CORINGA–HERALD NATIONAL NATURE RESERVE – IDENTIFICATION OF INVERTEBRATES COLLECTED ON THE 2007 INVERTEBRATE SURVEY

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Executive Summary

Major Findings in relation to management

1. A major change in composition of the invertebrate fauna on North East Herald (NEH) has occurred since the last monitoring event in 1997. The most significant is a change in the dominant ant species present resulting in habitat change in an important ecological community, the *Pisonia* forest. Our fieldwork also suggests that the Guinea ant, *Tetramorium bicarinatum*, is a key driver of these communities and can act as a surrogate in indicating reductions in epigaeic (active above the ground) invertebrates on these islands. These results indicate a need for ongoing monitoring of ants and strict quarantine controls applied for Magdelaine Island.
2. There are differences in species composition and/or abundance between the two island groups, Coringa and Magdelaine and the Heralds. These differences are in ant species composition and relative abundance and not related to vegetational differences, indicating a need to prevent transfer of organisms between island groups.
3. Some species that normally occur only in marine littoral habitats on larger landmasses are found inland away from the beach habitat on these islands, illustrating the process of colonisation of newly emerged land.
4. Many new taxa were recorded from the 2007 collections compared to previous collections and some species collected in 1995 and 1997 on NEH were not found in spite of more comprehensive sampling in 2007. These results support the hypothesis of repeated wind-borne invasions of many species that persist for varying periods depending on resources available and a relatively rapid turnover of species on these islands.
5. Up to 20 species of parasitic Hymenoptera were found, indicating a healthy and diverse range of species parasitic on Lepidoptera, Orthoptera, Hemiptera and other groups. The relative abundance and diversity of micro-Hymenoptera wasp parasitoids on the Heralds suggests that parasite-induced mortality may help stabilise the populations of at least some of the resident host species, for example, the grasshopper *Aiolopus thalassinus* and some of the moths, emphasising that the introduction of more parasitoids is not indicated.
6. Some non-vagile soil taxa, vulnerable to desiccation and intolerant of immersion in salt water, have colonised some habitats on NEH and South West Herald (SWH). In addition, one wingless beetle was discovered on SWH that had not been previously recorded anywhere in the Coral Sea. Dispersal of these organisms may be during extreme weather events as they are otherwise not mobile.
7. Major differences in invertebrate composition were found between the four common vegetation types on all four islands sampled in 2007, illustrating that a range of ecosystems allows a higher diversity of invertebrates to find niches to colonise.
8. The moisture content of the ground layer had a major influence on composition and abundance of invertebrate fauna at the period visited, which was the dry

season, suggesting that a lower rainfall would threaten the survival of these humid-loving faunas.

9. The total terrestrial invertebrate fauna of NEH and SWH is probably about 150 species. Although island endemism is probably non-existent, a few species appear to be restricted to the Coral Sea Island Territory (CSIT), indicating that some elements of the fauna have a high conservation value because of their rarity.
10. The resilience of terrestrial ecosystems, especially decomposer organisms, depends on high numbers of nesting seabirds providing nutrients to maintain a diverse and abundant invertebrate fauna, emphasising that a holistic approach to adaptive management of these islands should be adopted.

Summary of taxa of importance relevant to management

Taxonomic name	Common name	Ecological role	Relevance to management	Action required
Formicidae: *Tetramorium bicarinatum*	The Guinea ant	Predators and omnivores	Tends scale prey on native invertebrates, may interfere with nestling sea birds	Protocol required for monitoring, control of populations may be necessary
Lepidoptera: *Hippotion velox* *A. columnina*	Hawkmoth Cordia moth	Defoliators of *Pisonia* & *Cordia* respectively	Damage *Pisonia* forests, a tree considered endangered in Australia. Damage *Cordia* forests	None are migratory; weather determines arrivals from mainland and other islands
Hemiptera: Coccidae: *Pulvinaria urbicola*	Coccid scale	Sap-feeder on native and exotic plants	Damage *Pisonia* forests, a tree considered endangered in Australia	None at present while populations remain at low levels
Hemiptera: Pseudococcidae: *Ferrisia malvestra*	Mealybugs	Sap-feeder on native plants	Provide alternative food for predatory beetle biological control agent (BCA)	None
Coleoptera: Coccinellidae: *Cryptolaemus montrouzieri*	Ladybird beetle	Adults and larvae are predators of scale and mealybugs	Controls pest scale	None while present in reasonable numbers
Parasitic Hymenoptera	Parasitic Wasps	Parasitoids of arthropods including moths	May control numbers of Lepidoptera eggs and larvae, Possibly already control grasshopper populations	None as fauna is relatively diverse although control of ants could augment their numbers.
Pseudoscorpionida: *Nannochelifer paralius*	False scorpion	Predator on small invertebrates	This species is only known the Coral Sea Islands	Site where it occurs needs special protection
Collembola: *Dicranocentrus* sp.	Springtail	Feeds on microorganisms in marine littoral zone	This species is only known the Coral Sea Islands	The island shores where it occurs require protection through management to prevent damage to habitat
Tardigrada, Pauropoda, Symphyla, Cryptostigmata, Mesostigmata	Soil fauna	Detritivores of organic matter and predators of small invertebrates	Provide resilience and stability to island ecosystems through the breakdown of organic matter and recycling of nutrients	The forest floor where they occur requires protection through management to prevent damage to habitat

Other findings

1. The collection methods used were beating and sweeping vegetation, pitfall trapping, yellow pan collecting, light traps, Tullgren funnel extraction of leaf litter, soil and gravel sampling using flotation, and hand collecting from intertidal and other habitats on both islets. Each method collected a slightly different suite of species and it was considered that a reasonably comprehensive collection of invertebrates was made from NEH and SWH.

2. As it was only possible to obtain limited sampling from Coringa and Magdelaine, only a small proportion of the total fauna was collected.

3. All sorting has been completed. The fauna has been sorted to species or morphospecies, and documented and deposited in the Zoology Museum, School of Botany and Zoology, Australian National University (ANU) and the institutions of taxonomists who have or are identifying the fauna.

4. The fauna of both NEH and SWH is impoverished in terms of species richness compared to similar areas on the mainland. This is probably because of their small size, age, the limited number of habitats and host plants present and the distance from a source area for immigrants.

5. Our results indicate that a number of important feeding types necessary for ecosystem stability and resilience are absent from some vegetation associations or somewhat reduced in number on both these islands. They are generalist predators, parasitoids, soil-living macrodetritivores and pollinators. No terrestrial molluscs or earthworms were seen. This means that these islands are susceptible to invasion by exotics.

6. Species richness is low in all invertebrate groups present except for Collembola and Acarina. For example, the highly abundant group of ants (Formicidae) comprises only four species from the four islands while on the mainland, about 20 species of ants might be expected in similar sized areas and 21 are known from the Cocos Keeling Islands (Neville *et al*., 2007). Competition between ant species for resources is therefore low.

7. Because of comprehensive data already available for Willis Islet from a light trap (Farrow, 1984), it was possible to distinguish recent and annual immigrant species from resident species. It is evident that some defoliating moths are sporadically present on the islands and not resident species.

8. Previous surveys suggest that the Hawk moth, *Hippotion velox*, defoliating the *Pisonia grandis* and *Cordia subcordata* trees on NEH, is an episodic immigrant with non-persistent populations and efforts to permanently reduce its numbers using parasitoids are unlikely to be successful. Any non-

specific biological control agent (BCA) may also attack several species of native, non-target, noctuid moths.

9. Our preliminary data also indicates that there are significant differences between NEH and SWH in that ants and flies are much less abundant and widespread on the latter than on the former islet. This is likely to be because of the preponderance scale on *Pisonia* on NEH.

10. Collembola, mites and other soil-dwelling species are generally more abundant on SWH than NEH except in habitats where ants are abundant, indicating the strong predatory pressure of ants on these groups.

11. On Coringa and Magdelaine, there appears to be a different dominant species of ant, and in general ants and flies are much less abundant than on NEH and SWH. Although this could partly be an effect of season and weather, it may also be the reason for the *Pisonia* forest being healthier on Magdelaine than on NEH.

12. Species other than ants that are abundant in habitats occupied by ants, that is epigaeic species, appear to have some protective mechanisms against predation by ants, the biological control agent, *Cryptolaemus montrouzieri*, is one such species.

13. This data on invertebrates is the first for SWH as none of the earlier collectors of invertebrates (Heatwole, Hill, Donaldson nor Anderson) visited this islet to make collections. Soil flotation extraction, which produced one taxon not collected by any other method, has never been carried out before on CSIT soils. Biodiversity information on the islands is now more complete as a result of this project.

14. Collections of some taxa new to the islands including polyxenid millipedes, Symphyla, Pauropoda, a seed-feeding bug in the family Coreidae (Hemiptera), a carrion beetle, a Brenthid weevil, a Cucujoid beetle as well as nine Collembola species were made. Some of these species were not expected to be present on small, distant islands.

15. Samples of leaf litter and soil from the major vegetation types indicate that on NEH the humus and soil under *Pisonia* is the richest habitat and on SWH the moist gravelly soak or depression with decaying turtle hatchlings is the richest habitat. This means that a large proportion of the terrestrial invertebrate biodiversity of these islands are susceptible to reductions in rainfall.

16. A comparison of Donaldson's 1995/6 and Anderson's 1997 collections on NEH with the 2007 data shows that there are large differences in some species' abundances over the past 10 plus years with ants, scale insects and

flies becoming much more abundant, while beetles, and some Lepidoptera became less so. This illustrates a fairly rapid turnover of species on the islands as a result of extinction and immigration.

17. Familiarisation with the biological control program and the introduced exotic agents was undertaken. It was noted that the introduced scale predator *Cryptolaemus* beetle was established on NEH and also fed on a complementary food source, the mealy bug, *Ferrisia malvestra*, found on hosts other than *Pisonia grandis* trees, including *Argusia argentea* shrubs. *Cryptolaemus* therefore has the capacity to survive at reasonably high densities at times when scale populations are low.

18. Both crawlers (juveniles) of the pest scale and its attendant ant were most abundantly trapped in the grassland of NEH, followed by *Abutilon* herbland, *Argusia* shrubland and *Pisonia* forest in that order. This indicates that invasion of *Pisonia* by scale may begin at the open vegetation at the forest edge. Such clearings may be caused by cyclones or natural dieback.

19. The intertidal zone was searched for Collembola on both NEH and SWH. Five species were collected in this habitat by two different methods. One is a new species, possibly new genus, previously only known from Turtle Islet and Edna Cay in Lihou Reef and Carola Cay in Marion Reef in the GBR. This emphasises the conservation importance of the marine littoral fauna because of limited distribution of species.

20. The intertidal zone was also searched for the rare Pseudoscorpionida, *Nannochelifer paralius*, previously only known from Turtle Island, Lihou Reef. It was found on SWH in the gravel soak at the southern tip of the island.

21. Some preliminary recommendations on management of the islets, on future monitoring for resilience and on quarantine inspections have been made. Adoption of more stringent inspections should help protect these islands against future deleterious introductions.

22. As the islands are young, all species arrived relatively recently by long distance dispersal and the difference between exotic species and native species is not distinct. The only species considered exotic here are those that have only arrived as a result of human intervention. This is sometimes difficult to determine but we suggest that Tetramorium bicarinatum may be one such species.

Outcomes

1. All samples of invertebrates collected in 1995, 1997 and 2007 have been sorted to higher taxa.
2. Species or morphospecies have been distinguished for most taxa.
3. Specimens have either been distributed to specialists for identification to species or where no specialist is currently available, been stored in the Zoology Museum in the Australian National University.
4. Statutory Declarations made under the Statutory Declarations Act 1959 have been forwarded with collections to all specialist taxonomists involved and signed copies returned.
5. Identifications carried out or received so far have been incorporated into an Excel sheet. Further identifications of Diptera, Isopoda, Dicytoptera and Dermaptera, are expected in due course once the relevant taxonomists are able to devote time to the identifications.

Outputs

1. A database of species from the 2007 collections.
2. Recommendations for future management of the CSIT in relation to improving the necessary quarantine regimes are provided.
3. A protocol for future monitoring of significant species has been suggested, aimed at detecting incipient threats to ecosystem status.
4. Options for future management of invertebrate threats are provided.
5. Voucher collections of identified and unidentified species from the CSIT are being held by various institutes (museums, universities) for future reference, research and taxonomic studies.

