St Helena National Trust

# St Helena Airport DVOR fence realignment – invertebrate survey

Report commissioned by Basil Read

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## 1 – Rationale

Following relocation of the Doppler VHF Omnidirectional Range (DVOR) navigational installation at St Helena Airport it was found, during the second calibration flight, that there was interference from the adjacent fence; this was successfully reduced by temporary removal of the fence. A new fence alignment has been proposed that would not interfere with the equipment; however, this necessitates adding a small section of the Central Basin of Prosperous Bay Plain, 8170 m² in area, into the Airport Development Area (ADA) that has not been previously included within it. No development has been proposed in this area since the original survey of the Prosperous Bay Plain area in 2003 (Ashmole & Ashmole, 2004a); this area also lay just outside of the areas covered by the two most recent major surveys undertaken at the Airport site (Cairns-Wicks & Lambdon, 2011; Pryce & Paajanen, 2014). As a result of the potential importance of this area the St Helena National Trust was commissioned to undertake a rapid assessment of the invertebrates present within it.

## 2 – Constraints

As a result of the urgent nature of this survey it was undertaken over an extremely short period, between 24 March and 8 April 2016. The survey is therefore very much a snapshot of the species present at this time of year and the effects of seasonality on the composition of the fauna through the year cannot be assessed; many species may therefore have been missed. The site was also particularly exposed and windy, thus seriously compromising the ability of the Malaise trap to collect invertebrates as they were likely to be blown out before they had a chance to enter the collecting head. The nature of the soil made it particularly difficult to install the pitfall traps as, once the soil crust was disturbed, wind scour swept soil grains away from the traps, thus creating a step over which invertebrates had to climb before becoming trapped; the placement of stones as a wind-break only partially mitigated this.

## 3 – Site description

The site is located to the west of the cleared and graded area (CGA) on the edge of Prosperous Bay Plain to the north of the Airport terminal buildings and immediately to the west and north of the DVOR. The exposed geology comprises rocks of the Lower basalt of the upper shield series; at the southern edge of the area these are overlain by a relatively flat dusty wind-blown deposit, possibly overlying phosphate rock (Ordnance Survey, 1979). The top of the hill is relatively flat with exposed rock and a few flat dusty areas; the northern section of the proposed fence realignment is steeper and rockier with little surface soil. The main vegetation in the area consists of Samphire (*Sueada fruticosa*), Creeper (*Carpobrotus edulis*) and green fruticose lichen (*Ramalina* sp.); the desiccated remains of Ice plant (*Mesembryanthemum crystallinum*) are also common.

