Improving Biosecurity in the United Kingdom Overseas Territories

Identification service for invasive invertebrate plant pests

2023-2024

[redacted]

Figure 1. Colony of black bean bug *Brachyplatys subaeneus* on pigeon pea, Montserrat. It is native to tropical and subtropical humid areas of Asia and was first detected in the Caribbean in 2018. It is a minor pest of Fabaceae. [redacted]

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POTENTIAL THREATS TO BIODIVERSITY AND AGRICULTURE IN THE UKOTS IDENTIFIED DURING 2023-24

Figure 2 Greenhouse thrips *Heliothrips haemorrhoidalis* has been found for the first time on Ascension and Tristan da Cunha. It causes severe 'silvering' or chlorosis of foliage. [redacted]

Figure 3 Oriental scale *Aonidiella orientalis* is new for Ascension. It is broadly polyphagous and a pest of palms and fruit trees. [redacted]

Figure 4 Palm fiorinia scale *Fiorinia fioriniae* is new for Ascension. It is a pest of palms and avocado. [redacted]

Figure 5 Green house mealybug *Pseudococcus viburni* is new for Ascension. An important invasive pests of ornamental and crop plants © Fera

Figure 6 Yellow fever mosquito *Aedes aegypti* was confirmed from the Pitcairn Islands. It is a known vector of several viruses including yellow fever virus, dengue virus, chikungunya virus and Zika virus [redacted]

Figure 7 Common wasp *Vespula vulgaris* adult. A metabarcoding study of the gut content determined that these invasive wasps prey on St Helena's endemic invertebrates [redacted]

Figure 8 *Alecanochiton marquesi* is new for Montserrat and the Lesser Antilles archipelago [redacted]

Figure 9 Banana scale *Prococcus acutissimus* is new for Montserrat and the Lesser Antilles archipelago. It is a pest of several crops, including mango [redacted]

Figure 10 *Metamasius sericeus* is new for the Cayman Islands. Its larvae feed inside the stems of plants such as sugarcane, bananas, palms, bromeliads, and orchids. © Fera

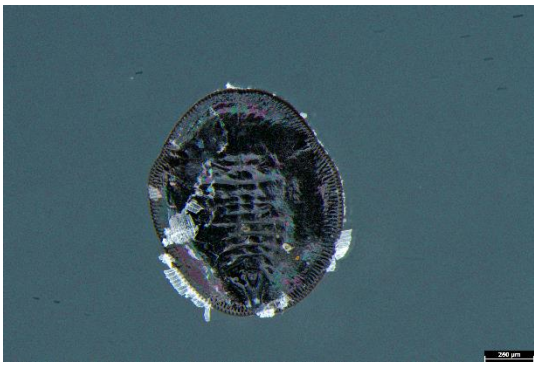

Figure 11 *Aleuroplatus* sp. nov., an undescribed whitefly from St Helena with black pupae © Fera

Figure 12 An undescribed whitefly from St Helena. Generic placement is uncertain © Fera

Figure 13 Croton scale *Phalacrococcus howertoni* is highly invasive in the Caribbean, including Montserrat, where it damages croton, soursop, and sugar apple [redacted]

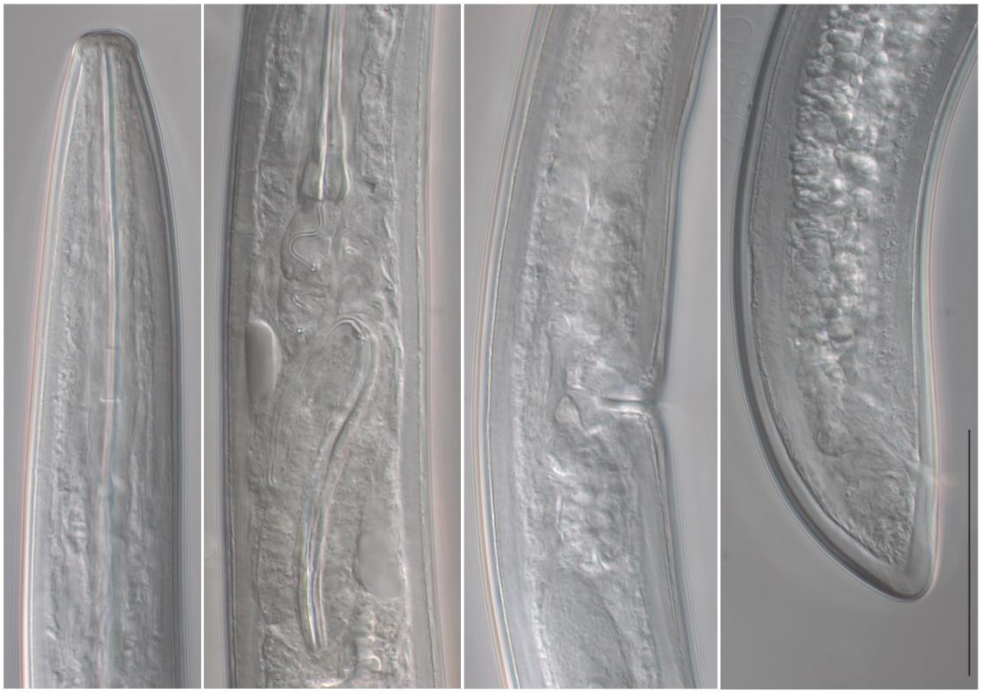

Figure 14 *Xiphinema diffusum*, a plant parasitic nematode and a member of the *X. americanum* - group recorded in Ascension for the first time, found at higher altitudes. The figure shows the anterior, pharyngeal region, vulval region, and posterior. Scale bar = 50µm © Fera

Figure 15 *Trissonchulus* sp. nov. A predatory marine nematode, new to science, found associated with a sand sample in the vicinity of a turtle nest, Ascension Island. Scale bar = 500µm. © Fera

Figure 16 *Aptinothrips rufus* is new for the Chagos Archipeligo © Fera

Figure 17 *Astrothrips* sp. is new for the Chagos Archipeligo © Fera

Figure 18 *Limothrips cerealium* is new for Saint Helena © Fera

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Executive summary

Biodiversity in the UK Overseas Territories (UKOTs) is globally significant and is recognised as being under threat from invasive alien species. [redacted] Rapid and accurate identification of potential invasive alien species is the essential first step. The Plant Protection Programme at Fera Science Ltd. provides statutory diagnostic and training services for the England and Wales Plant Health Service, and has a wealth of experience and expertise in the identification of all plant-feeding insects, mites and nematodes, as well as plant pathogens. The Invertebrate Identification Team has led a Defra-funded project to provide an identification service for invasive invertebrate plant pests for the UKOTs since November 2009. During 2023/24, representatives from six territories (Ascension Island, Cayman Islands, Montserrat, Pitcairn, Saint Helena, and Tristan da Cunha) used the service for identifications and biosecurity advice. During the reporting period, a total of 1215 samples (including more than 20 photographs) were submitted to Fera for diagnosis.

The pest records accumulated through sample submissions and surveys feed into checklists and provide essential baseline data by which future faunistic changes can be monitored and accurately assessed. Early detection of invasive pests increases the chance of effective and efficient eradication, therefore lessening the impact on the environment, biodiversity, and local economy. The data is also useful in terms of monitoring the spread of invasive species and identify potential future threats to the other UKOTs. Measures can be put in place to reduce the risk of pest entry, and to develop contingency plans to determine appropriate management actions should the pest be detected.

