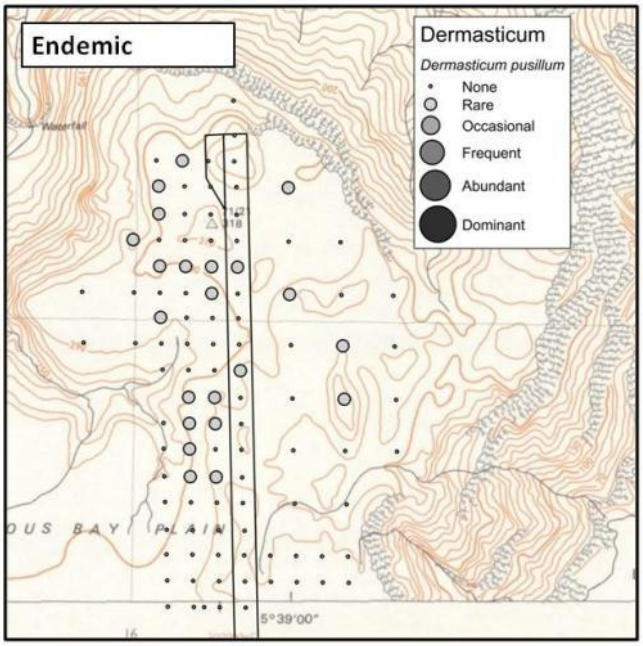
Site	Creeper	Babies toes	Ice plant	Sea-spinach	Wild mango	Blue weed	Wild coffee	Hairy fleabane	Pagoda plant	Smooth sow-thistle	Red tungi	White tungi	Saltbush	Samphire	Willow	Purslane	Tomato	Diddly dight	Lantana	Dermasticum	Dimelaena	Ramalina	Roccella	Golden hair lichen	Field sedge	Tropical finger grass	Fowl's foot grass	Fish-bone grass	Coastal cup-grass	Cape grass	Burr grass	Small finger grass	Bryum	Lily fern	Phlebodium	Disturbed soil	Bare soil
F2	3			3							2		4	2						2	2	2	2					2									6
F3	4										2		4			2			2	2	2	3						2								3	6
F4	4										2		4			2					2	3						2								3	6
G1	3										2		4	3		2			2		2	3	2					2								3	6
G2	4			2			2			2	2		4			2			2	2		3	2					2									
G3	4						2				2		4			2			2		2	2	2					2								4	6
G4	4									2	2		4			2			2		2	3						2								3	6
G5													2								2		2													6	
G6	3		2										3								2	4	2														6
G7	3												4			2						5	2							2							6
H1	3												3		2				2		2		2					2								3	6
H2	3			2							2		4			2			2	2	2	2				2		2								3	6
H3	3			2							2		4			2				2	2	3				2		2								4	6
H4	3												4			2			2		2	3	2					2								3	6
I1	3										2	2	4			2			2	2	2	4	2					2								5	6
I2	3											3	4			2			2	2	2	2				2		3								3	6
I3	3			2							2		4			3					2	2				3		2								6	5
I4													2								2		2													5	5
I5	4								2				3			2				2	2	4	3					2									6
I6	3	2	2										4			2						4	2	2												2	6
J1	4			2			2					2	4			2			2		2	3	2			2		4									
J2	3						2				2	2	4	3		2			2			2	2			3	2	2		2							6
J3	3					2	2				2		4			2			3		2	2	2			2											6
J4	2										2	2	4			3			2	2	2	2	2			4		3									6
K1	3											2		4		2					2							2								3	6
K2	3												3	4		2					2	2						2								3	6
K3	2			2								2	3	3		2			2		2	2				3		2								3	6
K4	3						2					2	4			2			2		2	3			2	2	2	3		2							6
K5	3	2					3	2			2	2	4			2						2			2	3		2		3						4	6
K6	2				3	2	3	2				2	4			2			2		2	2			3	3		2		3							6
K7	2	2											4			2					2	2						2									
K8	2	3											3	2						2	2	2														5	5
K9	2	2											3	3		2						2	2					2									
L1	3											2	4	3		2				2	2	2	2			2		2								4	6
L2													3	2							2							2								3	6
L3	2												3			2						2														3	6
L4	3						2					2	4			2					2	2	2			3		2									