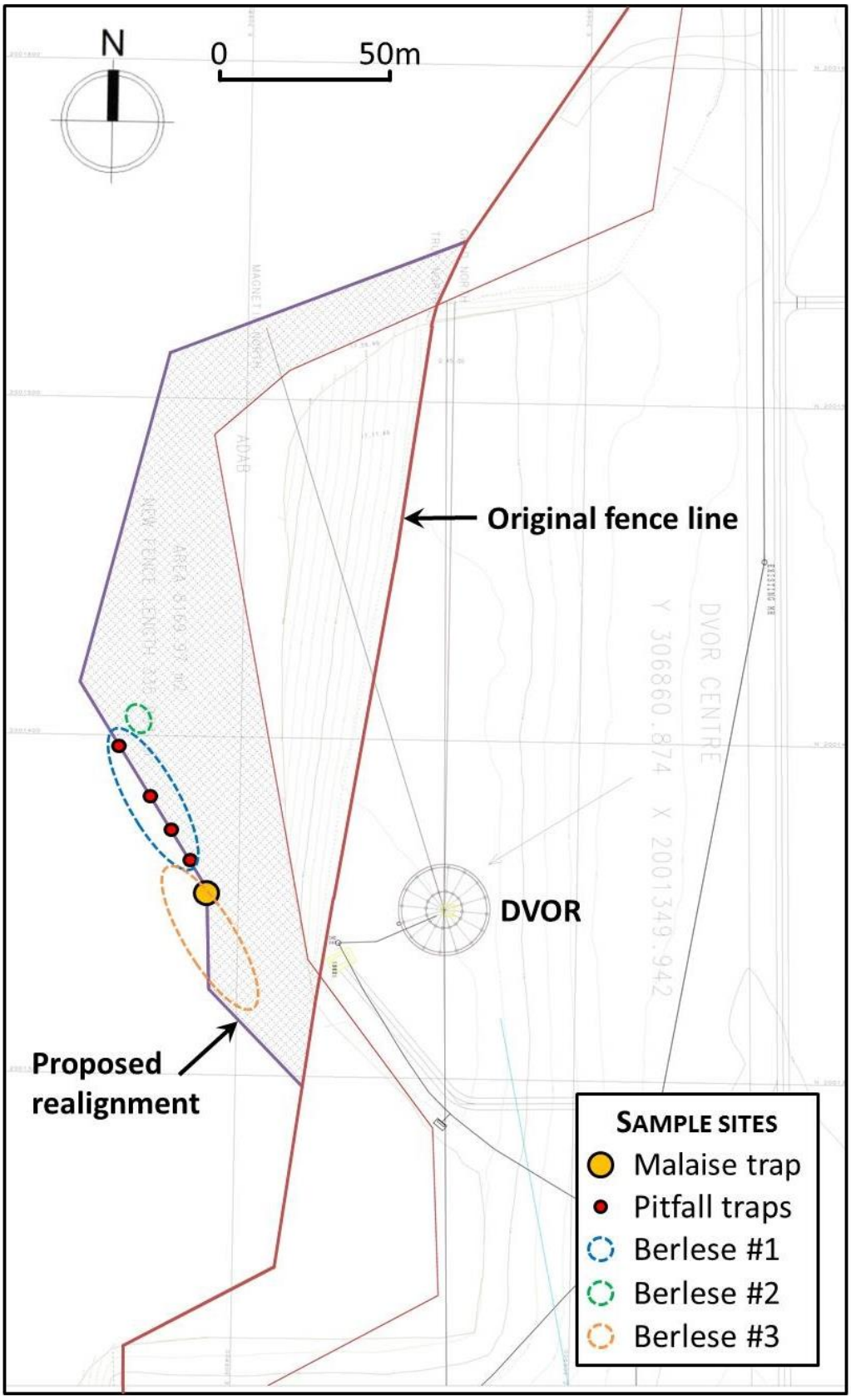


**FIGURE 1** Plan showing the proposed realignment of the fence into Prosperous Bay Plain to avoid interference with the DVOR.

Plan courtesy of Basil Read.

## 4 – Methodology

A Malaise trap was set up on 24th March 2016 using one of the provisional fence line markers as a partial support (Figure 2A). Four pitfall traps were installed along the line of the fence towards the next fence marker on the same date (Figure 2B-E). A sample of dead wood from Samphire (*Suaeda fruticosa*) showing obvious insect activity was also taken along with a sample of fruticose lichen (*Ramalina* sp.), both were from the area around the pitfall traps. These two samples were placed in a Berlese funnel where invertebrates are extracted using a chemical gradient of naphthalene (moth balls).

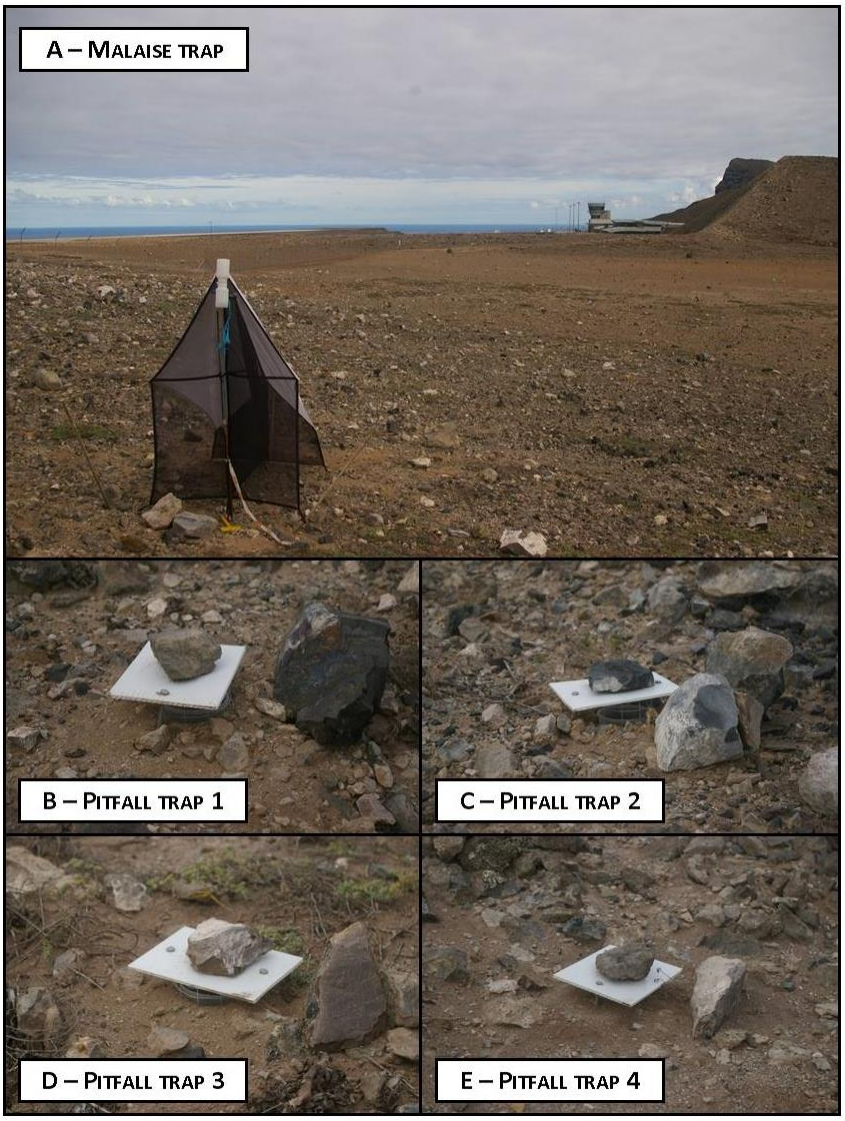


**Figure 2** A - The Malaise trap *in situ*; B-E, the pitfall traps before removal, note how wind scour has reduced the level of the soil around the traps.