Key achievements of the 2023/2024 project include:

- Across all the work packages 1215 samples were processed during 2023/24 from seven UKOTs: Ascension Island (165), Cayman Islands (353), Chagos Archipelago (3), Montserrat (487), Pitcairn Islands (3), Saint Helena (199) and Tristan da Cunha (5).
- At least 270 invertebrate taxa were identified through a combination of morphological study and molecular study.
- Approximately 30,000 individual specimens and photographs were examined, this figure is predominantly made up of ants.
- Thirteen insect species were recorded from Ascension Island for the first time, many of these were polyphagous plant pest Hemipterans. Numerous new host records arose, including three pests feeding on three endemic IUCN Red Listed Critically Endangered plant species: *Pseudococcus viburni* (Hemiptera: Pseudococcidae) (Fig. 5), the 'greenhouse mealybug' was recorded *on Ptisana purpurascens* (endemic fern); *Planococcus minor* (Hemiptera: Pseudococcidae), the 'passionvine mealybug' was recorded on *Pteris adscensionis* (endemic fern); and *Insignorthezia insignis* (Hemiptera: Orthezidae), the 'Kew bug' was reported on *Euphorbia origanoides* (Ascension spurge).
- Twenty-nine species of scale insect (Hemiptera: Coccomorpha) are recorded from Montserrat for the first time. The soft scales *Alecanochiton marquesi* Hempel (Fig. 8) and *Prococcus acutissimus* (Green) (Fig. 9) are also new for the Lesser Antilles

archipelago. The invasive species that appears to have the biggest impact is croton scale (*Phalacrococcus howertoni* Hodges & Hodgson) (Fig. 13), especially on croton (*Codiaeum variegatum*), soursop (*Annona muricata*), and sugar apple (*Annona squamosa*).

- The whitefly *Asiothrixus antidesmae* (Takahashi) is recorded from Montserrat for the first time. Enormous populations of the whitefly were found on *Ixora* spp.
- A species of fly was recorded from Montserrat for the first time, a fruitfly *Anastrepha maculata* Norrbom (Diptera: Tephritidae).
- One new species of thrips, *Limothrips cerealium* (Haliday) (Thysanoptera: Thripidae) reported for Saint Helena.
- *Astrothrips* sp. (Fig. 16) *Haplothrips gowdeyi* (Fig. 19)*, Aptinothrips rufus* (Fig. 16) - were recorded from Diego Garcia in the Chagos Archipelago (British Indian Ocean Territory)
- A first record of the invasive Yellow fever mosquito, *Aedes aegypti* (L.) (Diptera: Culicidae) (Fig. 6), was confirmed from the Pitcairn Islands. *Aedes aegypti* is a known vector of several viruses including yellow fever virus, dengue virus chikungunya virus and Zika virus.
- [redacted] presented a paper at the XVI International Coccidology Symposium (ICS) 17th-20th July 2023 in Tbilisi Georgia on the soft scale insects of Montserrat.
- A metabarcoding study of the gut content of *Vespula vulgaris* (L.) (Hymenoptera: Vespidae) (Fig. 7) collected on Saint Helena determined that these invasive wasps prey on the island's endemic invertebrates. Seven endemic species of spider and two endemic insects were detected within the wasp gut contents, including IUCN red listed species. This study supports Saint Helena National Trusts' (SHNT) Darwin Initiative funded 'Invasive Invertebrate Project' by contributing to the understanding of the biology of the wasp and in doing so assist with the management of invasive predators.
- Six invertebrates not known to occur in Saint Helena were detected in the gut content of *Vespula vulgaris*.
- [redacted] provided biosecurity training on ant identification, monitoring, invasive species management August 2023. Support was also provided by setting up an ant reference collection.
- 40 species of nematode were recorded from Ascension Island for the first time.
- Further samples of two species of undescribed whitefly (Aleyrodidae) have been identified on endemic plants in Saint Helena and are currently being studied.
- A possibly undescribed species of *Temnothorax* (Formicidae) was collected in the Cayman Islands. Morphological and molecular analysis will be conducted.
- A paper entitled 'Colonization and coexistence of non-native ants on a model Atlantic island' was published in *Diversity and Distributions.*
- Four scientific papers were prepared and are in the process of obtaining approval for submission.

Introduction and Aims

Biodiversity in the UKOTs is globally significant; the OTs support unique ecosystems and many rare and threatened species, many of which are found nowhere else in the world. This rich biodiversity is under threat from the introduction of alien species, a major cause of the loss of biodiversity globally, and island ecosystems are particularly vulnerable (Cheesman *et al*., 2003; Varnham, 2006).

[redacted] Effective conservation of biodiversity in the UKOTs is essential if the UK is to meet Biodiversity Targets, as well as commitments under other relevant Multilateral Environmental Agreements (MEAs).

[redacted] accurate and rapid species identification for suspect alien species is fundamental to the enforcement of eradication and quarantine measures.

The Plants Programme at Fera provides diagnostic and training services for the Plant Health and Seeds Inspectorate within the Animal and Plant Health Agency (APHA) and has a wealth of experience and expertise in the identification of all plant-feeding insect orders, plant-feeding mites, plant-parasitic nematodes, and plant pathogens.

Fera has over 50 scientists dedicated to providing fast and accurate identifications of plant pests and diagnosis of plant diseases to an international standard. This project was managed and largely delivered by the entomologists in the Invertebrate Identification Team.

The results of the project feed directly into the conservation work carried out by the Royal Botanic Garden's UK Overseas Territories programme and the project entitled 'Tackling Invasive Non-Native Species in the UK Overseas Territories' which forms part of the Conflict, Stability and Security Fund (CSSF).

This Defra-funded project was divided into three sections or work packages:

- Work Package 1 (WP1): *Identification Service for Invasive Invertebrate Plant Pests* made up the largest section and was conducted to provide an identification service for invasive invertebrate plant pests that may threaten biodiversity and agriculture in all of the UKOTs.
- Work Package 2 (WP2) *Identification of invasive ants (Hymenoptera: Formicidae) in the UKOTs* is a continuation of the initial 'proof of concept' study with a focus on the invasive ants of Ascension Island and Saint Helena (ODA) and identify potential future threats. In year two, expand the project to two territories within the Caribbean (Montserrat (ODA) and Cayman Islands). In year three, expand the study to two further territories (to be agreed).
- Work Package 3 (WP3): *Identification of Plant Pathogens on Endemic and Endangered plants in the UKOTs* was a pilot study to expand the identification

service offered to UKOTs to include identification of pathogens on endangered and endemic plants.

- Work Package 4 (WP4): *Gut content analysis of invasive predatory invertebrates in Saint Helena*. Support Saint Helena National Trust's endemic invertebrate recovery project (Darwin Initiative) in determining whether two invasive species, the common wasp (*Vespula vulgaris)* and the springbok mantis (*Miomantis caffra*) are preying upon SH's endemic invertebrates, such as the spiky yellow woodlouse, *Pseudolaureola atlantica.*

The aims of the project were to strengthen biosecurity in the UK Overseas Territories by delivering the following objectives:

WP1: Identification Service for Invasive Invertebrate Plant Pests

- Provide an identification service for invasive invertebrate plant pests for all of the UKOTs; including invasive non-native invertebrate plant pests, which impact on biodiversity and commercial interests.
- Provide rapid advice, wherever possible, when bio-security threats are detected, in the form of guidance on appropriate measures.
- Provision of remote (e.g. online) basic training to colleagues in overseas territories so that local capacity is developed where resources permit this.