Key management recommendations

1. The gravel soak depression at the extreme southern end of South East Herald should be designated as a site of “Special Scientific Interest” based on its unique faunal assemblage, and have its condition regularly audited.

2. Quarantine controls on official visits should be improved to be more in line with those operating for subantarctic islands (Heard and Macquarie) and American isolated Coral Islands such as Palmyra Atoll. Fumigation and/or freezing of equipment and inspections of boat and personal belongings should be instigated. Fresh fruit and vegetables should not be taken ashore.

3. Occasional re-introductions of the *Cryptolaemus* beetle may be necessary if their numbers drop, as this predator is probably keeping populations of the scale at non-outbreak levels, but introductions of parasitic Hymenoptera should be subject to further assessment.

4. The *Pisonia* forest is the most significant habitat for invertebrates on NEH and should be monitored as a surrogate for invertebrate biodiversity. Because this tree is still declining on this island, partly due to pest scale attack, pest ants should also be monitored in major vegetation associations, with the option of taking action to control ants if a (yet to be determined) threshold level is surpassed.

5. The cache of equipment and materials on NEH provide a habitat for a range of invertebrates and should therefore be removed to enhance the naturalness of the reserve.

Aims

Main aims

- Increase understanding of the terrestrial invertebrate fauna in the two Coral Sea reserves; and

- improve effectiveness of management interventions to protect *Pisonia* forests.

Detailed aims

- To sort and identify to morphospecies the invertebrates collected by a variety of different sampling methods and from a range of habitats on North East Herald and South West Herald in May 2007.

- To combine the Donaldson and Anderson collections held at the Australian National University (ANU) with the 2007 collections, and prepare and label the morphospecies for later identification.

- To update the species list for the two islets sampled in 2007 and any other islands for which there is data, together with references, distributions and an indication of abundance and habitat preference in an Excel spreadsheet.

- To measure changes in invertebrate diversity over time, if possible in the different habitats, by comparing current with previous invertebrate collection data; to distinguish species sustained by immigration from those in which immigration events are infrequent; to classify species according to ecological group; and to determine biogeographic origins of species in relation to island biogeography theory.

- To incorporate all results in this report.

- To elaborate on management recommendations made in previous reports using new data obtained, especially with reference to the possible effects of the biological control program for scale on other fauna.

Introduction

Background and Significance

The only forest species within the Coral Sea Island Reserve is the tree, *Pisonia grandis,* which is heavily used by Mutton-birds and Black Noddies for nesting. This tree species is endangered in Australia where only about 160 hectares of it occurs, mainly on offshore islands around the northern coast. Twenty seven hectares are found on North East Herald Islet (NEH) and the management of the terrestrial component of the reserve up until now has mainly focused on protecting and enhancing *Pisonia* groves, which are of importance to nesting sea birds.

The *Pisonia* forest on NEH has been attacked, with devastating consequences, by the cosmopolitan pest scale insect *Pulvinaria urbicola* (Hemiptera: Coccidae). The damage to *Pisonia* was so severe that Department of the Environment, Water, Heritage and the Arts (DEWHA) implemented a program of biological control in an attempt to improve survival of the tree. As a result, several biological control agents, including the ladybird *Cryptolaemus montrouzieri* (Coleoptera:Coccinellidae), were introduced to NEH Islet to control the scale. This beetle was subsequently found on South West Herald (SWH) and South West Magdelaine Islet. It was introduced also to Coringa Islet where the previously existing dense *Pisonia* forest had been entirely destroyed in the mid 1990s, presumably due largely to this pest, and no trees remained by 2001. According to Smith, Papacek and Smith (2001) and Freebairn (2006, 2007) the coccinellid predator appears to be exerting some control of the coccid on NEH. Several parasitoid Hymenoptera species were also introduced to some islets, including *Coccophagus ceroplastae,* which became established and appeared to parasitise the *Pulvinaria* scale. The history of the biological control program on the Coral Sea Islets is given in various reports by Smith, Papacek and Freebairn (2001-7).

The aim of the fieldwork in 2007 was to improve basic information on the total terrestrial invertebrate fauna of the reserve and provide a general assessment of the impacts of the *Pisonia* scale on plants and on other invertebrates and the suitability of associated management responses. A detailed attempt was made to observe 1) the impact of predator, if established, on the scale five years after initial introduction; 2) the effects of scale infestations on the endemic invertebrate fauna within the reserve if any; 3) the impacts of the introduced coccinellid on non-target invertebrates native to the islets if any; and 4) the possible introduction of exotic invertebrates in the soil on Coringa Islet brought in with the *Pisonia* plants. A comparison of the invertebrate faunas of parts of the islets with and without the introduced predator and with different levels of scale infestations was also to be attempted. The current project also had the aim of making management recommendations using a more holistic approach to ecosystem conservation. The aim of the Australian based project in 2008 was to examine and identify to species level the invertebrates collected in 2007 where possible and make recommendations for future management based on the data.

Previous collections over the past 40 years have been made from these islands, but none of the results of this sampling had been published, nor had data from these collections been integrated until Greenslade curated collections and collated and compiled a check list in 2007 (Greenslade 2007). The earlier collectors were Hal Heatwole (1967, 1981), Lionel Hill (1982, 1984), Roger Farrow (1984) (which dealt with light trap catches only on Willis Islet over one year), Stuart Donaldson (1994, 1995), and Alexander Anderson (1997). Much smaller collections were made by Hicks and Hinchey (1983) and Hicks (1984). Smith, Papacek and Freebairn made small collections relevant to their work on the pest scale nearly every year from 2001 to 2007.

These collectors deposited their specimens in various institutions including the Queensland Museum, the Australian National Insect Collection, the South Australian Museum, the Queensland Department of Primary Industry and Fisheries, the Australian Museum and previously DEWHA (but now in the Department of Botany and Zoology, Australian National University). Identification of the collections was to various levels of taxonomic discrimination, mainly to order level only, although some taxa, including most of the Collembola collection and the collection by Farrow from Willis Island, had been identified to species.

The current proposal is of scientific importance as it builds on comparative data on terrestrial invertebrate species present on the Coral Islets already documented. It also contributes to assessing the potential impacts of global warming or other climatic shifts on this fauna as well as natural processes of colonisation and extinctions. The information obtained also contributes to future management and monitoring of the reserve. In addition, it will make an important contribution to management of the reserve as far as the breeding bird population is concerned because of the possible deleterious effect of ants on ground nesting species as noted by Bellio *et al*. (2007) for a different ant, *Solenopsis geminata*, on ground nesting birds on Ashmore Reef.

Some groups of numerically dominant invertebrates have been selected for special investigation, namely Springtails or Collembola and the Formicidae. Springtails are a widespread and abundant group of decomposer invertebrates, mainly living in soil and leaf litter but also on vegetation and interstitially in intertidal beach sand. They make a contribution to ecosystem function and sustainability and are abundant and relatively diverse on these islands. A range of species have already been collected from the Coral Sea islets, and species are particularly abundant in marine littoral and supra littoral habitats. Priority is being given to Collembola in this investigation because: 1) their importance in ecosystem function; 2) they were a dominant group of organisms in Donaldson's 1995 collection (Gunn, 1995); 3) progress on identifying the species from existing collections had already been made; and 4) the required expertise is immediately available. The Formicidae are also targeted for particular attention because of their abundance and species composition varies markedly on the different islands. When numerically dominant, this group has a marked impact on other ground fauna as well as having a role in protecting and distributing the pest scale.

Methods

Intensive daily sampling took place at each islet visited but because of changes to the voyage schedule, only two islands, NEH and SWH, were studied in May 2007. The senior author was primarily responsible for sampling the surface active, soil and leaf litter fauna and setting up pitfall traps, yellow pans, Tullgren funnel extraction and flotation of soil and leaf litter samples (the latter after return to the mainland) (Appendix 1), hand collecting from under stones and from beach debris. The junior author was primarily responsible for sampling the above-ground fauna in the vegetation using sweep netting, beating trays, hand collecting, and for setting up the light traps and sorting the material collected. Fauna was sampled from representative vegetation types as given by Batianoff *et al.* (2007). Where possible, the sweeping was standardized to 50 sweeps using a net of 50 cm diameter. These methods represent standard techniques for comprehensively surveying invertebrates (Upton,1991). Methods were replicated on each island as far as possible so that comparisons could be made between and within sites and islands.

The interstitial sand fauna was sampled by digging a hole in the intertidal zone just above the water line but at least 1 m below the high tide mark in the sand until the water table was reached. Fauna then fell onto the surface of the water from the wet sand on the sides of the hole and were then removed using a fine nylon net. Deep soil/sand samples weighing about 10 kg collected to a depth of 1 m by G. Batianoff from *Pisonia* forest were extracted 250 gm at a time by immersing the sample in fresh water and stirring it. Any animals present floated to the surface and were removed with a fine brush or with forceps. Extraction normally took about two hours to complete for each sample of about 1 kg.

Semi-quantitative sampling of invertebrates living in the main vegetation types of each island was also undertaken using transects of five pitfalls, three yellow pans and about a litre leaf litter sample for Tullgren funnel extraction. The vegetation types sampled were *Pisonia* forest, *Abutilon* sub-shrubland, *Argusia* shrubland and grassland. Leaf litter was sparse under *Argusia*, *Abutilon* and *Pisonia* and non-existent under grassland. Pitfalls consisted on McCartney bottles of 1.8 cms in diameter, three quarters filled with absolute alcohol with a few drops of glycerol added to retard evaporation (Greenslade and Greenslade, 1971). Yellow pans were plastic take-away food containers of 17 x 11cm with a yellow painted base, half filled with water with a few drops of liquid soap added to reduce surface tension (Coy *et al*., 1993). Leaf litter and humus samples were extracted to dryness by placing them on a perforated zinc disc inserted into the top of simple plastic funnels of about 20 cm diameter with a tube of alcohol placed under the spout. Extraction usually took a minimum of three days.

In addition specific habitats such as rotten wood at DEW cache, beach sand, beach rock, hermit crab shells, empty eggshells, carrion (dead birds and turtles) and unoccupied birds' nests were sampled by hand. Two light traps were run for three successive nights on NEH and SWH.

Earlier (1994-7) collection methods used on the islets included light trapping, hand collections from vegetation, yellow pans and pitfall traps. Leaf litter samples and soil flotation had not been used before.

An attempt was made to observe the effects of the introduced predators and parasitoids on non-target organisms. Details of the individual samples taken are given in Appendices 1 and 2. All material was either preserved in ethyl alcohol or pinned and dried.
In October 2007, pitfalls were run on Coringa and Magdelaine islets for respectively one or two days. The pitfall method was identical to that used in May 2007. Details of the samples are given in Appendix 2.

All samples were sorted to Order, except Collembola, Formicidae, Coleoptera, macro Lepidoptera, Hemiptera, Orthoptera and the smaller Orders that were sorted to species. Numbers of individuals from the semi-quantitative collections (pitfalls and yellow pans) were counted. The specimens from each sample were data based (see Appendices 3, 4, 5 and 6). Specimens preserved in alcohol were kept in small tubes and labelled, and dry specimens were labeled and pinned. Collembola were mounted on slides in Berlese medium for identification after clearing in Nesbitt's solution. An attempt was made to identify Acarina to morphospecies.

Some taxa were stored for identification at a future date and others were sent to specialist taxonomists who had expressed an interest in looking at the material *gratis*. The distribution of material and the taxa stored are listed in Appendix 7. For the most part, these groups were small and with few species and few specimens. Identifications had not been received from a few taxonomists by June 2008, but will be available at a later date. Specimens that could not be identified were stored in the Zoological Museum at the Australian National University (School of Botany and Zoology). Identifications that were made were incorporated into a single Excel file that listed all taxa collected in 2007 (Appendix 8).

A summary timetable of the Australia based activities is given in Appendix 9.

Data and Results
The results are listed under three main headings. Firstly the collections are discussed under the method used and comparisons made between islands. Secondly, the fauna of individual vegetation types and special habitats are described and thirdly the results for individual taxa are provided.