During a second visit on 29th March to remove the Malaise and pitfall traps it was found that strong winds had caused the Malaise trap to collapse soon after installation. The pitfall traps were removed and the Malaise trap repaired, this was then left in place until 1st April; during this visit a further

sample of dead material from Samphire and Ice plant (*Mesembryanthemum crystallinum*) was taken from the area around the Malaise trap for Berlese extraction. Other invertebrates observed on site but not trapped were also noted. The GPS locations of the traps are given in Appendix 1. A further site walk-over and hand search on 8th April yielded additional species.

Invertebrates were preserved in 70% ethanol and identified to species (where possible) using a binocular zoom microscope at magnifications of 7 to 90x. Identifications were made using Ashmole & Ashmole (2004a, 2004b), Basilewsky (1970, 1972, 1976, 1977) and macro photographs of reference specimens from the Natural History Museum in London held by the SHNT.

## 5 – Results

A total of 133 specimens referable to 34 species or morphotypes were collected during the survey, of these 25 were determined to species level. Fourteen of the identified taxa are of endemic species and eight of these belong to endemic genera. Additional endemic species may well be present among the unidentified taxa but these require specialist knowledge and skills to identify with any degree of certainty; it was not possible to arrange this within the scope of this survey. 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 given in Appendix 2. The most important endemic invertebrates found are discussed below.

### 5.1 – Lycosidae sp. 3 – Prosperous Bay Plain mole spider

This important undescribed endemic genus and species was known to inhabit an area to the west of the proposed fence realignment but had not hitherto been recorded in this location. Despite several site walk-overs by National Trust and Halcrow staff, both before and during the survey, its presence on site was not detected until the final site visit on 8th April. Evidence of its presence, consisting of the distinctive mounds as described in Mendel, Ashmole & Ashmole (2008), were identified at low density (approximately one to two mounds every 10 metres or so) across the western part of the proposed fence realignment from the top of the slope down to the edge of the flatter dusty area. A couple of mounds were carefully excavated exposing the webbing at the entrance to the underlying tunnels. A careful walk-over of the area failed to locate a route for the proposed realignment that would avoid this area and also protect the potentially new taxa discussed below.

### 5.2 – *Homoeodera* sp.

Two specimens of this species were found in Berlese sample 3 (Samphire and Ice plant). They key out as *Homoeodera scolytoides* Basilewsky, 1972 (Bark beetle-like fungus weevil), a species last known from a location 29m above where the Airport terminal building now stands. However, *H. scolytoides* is specifically distinguished by the second segments of its antennae which are (in translation from the French original) "*very long*, *much longer than the third* [segment] *and even the scape* [first segment]" (Basilewsky, 1972). While these specimens strongly resemble *H. scolytoides* visually, in these two specimens the second segment is short and oval, almost globular in form, a

feature not found in any other species of this genus on St Helena. It is therefore possible that these two specimens represent a hitherto undescribed species.

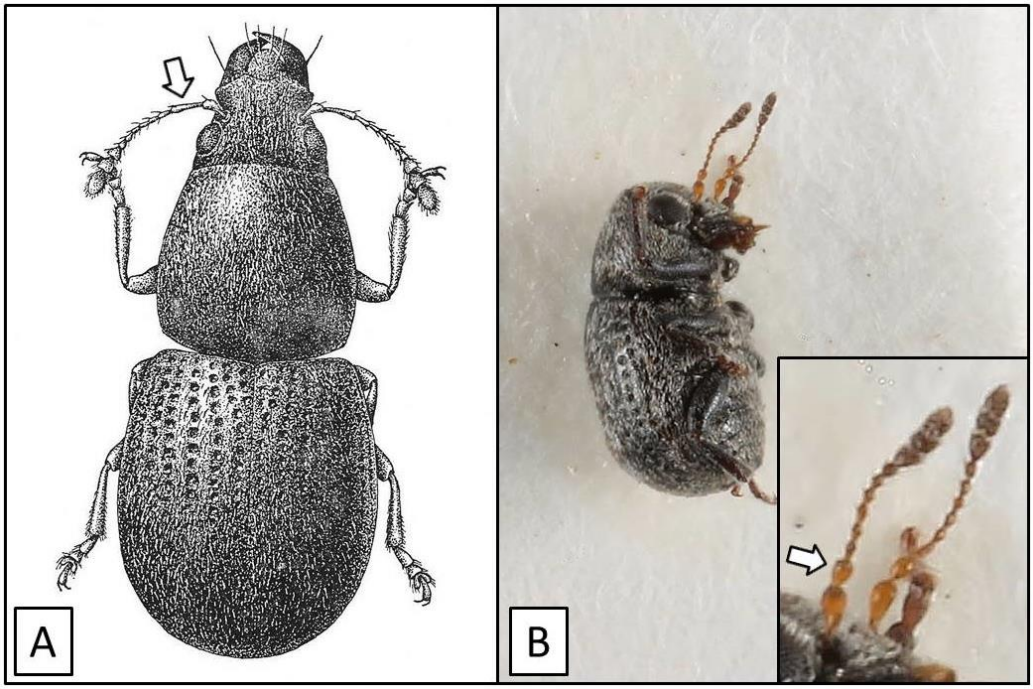


**FIGURE 3** *Homoeodera scolytoides* (left) and the potentially new species (right) with the second segments of their antennae indicated.