Work Package 2: Identification of invasive ants (Hymenoptera: Formicidae) in the UKOTs

- Provide a protocol for collection, preservation, and submission of ant samples to Fera.
- Provide training on ant collection, preservation methods and identification to UKOT biosecurity officers, increasing in territory capacity to identify non-native ants.
- Produce a written report detailing ant species identified and a field-guide to the ant species.
- Update checklists of invasive ants in the UKOTs to enable future potential threats to be identified.
- Pin, label, and photograph ants identified. Set up reference collections of validated specimens for the UKOTs.

Work Package 3: Identification of Plant Pathogens on Endemic and Endangered plants in the UKOTs

- Provide identifications of pathogens on endangered and endemic plants in the UKOTs. Photographs of plants with suspected disease symptoms will be submitted to Fera, from which pathology diagnosticians will determine whether submission of a sample is necessary.

Work Package 4: Gut content analysis of invasive predatory invertebrates in Saint Helena

- Provide a written report detailing:
  - Outcome of gut content metabarcoding analysis for each sample
  - Details of identifications of prey contents to species (for those represented on DNA databases) and to genus or family (for those not represented) and give approximate figures for the total number of species (identified and unidentified)

WP1: Identification Service for Invasive Invertebrate Plant Pests

1.0 Methods

1.1 Service launch and publicity

The main contacts within the UKOTs that have used the service previously were notified that the pest identification service would continue to be funded by Defra from April 2023 and encouraged to submit samples. This contact list is reviewed regularly due to staff changes within the territories. The identification service is promoted on the GB non-native species secretariat website, through the UKOT Conservation Forum and through other UKOT activities such as training courses.

1.1.2. Project delivery

All samples submitted by the UKOTs were scanned and triaged, and those representing plant-feeding groups that might pose the greatest economic or biodiversity threat were identified as a priority. Incidental invertebrates not thought to be of concern were not always identified beyond family rank. In addition, the reports were shortened, and pictures were not always included.

2.0 Results

2.1 The number of samples received, and identifications made

A total of 547 invertebrate samples, consisting of over 2000 specimens and photos were processed from 5 territories between April 2023 and March 2024: Ascension Island (165), Cayman Islands (97), Chagos Archipelago (3), Montserrat (248), Saint Helena (29) and Tristan da Cunha (5).

The results are included in the summary below and detailed in Appendix 1 (Arthropods) and Appendix 2 (Nematodes)

2.2 Summary of findings

Approximately 224 distinct taxa of invertebrates were identified at Fera during 2023-24, of which more than 160 were identified to at least generic level. Samples of Thysanoptera and Coleoptera from Cayman Islands, and Nematoda from Montserrat were still being processed at the time of compiling this report and have therefore not been reported here. Once analysis of these specimens has concluded the results for the samples will be compiled for and reported in the Year 3, March 2025.

The organisms identified so far belonged to the following classes and orders:

ACARINA: Mesostigmata (2spp.); Trombidiformes (3 spp.)

DIPLOPODA: (1 sp.)

INSECTA: Blattodea (3 spp.); Coleoptera (34 spp.); Diptera (17 spp.); Hemiptera (106 spp.); Hymenoptera (7 spp.); Lepidoptera (5 spp.); Mantodea (1 sp.); Neuroptera (1 sp.); Odonata (1 sp.); Orthoptera (2 spp.); Psocoptera (1 sp.); Thysanoptera (11 spp.)

MALACOSTRACA: Isopoda (1 sp.)

NEMATODA: Alaimida (2 spp.); Aphelenchida (2 spp.); Araeolaimida (2 spp.); Diphtherophorida (2 spp.); Dorylaimida (13 spp.); Enoplida (5 spp.); Monhysterida (2 sp.); Mononchida (4 spp.); Rhabditida (8 spp.); Tylenchida (6 spp.).

In terms of the number of species identified, the dominant group were the Hemiptera. This is not surprising as they are one of the most frequently transported groups of insects in plant trade and one of the most successful invasive alien insect groups (Miller & Miller, 2003; Pellizzari & Dalla Montá, 1997; Smith *et al*., 2007; Thomas, 2006).

A full list of the taxa identified during the reporting period can be found in Appendix 1 'WP1: Summary of invertebrate identifications 2023-2024' and Appendix 2 'WP1: Summary of Nematode identifications 2023-2024'. Some taxa are still being studied or are awaiting DNA sequencing results and have not been listed at species level. For certain invertebrate groups, world specialists were consulted when reliable keys or descriptions were not available. Further details regarding the individual samples, such as collector's name, location, date collected, has been recorded through Fera's Plant Health Information Warehouse Diagnosis Database and may be obtained by contacting the authors.

2.3 New geographical records and potential invasive threats

Published faunistic catalogues, regional checklists and taxonomic literature were examined to determine the validity of the new geographical records. For some groups, for example the scale insects and whiteflies (Hemiptera: Coccoidea and Aleyrodidae), there are accurate, up-to-date catalogues available online to check the distribution of species, whereas for some groups, the data is disparate and unreliable.

2.3.1. Ascension Island

One hundred and sixty-five samples were analysed from Ascension Island for identification, the majority of these were submitted directly by the Ascension Island Government Invertebrate Project Officer (113) while the remainder were collected by [redacted] during a summer 2023 visit to the island to provide training in ant identification (see Appendix 6 'WP2: Visit report: Ant biosecurity training and trial of ant chemical control in Ascension Island, South Atlantic Ocean').

Some of these samples were received during year one of the project were carried over to this project year due to the significant number received and considerable time required to produce slide preparation, conduct DNA analysis, and study them. Many specimens were collected on sticky traps therefore arrived in poor condition, both factors increase the time needed to process and identify them.

Thirteen species of insect and approximately 40 species of nematode were recorded from Ascension Island for the first time.

Diptera:

The following species of fly were recorded from Ascension for the first time:

Dasyhelea ludingensis Zhang & Yu (Diptera: Ceratopogonidae) – a biting midge
Leia arsona Hutson (Diptera: Sciaridae) – a fungus gnat
Bradysia ocellaris (Comstock) (Diptera: Sciaridae) - Moss gnat
Corynoptera latistylata *(Hardy)* (Diptera: Sciaridae) – a black fungus gnat
Cratyna keilini (Edwards) (Diptera: Sciaridae) – a fungus gnat

Black fungus gnats (sciarids) are among the most important pests in undercover crop production. Larvae may cause direct physical damage to plant roots, and create entry points for soil-borne plant pathogens. Adults can transfer fungal and bacterial pathogens. They can be distributed through wind and drifting, for example on dead wood and other forms of organic debris, but are most frequently introduced accidently by humans, by means of transported plants or organic matter.

Hemiptera:

The following hemipterans were recorded from Ascension Island for the first time:

Paraethus capicola (Westwood) (Hemiptera: Cydnidae) – a burrowing bug
Aonidiella orientalis (Newstead) (Hemiptera: Diaspididae) – Oriental scale (Fig. 3)
Hemiberlesia lataniae (Signoret) (Hemiptera: Diaspididae) – Latania scale
Chrysomphalus pinnulifer (Maskell) (Hemiptera: Diaspididae) – Pinta-amarela
Fiorinia fioriniae Targioni Tozzetti (Hemiptera: Diaspididae) – Palm fiorinia scale (Fig. 4)
Pseudococcus viburni *(Signoret)* (Hemiptera: Pseudococcidae) – Obscure mealybug

All these scale insects are pantropical polyphagous pests that are potential invasive.