The results under each heading are not necessarily consistent and vary in detail and in evenness. The reasons for this are multiple. Some collections were quantitative or semi-quantitative and others were qualitative, hence numbers of individuals for the latter were not given as they had no meaning. The higher taxa found varied enormously in their species richness from having only one species represented to 20 or 30, hence a variation in the data obtained. Also species vary in their relevance to the project aims and terms of the contract with DEWHA. This explains why more emphasis is given to the ants and springtails. Finally, the level of identification varied between taxa as funds were not available to provide for identification of some large groups such as the mites. This explains why a summary of the group rather than a detailed species level treatment was supplied for some taxa.

Common names for very few taxa are available (AICN, 2005). Where they are available, they are used.

Summary of collections according to method and island

<u>Light Traps</u>

Two traps were operated on NEH for two nights in four different locations. On the first night the traps were installed about 30 m and 50 m respectively west of the temporary campsite near the southeastern coast, in open areas sheltered from the southeasterly winds by the *Pisonia* forest. On the second night they were installed in *Argusia* shrubland on the east shore and in *Abutilon* herbland about 5 m east of the camp located on the southwestern shore. All four catches were dominated by the moth, adult *Hippotion velox*, which caused substantial physical damage to the rest of the catch.

The following moths (Lepidoptera) were identified:the migratory Hawk moth *Agrius convolvuli*, the migratory noctuid, *Achaea janata,* the Cordia defoliators *Ethmia* sp and *Armectia columbina*, an *Agrotis* sp., and several taxa of microlepidoptera. A single specimen of a parasitic wasp (Hymenoptera:Ichneumonidae) was recorded as well as the carrion-feeding beetle *Dermestes ater* (Coleoptera:Dermestidae).

<u>Tullgren funnel extraction of leaf litter, humus and soil</u>

Tullgren funnel extraction collects fauna that is not very vagile (mobile) but has a preference for moist conditions and can move away from adversely desiccating environments. Numbers reflect the efficiency of the funnels and of faunal sensitivity to lack of moisture. The number of samples is given in Appendix 1.

The samples listed in Appendix 1 were extracted on the mainland as Tullgren funnels could not be used on board M.V. Tusa IV, taking about three days for full extraction. In summary, each vegetation type and habitat sampled seemed to contain a different suite of species with some species apparently restricted to single habitats. The *Pisonia* leaf litter on NEH and the gravel soak on SWH were the richest sites sampled and were dominated by numerous species of oribatid mites. The *Pisonia* also contained numbers of enchytraeid worm, Pauropoda, Symphyla, a pseudoscorpion, centipedes, some species of Collembola, and uropodid mites not found elsewhere. The gravel site harboured a different pseudoscorpion species and Embioptera not found in other habitats. About 12 species of Collembola occurred in these samples, some in high numbers. *Argusia* and *Abutilon* leaf litter was fairly poor with prostigmatid mites being the most abundant group in both habitats. More details on the contents of the samples are given below.

The numbers of invertebrates collected by funnel extraction of *Abutilon* and *Argusia* leaf litter on NEH and SWH were very low. There was no leaf litter on the grassland site so no samples for funnel extraction could be made from this vegetation type. Humus and soil (leaf litter was sparse) taken from under *Pisonia* trees was very rich both in species and individuals, with the Acari dominating numerically and in species richness. The same was true of funnel extraction of gravel from SWH and several taxa, as three of the eight species of Collembola were only collected from this site. Several individuals of a second species of Isopoda, not collected elsewhere, were found in Tullgren funnel extractions of the gravel as well as large numbers of mesostigmatid mites only found in abundance at this location. Oribatid mites were both diverse and numerous in Tullgren funnel samples of *Pisonia* soil and humus from NEH as well as the gravel on SWH. Six species of Collembola were found in the *Pisonia* humus and soil. Two were only found here, but only as single individuals.

The richness of the gravel site for invertebrates was unexpected and probably due to the fact it was rather moister that other sites on SWH and very few ants were found there. The *Pisonia* soil and humus was also a rich site and it is suggested that many species can survive here because the Guinea ant, *Tetramorium bicarinatum*, does not appear to penetrate below the soil surface.

Pitfall Traps

Pitfall traps collect fauna that is active on the ground and numbers reflect both abundance and activity. The number, position and length of time pitfalls were exposed are given in Appendix 1. Samples collected (see Appendix 1 and 2) were sorted and identified in Canberra and the raw data is given in Appendix 3.

More than 7500 individuals were trapped in the 55 pitfall traps run for two days each, giving an average of 68 individuals per trap day. On both islands, most of the individuals trapped were Formicidae (ants) (73%) followed by Collembola and Acarina (mites) in about equal numbers (11% and 6% respectively). Most Collembola were trapped near or on the beach while the Acarina were more abundantly trapped in grassland and leaf litter under *Argusia*, the latter also near the beach. It is estimated that nearly 50 taxa, equivalent to species or morphospecies, were distinguished. Approximate numbers were: Collembola x 8, Psocoptera x 1, Dictyoptera x 1, Orthoptera x 3, Hemiptera x 5, Diptera x 5, Coleoptera x 3, Lepidoptera x 1 , Hymenoptera x 5, Formicidae x 2, Acari x 9, Pseudoscorpionida x 1, Chilopoda x 1, Polyxenida x 1, Isopoda x 1.

Differences in catches of invertebrates between these two islands were considerable (Table 1). There were over twice as many individuals trapped on NEH compared to SWH. The difference is accounted for by greater numbers of Formicidae and Diptera trapped on NEH, particularly in *Argusia* and to a lesser extent in grassland. Single species of *Tetramorium* ants and sarcophagid flies on NEH were largely responsible for these differences. There were also more Collembola found on NEH compared to SWH (929 compared to 11). Although most of the difference in numbers of Collembola on NEH and SWH was accounted for by large numbers of individuals in beach traps on NEH, there were actually more species found on beaches in SWH (4) compared with NEH (3). No taxon was found exclusively on SWH in numbers considered significant while a number of taxa were only trapped on NEH, notably Collembola belonging to the genera *Archisotoma* and *Lepidocyrtus*. Also, crawler scale were only recorded in traps from NEH.

In summary the traps on NEH and SWH collected mainly Diptera and Formicidae, often in large numbers. It was noticeable that the largest catches of both orders were only made on NEH. Ants and flies were much less numerous on SWH although ants were fairly numerous on the grassland site on this islet.

Table 1. Total number of individuals trapped on NEH and SWH in four vegetation types and two habitats

Vegetation type or habitat	**Island**	
	NEH	**SWH**
Pisonia forest	444	–
Argusia shrubland	2028	208
Abutilon herb field	671	256
Grassland	2156	1295
Beach west	320	–
Beach east	111	18
Gravel	–	27

On SWH there were consistent differences between vegetation types. The most notable of these was the gravel site, which had few invertebrates active on the ground, and the surrounding open grassland that had many (particularly ants). This is probably because the grassland is more open and temperatures are likely to be higher on the ground, which favours ants. Immature crawler scale was only noticed in the grassland site on NEH.

As expected from earlier collections in the Great Barrier Reef (King and Greenslade, 1983), the beach site had a relatively high diversity of marine littoral Collembola, but otherwise numbers were low so further comment on the trapping data wass difficult. Total numbers of taxa recognised from all five trapping sites were similar and ranged from seven to 10.

Numbers of invertebrates trapped were highest on NEH in grassland and *Argusia* habitats, mainly accounted for by *Tetramorium* ants and flies, the latter probably attracted to the alcohol in traps. But in the *Pisonia* forest, where ant-tending of scale was a problem, traps collected fewer ants than traps in any of the other vegetation types except the beach. Also no crawlers were noticed here in traps in Pisonia forest. There were few other differences between vegetation types on NEH except for the Collembola. Marked differences were apparent here in the distribution of species in traps. *Lepidocyrtus* sp. was nearly entirely restricted to *Pisonia* forest, *Xenylla* sp. to *Argusia* shrubland, and *Archisotoma* and *Oudemansia* to beach sites. The traps in grassland collected few Collembola. It is notable that the east and west beach sites had different fauna, *Archisotoma* on the latter and *Oudemansia* on the former. *Archisotoma* is a species that lives interstitially in sand and *Oudemansia* is believed to be cryptic under rocks and stones. The two beaches differed in that rocks and stones were absent from the west beach.

Trap details for Coringa and Magdelaine pitfalls collected in October 2007 are given in Appendix 2 and fauna collected is documented in Appendix 5. All traps collected some species but catches were variable, ranging from three to 510 individuals. As some traps were apparently interfered with during the trapping period probably by birds, this variability is not surprising. Despite this some differences between islands and between vegetation types between islands were apparent.

Total individuals in traps numbered 2368, averaging 33 individuals per trap day. Overall the fauna was numerically dominated by Collembola (48% of individuals), followed by Acari (38%) and then Formicidae (10%).

The most species rich taxa collected were the Acari and Hemiptera, each with five species or more followed by the Formicidae with three species. Several groups were represented by two species (Collembola, Coleoptera, Araneae) and the remainder by one species only. Species richness was very low.

Traps collected two and a half times more individuals per trap day on Magdelaine (52) than Coringa (20) and there were also fewer taxa identified from Coringa (Table 2). This is partly explained by the absence of *Pisonia* on Coringa while on Magdelaine some taxa were only found in traps under *Pisonia* trees. Notably the *Pisonia*-restricted taxa were Collembola, Trombidiidae, Acari, Dermaptera and Isopoda. However there were also differences in trapping success between the same vegetation types on the Coringa and Magdelaine islands.

Table 2. Total number of individuals per trap day on the two islands in three vegetation types

Island	Vegetation type		
Island	*Abutilon*	*Argusia*	Grassland
Coringa	71	145	88
Magdelaine	45	546	182

With these limited collections, conclusions as to real differences between the faunas of the two islands must be made with caution. However as these islands are very low in species richness, and despite limited collections, a reasonably representative list of the numerically dominant species present has probably been made.

The data indicated that many more individuals were trapped in *Argusia* vegetation on Magdelaine than Coringa. This was mainly because of the presence of a species of Collembola, *Xenylla* sp., which was not trapped on Coringa as well as more ants. The Acari also seem to be more abundant in this vegetation type on Magdelaine. However, Formicidae were more numerous in traps on Coringa. The absence of *Xenylla* from Coringa also accounts for the difference in individuals trapped in grassland on the two islands. The reason for these differences is not apparent but may be related to the recent history of the islands. Coringa suffered a population explosion of the scale, *Pulvinaria urbicola*, from the late 1970s until all *Pisonia* trees were killed in the late 1990s. The presence of the scale on Coringa would have allowed ant numbers to also build up (Greenslade, 2008). The absence of Collembola may be related to increased predation by ants.

Pitfalls run on the two different groups produced very different results. On Coringa and Magdelaine, 33 individuals per trap day were caught and 68 individuals per trap day in the Herald group, over twice as many. The fauna on Coringa and Magdelaine was dominated by Collembola and mites while in the Herald group ants were in very high abundance in the traps. No Diptera were collected in pitfalls on Coringa or Magdelaine, while they were fairly abundant on NEH but not SWH.

One species of Collembola, *Seira* sp., was trapped on Magdelaine in large numbers, but was not present on any other island. On NEH, an *Ascocyrtus* sp. was collected in the same habitat. Another notable difference was the absence of the pseudoscorpion, *Oratemnus* sp. from the Herald group although it was not rare on Magdelaine and was trapped also on Coringa. It is possibly significant that this species was found on NEH in 1997 at a low intensity of collecting. Another major difference, as noted elsewhere, was that *T. bicarinatum* was only trapped in the Heralds and *T. lanuginosum* only trapped on Coringa and Magdelaine.

Our evidence suggests that the fauna of NEH and SWH are similar to each other as are Coringa and Magdelaine in some respects. Coral faunas apparently show a similar pattern of distribution (C. Vernon, pers. comm.).

Yellow pans

Yellow pans collect fauna that is active on and above the ground, blown by wind and leaping, with numbers reflecting abundance and activity. Differences between vegetation types are therefore semi quantitative. The number, position and length of time yellow pans were exposed are given in Appendix 1 and raw data provided in Appendix 4.

As for the pitfall traps, samples collected (see Appendix 1) were sorted and identified in Canberra. Again as for the pitfall traps, the fauna trapped was dominated by Diptera, Formicidae and immature coccoids in that order and often in large numbers. It was noticeable that large catches of both orders were only made on NEH. Ants and flies were much less numerous on SWH. Low numbers of other groups such as Dictyoptera and Orthoptera and other Hemiptera were also found.