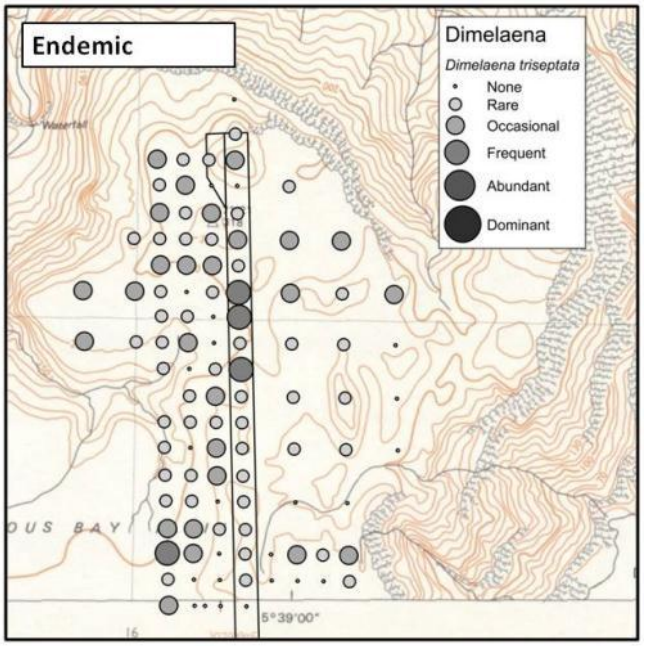
Site	Creeper	Babies toes	Ice plant	Sea-spinach	Wild mango	Blue weed	Wild coffee	Hairy fleabane	Pagoda plant	Smooth sow-thistle	Red tungi	White tungi	Saltbush	Samphire	Willow	Purslane	Tomato	Diddly dight	Lantana	Dermasticum	Dimelaena	Ramalina	Roccella	Golden hair lichen	Field sedge	Tropical finger grass	Fowl's foot grass	Fish-bone grass	Coastal cup-grass	Cape grass	Burr grass	Small finger grass	Bryum	Lily fern	Phlebodium	Disturbed soil	Bare soil
M1	4							2				2	4	4		2					2	2	2			2		2		2						3	6
M2	3											2	4	4							2	3		2				2								3	6
M3	3			2								2	4	3		2			2		2	3	2					2									6
M4	2						2						3	2								3	2					2								3	6
M5	4						2	2			2	2	4			2			3	2	2	3	2		2	3		2									6
M6	2				2							2	3			2			2		2	3	2			3		2								4	6
M7		2											3							2	2	2															6
M8		2											3	3		2					2	2	2					2									6
M9												3	4	3		2					2	4	2					2			2		2				
N1							2	2				2	4	3		2			3	2	2	3	2	2		2		2	2	2	2	2		2		3	
N2	4						2					2	4			2			2	2	2	2	2			3		2			2						
N3	3						2					2	4						2	2	2	3	2			3		2								3	6
N4	2	2											4						2	2	2	2	2			2		2								4	6
O1	4				2							2	4			2			2	2	2	2	2			2		3			2						
O2	4						2					2	4						2		2	2	2			3		3									
O3	2												4	2		2			2		2	3	2			2	2	2								2	6
O4	3												3			2		2			2	2	2			3	2	2			2						3
O5	2	2											3	2							2	2	2			2		2								2	6
O6	2	2										2	3	2							2	2						2									6
O7	2	2										2	4	3							2	2	2					2			2						
P1	4										2		4							2	2	2	2					2			2		2				
P2	2												3	2							2	2	2					2								4	6
P3	3												3	3		2					2	2	2			3		2									
P4	2											2	4	4							2					3		2			2					5	6
Q1	4					2						2	4	2		2				2	2	2	2			2		2	2				2				
Q2	4				2							2	4	2					2		2	2	2	2		3				2	2				3	6
Q3	2	2										2	3	3					2			3	2												3	6
Q4	2				2							2	5	4					2			3	2	2				2							3	5
Q5	3	2										2	3	3						2	2	2				2		2			2					6
R1	4											2	4	3					2		2	3	2	2		2		2					3			3	3
R2	4							2			2		4	2					2	2	2	2	2			2		2	2	2	2		2				
R3	2					2					2		4	3		2			2		2	2	2			2		3			2						
R4	2												4	3		2			2		2	3	2			2		2			2		2				6
S1						2						2	3	3			2		3		2	3	2					3	3								
T1	2					2							3	2		2			2							2		2	2								