Thysanoptera:

The following species of thrips were recorded from Ascension Island for the first time:

Frankliniella schultzei (Trybom) (Thysanoptera: Thripidae) – Common blossom thrips
Heliothrips haemorrhoidalis (Bouché) (Thysanoptera: Thripidae) – Greenhouse thrips (Fig. 2)

New host records:

Azadirachta indica and *Livistonia chinensis* are new hosts for *Aonidiella orientalis; Azadirachta indica* and *Casuarina equisetifolia* are new hosts for *Hemiberlesia lataniae; Livistonia chinensis* and *Carex flacca* are new hosts for *Chrysomphalus pinnulifer; Plumeria alba* is a new host for *Parasaissetia nigra; laeodendron croceum* is a new host for *Fiorinia fioriniae; Euphorbia origanoides* is a new host for *Insignorthezia insignis; Pteris adscensionis* is a new host for *Planococcus minor; Ptisana purpurascens* is a new host for *Pseudococcus viburni*

The most significant of these new host records are those introduced species of scales and mealybugs endemic IUCN Red Listed Critically Endangered plant species: *Ptisana*

purpurascens, an endemic fern – according to Niissalo et al (2012) a single population exists in less than a 0.5km area; *Pteris adscensionis*, a second endemic fern - according to Renshaw et al (2012) only a few hundred fertile individuals remain, distributed across a few main localities; *Euphorbia origanoides*, Asscension Spurge – assessments have shown that numbers continue to decline, Gray et al (2016).

Nematoda:

[redacted] sampled soil from 11 localities on Ascension Island to study the soil nematode community structure.

Once the soil samples arrived at Fera they were processed following the Whitehead tray technique (EPPO, 2013) (Fig. 16.) for 24 hours to separate live, motile nematodes from the substrate. Motile nematodes were isolated by washing through three 53µm sieves, collected in boiling tubes, sealed using parafilm and stored at 5°C.

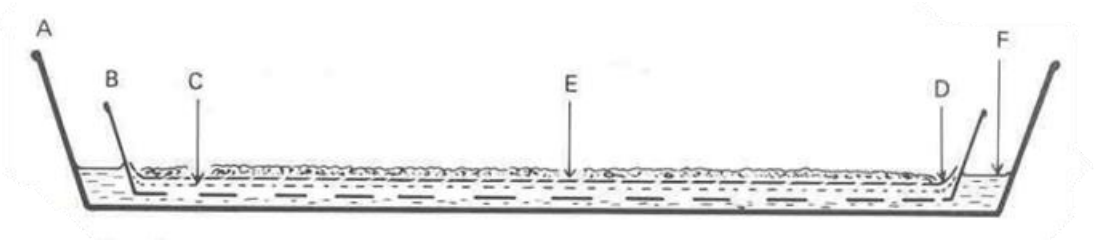

Fig. 16. Schematic of Whitehead tray modified Baermann for extraction of live, motile, vermiform nematodes from substrate. A: large photographic tray; B: metal wire tray; D: filter; E: thin layer of 200g of soil substrate; F: sufficient water to moisten soil substrate.

Nematode species were confirmed by means of morphological study. Nematodes were quantified and identified to type using a Leica M50 stereomicroscope (Leica microsystems, Wetzlar, Germany). Ten adult specimens representative of each type (plant-parasitic and non-parasitic nematodes) were picked out and studied. Nematodes were identified to species or genus and separated according to the feeding habit, using a high-power compound microscope (Zeiss Axio Imager 2, ZEISS, Germany) tilizing differential interference phase contrast (DIC) and image analysis software.

Thirty-six nematode taxa (Figs 14 and 15), within different trophic groups, were obtained across 4 elevation site samples: 12 bacterivores, 7 herbivores (plant-parasitic and root hair feeding nematodes), 5 fungivores, 3 omnivores and 9 predators in the soil samples and 2 taxa of marine nematodes (*Trissonchulus* sp. (Fig. 15) and *Crustorhabditis scanica*) in the sand samples. There were one, possibly two species new to science among the samples and will be studied further by Fera nematologists (see Appendix 2 for details of results).

Understanding the organisation of nematode communities can help with understanding soil processes, the food web, the health and stability of ecosystems, and the biodiversity of the soil. Nematodes from different feeding groups are involved directly and indirectly in carbon transformation, nutrient cycling from plant roots and dead plant residues. In collaboration with [redacted] (invertebrate ecologist and former Invertebrate Project Officer at Ascension Island Government Conservation and Fisheries Directorate), the results of this survey were analysed and a study on the functional composition of a terrestrial nematode

community on Ascension is in progress, with the aim of submitting a scientific report for publication within the next 6 months.

2.3.2. Cayman Islands

Ninety-seven samples of insects were submitted to Fera by the Agricultural Health Inspection Services, Cayman Islands Government. Many of the samples were of import inspection origin, predominantly interceptions on plants and produce from North America, however the bulk of the samples were beetle collected in palm weevil (*Rhynchophorus ferrugineus*) surveillance traps. Some of the beetles have only been identified to family rank thus far, and none of the Thysanoptera have been studied, there results will be shared during the next (Year 3) project report.

Metamasius sericeus (Olivier) (Coleoptera: Curculionidae) (Fig. 10), the 'silky cane weevil' was observed within the samples. We could find no previous record of the species from the Cayman Islands, however, this species is reportedly endemic to the Greater Antilles, Mexico to Colombia and western Ecuador. The larvae of the silky cane weevil feed inside the stems of plants such as sugarcane (*Saccharum* spp.), bananas (*Musa* spp.), palms, bromeliads, and orchids. It is usually considered a secondary pest that attacks damaged or unhealthy plants but can occasionally attack healthy sugarcane and cause economic losses to sugarcane production.

2.3.3. Chagos Archipelago – Diego Garcia (BIOT)

Specimens collected by [redacted] on a study visit to Diego Garcia in 2022 were studied further during the 2023/2024 project year. Three species of thrips previously unrecorded for the island were identified:
Astrothrips sp. (Thysanoptea: Thripidae) (Fig. 17) on *Morinda citrifolia*; *Haplothrips gowdeyi* (Thysanoptera: Phlaeothripidae) (Fig. 19) on *Terminalia catappa* and *Aptinothrips rufus* (Thysanoptea: Thripidae) (Fig. 16) on *Terminalia catappa.*

2.3.4. Montserrat

[redacted] visited Montserrat in April 2023 to provide specialist training in the identification and detection of invasive ants (Formicidae: Hymenoptera), mosquitoes (Culicidae: Diptera) and fruit flies (Tephritidae: Diptera). [redacted] conducted an insect pest survey during his visit [redacted], collecting 242 samples. One of the outputs of this survey was an up-dated checklist of the scale insects for Montserrat, which will provide baseline data from which future faunistic changes, due to factors such as international trade and tourism, can be monitored and accurately assessed (Malumphy et al, in press).
The samples were returned to Fera and processed, and thirty-one new island records and two new to the Caribbean records were detected. Twenty-six species of scale insect, a whitefly, three species of mealybug and a species of fruit fly is recorded from Montserrat for the first time.