The yellow pans on SWH collected 637 individuals while those on NEH collected 1546 individuals. However, the traps on SWH were open for only one day while those on NEH were open for two days. *Pisonia* forest was only sampled on NEH because it did not occur on SWH. Excluding the *Pisonia* traps and adjusting for trapping time, numbers trapped on NEH were 1261. As a result the difference in numbers of invertebrates trapped between the two islands was not great.

There was a difference in the composition of trapped fauna. There were three times as many Formicidae trapped on NEH (253) than on SWH (83) and 20 times as many Diptera on NEH (224) compared with SWH (14). On the other hand there were more Hymenoptera and slightly more Orthoptera, Hemiptera and Acari trapped on SWH compared with NEH. Parasitic Hymenoptera were best collected in yellow pans.

Although trapping time was limited, numbers of individuals trapped were high enough to indicate that some real differences in species dominance were present on the two islands. NEH was dominated by a single species of Diptera and single species of Formicidae. This dominance was not evident on SWH where other groups of invertebrates were more abundant. Of note is that numbers of immature pest scale were similar on the two islands but were highest in the grassland on SWH and highest in the *Argusia* vegetation on NEH.

Soil flotation

Hand picking from flotation of deep soil samples in water collects fauna that are relatively immobile. Numbers reflect abundance and efficiency of extraction and hydrophobic nature of the cuticle of the animals.

Although a large volume of soil taken at various depths of up to one metre by G. Batianoff from under *Pisonia* trees was examined, faunal abundance was very low and appeared to be largely restricted to samples taken between 10 and 20 cm deep. Collembola appeared to be the dominant group but only one species, *Acherontiella prominentia*, which was also present in upper soil samples, was collected and Symphyla, Acarina and Chilopoda were rarely present. In particular, Symphyla were only and Chilopoda most abundantly collected from these deep soil samples.

The number of invertebrates collected was very low but one group, the Symphyla, were only collected by this method and not detected elsewhere. The Chilopoda were also relatively frequent in the deep soil samples as was one species of Collembola, *Acherontiella* sp. The latter was also abundant in *Pisonia* humus and soil.

Sweeps and beats

The arthropods living on the grasses (*Sporobolus*, *Lepidurus*), herbs (*Tribulus*, *Boerhavia Lepidium*) and soft shrubs (*Abutilon*, *Achyranthes*) were collected by sweeping. Those living on the hard shrub *Argusia* were collected by beating. Differences in the height of the vegetation and resistance of the vegetation to sweeping meant that it was unwise to attach much significance to differences in the numbers of individual species caught in each collection so the analysis wass confined to comparisons of the diversity of species collected (Appendix 6). The main feature is that many of the same species are distributed through the different plant associations described earlier. This may be due in part to the presence of sub-dominant plant species in the associations described below. About 64 taxa were recorded. The final number may vary slightly from this preliminary assessment once Diptera and Araneae have been examined by experts. Species diversity wass less on SWH than NEH (40 as opposed to 27 species), although there were several species of Coleoptera, Homoptera and Hymenoptera found on SWH that were not collected on NEH (Appendix 6). Diversity at the order level was highest in the sap-feeding Hemiptera bugs, although only two out of the seven species of cicadellid collected (sp.1 and sp2) were common. The two mirids and one delphacid (sp. 1) were also common. Single individuals of six species of parasitic Hymenoptera were collected including one observed as an external larva on a cicadellid (sp 2), probably a dryniid. The results are detailed under vegetation associations

Hand collections

The results from these collections are further considered under vegetation association, habitat type and then under individual taxa.

Epigaeic fauna of different vegetation types

The classification of vegetation types sampled broadly followed the terminology used on the maps CAB 3708/134-137(1969) and CAB 3708/46-47 provided by DEWHA, namely *Pisonia grandis* forest, *Cordia subcordata* forest, *Argusia argentea* shrubland, *Abutilon albescens* sub-shrubland and grassland. In addition the *Achyranthes aspera* sub-shrub patch was sampled, while the grassland was subdivided into *Sporobolus virginicus*-dominated grassland and *Tribulus cistoides*-dominated herbland. The *Lepidium englerianum* herbpatch and *Lepturus repens* grass patch on the west beachfronts were added. Minor components of the herbland include *Boerhavia albiflora* var *albiflora* and

Portulaca oleracea. The former was sampled in a mixed association of *Tribulus/Boerhavia,/Sporobouis* in the south of SWH. In all about ten different vegetation types were sampled.

Pisonia grandis Forest (NEH only)

Extensive but patchy defoliation by larvae of the Hawk moth *Hippotion velox* was evident with few remaining larvae, most having pupated and emerged. Light traps indicated a large population of young moths, some of which were starting to lay a few eggs on new foliage. The presence of adults attracted to light at night on the M. V. Tusa 4 anchored about 300 m offshore from NEH and on SWH where there were no host plants suggested a proportion of the population was emigrating. The absence of any stages of *H. velox* during the December 2006 visit (Freebairn, 2007) suggested the parents of the present generation were possibly immigrants from the mainland as discussed in Farrow (1984). Some defoliation by the large grasshopper, *Austracris/Valanga* sp. occurred on fully leaved *Pisonia* along the western edge of the forest bordering the shrublands and grasslands. A localised infestation of *Pulvinaria urbicola* on one tree was examined and the introduced parasite *Coccophagus ceroplastae* noted as well as huge numbers of the ant *Tetramorium bicarinatum*. A small infestation of the mealy bug, *Ferrisia* sp. was found on one isolated tree in the north of the Islet. No other arthropods were found from beating the leaves of fully foliated specimens of *Pisonia*. Dead *Pisonia* trunks are invariably attacked by a weevil (Coleoptera:Curculionidae) (larvae and adults in rotten wood), which hastens decomposition.

Argusia argentea Shrubland (NEH, SWH)

The widely separated shrubs of this species border the ocean and have suffered extensive dieback in recent years from unknown causes, although a fungus (Donaldson, 1994), drought, old age and the retreat of the freshwater lens during the recent drought may be implicated. The dead trees are all affected by a stem borer but it is not known whether this affected already dying trees or was a direct cause of their death. The type of attack resembles that of a cossid or xyloryctid moth. On the NEH nearly all the leaf buds and many flower and fruiting heads supported colonies of the mealybug *Ferrisia* sp. together with the predatory BCA, *C. montrouzieri*, but the scale had no visible impact on overall shrub health. Beating showed that the foliage supported large populations of the cockroach (Blatellidae sp.), the Scaled Cricket, *Ornebius* sp., and sarcophagid flies (Diptera:Sarcophagidae) all of which were probably associated with the presence of the mealybug because of the sugar laden food source it provided, although nectar production by flowers may have also attracted insects. A lacewing (*Chrysopa* sp.) was also collected, attracted by the mealybug, upon which its larva feeds. A single parasitic wasp was collected also, probably attracted by mealybug honeydew. Predatory spiders were also present. Localised defoliation by the grasshoppers (*Valanga*/*Austracris* spp) was observed. No defoliation by larvae of heliotrope moths in the genus *Utetheisa* was seen. The *Argusia* on SWH were mealybug free and virtually arthropod free apart from scavenging omnivorous cockroaches and predatory spiders.

Cordia subcordata Forest (NEH)

This was the most defoliated of all vegetation associations on NEH. The upper branches were mostly dead from the effects of protracted feeding by lepidopterous larvae from three species, *Hippotion velox, Ethmia* sp. and *Armectia columbina*. Only larvae of *Ethmia* sp. were seen feeding on localised basal regrowth in one *Cordia* stand. Periodic defoliation and recovery of *Cordia* stands has been observed from aerial photos since at least 1988. It is not known what caused these early defoliations as neither *Ethmia* sp. and *A. columbina* have been recorded until recently in Freebairn (2007). It is possible that these species were collected by Donaldson in 1994 or 1995, but his collections still await full identification. Neither is known to be migratory (although an adult *A. columbina* was found on SWH where there is no *Cordia*) so *H. velox* is the likely suspect defoliator. It is probable that this species has been a regular migrant to NEH for many years even before any collections were made.

Abutilon albescens Sub-shrubland (NEH, SWH)

This shrubland appears to be expanding as a result of the decline in the forest species (*Pisonia*) on NEH and of grassland on SWH. The only defoliation observed appears to be caused by the grasshopper *Austracris* sp. while some plants are locally affected by the mealybug *Ferrisia* sp. and its predator BCA (Fig 16). There are small patches of dieback, possibly drought-induced. The flowers are visited by a solitary bee yet to be identified. Sweeping revealed the usual arthropod complex of the scaled cricket, *Ornebius* sp., the cockroach, Blatellidae sp., and the bush cricket, *Polichne* sp., as well as a number of species of spider (Araneae). *Valanga*/*Austracris* sp. nymphs were also found. Insect diversity is lower in this vegetation association than any other (Appendix 6).

Achyranthes aspera Sub-shrub patch (NEH SWH)

The patches of this species situated between the *Argusia* and *Abutilon* shrublands support a diverse complex of arthropods including the scaled cricket, *Ornebius* sp., the cockroach, Blatellidae sp., the two species of Tettigoniidae and *Trigonidium* sp, sap-feeding plant bugs, Cicadellidae and Miridae and a small moth (Lepidoptera). No insect damage was observed apart from a localised mealybug infestation.

Sporobolus virginicus Grassland (NEH SWH)

No defoliation was observed except in *S. virginicus* patches in a large *Abutilon* stand on the NE of the Islet, possibly due to grasshopper feeding. This grassland invertebrate fauna is dominated numerically by several species of plant hopper (Hemiptera: Cicadellidae, Delphacidae and Miridae) and a leaf-running cricket (Trigonidiinae sp.). The grasshopper *Ailopus thalassinus* and the meadow bushcricket *Conocephalus semivittatus* (mostly nymphs) were the dominant large insects recorded. This grassland is the most arthropod-diverse of all the vegetation association with 24 taxa recorded on NEH as opposed to 19 on SWH.

Tribulus cistoides Herbland) (NEH SWH)

This species supports a diverse groups of arthropods including plant bugs, Miridae spp., seed-feeding geocorid bugs (Lygaeidae:Geocorinae spp.), *Polichne* sp. and ladybirds (Coccinellidae spp.). No defoliation was observed. No insect visitors to its flowers were observed by day. Eighteen species were recorded from NEH.

Tribulus//Boerhavia/Sporobolus (SWH)

This complex also supports a diverse range of arthropods on SWH, 20 species in all.

Lepidium englerianum Herbpatch (NEH SWH)

Although very sparsely distributed on the west beachfront, this species supports large numbers of small flies (Diptera spp) and some planthoppers, (Cicadellidae).

i) Lepturus repens Grasspatch *(NEH SWH)*

Widely separated tussocks of this grass on the west beach at SWH supported high densities of planthoppers (Cicadellidae) and small flies (Diptera spp).

Most samples from all plant associations contained large numbers of the ant, probably *T. bicarinatum.* It was observed feeding on insects such as mirid bugs and planthoppers in the sweep net, so it is assumed this would be its natural behaviour in the wild. As such, it would have a major impact on arthropod numbers and diversity in all habitats.