## 5.3 – *Acanthinomerus* nr. *monilicornis* (Wollaston, 1869)

A single specimen that keys out to this species was found in the first Berlese sample (Samphire) and a further six from the third Berlese sample (Samphire and Ice plant). This species was originally described from specimens collected by Melliss (1875) who wrote that it was "abundant amongst the indigenous cabbage-trees on the high land and the exotic plants at a lower altitude ". The species was found again by Wollaston (1877) who wrote:

> "This is the common *Acanthomerus* [sic] at Plantation, – where it swarms in the dead branches and trunks of the various species of oak, as well as in the crevices of old posts etc.; and I am inclined to think that it be should looked upon as having been attached originally to the Gumwoods, which must once have been dominant throughout that district; and I have taken it amongst the Gumwoods at Thompson's Wood, where, however, it is less abundant than the *A. ellipticus*."

This species was not located during the two expeditions from the Royal Museum for Central Africa at Tervuren in Belgium during the mid- to late-1960s (Decelle & Voss, 1972) and it has not been encountered during any more recent surveys either (Ashmole & Ashmole, 2004a, 2004b; Mendel, Ashmole & Ashmole, 2008; Cairns-Wicks & Lambdon, 2011; Pryce & Paajanen, 2014). However, Decelle & Voss (1972) also synonymised *A. ellipticus* (Wollaston, 1877), a species that Wollaston thought closest to *monilicornis*, with *A. armatus* Boheman, 1859, thus complicating the issue further.

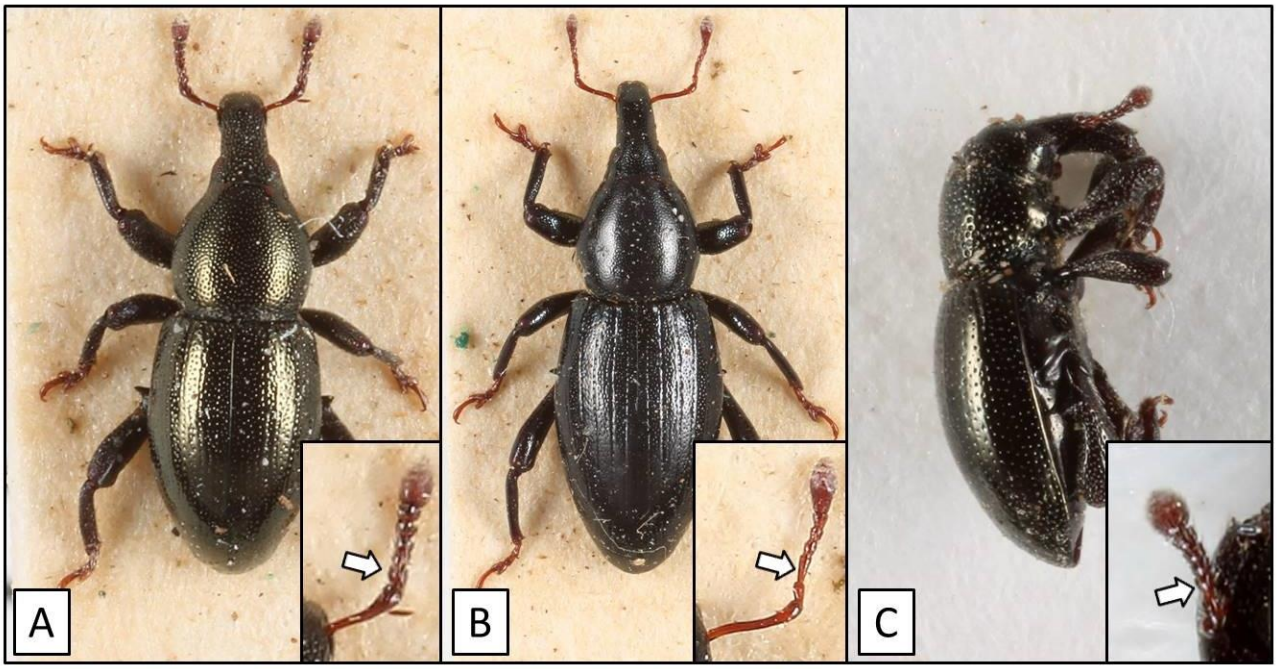


**FIGURE 4** Specimens of: A – *Acanthinomerus monilicornis*, B – *Acanthinomerus armatus* and, C – *Acanthinomerus* sp. collected during this survey, with close-up views of their antennae.