The following insects were recorded from Montserrat for the first time:

Alecanochiton marquesi Hempel (Hemiptera: Coccidae)

Anatrespha maculata Norrbom (Diptera: Tephritidae) – a fruitfly
Antonina graminis Maskell (Hemiptera: Pseudococcidae) – Rhodesgrass mealybug
Aonidiella orientalis (Newstead) (Hemiptera: Diaspididae) – oriental scale
Asiothrixus antidesmae (Takahashi) (Hemiptera: Aleyrodidae). Some researchers assign this species to the genus *Aleurothrixus*.
Aspidiella sacchari (Signoret)(Hemiptera: Diaspididae) – brown sugarcane scale
***Asterolecanium* sp.** (Hemiptera: Asterolecaniidae) – a pit scale
Ceroplastes dugesii Lichtenstein (Hemiptera: Coccidae) – Duges wax scale
Ceroplastes rubens Maskell (Hemiptera: Coccidae) – red wax scale
Ceroplastes rusci (Linnaeus) (Hemiptera: Coccidae) – fig wax scale
Crypticerya genistae (Hempel) (Hemiptera: Monophlebidae) – White scale
Eucalymnatus tessellatus (Signoret) (Hemiptera: Coccidae) – tessellated scale
Ferrisia virgata Cockerell (Hemiptera: Pseudococcidae) – Striped mealybug
Icerya seychellarum (Westwood) (Hemiptera: Monophlebidae) – Seychelles scale
Ischnaspis longirostris (Signoret)(Hemiptera: Diaspididae) Black thread scale
Kuwanaspis* sp. *?pseudoleucaspis (Lindinger) (Hemiptera: Diaspididae) – bamboo white scale
Lepidosaphes tokionis (Kuwana) (Hemiptera: Diaspididae) – Croton mussel scale
Milviscutulus mangiferae (Green) (Hemiptera: Coccidae) – mango shield scale
Nipaecoccus nipae (Maskell) (Hemiptera: Pseudococcidae) – Coconut mealybug
Paratachardina pseudolobata (Hemiptera: Kerriidae) – Lobate lac scale
Phalacrococcus howertoni Hodges & Hodgson (Hemiptera: Coccidae) – croton scale
Philephedra broadwayi (Cockerell) (Hemiptera: Coccidae)
Philephedra tuberculosa Nakahara & Gill (Hemiptera: Coccidae)
Prococcus acutissimus (Green) (Hemiptera: Coccidae) – banana-shaped scale
Protopulvinaria longivalvata Green (Hemiptera: Coccidae)
Pseudaonidia trilobitiformis (Green) (Hemiptera: Diaspididae) – Trilobite scale
Pulvinaria urbicola Cockerell (Hemiptera: Coccidae) – urbicola soft scale
Saissetia miranda (Cockerell & Parrott) (Hemiptera: Coccidae) – Mexican black scale
Saissetia neglecta De Lotto (Hemiptera: Coccidae) – Caribbean black scale
Undetermined sp. nr. *Odonaspis* (Hemiptera: Diaspididae) – bamboo diaspid

Two species were detected in the Caribbean for the first time:

Kuwanaspis sp. (suspect *K. pseudoleucaspis*), a bamboo feeding armoured scale native to Asia was collected on *Arundinaria.* Originally described from Japan, this scale has spread throughout Europe and North America, and it also occurs in Bermuda, Hawaii, and New Zealand. It is oligophagous on Poaceae, feeding on plants assigned to 10 genera: *Arundinaria; Bambusa; Cynodon; Fargesia; Paspalum; Phyllostachys; Pleioblastus; Sasa*; *Semiarundinaria*; and *Sinobambusa*. In addition, it has been recorded by Fera in the UK on *Drepanostachyrum* and *Himalayacalamus*. It is a serious pest of bamboo in China but in Europe even high infestations do not apparently affect the vigour of the host plant (Malumphy & Salisbury, 2016).

A new second diapsid species was collected on bamboo, it appears closest to the genus *Odonaspis*, but requires further study.

Nematoda:

In January 2024 [redacted] sampled soil in banana and almond plantations on Montserrat for plant pest nematode analysis. These samples are currently being processed and full results will be reported in due course. Preliminary results are reported in Appendix 2.

2.3.5. Pitcairn Islands

Photographs of three invasive insect species were submitted from Pitcairn for identification. The most significant being the invasive 'Yellow fever mosquito', *Aedes aegypti* (L.) (Diptera: Culicidae), a first record for the Pitcairn Islands. *Aedes aegypti* is a known vector of several viruses including yellow fever virus, dengue virus chikungunya virus and Zika virus.

2.3.6 Saint Helena

Twenty-nine samples were studied from St Helena, they were submitted by the Saint Helena National Trust and Vicky Wilkins of the Species Recovery Trust.
Three samples of worker and termite soldiers were studied and confirmed as *Heterotermes* sp. (Blattodea: Rhinotermitidae). They are most likely *Heterotermes perfidus*, the damp-wood termite, a major pest of forest trees and timber in buildings, although morphological study and DNA barcoding were inconclusive.
Among a batch of samples collected by Roger Key was a single adult *Limothrips cerealium* (Haliday) (Thysanoptera: Thripidae) (Fig. 18), thought to be the islands' first known record. Commonly called 'grain thrips' or 'corn thrips', *L. cerealium* is a pest of Rosaceae, including cereal crops like barley, maize, oats and wheat. Found worldwide in temperate regions, it is also reported from South Africa (Cabi, 2024).

2.3.7 Tristan da Cunha

[redacted] visited Tristan da Cunha in November and December 2023, as part of a Darwin funded project for the biological control of brown soft scale *Coccus hesperidum* L., to protect the *Phylica*-forest and associated endemic finches. The opportunity was taken to collect and record suspected non-native invertebrates, and the samples will be processed during 2024/25.

2.4 Biosecurity and pest management advice provided

A summary of the distribution, host range, biology and economic importance is provided to the UKOTs when new pests are recorded. This information will assist the UKOTs to make a rapid assessment of the potential risk posed by the organism. If available, photographs of the pest and symptoms are also provided to aid detection and identification.

Fera received a request from Montserrat Governments' Department of Agriculture to provide a pest factsheet on 'black bean bug' *Brachyplatys subaeneus* (Westwood) (Hemiptera: Plataspidae) (Fig. 1), a new insect on pigeon pea (*Cajanus cajan*) that had

spread widely on farms and in gardens throughout the north of the island. See Appendix 3 WP1: Pest factsheet - Black bean bug.

2.5 New species to science

Further samples were received of whitefly on two endemic plants, dogwood (*Nesohedyotis arborea*) and whitewood (*Petrobium arboretum*). These appear to represent two undescribed species which are currently being studied. One of them appears to belong to the genus *Aleuroplatus* (Fig. 11). There are 78 species currently assigned to this genus and the majority are found in Africa. There is no comprehensive diagnostic key to this genus and many of the descriptions are in relatively inaccessible journals, so it will take time to study these species. The generic placement of the second species (Fig. 12) is uncertain. It has some morphological characters that are consistent with *Trialeurodes*, but the molecular analysis suggests that it is not congeneric.

2.6 Scientific publications

Four scientific papers are in the process of being prepared for submission:

[redacted] (In prep.). Non-native vegetation drives functional turnover in terrestrial nematodes (working title)

[redacted](In prep.) Far, far away: The Diptera of Tristan da Cunha and an updated checklist.

[redacted](In prep.). A new Cynid (burrowing bug) for Ascension Island.

*[redacted] (In prep.). An annotated checklist of soft scale insects (Hemiptera: Coccomorpha: Coccidae) of Montserrat, West Indies

*[redacted] presented this paper at the XVI International Coccidology Symposium (ICS) 17th-20th July 2023 in Tbilisi Georgia on the soft scale insects of Montserrat.

2.7 Building diagnostic capacity in the UKOTs

As well samples and photos of invertebrates to diagnose we routinely receive other enquiries from our biosecurity contacts seeking diagnostic keys and descriptions of pests to assist them in making species determinations. We have provided advice to a few of the UKOTs on camera and microscope equipment to enable them to better study and image pests.