Fauna collected in other habitat types

a) Carcasses (Fig 26) (NEH)

A recently deceased turtle contained a large population of clerid beetles (Coleoptera:Cleridae) whose larvae feed on carrion. Two species of Histerid beetle were collected nearby, and adults and larvae of these are predators of carrion-feeding larvae. A tern carcass was turned over on SWH and several specimens of a species of *Phytosecis* (a carrion beetle) were found. A species of this wingless beetle is reported from fish carcasses on the coast of Queensland (CSIRO 1991). Other bird carcasses examined were devoid of carcass feeders. The decaying turtle hatchlings present in the depression on SWH were associated with an abundance of fly maggots and may also have attracted a range of other species, including the web spinners (Embioptera) and a species of predatory staphylinid rove beetle (predator). It was expected that the carrion beetle, *Dermestes ater,* would be found in the carcasses but none were seen although it was recorded from the light trap.

b) Birds Nests (NEH)

Two unoccupied brown noddy nests were shaken out over tray, but only juvenile scaled crickets (*Ornebius* sp.) were found as well as the ubiquitous *Tetramorium* ants.

c) Beach sand

Large numbers of poduromorph Collembola of two species were found to be present and often a dominant part of the interstitial sand fauna. Individuals of three species of a different family, the Isotomidae, were found in the beach pitfalls as well as in the sandpits, often in large numbers. The Thysanura, *Heterolepisma* sp., was also collected in beach sand at SWH.

d) Rock pools
These were colonised at low tide by adult Diptera species (yet to be identified) flying low over the water surface and adjacent rock and coral sand surfaces.

e) Hermit crabs
The shells of Hermit crabs (*Coenobita* spp) were searched by dunking the cracked shells in water in an effort to collect rare and unusual species of Collembola that are known to inhabit the shells of *Coenobita* species in Papua New Guinea. No specimens were found.

f) Dead Pisonia *trunks*
On NEH, trunks were infested with large populations of a weevil (Coleoptera: Curculionidae), both adults and larvae, which would have assisted in the decomposition of dead *Pisonia.* A single powder-post beetle (Bostrichidae)was swept from grassland. This is an obligate, generalist sapwood borer that could be attacking any of the woody trees and shrubs.

g) Rotten timber lengths (introduced)
The timber stacks on NEH sheltered large numbers of *Teleogryllus oceanicus* (Black Field Cricket), the tenebrionid beetle *Gonocepahalum torridum*, the above weevil and Isopoda species (woodlice) as well as the ubiquitous *Tetramorium* ants. One interesting insect collected here was a predatory bug (Hemiptera: Reduvidae: Emesinae) with raptorial forelegs, which is a known migratory species.

h) Deep soil mainly below Pisonia forest (NEH)
Chilopoda and Symphyla were found in small numbers and Collembola in reasonable numbers, but only one species of each group. They were most abundant at depths of 10 to 20 cm. No ants were found in these samples, indicating that the soil fauna could only persist in habitats where ants were absent or present in very low numbers

i) Surface gravel, pumice & organic matter in a damp depression, SWH (Fig 24)
This site at the extreme south end of the island, which included a turtle nest with dead hatchlings, (Fig 25) yielded a wide variety of arthropods by searching (Fig 27) and extraction of gravel samples. These included web-spinners (Embioptera), mites (Acari), bristletails (Thysanura), false scorpions (Pseudoscorpionida), and spiders (Araneae).

j) DEW equipment cache (NEH)
Metal drums kept in the store harboured a population of crickets, *Teleogryllus* sp.

k) Miscellaneous
The wasp *Scelio* sp., which parasitises grasshopper egg pods, was seen frequently on SWH running over the soil surface in its search for host material.

Notes on Fauna Collected

Arthropoda: Arachnida

Acarina (Mites)

Large numbers of mites were collected in 2007 as well as in 1995 and 1997. Altogether there are over 100 tubes of specimens and an estimated 5000 specimens. Practically all collections included some mites. The most widespread species belonged to the Prostigmata and were minute, white species. Nannochestidae were fairly common in open, sandy habitats in pitfall traps. Species of this family are abundant in the arid zone on sandy soils, and the family also occurs in Antarctica. They are believed to feed on alga. Species of Trombidiidaewere also fairly abundant. The Bdellidae and Cheliferidae were rare – and both families are predators. Oribatida were only collected from *Pisonia* leaf litter and were found there in large numbers. Probably up to 20 species were present. In *Pisonia* they were dominant in collections, whereas Prostigmata were rare. Pisonia leaf litter and humus samples were the only collections where Mesostigmata were found, notably the family, Uropodidae, that are detritivores. Other predatory Mesostigmata mites were rare. No specimens of Acaridae were collected. It is estimated that 40 species at least were present in collections. Although mites were recorded by Heatwole (1967, 1979) from the Coral Sea islets, he made no identifications except to record Eriophyidae and ticks as parasites of birds. No ticks were collected in 2005 and no attempt made to collect them because of reluctance to disturb nesting birds. Ticks have been implicated in lower viability of nestling sea birds occasionally (Neville *et al.*, 2005). More detailed identifications can only be carried out by a specialist taxonomist.

Araneae (Spiders)

Altogether there were about 90 tubes of spiders collected in all three years. Most specimens were collected in 1995 by S. Donaldson and only 18 tubes of specimens were collected in 2007. It was notable that many large and adult species were collected in 1996, but only small immature specimens for the most part in 2007. The number of species and individuals has fallen to very low levels in 2007, probably because of the dominance of the ant, *T. bicarinatum*. The previous records of spiders from the region consist of 15 species (Greenslade 2007), of which two can be discounted as unidentified except as an already recorded family and anotherfamily has been synonymised, leaving 12 species belonging to 11 families (see below). One species of Salticidae, *Plexippus paykullii* (Audouin), has already been recorded from NEH. which was collected in 1964 (B.Richardson, pers. comm.). Only five of the families (in bold below) have been recorded from the islands under study here. All were from NEH.

Araneidae	***Araneus theisi***	Unlikely identification as the genus European only
Argyopidae	**indet.**	Now synonymised with Araneidae
Clubionidae	***Cheiracanthium* sp.**	
Desidae	*Desis* sp	
Gnaphosidae	*Anzacia* sp.	

Linyphiidae	*Erigone* sp.	
Linyphiidae	*Lepthyphanthes angulatus*	
Lycosidae	***Trochosa* sp.**	unlikely identification as the genus European only
Oonopidae	*Gamasomapha* sp.	
Pholcidae	*indet.*	
Salticidae	***Damoetus* sp.**	
Scytodidae	***Scytodes* sp.**	
Theridiidae	*Theridion* sp.	

Specimens collected in 1997 by A. Anderson (14 samples) have been identified to some level. They consisted mainly of immature specimens that cannot be identified to species, but some names can be assigned as given below. Several previous records proved to be misidentifications or names have been changed from the earlier records (S. Roy, pers. comm. 2008). Six families are represented, which are the same as those listed earlier. It is likely therefore that six species of spider occurred on NEH in 1997. The species present in the 2007 collection cannot be determined without a specialist taxonomist.

Araneidae sp.	immatures only
Clubionidae *Cheiracanthium* sp. 1	male, also recorded from Cato Island
Lycosidae sp. 1	female plus immatures
Oonopidae cf. *Gamasomorpha* sp.	1 male plus immatures - new record for NEH
Salticidae sp. 1	immature
Syctodidae *Syctodes* sp. 1	female plus immatures

Pseudoscorpionida (Fig. 1)

Three species were collected. One belonged to the family Cheliferidae, *Nannochelifer paralius*, a rare species only previously known from a marine littoral habitat on Turtle Islet, Lihou Reef. Only one specimen of this species was collected from the gravel soak on SWH, a terrestrial/fresh water habitat rather than a marine littoral one. The most common species found was an undescribed species of *Oratemnus* (Atemnidae), which occurred on Coringa and Magdelaine quite commonly but was not found on SWH and only on NEH in 1997. The third species belonged to an unknown genus of Cheiridiidae, which was only found in *Pisonia* humus and soil on NEH. The common marine littoral pseudoscorpion, *Parahya submersa*, which occurs from New Caledonia east to the northern Australia and south east Asia, was not collected. Previous records from the region comprised four taxa, of which two were identified to species as listed below. Three of the four were collected in 2007. Pseudoscorpions are considered to be lie-in-wait predators on the ground surface. Because of their small size, they are considered to prey mainly on Collembola. Specimens were identified by Dr M. Harvey of the Western Australian Museum.

Records prior to 2007

Oratemnus sp.	Chilcott Is.
Nannochelifer paralius	Lihou Reef, Turtle Island.
Cheiridiidae	North East Herald.

Withius piger Cato Island, Bird Island. – introduced tropical exotic stored product pest

Collection records

1995

Coringa, 20 Mar 95 *Pisonia Oratemnus* sp.
Magdelaine, shrubland, *Abutilon*, *Plumbago*, 13 Mar 95, *Oratemnus* sp.

1997

NEH, Dune crest, *Argusia*, *Abutilon*, grasses, No. 71, A. Anderson, June 1997, *Oratemnus* sp.
Pisonia, yellow pan, A. Anderson, 1997, Cheiridiidae

2007

NEH *Pisonia*, 16 May Tullgren Cheiridiidae
SWH, gravel (wrong label), May 07 *Nannochelifer paralius*
SW Coringa, pitfalls, *Abutilon*, Oct 07, *Oratemnus* sp.
Magdelaine, pitfalls *Abutilon*, Oct 07 *Oratemnus* sp.
Magdelaine pitfalls, grassland, Oct 07, *Oratemnus* sp.

Arthropoda: Crustacea

Isopoda (Woodlice, Slaters, Sowbugs)

Three species were collected in 2007 while two species were recorded in previous collections from NEH. However only one species was collected from NEH in 2007 (this one also from SWH, Magdelaine and Coringa) and the other two species were only found on SWH in the moist gravel area in the extreme south of the island. The species on both islands may be generally widespread and is dorsoventrally flattened and pale grey in colour. The other two species are paler, one being pinkish white, highly sculptured and able to partially roll into a ball, the other is dorsoventrally flattened, white with minute dark specks. Unidentified Isopoda have been recorded from a wide range of Coral Sea islands previously including NEH but not SWH. This is the first record of Isopoda from SWH, Coringa and SE Magdelaine Islands. Isopoda feed on decaying plant material and so are classified as detritivores. All specimens have been given to Dr Wilson at the Australian Museum for identification.

Collection records

1995

Magdelaine, shrubland, *Plumbago*.X2
NEH *Boehovia*, *Spirubulus*
` SW Coringa, clearing in *Pisonia*
No data

1997

NEH, rotten wood, *Pisonia*,June 1997
NEH, leaf litter, *Pisonia* x 2 June 1997

2007

SWH gravel, Tullgren, 18.5. (incorrectly labeled but corrected)
NEH *Pisonia* DEW cache leaf litter
NEH beach, pitfalls, beach east
NEH *Pisonia* leaf litter transect 3
NEH grassland, pitfalls
SWH grassland, pitfalls
SWH beach pitfalls.
Magdelaine, pitfalls, *Argusia*

Other Crustacea (Crabs, Hermit Crabs)

1996

Dardanjus gjuttatus (Diogenidae) NEH, 29.viii.96

2007

Coringa, pitfall, *Argusia*, May 2007.
NEH, Intertidal, May 2007

Arthropoda: Tardigrada (Fig. 2)
These animals and minute soft bodied and four legged but without antennae. They are capable of surviving in a dehydrated state and it is supposed this is how they are dispersed widely on wind currents. Tardigrades only become active when moistened.

Collection records
1995
x 2 tubes, *Ximonia* shrubland, *Lepturus*.

Arthropoda: Collembola (Springtails) (Figs 3, 4)
Collembola were one of the most abundant and diverse groups of arthropods on the islands in leaf litter, humus and in the soil after the Acarina. In 2007, Collembola were collected from NEH, SWH, Magdelaine but none were found in pitfall traps on Coringa Island. Altogether in 2007 19 to 20, species were collected on the three island groups which doubled the number of species records for NEH and nearly all records from the other islands were new. Only two species collected from NEH in previous years were not re–collected. They were *Brachystomella* sp. nr *unguilongua* Thibaud and Weiner and *Hemisotoma* sp.cf. *thermophila* Axelson. The absence of these two species may possibly indicate that extinction and colonisation rates on these islands are high causing a fairly high turnover of species over ten years. The total number of individuals collected in 2007 was just over 2350.