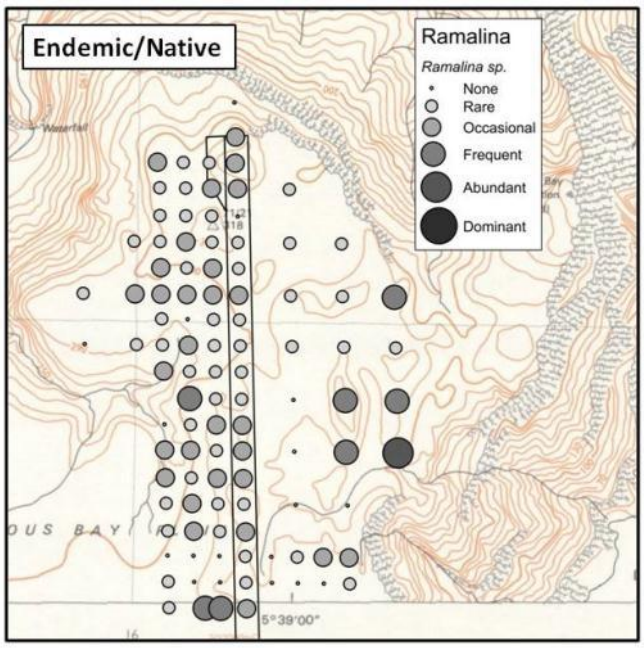
C – SPECIES MAPS

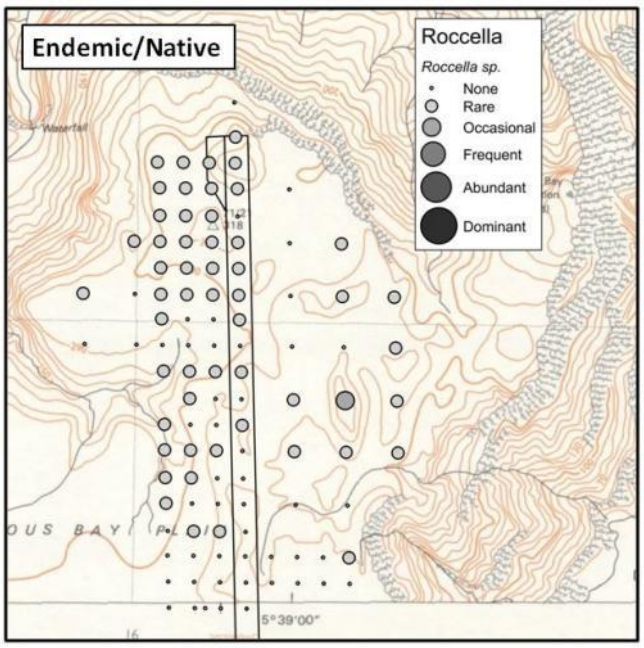


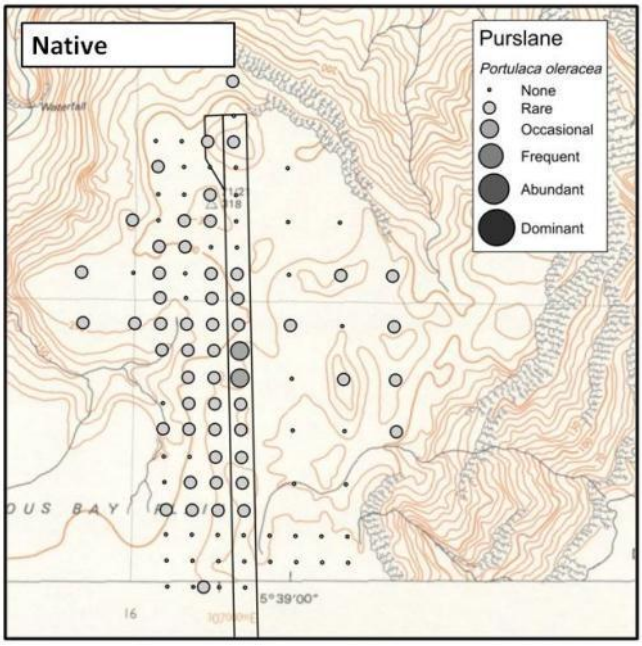


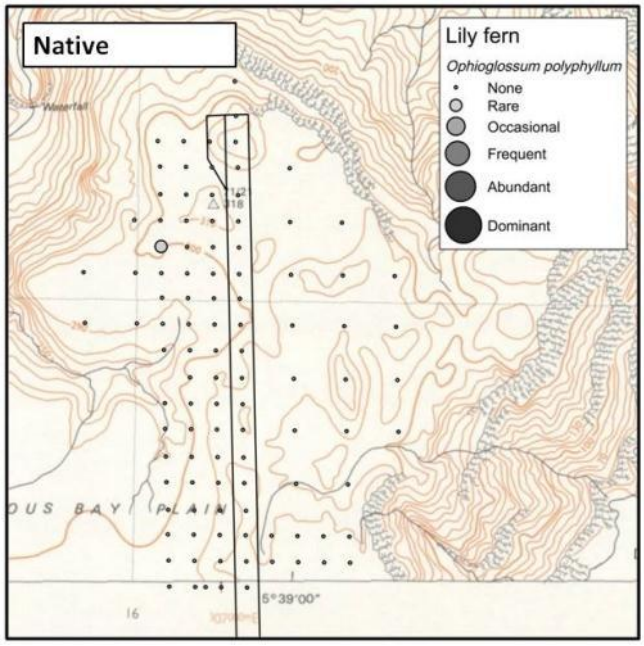


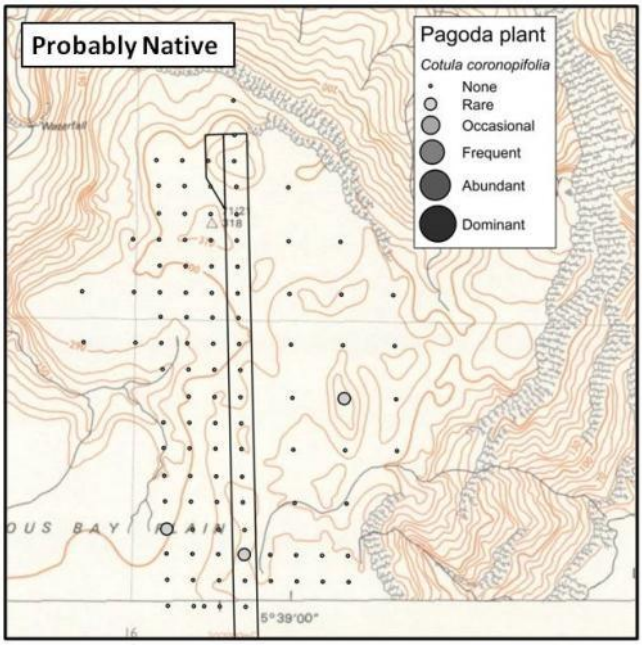


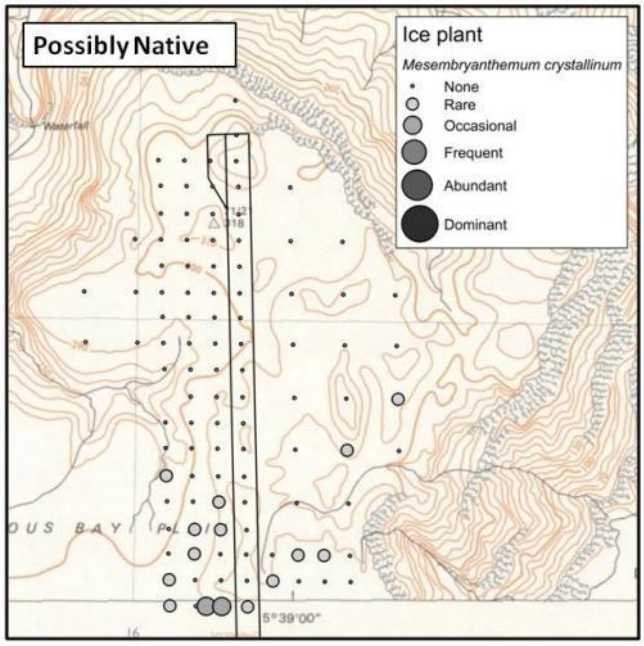


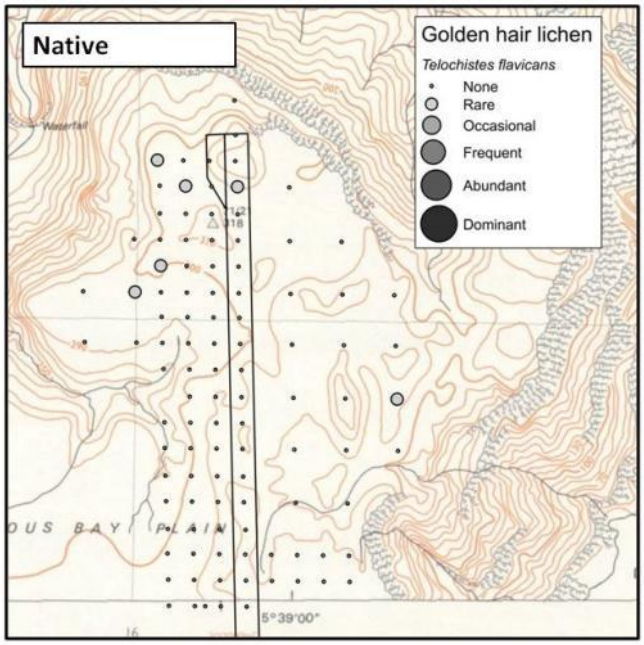