3.0 Conclusions

[redacted] Accurate and rapid species identification for suspect alien species is fundamental to the enforcement of eradication and quarantine measures to protect biodiversity and agriculture.

We have received a great number of enquiries and photographs of suspected biosecurity threats, which demonstrates that there continues to be a clear demand for an identification service for invasive invertebrate plant pests to improve biosecurity and support the preservation and conservation of biodiversity in the UKOTs. It has, however, always been required that if this service was to continue to be funded it should not only provide inventories of pests present in each territory, but demonstrate that the service has practical benefits. These benefits demonstrated during the 2023/24 reporting period include:

1. The service helped identify and evaluate immediate threats so that appropriate action could be taken.
2. The service helped identify potential threats and prioritise conservation efforts in some of the UKOTs.
3. More than fifty new species records were reported for the UKOTs. Thirty-one insects are recorded from Montserrat, for the first time, thirteen species of insect and 40 species of Nematode are reported new for Ascension Island, three species are recorded new for Chagos Archipelago (British Indian Ocean Territory), and one new species for Pitcairn Islands and Saint Helena. These reports include some highly invasive pests that may continue to spread in the UKOTs.
4. In each case where a new pest is recorded, a summary of the distribution, host range, biology and economic importance is provided to assist with the UKOT making a rapid risk assessment and deciding upon appropriate action.
5. The presence of natural enemies in the samples have been recorded which over the longer term may be investigated and used to help suppress the numbers of invasive pests.
6. The service has provided data for the compilation of checklists of species for each Territory. Such checklists provide essential baseline data by which future faunistic changes, due to factors such as international trade, tourism, and climate change, can be monitored and accurately assessed. The early detection of exotic introductions improves the chances of eradication and can thus protect the environment, biodiversity and local economy.

Since the identification service was launched in February 2010, twelve UKOTs have made use of the service and submitted more than 2500 samples. More than 150 of the invertebrate species examined to date have never before been reported from the UKOTs. More than twenty-five species apparently new to science have been observed. One new species from the Cayman Islands has been described: *Scirtothrips cocolobae* Collins & Evans (Collins & Evans, 2013) and one new species from Montserrat: *Schoenlandella montserratensis* Kang, (Hymenoptera, Braconidae) Kang I, Sharkey MJ, Diaz R (2021).

In conclusion there is a continued high demand for the identification service and the project continues to fulfil its aims.

WP2: Identification of invasive ants (Hymenoptera: Formicidae) in the UKOTs

The introduction of non-native ants can be ecologically disastrous and economically damaging throughout the world, and island ecosystems are particularly vulnerable. Invasive ants in natural ecosystems can lead to the displacement and/or loss of native ant species. In addition, non-native ants affect other organisms including the human population and alter ecosystem processes both directly and in-directly. The absence of their natural predators results in an uncontrolled abundance in their introduced range and they may outnumber native species. Moreover, invasive ants compete with and prey upon different organisms, including some vertebrates, and consequently disrupt mutualistic interactions with numerous plants and other organisms. The introduction of invasive ants will result in a change to the biogeographical pattern as well as a loss in biodiversity, especially in oceanic islands with few or no native ant species, such as many of the UKOTs. Mutualistic relationships between invasive ants and invasive honey-dew egesting hemipterans (aphids, psyllids, scale insects and whiteflies), can increase the population density and negative impact of both species.

1.0 Methods

1.1 Protocol for collection, preservation, and submission of ant samples

A protocol for the collection, preservation, and submission of ant samples was shared with and demonstrated to biosecurity officers who attended a training in Montserrat in April 2023. Different sampling methods were presented to sample ants across different habitats when applicable. The sampling methods within the protocol aim to provide information on the different native and non-native ant species as well as potentially monitoring the presence or potential entry of any invasive species that may impact the environment of the territories in question. The sampling methods are also useful in monitoring the effectiveness of treatments or control measures on the population density of target invasive ant species. Furthermore, the sampling protocols can also be used to address research objectives relating to the understanding of ant species diversity, functional diversity, population genetics, island of biogeography and conservation studies. See Appendix 5 for the details of the sampling protocol.

Samples collected in the UKOTs were catalogued, preserved in 70% ethanol and sent to Fera for analysis. Some individual specimens were mounted on card points for study, photography and dry preservation, while other specimens were preserved in 95% for molecular analysis.

1.2 Training and advice

1.2.1 Ascension Island

[redacted] was invited by the Ascension Island Government to provide training in ant identification, provide technical advice on surveillance, monitoring and trial control of invasive ant species. To make it easier to identify non-native and high-risk ant species after

the training session, time was spent setting up an ant reference collection. This training visit took place in August 2023, see Appendix 6 for the visit report.

1.2.2. Caribbean UKOTS

In April 2023, [redacted] visited Montserrat and provided insect identification training to biosecurity officers from all the Caribbean UKOTs.

Project FR/002795: "*Training Course for Biosecurity Officers in the Caribbean UK Overseas Territories".* Funded by Defra via GBNNSS (UKOT)

[redacted] provided training in the identification and detection of invasive ants.

1.2.3. Saint Helena

Pharaoh ant, *Monomorium pharaonis* (L.), is a cosmopolitan species of African origin that although present on Ascension Island has not reached Saint Helena. Strict biosecurity measures on imported goods and travellers' baggage from Ascension Island has been implemented. In January 2024 Fera received a request for advice on the identification and management of pharaoh ant, to support the Biosecurity Department and the Saint Helena National Trust in keeping this pest out. In addition, specimens of fire ants (*Solenopsis invicta*, *Solenopsis geminata* and *Wasmannia auropunctata*) and yellow crazy ant (*Anoplolepis gracilipes*) were also given to the St. Helena biosecurity office and St. Helena National Trust to enable them to become familiar with the diagnostic characteristics of these invasive species to aid them in the event of possible future interceptions.

2.0 Results

2.1 The number of samples received, and identifications made

A total of 595 ant samples were received from St. Helena Island, Cayman Islands and Montserrat. Eighty-eight species of ants belonging to 33 genera and seven subfamilies of ant were identified. Most of the species collected particularly in St. Helena are considered non-native whereas four species in Montserrat and three species in Cayman Islands are listed as known invasive species. Most species collected in Montserrat and Cayman Islands are known to occur in the neotropics and five species are considered known "tramp species". Many ant species were from the subfamily Myrmicinae, the most diverse group among the Formicidae. No ant samples were received from Ascension Island, however four photos of ants were submitted for species confirmation.

The samples were identified under a dissection microscope to generic level and then card-pointed to identify to species. They were determined by using published keys and descriptions, and by comparison of images through online resources such as www.antweb.org and www.antwiki.org. To determine the geographical distribution of each species, we compared the list to previous published literature (e.g. Wetterer, 2007) and online resources. Five specimens were sent for molecular sequencing to ascertain the species identification due to lack of adequate keys and descriptions.

Samples were preserved in 70% ethanol, some individuals were mounted on card points for study and deposited in collections held by Fera, Ascension Island and St Helena National Trust. Samples received from Cayman Island and Montserrat will be sent back to serve as their reference collection.

The results are included in the summary below and detailed in Appendix 4.