Previous records

Species	Collection records	Comments
Xenylla manusiensis Gama, 1967	Flinders Reef; North East Herald; Coringa Islet, Lihou Reef.	
Paraxenylla sp. cf affiniformis (Stach, 1929)	North East Herald	Now *Paraxenylla pilou*
Acherontiella sp. cf. *promentia* Thibaud &Weiner, 1997	Turtle Islet, North East Herald	
Xenylla sp. Indet	North East Herald	Probably Xenylla manusiensis
Brachystomella spp.	North East Herald	Not collected 2007
Oudemansia sp. 1 cf. *schoetti* Denis, 1948	CarolaCay, Marion Reef;	
Oudemanisia sp. 2	GannetCay SwainsReef; Carola Cay, Marion Reef; NamelessCay, Creal Reef;	Possibly only one species of Oudemansia is present
Yuukianura sp. cf. *halophila* Yosii, 1955	Turtle Islet, Brodie Cay	
Pseudanurida billitonensisSchott, 1901	North Reef Cay, Frederick Reef;	Not collected 2007
Immature undetermined Poduromorpha	North East Herald	n.a.
Archisotoma sp. cf *interstitialis* Delamare-Deboutteville, 1953	North Reef Cay, Frederick Reef;	
Axelsonia sp. cf. *littoralis* (Moniez, 1890)	CarolaCay, Marion Reef; GannetCay SwainsReef; NamelessCay, Creal Reef; North Reef Cay, Frederick Reef.	Not collected 2007
Folsomides exiguusFolsom, 1932	North East Herald	
Hemisotoma sp. cf. *thermophila* grp (Axelson, 1900)	North East Herald	Not collected 2007
Psammisotoma kingi Greenslade & Deharveng, 1986	Georgina Cay	Not collected 2007
Entomobrya multifasciata (Tullberg, 1871	Cato Reef;	Not collected 2007 but either a stray or transient
Entomobrya atrocincta Schott, 1896	Cato Reef;	Not collected 2007 but either a stray or transient
Acrocyrtus sp.	Coringa Islet, Lihou Reef	
Dicranocentrus n. sp.	Marion Reef; Carola Cay; Turtle Islet; Edna Cay; Georgina Cay	
Pseudosinella sp.	North Reef Cay, Frederick Reef	
Lepidocyrtus sp.	North East Herald	
Entomobryidae immature indet.	North East Herald	

Sphaeridia sp.	North East Herald	Collected NEH 2007
Symphypleona indet immature.	North East Herald	
Dicyrtomidae sp.	Gannet Cay, Swains Reef;	Not collected 2007

Ecological and distributional notes on the individual species are given below.

Brachystomellidae: *Brachystomella* sp.cf. *unguilongua* Thibaud and Najt
Not found in 2007. Recorded by S. Donaldson from *Pisonia* forest on NEH in March, 1995. This species has so far only been recorded from inland forest in New Caledonia but may now be extinct on NEH.

Neanuridae: *Oudemansia schoetti* Denis
Although two species were recorded previously from the region in this genus, there might be only one species of *Oudemansia* present in the Coral Sea Territory. Variability in the number of anal spines has been noted in the 2007 collections within populations, and since species differentiation has depended on the number of anal spines in the past, this character is clearly unreliable. Another marine littoral species, *Friesea tilbrooki* Wise, has been shown to vary within a single population in the number of spines on the abdomen (Greenslade, 1986). Specimens were only collected intertidally in marine littoral habitats on both NEH and SWH in 2006, but were collected also in previous years although not on the four islands sampled in 2007. Twelve specimens were mounted: two anal spines were observed on eight specimens, three anal spines on two specimens, and four anal spines on two specimens. Specimens all came from NEH except for three, with two anal spines from SWH. Chan and Trott (1972) studied *Oudemansia esakii* Kinoshita on beaches in Hong Kong and found it was totally marine littoral as all stages, even eggs, were found in the intertidal zone. It occurred between high and low tide marks and emerges from the wet sand to be active on the surface for a few hours just after the tide retreats. They are scavengers feeding on dead marine invertebrates such as barnacles and oysters. These animals have a very granular cuticle, which would have hydrophobic properties, and so can float on water surfaces. Chan and Trott (1972) found they could survive at least 72 hours on water. Unexpectedly no *Oudemansia* species were recorded on New Caledonia by Thibaud and Weiner although Yoshii (1960) recorded *Oudemansia schoetti* from there. Distribution of the genus is almost exclusively tropical and it has been recorded in Queensland already.

Neanuridae*: Friesea* sp. 1 cf. *pins* Thibaud and Weiner.
Several large specimens were found in Tullgren funnel extraction from gravel on SWH, but only in this sample. The species has three distinct anal spines on abdomen VI and a longish curved mucro with well developed basal lobe stretching half way up the mucro. The mucro is fairly long and the dens: mucro ratio was 1:2.

Neanuridae*: Friesea* sp. 2
Only a single specimen from pitfalls set under *Argusia* on SWH was collected. It was medium sized, with short triangular antenna, abd VI with three shortish spines, furca and mucro present and well developed, with four setae on dens. The mucro was small and

roundish, triangular in form and much shorter than the dens. The ratio of dens to mucro was 4: 1. Species of *Friesea* are common in marine littoral habitats in southern regions. They are carnivorous and believed to feed exclusively on rotifers. Rotifers were not sought on the islands.

Neanuridae*: Yuukianura* sp.nr *halophila* Yosii
A single specimen of this species was found in Tullgren funnel extraction of gravel from NEH. It was recorded from Turtle Is, Lihou Reef and Brodie Cay by Greenslade and Deharveng (1992).

Hypogastruridae: *Xenylla manusiensis* Gama
This species was originally described from marine littoral habits on Manus Island in the Bismark Archipelago, Papua New Guinea. It has been recorded in large numbers from habitats in the Swains Reef in 1982 and Flinders Reef in 1981, both in leaf litter from shrubland and from under carcasses of dead birds (King and Greenslade 1983). In 2007, it was also found in large numbers both in and away (mainly in *Argusia*) from marine littoral habitats on NEH, SWH and Magdelaine, and on Coringa in 1995. Quantitative Tullgren funnel samples of soil/sand cores from cays ranging from no vegetation to dense vegetation coverage in the Swain Reef in 1983 collected *X. manusiensis* almost exclusively on the vegetated cays, but mainly *Archisotoma* species on the cays with less or no vegetation. Densities ranged from 198 to 1,731,000 m^{-2} per core and were linearly related to the amount of organic matter in the samples (King and Greenslade 1983).

Hypogastruridae: *Paraxenylla piloua* Thibaud and Weiner, 1997
This species was originally described from New Caledonia. The record from the Coral Sea Territory is the first record of the species outside that country. The genus was revised by Palacios Vargas and Janssens (2006). Another species in the genus *P. peruensis* was found to feed on the alga, *Ulva* sp. (Catenazzi and Donnelly, 2007), but *P. piloua* was only found in *Pisonia* leaf litter on NEH and not in marine littoral habitats in May 2007. It was also found in 1995 on NEH and on Turtle Island in 1982. This is the first time the species has been found outside New Caledonia. This species is small and pale blue grey. It rather has the appearance of a *Brachystomella* species than a *Xenylla*.

Hypogastruridae: *Acherontiella prominentia* Thibaud and Weiner or *A. thibaudi* Barra
This species was abundant on sandy beaches in New Caledonia and appeared to be very widespread in the country but only in marine littoral habitats. The record from the Coral Sea Territory is the second record of the species outside that country; it has also been found in Vanuatu. The record from the CSIT is the first outside the marine littoral habitat. The species is very close to a species from South Africa, *A. thibaudi* Barra. In some respects the Coral Sea species has characteristics of both species and so there may only be one variable species. This is the first record of the genus (and species) for Australia. It was found very abundantly on NEH in leaf litter of *Pisonia* forest in 2007 and also in 1995 NEH, although in herbfield and shrubland. It was collected in 1982 from Turtle Island. The species has a cuticle that consists of very coarse granules so it is likely that it can retain a plastron (air-filled cushion) around the body, allowing survival in water.

Isotomidae: *Folsomina onychiurina* Denis, 1931
This species is pantropical in distribution; in Australia it is found in a wide variety of humid soils even to 2 m deep. It is parthenogenetic. In New Caledonia it was common and abundant on beaches but in the Coral Sea it was fairly rare with fewer than 20 specimens found and only in *Pisonia* leaf litter on NEH in gravel pit on SWH.

Isotomidae: *Folsomides exiguus* Denis
This species is pantropical in distribution and in Australia is found in a wide variety of humid soils and humus. It is probably parthenogenetic and was very rare with only two individuals collected from *Pisonia* forest on NEH. It was also collected on Coringa in 1995.

Isotomidae: *Archisotoma* sp.
This genus is entirely marine littoral and is extremely abundant on many beaches interstially in sand just below high tide mark. It was found commonly on NEH on the west beach but rarely on SWH. There are a number of undescribed species in this genus in Australia. Species were previously recorded as *Archisotoma interstitialis* but are now found to be close, but not identical, with this species. There may be two species in collections that are close if not identical with species from New Caledonia. They were abundant in pitfalls on the west beach of NEH but rare or absent elsewhere.

Isotomidae: *Hemisotoma thermophila* Axelson grp.
This species has only been found on NEH in 1997 and was not re-collected in 2007.

Isotomidae: *Isotoma* sp. *Parisotoma* sp.
One light grey species was found of this genus. It had 2 + 2 spines anteriodistally on the manubrium, abdomen V and VI separate, a mucro with three teeth, a large postantennal organ and 6 + 6 ocelli. It was found on SWH in pitfalls set in *Argusia* vegetation and in the funnel extraction of gravel samples.

Entomobryidae: *Dicranocentrus* sp.
Individuals that represent a new species, and probably a new genus, were found in pitfall traps on beach sites of both NEH and SWH. It is purplish black in colour and over 1 mm long with fairly long antennae annulated for the last two segments. The species has previously been collected from Georgina Cay, Lihou Reef, Carola Cay and Marion Reef. Related species are known from marine littoral habitats in Indonesia, Papua New Guinea and the Phillippines.

Entomobryidae: *Pseudosinella* sp.
A few specimens of this genus were collected in 2007. The species were white with an eye spot reduced to 1 + 1. They were found in *Pisonia* leaf litter. A different species of *Pseudosinella* with 6 + 6 ocelli was collected in 1995 on Coringa and in 1982 from Frederick Reef.

Entomobryidae: *Ascocyrtus* sp.cf.*kuakea* Christiansen and Bellinger

Specimens appeared to be conspecific with this species originally described from the Hawaii islands but also considered to be common in eastern Australia. It was found in 2007 in NEH commonly in *Pisonia* leaf litter and more rarely in grassland and *Abutilon* and *Argusia* pitfalls. It was also collected in 1995 on Coringa but not in 2007. Specimens are largely yellowish or fauwnish white with pale blue antennae.

Entomobryidae: *Lepidocyrtus* sp. *cyaneus* grp.
A single specimen of a dark blue *Lepidocyrtus* was collected from Tullgren funnel extraction of gravel from SWH. It has not been collected before from the CSIT, but belongs to a group of species with near cosmopolitan distribution. The group occurs in Australia and is probably introduced from Europe.

Entomobryidae: *Seira* sp.
Species were abundant, but only in *Pisonia* forest. On NEH in the same habitat a different genus of Entomobryidae seems to be filling this niche indicating the stochastic nature of invasion and colonisation of these islands. The characters of the species were: head white, many macrochaetae on ant thorax and sparser elsewhere, abd III, II broad band of diffuse navy blue interrupted medially, also posterior eighth of abd IV, also interrupted medially, antennae all blue, ribbed scales present, mucro single tooth. No other records of this species are known but it may occur in Queensland.

Sminthurididae: *Sphaeridia* sp.
Only a very few specimens were collected from *Pisonia* and *Abutilon* leaf litter extraction from NEH. Most were immatures but one female was seen. Species can only be distinguished using males so no further determination can be made of these specimens.

Bourletiellidae: *Bourletiella viridescens* Stach, 1920
Stray specimens probably entered samples during extraction as only two were found in flotation extraction of deep soil samples. This species is normally only found on exotic grasses. It is not therefore considered a valid record.

Neelidae: *Megalothorax* sp.
This species is minute, lacks eyes and pigment. Only a single specimen was found in Tullgren funnel extraction of gravel from SWH. *Megalothorax* individuals occur in many moist soils in Australia. It is believed that only a few species are involved.