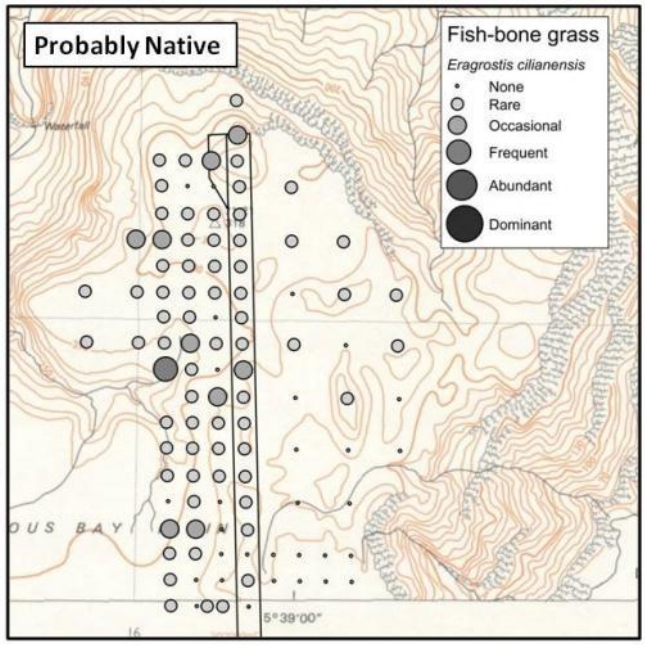

Native
Purslane
Portulaca oleracea
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

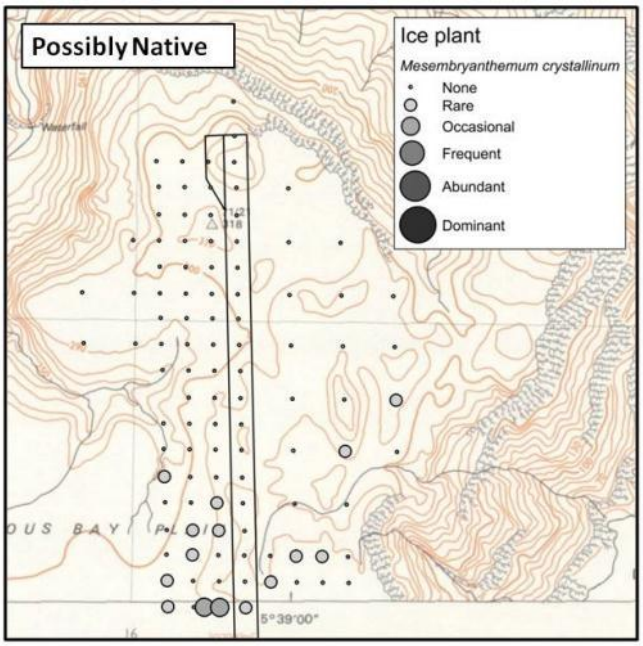

Native
Lily fern
Ophioglossum polyphyllum
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