2.2 Summary of findings

2.2.1 Saint Helena

One hundred ant samples were received from Saint Helena since March 2023. Samples were collected during the ongoing non-native invertebrate monitoring survey being undertaken by the St. Helena National Trust. Due to the current *Phytophthora* outbreak in the cloud forest, ant surveillance was restricted to the surrounding areas and endemic sites. Based on the samples received it was possible to determine that there were no new ant introductions to the island. To date, a total of 20 species were collected since the start of the project in 2021 and four species were new ant records since 2007.
Current data from the St. Helena National Trust indicates the presence of the invasive ant in new areas, and it is suspected that these introductions are due to ants arriving from untreated adjacent infested areas. The control of *P. megacephala* still continues in various places and near the cloud forest using a modified treatment layout.

2.2.2 Montserrat

To date, a total of 47 species from 24 genera belonging to five subfamilies were identified from the two batches of samples collected in April 2023 and January 2024. A total of 124 ant samples were collected from Montserrat during the training course in April 2023. In January 2024, an additional 115 samples were taken within and around the fire ant infestation zone. These samples were collected to determine which species of invertebrate are likely to be affected or may co-exist within the infested area. This is to provide baseline information on the negative impact of fire ants on invertebrate diversity. Non-ant taxa within these samples are currently being studied and the results will be included in a subsequent report.
The ants were collected using a combination of sampling methods i.e leaf litter extraction using Winkler traps, tube baiting and hand collection. Important and concerning species were collected such as fire ant's species of *Solenopsis Invicta* Buren, *S. geminata* Fabricius and *Wasmannia auropunctata* [redacted]. Other significant species collected that are considered invasive or concerning were *Pheidole megacephala* Fabricius and *Trichomyrmex destructor* [redacted].

2.2.3 Cayman Islands

A total of 256 tube samples containing ants were identified in September 2023. The samples were collected [redacted] using different sample protocols from various sites. A total of

41 species were identified including two fire ant species *S. invicta* and *S. geminata.* Several species were also introduced but most of the species were typical of the neotropic regions.
One species from the genus of T*emnothorax* was sent for molecular sequencing and did not match any of the available genetic sequences in the database. The ant is now being studied morphologically to determine if it an undescribed species.

2.3. Field-guide to the ant species in the UKOTs

A field guide is being drafted to assist in the identification of ants in the UKOTs with brief diagnostics feature, behaviour and ecology. The guide is being developed to incorporated ant species from all UKOTS studied as parted of this project. A completed field-guide will be submitted at the end of the project term (March 2025).
A draft key to the ants of the Caribbean UKOTs was produced (see Appendix 7) and will continue to be developed as further Caribbean UKOTs are studied.

2.4. Setting up of reference collections of validated specimens for the UKOTs

Specimens received from previous years were mounted, stored in tubes containing 70% ethanol and labelled accordingly. A total of 11 ant samples from St. Helena were returned in October 2023 via [redacted] Species Recovery Trust. An additional three species of high-risk ant (*Anoplolepis gracilipes*, *Solenopsis invicata* and *Wasmannia auropunctata*) that are not currently found in St. Helena were sent as a reference material for biosecurity measures and to ensure that staff are familiar with the diagnostic features in case they arrive on the island.
In August 2023, an ant reference collection was set-up on Ascension Island for 12 species and three high-risk ants as above. The ant specimens were mounted on card points and stored in tubes with 70% ethanol.
Ant species collected from Cayman Islands and Montserrat are currently being mounted on card points and stored in 70% ethanol with labels and once completed will be sent back to both islands as reference collection.

2.5. Scientific publications

As a result of last years' project a paper on Colonization and coexistence of non-native ants on a model Atlantic island was co-authored and published. The paper discussed the mechanisms on how non-native ants spread as influenced by human settlement, weather and resource partitioning. It also highlighted the importance of strengthening biosecurity and habitat restoration to prevent further introductions of invasive species.

[redacted] Colonization and coexistence of non-native ants on a model Atlantic island. *Diversity and Distributions*, *29*(10), 1278–1288.

Abstract

Aims: Colonization by non-native ants represents one of the gravest potential threats to island ecosystems. It is necessary to identify general mechanisms by which non-native species can colonize and persist in order to inform future prevention and management. We

studied a model-island assemblage of 17 non-native ant species with aim of identifying the spatial source of introductions and assessing how such a diversity of species are able to coexist.

Location: Data were collected on Ascension Island: an ideal study system for its intermediate area, compact shape, spatial heterogeneity, lack of native ant species, and availability of non-native ant records dating back to the 1800s.

Methods: We collected over 47,000 individual ants from 73 sites using a range of baited traps and survey techniques. We combined this novel data with past occurrence records in order to determine whether human settlements have historically been the source of ant introductions and to quantify the mean rate at which species have dispersed across the island. Analysis of standardized field data revealed the extent to which ants were partitioning ecological niche space via (1) habitat separation, (2) fine-scale resource partitioning and (3) climatic heterogeneity.

Results: Ants were radiating at a linear rate of approximately 0.5 km^2 per year from human settlements on this island, with the most widespread species having been introduced earliest. After accounting for incomplete colonization, we found no evidence to suggest habitat separation between species. Instead, we found significant niche separation through resource partitioning and weather-dependent activity patterns.

Main Conclusions: Our results indicate that non-native ants can coexist in very close proximity and are therefore capable of existing at great diversity on even small islands. It is inevitable that ant colonization will continue without increased biosecurity measures, habitat restoration around settlements and conservation of native species populations.

Manuscript in preparation:

Suppression of an invasive ant facilitates a rapid increase in island-endemic invertebrates through reduced predation pressure.

[redacted]

This is a collaborative paper between Ascension Island Conservation Department, St. Helena National Trust, Fera, Imperial College, IUCN Species Survival Commission, & Atlantic Island Invertebrate Specialist Group.

The manuscript focuses on the result of suppressing the invasive ant *P. megacephala* to increase the population of endemic invertebrates on Ascension Island and St. Helena.

3.0 Conclusions

The ant species collected in Ascension Island and St. Helena are primarily introductions to the islands because of human activities, particularly international trade. Some of the ants are considered invasive and studies on their negative impact, particularly on biodiversity, should be taken into consideration. The presence and survival of non-native ants is influenced by human activities of which some species possess a high risk of negative impact on the island's ecosystem. As shown by the ant data in Ascension Island ([redacted] 2023, in review), the establishment of non-native ants on the island is also affected by species coexistence, spatial and climatic heterogeneity, foraging behaviour and habitat quality. Ant data in St. Helena will provide similar result especially using the same sampling methodology and efforts.

The data gathered in Ascension and St. Helena had validate the importance of using different collection method in various habitats that represent the different strata of the island's ecosystem i.e. from ground-dwelling ant groups, understory groups and canopy groups.

From this year's output, we have identified the most significant drivers of invasive ant coexistence and inferred conservation implications for oceanic islands globally. Because of this, it is likely that non-native ants can potentially persist at diversities far greater than we currently observe on oceanic islands, and may never become self-limiting as a result of saturated niche space. For this reason, we stress that prevention of future invasions is critical to avoid negative impacts on native biodiversity, even on islands where many non-native ant species are already established.

The ant species collected in the South Atlantic Ocean are primarily introduced species but not the ants from the Caribbean which are mainly typical species occurring in the neotropical region. The presence of non-native ants from both subregions were associated with human activities such as trade and travel including some of the significant invasive species with known negative impacts on biodiversity, economic and public health.