General remarks
Nearly all Collembola are considered detrivores, feeding on microorganisms living on dead plant matter. Species found on the island in leaf litter, humus or soil are likely to be all fungivores but the marine littoral species may be preying on nematodes, Protista and possibly rotifers, at least the *Friesea* and *Oudemansia* species. The other marine littoral species probably feed on algae and on diatoms or microfauna living interstitially in sand or under rocks. Half the species collected are considered to be exclusively marine littoral in habitat elsewhere but on these islands four of these species also occur in inland

vegetated habitats. The significance of the Collembola records is that they illustrate six main characteristics of the invertebrate faunas of these small coral cays:

1. Collembola can be diverse and abundant in these somewhat severe habitats.
2. Some mainly marine littoral species are primary colonisers.
3. Species that are marine littoral exclusively on larger land masses can colonise inland habitats on small islands. This may be due to the low invertebrate species diversity on small islands resulting in lower competition and predatory pressure.
4. Some species and genera occur on these cays that do not appear to occur elsewhere in Australia.
5. The fauna shows most affinity to New Caledonia but also to South East Asia and the South West Pacific rather than to Australia.
6. There appears to be a fairly rapid turnover of species i.e. 10% of species lost in 10 years.
7. Dispersal of species over fairly long distances appears to some extent to be the result of the prevailing wind and currents at the times of dispersal movements.

Arthropoda: Insecta

<u>Dictyoptera (Cockroaches)</u>

One species was commonly collected in 2007 but other species as well as this one were collected in 1995 and 1997. Identifications may be possible in due course.

1995

13 Mar , SE Magdelaine, x 2 large
Coringa, clearing in Pisonia forest, 17 Mar

2007

NEH, *Pisonia*, pitfalls, May 07
NEH grassland, Yellow pans, May 07
NEH yellow pan *Pisonia*
NEH yellowpan *Abutilon* x 2.
SWH YP *Abutilon,* May 2007

<u>Coleoptera (Beetles)</u>

Anderson and Donaldson collected much the same range of species as detected in the present study. Given the additional time spent on the island by these investigators, the few additional species of ladybirds (Coccinellidae – migratory and scale predators) and weevils (Curculionidae – probably stem-boring larvae) collected by them is not surprising. The notable exception was the abundance of the carrion-feeding beetle *Dermestes ater* in Donaldson's time and the absence of the Clerid beetle, which could be associated with differences in the abundance of carcasses. Both species are good fliers and could be migratory as well. Donaldson also collected the powder post beetle (Bostrychidae) found in the present study. The *Phycosecis* beetles found in carrion on SWH (new record) were also collected in a pitfall from Coringa in October 2007.

Dermaptera (Earwigs)

Possibly only one species was collected in both years. Specimens have been sent to Dr Cassis at the University of NSW. Dermaptera feed on dead plant or animal organic matter.

1995

South East Magdelaine,13 Mar 95 x 1
Coringa, herbfield x 1
Coringa, herbfield x 1

2007

South East Magdelaine, *Pisonia* pitfalls Oct 07 x 4

Diptera (Flies)

A very large number of Diptera specimens were collected belonging to between 10 and 20 species in all years. They were particularly abundant in 2007 on NEH. The most abundant individuals belonged to the family Sarcophagidae and were feeding on sugar exudates from scales and possibly nectar from *Argusia* and other flowers, although the larvae are carrion feeders. This group was much less abundant in 1995 and 1997. The dead turtle present in 2007 could have supported thousands of larvae prior to our visit. Although large numbers of this family were collected on NEH in pitfalls in May 2007, none were collected in pitfalls on SWH at that time nor were any collected in pitfalls on SW Magdelaine or Coringa in October 2007. This suggests that this family was likely to be associated with the scale/ant infestation on NEH and were possibly attracted to the preservative in traps. The other Diptera are probably generally saprophytic, that is, living on dead animal matter. Diptera are currently being identified by D. Bickel at the Australian Museum.

Hemiptera (True bugs, scales etc)

Crawlers were recorded by Donaldson on NEH in 1995, which could have come from *Pulvinaria* or *Ferrisia*, although he also found a hard scale (Diaspidae) on *Abutilon*. In the 2007 collection, seven planthopper taxa (Hemiptera:Cicadellidae) were collected from NEH, Coringa and Magdelaine, although the size of collections was larger in 1995, suggesting that planthoppers were more abundant a decade earlier. The Mirids and Delphacids were represented by the same taxa found in the present study.

Hymenoptera (Wasps, Ants and Bees)

In the 2007 about eight taxa of micro-Hymenoptera (not all distinguished here) were collected. All are parasitoids of other arthropod stages, one of the most obvious being the ectoparasitic dryniid larva, which was found on a cicadellid. Except for the *Scelio* spp., which parasitises grasshopper (*A. thalassinus*, and *Austracris* sp.) egg pods, the hosts of the other species are unknown, although there are many candidates on NEH and SWH, including the eggs and larvae of moths (Lepidoptera) and insects from other orders as well as spiders (Araneae). There are representatives of this group from the Donaldson and Anderson collections, but they are rare in other collections (Greenslade 2007). These parasitoids have the potential to exert some biological control of host numbers and may help to regulate populations of phytophagous insects on the islands. Many species have been recorded migrating in the upper air by day (Farrow, unpublished data). In the 2007 collection, one specimen of a macro-parasitoid in the light trap was found, probably *Pterocormus* sp. (Ichneumonidae), and Donaldson collected several species of macro-parasitoids belonging to the family Ichneumonidae that parasitise noctuid moth larvae such as the *Agrotis* species present on the islands. Two well-known migratory macro-ichneumonids were recorded from Willis Island (Farrow 1984). The single species of solitary carpenter bee (Anthophoridae) collected has been previously recorded. It is probably an important pollinator of *Abutilon*, *Tribulus* and other flowering plants.

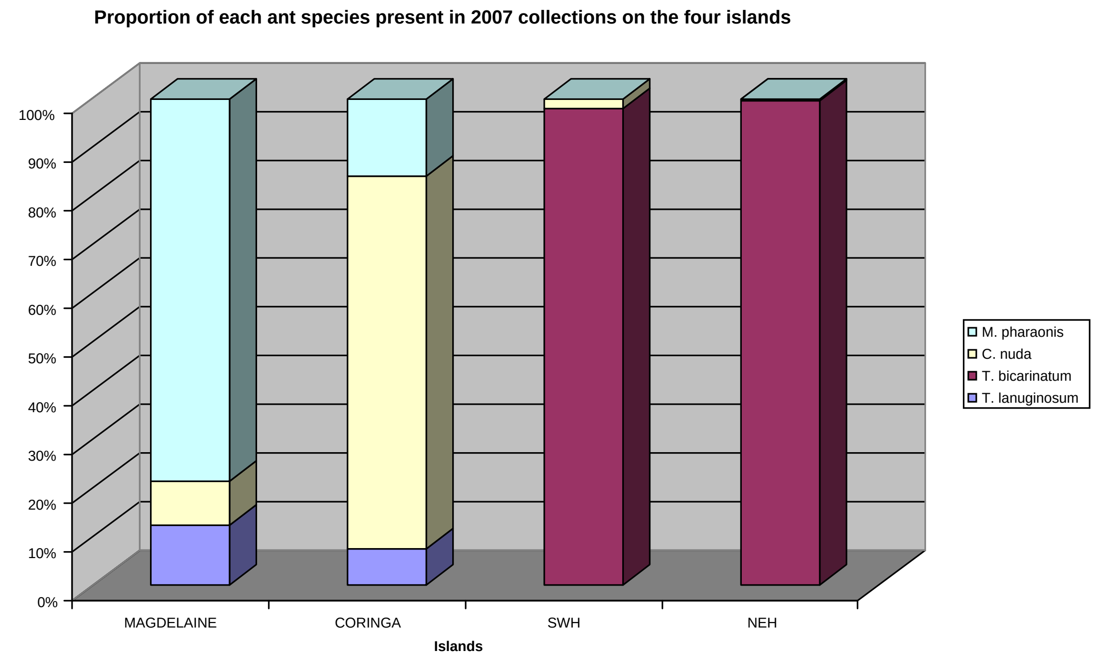
Formicidae (Ants)

The collections made in 2007 from NEH, SWH, SW Magdelaine and Coringa contained four species as shown below. There was also a single specimen of *Oecophylla smaragdina* found in a pitfall. It was damaged and clearly dead before collection. As it was in a pitfall, it could not have been a stray in traps but it was suggested that it was a recent arrival on the island and had been preyed upon and killed by *T. bicarinatum*. The species is common around Cairns and elsewhere in the tropics. Species identifications on each island and for each collection are given in Appendix 10.

Species	**Islands from which recorded**	**Comments**
Cardiocondyla sp. cf. *nuda* (3)	NEH SWH Coringa Magdelaine	Rare
Monomorium pharaonsis (4)	SWH Coringa Magdelaine	Rare
Tetramorium bicarinatum (1)	NEH, SWH	Abundant
Tetramorium lanuginosum (2)	Coringa Magdelaine	On on Magdelaine and Coringa

The data clearly indicates that *T. bicarinatum* is only present on NEH and SWH and that a different species of the same genus, *T. lanuginosum*, is present on Coringa and Magdelaine. Moreover *T. bicarinatum* is so dominant on NEH and SWH that other species are either absent or present in very low numbers. A contrasting situation is present on Coringa and Magdelaine where *T. lanuginosum* is less or not at all dominant and three species of ants coexist in relatively similar abundance. This major difference in species composition between islands has not been noted before and may have a major influence on numbers of pest scale and other invertebrates. Although collections on Coringa and Magdelaine were not of a similar intensity to those on NEH and SWH, the proportional representation of species present in collections is an indication of abundance, especially as ants were predominately collected in pitfall traps, and these traps were run on all four islands.

Figure 1.



Another point to note from the data is that on NEH and SWH, *T. bicarinatum* is most abundantly caught not in *Pisonia* forest, but in grassland and nearly as numerous in traps in *Abutilon* vegetation. This is probably because of the ant being most active at high temperatures, grassland being a more open habitat.

Table 3. Numbers of the Guinea ant, *Tetramorium bicarinatum*, trapped on NEH and SWH in May 2007

Vegetation type	NEH	SWH
Grass	2203	1262
Argusia	1546	201
Abutilon	760	271
Pisonia	495	0
Beach	55	13

The table also shows that this species was not collected in Tullgren funnel extractions of leaf litter, soil and humus from *Pisonia* forest and gravel on NEH and SWH respectively, indicating that it was not nesting on the ground in this habitat and that other arthropods are able to exist in this habitat free from predatory pressure from ants. It was possible to compare changes in ant species composition on NEH over 12 years as collections were available from 1995/6, 1997 as well as 2007 (Appendices 10, 11, 12). Although collections were of different intensity, slightly different methods were used and were made at different times of the year, the data was unequivocal that the dominant ant present on the island now, *T. bicarinatum,* was not present on the island in 1995, 1996 or 1997 (Table 4).

Table 4. Total numbers of ant species caught in three years on NEH

Ant species	1995/6	1997	2007
T. lanuginosum	**149**	**44**	0
T. bicarinatum	0	0	**5059**
C. nuda	40	47	17
M. pharaonis	127	49	0

As this species was first recorded from the island in the early 2000s, when the pest scale was first noticed to becoming a problem, it was suggested that it was introduced to the island sometime between 1997 and about 2001. The most likely pathway by which the species arrived would have been in timber, packing cases, or any other container holding food, camping or other equipment. A large party camping on the island for a week or two would be the most likely sources.

Again this was the first time that significant changes in invertebrate faunas of these islands had been noted and it was especially significant that it occurred in a short time scale and during a time of significant pest scale increase. However, it should be noted that the scale contributed to the destruction of the *Pisonia* forest on Coringa and there was no evidence that *T. bicarinatum* ever occurred on that island. Only *T. lanuginosum* was present in 1995/6 as well as the 2007 collections. However it is believed that other factors beside the scale, such as a severe hurricane and particularly intense and frequent El Nino events in the mid 1990s, were also contributing factors there.

Of relevance is the situation on the Cocos and Keeling Islands. Neville *et al.* (2007) found 21 species of ants in all after surveying five main islands in the group. The list included the Guinea ant, *T. bicarinatum* but it was present in low numbers and the Crazy ant, *Anoplolepis gracilipes* was numerically dominant. Apparently no scale was present on the islands in 2005 (Neville *et al.*, 2005). The increased competition from other ants and the lack of scale may here be preventing the Guinea ant increasing in abundance.

Previous records

Greenslade (2007, Table 4) recorded 13 taxa of ants from over 12 reports on the Coral Sea Islands. They can be reduced to six taxa (underlined in Table below) even though some specimens still need to be examined to confirm species. As the location of most of these specimens is unknown, this may be impossible.