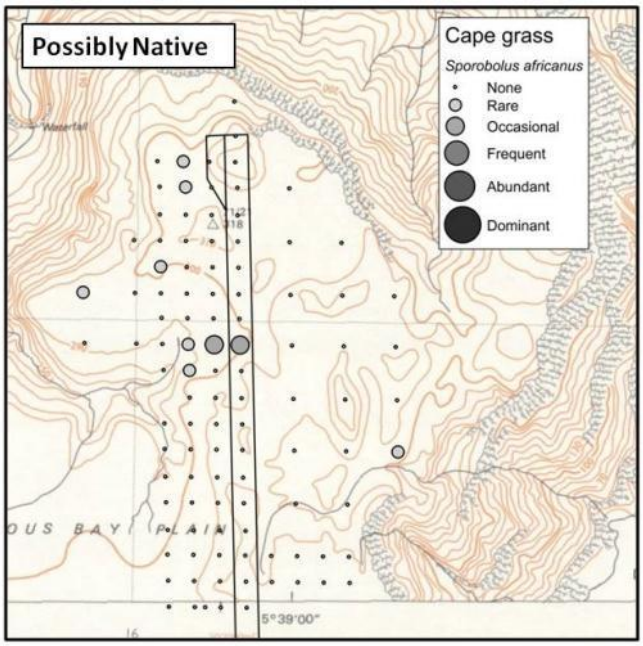

Probably Native
Pagoda plant
Cotula coronopifolia
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

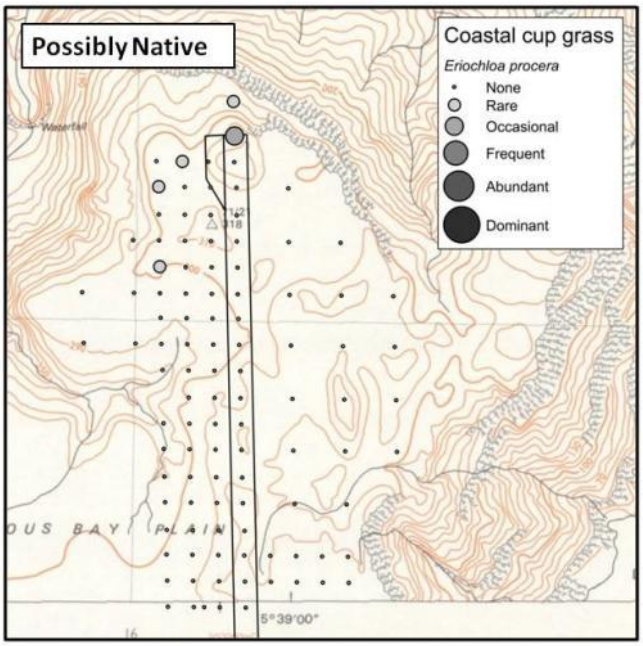

Possibly Native
Ice plant
Mesembryanthemum crystallinum
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