Further colonization of the non-native ants such as on Ascension Island was influenced by species coexistence, spatial and climatic heterogeneity, and habitat quality. However, it is a different scenario in the Caribbean due to the presence of fire ants. Fire ants are aggressive, so will likely displace native species however, this may only occur in open and disturbed areas where the population density of fire ants is high as seen in Montserrat and Cayman Islands. Most of the fire ants were collected from farmlands and urban areas and had caused disruption on some of the human activities such as school's sports day, tourism, crop planting and harvesting, camping among others.

In the South Atlantic Ocean, *P. megacephala* remains to be the highest threat among endemic species hence, the control is now being continued due to fluctuations of their population especially when chemicals are not available. Results from last year's control showed that following treatment, some of the endemic invertebrates such as *Discophallus ascension* on Ascension Island and *Sanctahelenia decellei* on St. Helena Island have increased while the population density of *P. megacephala* have decreased. The data is showing that suppressing the population of the invasive ant will help the island-endemic invertebrate to recover rapidly however it is important to sustain the control methods over a long period.

The control of fire ants in Montserrat began in 2022 but the level of infestation remains high, particularly in farmlands and public places and now eradicating it will be impossible. Reducing the negative impact is being sought by developing a management plan using a combination of methods and suitable chemicals. The management plan is taking into consideration the safety of non-target species and the possible contamination of natural resources (e.g. water, soil, and food) especially in small islands.

The different species collected in the South Atlantic Ocean and Caribbean demonstrates the importance of using different sampling methods in various habitats. By doing so, data will produce information not only on species richness but will also provide information on their feeding guilds and nesting behaviour which are essential in understanding their functional diversity. For instance, the data from Ascension Island, showed that non-native generalist and ground-dwelling ants are likely to coexist and follow a similar pattern of colonization through time. Predatory species on the other hand are dependent on limited resources and

habitat, reducing their ability to compete with more aggressive ant species like the fire ants in Montserrat. For this reason, we stress that prevention of future invasions is critical to avoid negative impacts on native biodiversity, even on islands where many non-native ant species are already established.

4.0 Recommendations and Future outcomes

The data generated from previous years is serving as a baseline data for ant diversity in the South Atlantic Islands and Caribbean that is useful in the strengthening of biosecurity measures, management of invasive species and engaging more ecological restoration. It is deemed necessary that monitoring of ants in all possible ports of entry should be carried out on a regular basis to detect possible high-risk species and prevent further spread on any of the islands, otherwise controlling them will be a very challenging task as it requires large financial and logistical support.

Therefore, it is recommended that a bi-annual ant survey takes place, especially on vulnerable islands i.e. with active trade and/or travellers arriving from areas with high level of high-risk species. To achieve this, there is a need to strengthen the taxonomic capacity of biosecurity staff in detecting all possible invasive species to the island by providing continuous training and upgrading equipment in identification such as microscopes with higher magnification. Furthermore, biosecurity staff should also be trained in the management of controlling invasive ant species using recommended or a combination of methods in the event of early detection of suspected high-risk species. Managing invasive species could be using chemical, physical, and ecological control and should take into consideration the reduction of associated risks on non-target species and the environment as per the local legislation.

Measures on safeguarding the island biodiversity against the threat of non-native ants is important especially with climate change contributing to invasive species' distribution and movement. In consideration of this, we recommend that future research on ant invasion ecology extends to other oceanic islands.

WP3: Identification of Plant Pathogens on Endemic and Endangered plants in the UKOTs

No samples were submitted for the detected of plant pathogens during 2023/2024.

WP4: Gut content analysis of invasive predatory invertebrates in Saint Helena.

See Appendix 8 for a full report on this section of the project. Supplementary tables and figures can be found in Appendix 9-12.

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References

Cabi, 2024. Datasheet on *Limothrips cerealium.* CABI Compendium (cabidigitallibrary.org) Accessed March 2024

Cheesman, O.D., Clubbe, C., Glasspool, A.F. & Varnham, K. 2003. Dealing with invasive species: sharing knowledge and experience. In: M. Pienkowski ed. A Sense of Direction: a conference on conservation in the UK Overseas Territories and other small island communities. Over Norton: UK Overseas Territories Conservation Forum, 257-272. Available from: http://www.ukotcf.org.

Collins, D W. & Evans, G. B. 2013. *Scirtothrips coccolobae* sp. nov. (Thysanoptera: Thripidae), a Leaf-Feeding Thrips on Sea Grape Known from Florida and the Cayman Islands. *Florida Entomologist* **96** (4): 1359-1364.

EPPO. (2013), PM 7/119 (1) Nematode extraction. EPPO Bull, 43: 471-495. https://doi.org/10.1111/epp.12077

Gray, A., Stroud, S., Lambdon, P.W., Niissalo, M. & Renshaw, O. 2016. *Euphorbia origanoides*. *The IUCN Red List of Threatened Species* 2016: e.T43921A88582641. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T43921A88582641.en. Accessed on 22 March 2024.

Malumphy, C., White, L.F., Hall, J., Hodgetts, J. & Hamilton, M. 2015. Five invasive mealybug species new for Ascension Island (Hemiptera: Pseudococcidae), with a revised checklist of scale insects for the island. *Entomologist's Monthly magazine* **151**: 131-138.

Miller, G.L. & Miller, D.R. 2003. Invasive soft scales (Hemiptera: Coccidae) and their threat to US Agriculture. *Proceedings of the Entomological Society of Washington*, 105, 832-846.

Niissalo, M., Stroud, S., Gray, A., Lambdon, P.W. & Renshaw, O. 2012. *Ptisana purpurascens*. *The IUCN Red List of Threatened Species* 2012: e.T43922A2990240. https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T43922A2990240.en. Accessed on 22 March 2024.

Pellizzari, G. & Dalla Montá, L. 1997. 1945-1995: Fifty years of incidental insect pest introductions to Italy. *Acta Phytopathologica et Entomologica Hungarica*, 32, 171-183.

Renshaw, O., Stroud, S., Gray, A., Lambdon, P.W. & Niissalo, M. 2012. *Pteris adscensionis*. *The IUCN Red List of Threatened Species* 2012:

e.T43924A2990518. https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T43924A2990518.en. Accessed on 22 March 2024.

Smith, R.M., Baker, R.H.A., Malumphy, C.P., Hockland, S., Hammon, R.P., Ostojá-Starzewski, J.C. & Collins, D.W. 2007. Recent non-native invertebrate plant pests establishments in Great Britain: origins, pathways, and trends. *Agricultural and Forest Entomology*, 9, 307–326.

Thomas, M.C. 2006. The exotic invasion of Florida. A report on arthropod immigration into the sunshine state. Available from: http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Science/The-Exotic-Invasion-of-Florida

Varnham, K. 2006. Non-native species in UK Overseas Territories: a review. JNCC Report 372. Peterborough: United Kingdom.

Wetterer, J. K.; Espadaler, X.; Ashmole, N. P.; Mendel, H.; Cutler, C.; Endeman, J. 2007. Ants (Hymenoptera: Formicidae) of the South Atlantic islands of Ascension Island, St Helena, and Tristan da Cunha. Myrmecological News 10:29-3

Appendices

WP1: Summary of invertebrate identifications made during 2023-2024
WP1: Summary of Nematode identifications 2023-2024
WP1: Black bean bug Plant Pest Factsheet 2023
WP2: Ant species list for the Atlantic and Caribbean UKOTs
WP2: Protocol for collection, preservation, and submission of ant samples
WP2: Ant biosecurity training and trial of ant chemical control in Ascension Island
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WP4: Gut content analysis of invasive predatory invertebrates in Saint Helena
WP4: Supplementary Figure. 1 Map of nest sites
WP4: Supplementary Table 1
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