The specimens are distinctive and belong to the subgenus *Acanthinomerus* which are distinguished by having a large spine on the upper surface of their hind femora. Of the four species currently in this subgenus, three are restricted to the High Central Region and intermediate elevations. The fourth (*A. armatus*) is found at intermediate and lower elevations, including the Prosperous Bay Plain area (Decelle & Voss, 1972) where the synonymised *ellipticus* was also found. The difference again occurs in the antennae, in this case the *'funiculus'*, that is the elbowed section beyond the much lengthened first segment or *'scape'*. In *A. armatus* the second segment of the funiculus is the longest, the first segment slightly shorter, and the third, fourth and fifth shorter still and more or less equal in length. In these specimens all five segments are short and more or less equal in length, as found in *monilicornis* and *ellipticus*.

There is obviously some doubt as to which specimens are referable to which species and it is quite likely that a species complex is present in the *monilicornis-ellipticus-armatus* group, an issue that will probably not be resolved until DNA analysis has been undertaken (Roger Key, pers. comm.). In the meantime, it is suggested that a precautionary approach be taken and these specimens be regarded as taxonomically distinct, pending any further revisionary work.

## 5.4 – Other important endemic species

During the site walk-over on 8th April six dead specimens of Decelle's darkling beetle (*Tarphiophasis decellei* Ardoin, 1972) were found in spiders webs underneath fly-rock in the flat dusty area to the south west of the proposed fence line. This species was described as new to science following the two expeditions from the Royal Museum for Central Africa (Tervuren, Belgium) in the mid- to late-

1960s. While the type-series consisted of 1600 specimens from Prosperous Bay Plain and a further eight from Holdfast Tom, the species now seems to be much rarer. During the initial survey of Prosperous Bay Plain prior to Airport development (Ashmole & Ashmole, 2004a, 2004b) only a single individual was found in the western section of Prosperous Bay Plain. While the Belgian specimens were collected later in the year than this particular survey, more recent survey work over a wider time frame has also failed to locate it again (Mendel, Ashmole & Ashmole, 2008; Cairns-Wicks & Lambdon, 2011; Pryce, 2013; Pryce & Paajanen, 2014). The presence of these dead specimens under fly-rock shows that they must have been predated by the spiders over the last two years, potentially indicating a healthy population at this site. Two dead specimens of the scarce Daisy click beetle (*Anchastus compositarum* Wollaston, 1877) were found in the same manner in this area.

Two specimens of the Fragile ant-like beetle (*Anthicodes fragilis* Wollaston, 1877) were found in the third Berlese sample (Samphire and Ice plant). This species is currently restricted to the Prosperous Bay Plain area, although there are two 19$^{th}$ century records from Flagstaff and the Sane Valley (Wollaston, 1877) – a time when the island was much less vegetated than today. This species has a preference for sheltering by day under small stones lying on the ground surface, emerging to feed at night (Ashmole & Ashmole, 2004a). The presence of increased vegetation promotes the formation of soils, thus reducing the number of small surface stones; this possibly accounts for the fact that species has not been found since at these two locations.

Benoit's darling beetle (*Pseudoleichenum benoiti* Ardoin, 1972) was again discovered during the two expeditions from the Royal Museum for Central Africa. A total of 2900 specimens were found at Prosperous Bay Plain and Sandy Bay Beach although it was not stated how many specimens were found at each site or in each month; however, very much less sampling effort was put in at Sandy Bay (Ardoin, 1972). The species was found to be widespread during the initial Airport survey (Ashmole & Ashmole, 2004a, 2004b) although there have only been two other records, both around Prosperous Bay Plain since this time.

Eight specimens of endemic moth of the genus *Opogona* were found in the pitfall trap samples. These belong to an undescribed, probably flightless species (the wings are reduced), however, pending a revision of this genus on St Helena it is not possible to say how common or scarce it might be. The remaining endemic species are all common and widespread, at least in arid habitats.

## 5.5 – 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 trend-line in Microsoft Excel and, using the associated $R^2$ and trend-line equation, estimate the effectiveness of the survey.

The synthetic species accumulation curve generated from the invertebrate data collected in this survey is shown in Figure 4 (thicker red line) with 95% confidence limits (thinner red lines) with the associated logarithmic trend-line (black dashed line) generated from the last four of the seven data points.

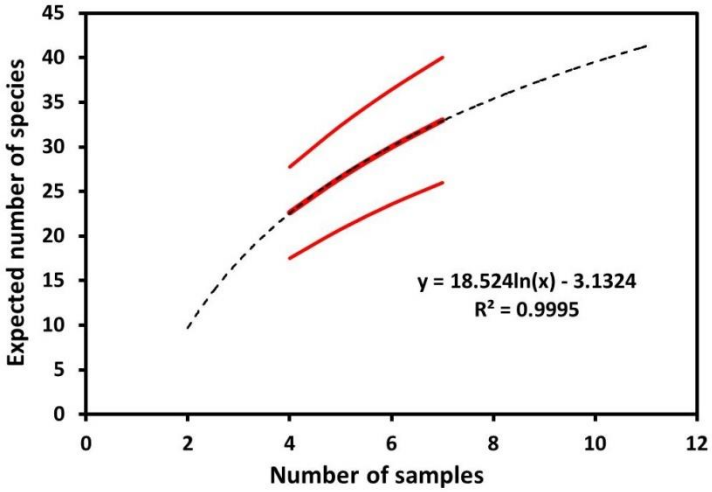


**FIGURE 5** Invertebrate survey synthetic species accumulation curve and 95% confidence limits generated by EstimateS with logarithmic trendline, associated equation and $R^2$ value.