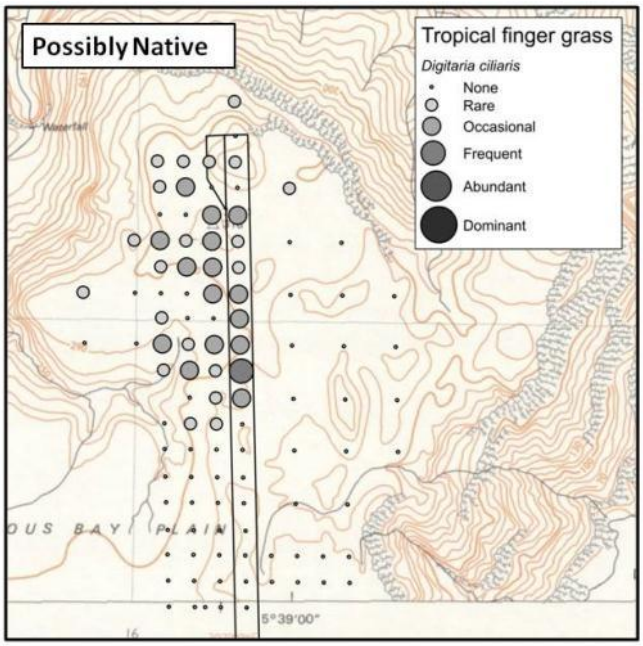

Native
Golden hair lichen
Telochistes flavicans
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

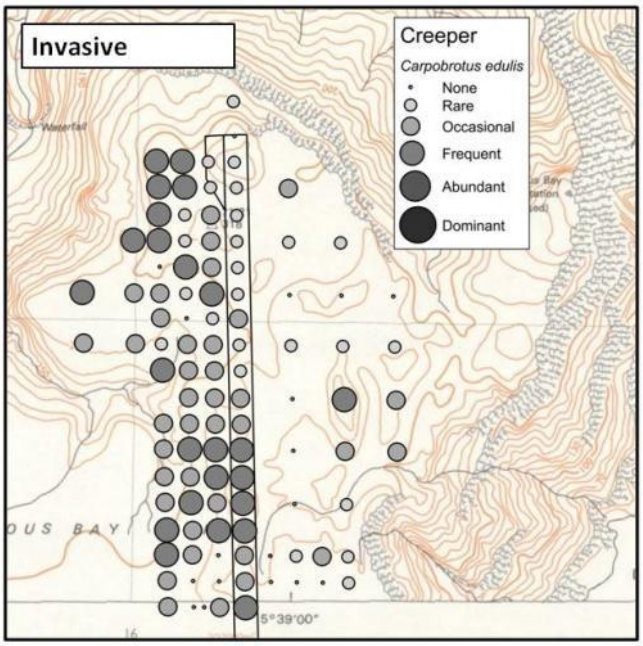

Probably Native
Fish-bone grass
Eragrostis cilianensis
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

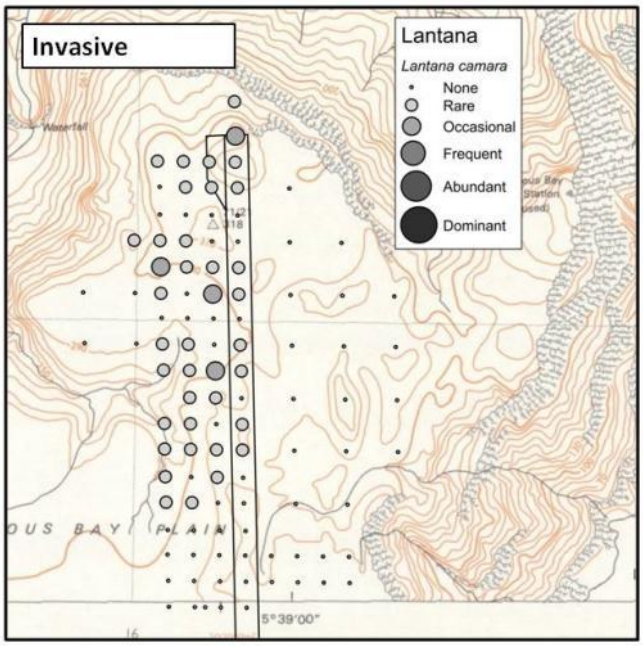

Possibly Native
Ice plant
Mesembryanthemum crystallinum
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