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

| NO. SURVEYS | PREDICTED NO. TAXA | % INCREASE |
|---|---|---|
| 2 | 45.75 | 38.65 |
| 3 | 53.26 | 61.41 |
| 4 | 58.59 | 77.56 |
| 5 | 62.73 | 90.08 |
| 6 | 66.10 | 100.32 |

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

It can be seen that the amount of effort necessary to double the number of taxa recovered would have been just under six surveys (approximately 42 samples). This is comparable with the Rupert's Hill survey (Pryce, 2014) where six to seven surveys of nine samples each would have been required to double the number of species. However, it is considerably less thorough than the North Runway survey (Pryce & Paajanen, 2014) where an additional nine surveys of 18 samples each would have been required to generate the same result.

## 6 – Conclusions

This site holds a significant endemic invertebrate fauna. Of particular interest are two species of beetle found in dead organic matter, specifically Samphire (*Suaeda fruticosa*) and Ice plant (*Mesembryanthemum crystallinum*); these were both found immediately on, and adjacent to, the

proposed fence realignment. The discovery of the Prosperous Bay Plain mole spider, albeit at low density, to the east of its previously known location is also of considerable importance. Other endemic species that are largely restricted to the Prosperous Bay Plain area are also present. By using species diversity assessment software it has been shown that numerous other taxa should also be present and, if the endemic to non-endemic ratio is the same as that for the species identified so far, approximately 50% of these will be endemic. As a result of this the utmost care should be taken to minimise disturbance to the site during the construction phase of the works.

## 7 – Recommendations for mitigation and remediation

Taking into account the potential importance of the site, the following points are recommended:

### 7.1 – Mitigation

It is proposed that the fence realignment be adjusted slightly, moving one section of it further south and west (Figures 6 and 7). The first segment of the proposed realignment remains unchanged, however, rather than dog-legging up the hill it is recommended that the fence continue along the base of the slope for approximately 75m before turning back up the hill just past the main Samphire area to re-join the original realignment at the crest of the slope, increasing the take from the ADA by 1376 m² to 9545 m². The rationale behind this change is that the micro-habitat block containing the Samphire and Ice plant will remain relatively undisturbed, thus minimising potential fragmentation in an area containing significant invertebrate interest. In addition to the above:

- The fence, while being 5.5 m longer, will only have a single sharp change in direction as opposed to three in the original proposal, thus making construction of this section simpler.
- By avoiding the dog-leg up and across the slope, construction should again be easier as a greater proportion of the new fence line will be built on the level and in an area with much less surface rock.
- The fence will be lower in this section thus reducing even further any potential interference with the DVOR.

A cairn has been built at the point where the fence should turn up the hill slope in this proposed new realignment (yellow spot, Figure 6).

Further to the above, the following measures should also be taken to minimise potential impacts at the site:

- Access to the site should be by foot only, avoiding the trampling of Samphire if possible.
- The access and operation zone should be as narrow as possible, preferably **not exceeding two metres wide**.
- Areas where practical considerations mean that the zone of operation has to exceed two metres should be agreed with the PMU in advance and should **not exceed three** metres in width if at all possible.

- When moving compressed air hoses and other equipment care should be taken to avoid damage to any Samphire plants present.
- All spoil from trench construction should be held on the Airport side of the fence line, thus minimising disturbance in the Central Basin of Prosperous Bay Plain.
- After re-filling the trench the fill should be tamped manually prior to the reinstatement of the surface soil and lichen-covered rocks.

**FIGURE 6** The current (red line) and proposed (yellow dashed line) fence realignments.

## 7.2 – Remediation

Once the works have been completed a site walk-over should be undertaken to remove any litter and any other obvious signs of disturbance.

Encouraging Samphire (*Suaeda fruticosa*) at this site would be of particular benefit. It is recommended that, due to difficulties in growing this species from seed, plants raised from cuttings be planted out once the winter rains have commenced as this should maximise the survival rates. This work should be undertaken both inside and outside of the fence line across the area where Samphire is currently found.

Ice plant (*Mesembryanthemum crystallinum*) appears to be widespread at the site; as this species is an annual there should be a sufficient seed bank present to allow rapid reestablishment of the species.