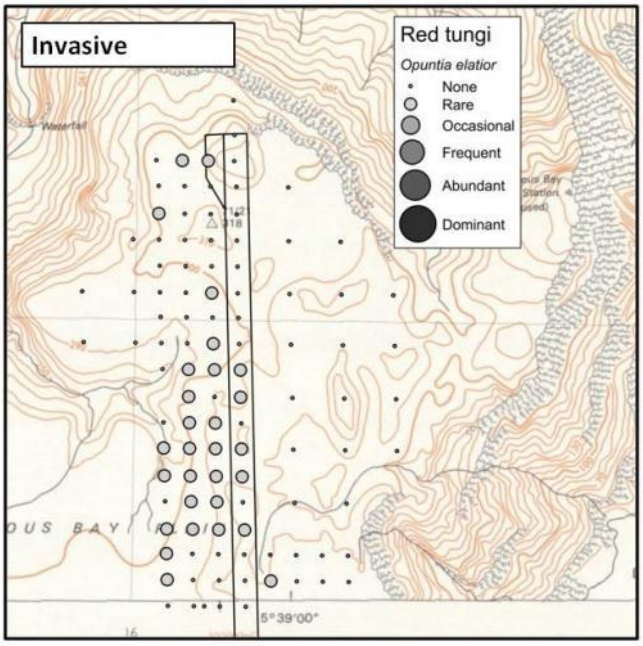

Possibly Native
Cape grass
Sporobolus africanus
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

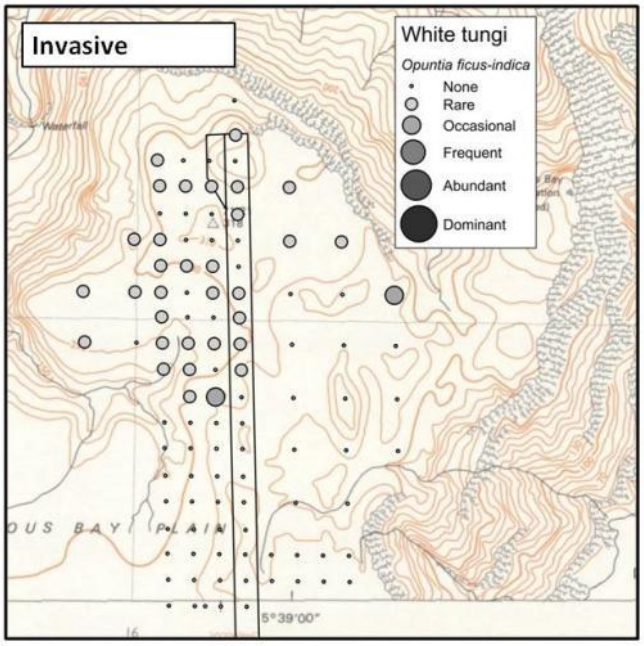

Possibly Native
Coastal cup grass
Eriochloa procera
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

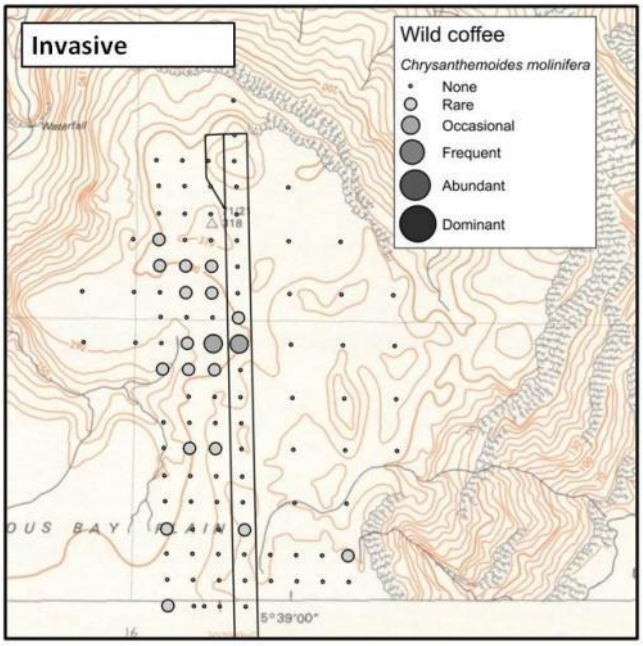

Possibly Native
Tropical finger grass
Digitaria ciliaris
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