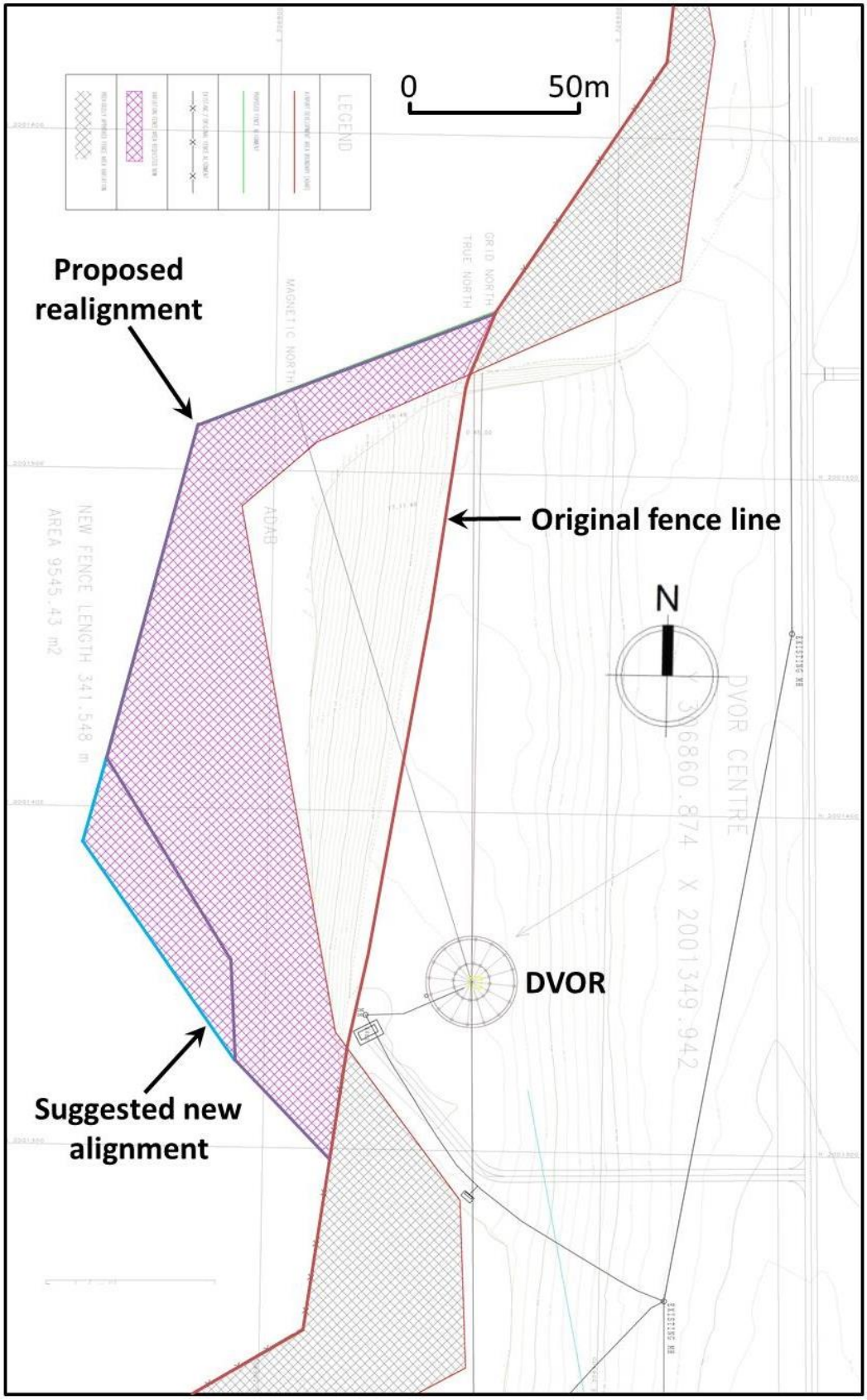


**FIGURE 7** Plan showing the proposed and suggested new fence alignment.

Plan courtesy of Basil Read.

## Acknowledgements

I would like to thank Robert Kleinjan at the Project Management Unit (Halcrow) and Jeremy Harris at the St Helena National Trust for facilitating this survey. Thanks also go to Robert Kleinjan for assistance during site visits and for the use of his photographs. I would also like to thank Rebecca Cairns-Wicks and Martin Hannah for help and advice during the execution of the survey.

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## Appendix 1 – Sample sites

Invertebrate trap locations (GPS, WGS84):

| | | | |
|---|---|---|---|
| Pitfall trap 1 | 0216497 | 8233782 | |
| Pitfall trap 2 | 0216492 | 8233792 | Approximate centroid for Berlese sample 1 (Samphire) |
| Pitfall trap 3 | 0216479 | 8233808 | Approximate centroid for Berlese sample 2 (Lichen) |
| Pitfall trap 4 | 0216466 | 8233825 | |
| | | | |
| Malaise trap | 0216503 | 8233775 | Approximate centroid for Berlese sample 3 (Samphire + Ice plant) |

General invertebrate observations were made during site walk-overs across the whole area on 24 March and 8 April 2016.