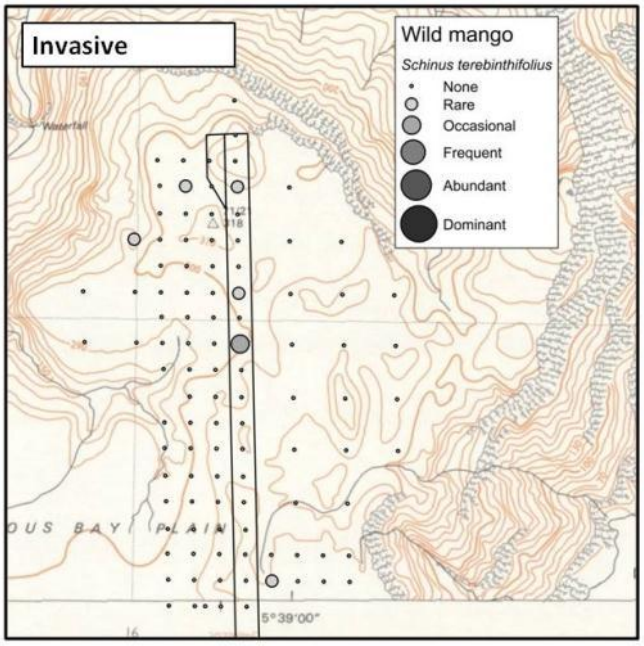

Invasive
Creeper
Carpobrotus edulis
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

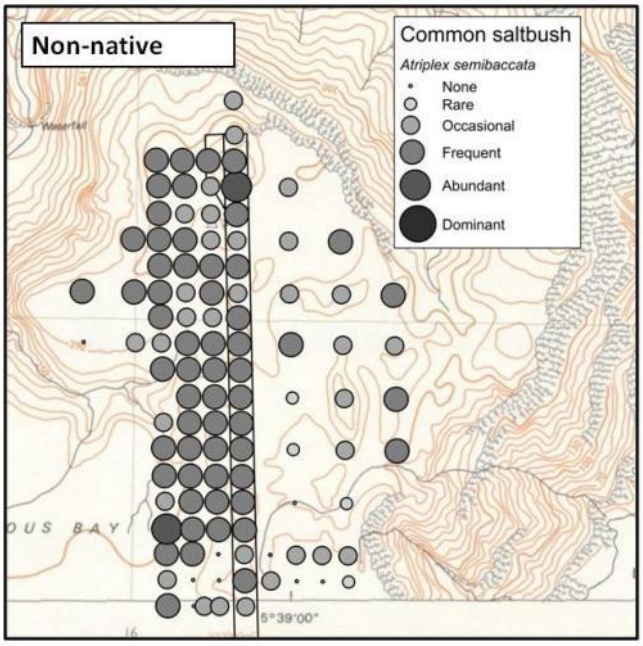

Invasive
Lantana
Lantana camara
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"


Invasive
Red tungi
Opuntia elatior
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"


Invasive
White tungi
Opuntia ficus-indica
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"


Invasive
Wild coffee
Chrysanthemoides molinifera
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"


Invasive
Wild mango
Schinus terebinthifolius
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"


Non-native
Common saltbush
Atriplex semibaccata
None
Rare
Occasional
Frequent
Abundant
Dominant
5°39'00"

D – ENDEMIC PLANT POPULATIONS OF THE EASTERN CLIFFS

All GPS readings taken with WGS84 map datum.

Tea Plant (*Frankenia portulacifolia*)

1 specimen	0216932 8234118, 15°57.369'S 005°38.659'W	To be moved
35 specimens	0216977 8234096, 15°57.382'S 005°38.634'W	Tea Plant Gully

Scrubwood (*Commidendrum rugosum*)

1 inaccessible, distant specimen visible on a ridge to the east of the site below Tea Plant Gully.

10 specimens	0217105 8234271, 15°57.288'S 005°38.561'W	Along eastern side of ridge
7 specimens	0217114 8234295, 15°57.273'S 005°38.556'W	South of gully
44 specimens	0217121 8234311, 15°57.266'S 005°38.553'W	North of gully
27 specimens	0217122 8234325, 15°57.258'S 005°38.551'W	Around top of hill
1 specimen	0217149 8234353, 15°57.244'S 005°38.537'W	East side of hill top
31 specimens	0217198 8234363, 15°57.243'S 005°38.509'W	Down gully
3 specimens	0217182 8234375, 15°57.231'S 005°38.518'W	Slope above gully
1 specimen	0217195 8234382, 15°57.227'S 005°38.510'W	Top of slope above gully
2 specimens	0217241 8234402, 15°57.217'S 005°38.485'W	Beyond Old Father site
~60 specimens	0217267 8234407, 15°57.215'S 005°38.470'W	Top of eastern cliffs
7 specimens	0217129 8234432, 15°57.201'S 005°38.547'W	Along Signal Station track
1 specimen	0217072 8234369, 15°57.234'S 005°38.579'W	Dead Scrubwood

Old Father Live Forever (*Pelargonium cotyledonis*)

1 specimen	0217209 8234382, 15°57.228'S 005°38.503'W	Found dead