## Appendix 2 – 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 Helenian common name | Status | Scarcity | No. samples | No. specimens |
|---|---|---|---|---|---|---|---|
| **Insecta** | | | | | | | |
| **Blattodea** | | | | | | | |
| Corydiidae | *Euthyrrhapha pacifica* | (Coquebert, 1804) | Pacific cockroach | - | Common | 2 | 4 |
| **Coleoptera** | | | | | | | |
| Anthicidae | *Anthicus fragilis* | Wollaston, 1877 | Fragile ant-like beetle | ** | Scarce | 1 | 2 |
| Anthribidae | *Homoeodera* sp. | - | - | ** | Rare | 1 | 2 |
| Corylophidae | *Sericoderus lateralis* | (Gyllenhal, 1827) | Hooded beetle | - | Common | 1 | 1 |
| Curculionidae | *Acanthinomerus* ?*monilicornis* | Wollaston, 1869 | ?Moniliform weevil | ** | Rare | 2 | 7 |
| Elateridae | *Anchastus compositarum* | Wollaston, 1877 | Daisy click beetle | * | Scarce | 1 | 2 |
| Tenebrionidae | *Pseudoleichenum benoiti* | Ardoin, 1972 | Benoit's darkling beetle | ** | Scarce | 2 | 3 |
| Tenebrionidae | *Tarphiophasis decellei* | Ardoin, 1972 | Decelle's darkling beetle | ** | Rare | 1 | 6 |
| **Dermaptera** | | | | | | | |
| Labiduridae | *Labidura riparia* | (Pallas, 1773) | Tawny earwig | - | Common | 1 | 1 |
| **Diptera** | | | | | | | |
| Chyromyidae | *Aphaniosoma approximatum* | Becker, 1903 | - | - | Scarce | 1 | 1 |
| Dolichopodidae | *Syntormon flexibilis* | Becker, 1922 | Flexible doli-fly | - | Common | 1 | 1 |
| Muscidae | *Limnophora helenae* | Pont, 1977 | St Helenian muscid | * | Common | 2 | 4 |
| Scenopinidae | *Scenopinus* sp. | - | - | ? | ? | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Hemiptera** | | | | | | | |
| Anthocoridae | *Cardiastethus exiguus* | Poppius, 1913 | Small orange flower bug | - | Scarce | 1 | 2 |
| Miridae | *Hirtopsallus suedae* | Schmitz, 1977 | St Helena Samphire plant-bug | ** | Common | 2 | 2 |
| **Hymenoptera** | | | | | | | |
| Braconidae | *Aphaereta minuta* | (Nees, 1811) | Minute braconid | - | Common | 1 | 1 |
| Formicidae | *Cardiocondyla emeryi* | Forel, 1881 | Emery's sneaking ant | - | Common | 1 | 3 |
| **Lepidoptera** | | | | | | | |
| Tineidae | *Opogona* sp. | - | - | * | ? | 2 | 12 |
| **Orthoptera** | | | | | | | |
| Acrididae | *Primnia sanctaehelenae* | (Stål, 1861) | Dryland grasshopper | ** | Common | 2 | 2 |
| **Psocoptera** | | | | | | | |
| Ectopsocidae | *Ectopsocus* sp. | - | - | - | ? | 1 | 1 |
| Liposcelidae | *Liposcelis* sp. | - | - | ? | ? | 3 | 4 |
| Trogiidae | *Cerobasis guestfalica* | (Kolbe, 1880) | Globe-winged barkfly | - | Scarce | 1 | 2 |
| **Thysanoptera** | | | | | | | |
| Thripidae | *Heliothrips haemorrhoidalis* | (Bouché, 1833) | Glasshouse thrips | - | Common | 3 | 17 |
| Indet. | Thysanoptera indet. | - | - | - | - | 1 | 1 |
| **Thysanura** | | | | | | | |
| Lepismatidae | *Ctenolepisma sanctaehelenae* | Wygodzinsky, 1970 | Violet-marked silverfish | * | Scarce | 2 | 2 |
| **Arachnida** | | | | | | | |
| **Araneae** | | | | | | | |
| Indet. | Juvenile six-eyed spider | - | - | ? | ? | 1 | 1 |
| Indet. | First instar juvenile spiders | - | - | ? | ? | 2 | 3 |
| Lycosidae | *Lycosidae* sp. 3 | - | Prosperous Bay Plain mole spider | ** | Rare | 1 | Present |
| Oonopidae | *Oonops erinaceus* | Benoit, 1977 | Hedgehog goblin spider | * | Scarce | 1 | 1 |
| Salticidae | *Hasarius adansoni* | (Audouin, 1826) | Adanson's house jumper | - | Common | 1 | 1 |
| Salticidae | *Pellenes inexcultus* | (Pickard Cambridge, 1873) | Modest jumping spider | * | Common | 1 | 1 |
| Theridiidae | *Latrodectus geometricus* | Koch, 1841 | Brown widow | - | Common | 2 | 8 |
| **Acari** | | | | | | | |
| Indet. | Acari indet. | - | - | ? | ? | 3 | 32 |
| **Crustacea** | | | | | | | |
| **Isopoda** | | | | | | | |
| Porcellionidae | *Porcellionides pruinosus* | (Brandt, 1833) | Plum woodlouse | - | Common | 1 | 3 |