Table 5. Records of ant species from the CSIT

Species	Islands from which recorded	Comments
Cardiocondyla nuda	NEH, CI, CCR, CHI	*Species verified*
Triglyphothrix striatidens	CCR, NEH, CHI	Genus a synonym of *Tetramorium*
Iridomyrmex purpureus	BI	Species probably correct
Monomorium pharaonis	NEH, BI, CCR, CHI	Species verified
Monomorium sp.		Not identified to species but probably *M. pharaonis*
<u>*Pheidole megacephala*</u>	WI	Species probably correct
Tetramorium bicarinatum	NEH	Species verified
<u>*Tetramorium simillimum*</u>	NEH	Species to be checked
indet. (5)		Not identified to any level so discarded

Notes on the biology of genera and species from Shattuck and Barnett (2001) follow.

Tetramorium
Species in the genus are more common in hot, dry environments where they can be very abundant. Individuals normally forage on the ground, often in large numbers and are most active in the morning and evening. On the islands they also commonly forage arboreally and are considered to be generalist predators. Nests are usually in soil.

Tetramorium bicarinatum (Nylander) (The Guinea Ant) (Fig. 5)
This species is common and widespread in all parts of Australia and in many habitats. Nests on the islands consist of small colonies under rocks or under bark or in decaying timber. They are generalist predators. Foraging is mainly during the day. *Tetramorium bicarinatum* is cosmopolitan in distribution and has been carried by commerce to all inhabited regions of the world. In Australia it is considered that the species has been introduced from South East Asia and occurs in all states except Tasmania. It can be found in woodlands and forests, even in arid areas, and depending on temperature can be active during day or night. Although it is mainly predatory, it has been found in association with coccoids. It can colonsise disturbed areas. Identification features are: bulky build, not curled, and hairy long grooves on anterior head rather than granules.

Tetramorium lanuginosum Mayr (Fig. 6)
This species has only been recorded in Queensland and the Northern Territory. It is a predator, active either by day or night, and found in forests. It nests in the ground layer. Morphological characters that distinguish it are: reddish brown, extremely setose, heavily

sculptured head and thorax granular rather than grooved, bulky, curled body in death, and setae on thorax double.

Cardiocondyla
Only four species are recorded in Australia but the genus is widespread and occurs in north east Queensland. Species are ground nesting and workers also forage on the ground, and are rarely found foraging aboreally. They are small, slender and slow moving individuals. Some of the four species are found outside Australia but it has not been determined if they are introduced or a native. *Cardiocondyla* species can be found in a range of habitats but are more common in woodlands and in disturbed areas. Males are unusually lackingwings and are worker-like. Morphological characters are: small, slender, brown body, black shiny abdomen, fine granular cuticle, post petiole much broader than petiole, and ocelli fairly large.

Monomorium pharaonis (Linnaeus) (The Pharaoh ant)
This is a large genus which is found throughout Australia. The Pharaoh ant is a common household pest and found worldwide. It is said to be the most difficult species to control domestically because of its cryptic nesting habits in buildings. It does not nest outside in temperate regions. Colonies tend to be large and can reach several hundred thousand individuals. It takes 38 days for development from egg to adult. Mating is within the nest: no swarming has been observed. Queens are said to produce up to 400 eggs in her life time and live for several months. New colonies can form by budding off from existing colonies and can establish without a queen as long as a brood is present. There can be many queens in large nests. Workers form feeding trails and transmit pathogens. Morphological characters are: small, yellow, slender, granulate cuticle, slightly larger than *C. nuda*, petiole upright, thinnish, projecting slightly anteriorly, and ocelli small.

Isoptera (Termites)

Two collections were made but none in 2007. Both were in A. Anderson's collections made in 1996. They could not be identified as no soldiers were present in the collections. None were collected in 2007 and it was possible that the group was extinct on the island having been heavily predated by ants.

Collections
1996
North East Herald, single specimen from beach, August 1996.

1997
North East Herald, several specimens, rotten *Pisonia* wood, 18.vi.1997.

Lepidoptera (Butterflies and Moths)

These insects are recorded almost entirely from light-trap collections at night. No day-flying butterflies or moths were seen. Our collections were dominated by the massive populations of the Hawk moth, *Hippotion velox*, from the *Pisonia* and the noctuid, *Armectia columbina*, from the *Cordia*. The former is widely distributed on islands in the

Indo-Pacific where often massive, short-lived outbreaks on different host plants are frequent. In 1995, Donaldson recorded *Hippotion velox* and *A. columbina* in low numbers from the light trap at NEH while *A. columbina* was also collected at Coringa. Additionally he recorded a range of known migratory species at the light trap at NEH and Coringa, including the Varied Eggfly (*Hypolimna bolina)* and Lesser Wanderer *(Danaus chrysippus)* butterfies, a large fruit-piercing moth, possibly *Khadira aurantia*, plus a number of arctiid, noctuid, pyralid, and sphingid moth species, including several of those recorded at Willis Island (Farrow 1984) suggesting he was there after or during an immigration period from the mainland. The collection awaits complete identification.

Neuroptera (Lacewings)

The scale-feeding, migratory lacewing *Chrysopa* spp. has been recorded widely from islets in the Coral Sea. *C. ramburi* was recorded from Willis Island.

Orthoptera (Grasshopppers and Crickets)

All but one of the species recorded have been widely reported from many islets in the Coral Sea. The only puzzle is the unusual nymph recorded from a pitfall on Coringa in October 2007 which appears to be a new species of Acrididae for the Coral Sea. The adult needs to be collected for identification purposes.

Psocoptera (Booklice)

Plant lice or Pscoptera were not numerous and cannot be identified at the present time. Members of this group are largely scavengers feeding on unicellular materials.

1995

Coringa *Pisonia grandis* 20 Mar

2007

Coringa, Abutilon, pitfall Oct 97
NEH, Abutilon, yellow pan, May 07
SE Magdelaine, pitfall, grassland, Oct 07
SE Magdelaine, pitfall, *Argusia*, Oct 07
NEH *Tribulus* Sweep May 07
SWH *Sporobolus* Sweep May 07
SWH *Tribulus* Sweep May 07

Thysanoptera (Thrips)

Only one species was collected. It appears to be fairly widespread but not abundant. It cannot at present be identified because of institutional problems.

1995
NEH Abutilon, 2 Mar 95
Coringa, Ipomea, 18 Mar 95
Coringa, herbfield, 15 Mar 95
Coringa, Pisonia forest

Coringa, Pisonia forest
Coringa, Plumbago
Coringa Plumbago
Coringa, Abutilon

2007
Gravel, SWH, May 2007

Thysanura (Silverfish)

Six specimens only were found and sent for identification by Dr G. Smith. Two belong to the genus *Heterolepisma* but as they are juvenile, they cannot be identified to species and the genus needs revision. The other four are yet to be identified. There are four species known in Australia. The genus is common in Australia and on islands in the Pacific.

Collection records

1997 (A. Anderson)
NEH, hand collection from rotting timber in *Pisonia* forest, 20.vi.97

2007 P. Greenslade, R. Farrow
NEH, Tullgren funnel extraction of *Abutilon* leaf litter, 16.v.07
SWH, hand collections from gravel soak, May 2007.
SWH HC Beach Sand, May 2007
SWH HC Gravel soil in soak May 2007

Arthropoda: Myriapoda
Myriapoda were rare in collections with only three species collected.

Pauropoda (Fig. 7)

Pauropoda were extremely rare in these collections and only three individuals were found in 2007. The only collections were from Tullgren funnel extractions of *Pisonia* soil and humus. Pauropoda are a new record for the Coral Sea Islands and collected for the first time in the CSIT during this fieldwork. These animals are minute, about 1 mm long and blind, white, soft bodied and with branched antennae. They can be very numerous and diverse in soils, but little recognised (Postle and Majer 1991). There is one specialist taxonomist for the group overseas who will have time to identify these specimens in late 2008.

Collection records

2007
North East Herald, *Pisonia* humus and soil, nr transect 3, 16.v.2007, Tullgren funnel extraction.

North East Herald, *Pisonia* humus and soil, nr DEWHA cache at southern end of island, 17.v.2007, Tullgren funnel extraction.

Symphyla (Fig. 8)

Symphyla were found only by flotation of deep soil samples taken from *Pisonia* forest. Twelve individuals were found in about 10 kg of soil extracted after extremely intensive examination of the samples over several days. Symphyla are a new record for the Coral Sea Islands and collected for the first time in the CSIT during the 2007 field work. These animals are blind, white, elongate myriapods with long bead like antennae that are very fragile. In Australia they can be fairly abundant in logs, leaf litter and on tree trunks in moist forest habitats. There is one specialist taxonomist for the group overseas who will identify these specimens when he has time later in 2008. Preliminary examination has identified specimens as belonging to the family Scutigellidae, genus *Scolopendrellopsis* (Bagnall). One species of the genus was already known from Australia, which was collected in the Kimberley region of north west Western Australia. Characters of importance are the presence of terminal transverse ridges on the cerci, pointed posterior external corners to scuta, small styli, the first pair of legs about half the length of second pair , and cuticle on the head with central longitudinal division.

Collection records

2007
North East Herald, *Pisonia* forest, hand picked from deep soil flotation in water, May 2007.

Diplopoda – Penicillata –Polyxenida (Pincushion millipedes) (Fig. 9)

No other Diplopoda were collected except for a few specimens of penicillate millipedes in the order Polyxenida and family Polyxenidae. Most were immature specimens. Polyxenids are a new record for the Coral Sea Islands and collected for the first time in the Territory during this fieldwork. These animals are small, less than 5 mm long, with numerous bristles and a soft body, and are often found in leaf litter in dry environments. Dispersal is considered to be by means of wind currents. Specimens were identified to family by Dr Megan Short of Deakin University. It appears that the species is new and belongs to a family where the remainder of the species in the family live in caves. This species also is pale in colour and has reduced eyes so appears to be adapted to a troglodytic way of life. Individuals were collected by Tullgren funnel extraction of leaf litter, humus and gravel, but rarely in pitfalls.

Collection records

2007
North East Herald, *Pisonia* humus and soil nr transect 3,16.v.2007, Tullgren funnel extraction.

North East Herald, *Abutilon*, near transect 1, 15–17.v.2007, pitfall.

South West Herald, gravel pit at extreme southern tip of island, 18.v.2007, Tullgren funnel extraction.

Chilopoda – Geophilidae (Centipedes)

This group of myriapods were the most frequently collected of this Class of arthropods. Individuals are extremely elongate, white, with numerous legs and a chitinised head. Again they are relatively common and widespread in Australia. They were collected by various methods – pitfalls, Tullgren funnel extraction and deep soil flotation – indicating that they occupied a wide range of habitats in these islands. Moreover, they were collected on three of the four islands sampled so the species appeared to be very widespread. There is no specialist taxonomist of this group anywhere in the world in spite of the group being extremely widespread and diverse.

Previous records

Unidentified Geophilomorpha centipedes have been recoded from a range of Coral Sea Islands previously, including NEH but from none of the other three islands sampled in 2007. There are nine records from this group, five of which were made in 2007 from the Coringa-Herald National Nature Reserve.

Collection records

1995

NEH

pit 1, 27.viii.96

pit 2, 28.viii.96

pit 4, 30.viii.96

1997

NEH

Decaying timber in *Pisonia* forest by hand, June 1997

2007

NEH

Pisonia forest, hand picked from deep soil flotation in water, May 2007.

Pisonia forest DEWHA cache southern tip of island, soil and humus, 16.v.07, Tullgren funnel extraction.

Pisonia forest near transect 3, soil and humus, 15.v.07, Tullgren funnel extraction.

Magdelaine,

Argusia, pitfall, October 2007.

Coringa

Grassland, pitfall, October, 2007

No comment can be made on the conservation significance of these four taxa until identification to species is made because it is not known if the species is endemic to the islands or not. The different Myriapoda occupy different niches in the environment. Symphyla feed on roots, Chilpoda are predators of small arthropods and Polyxenida and Pauropoda aredetrivores feeding on microorganisms and decaying organic matter.

Annelida: Oligochaeta: Enchytraeidae (Sewage worms)

Collection records
2007 *P. Greenslade*
NEH, *Pisonia* Tullgren extraction 16 May

A number of these small worms were found in extractions of *Pisonia* humus. These animals are associated with moist, organic rich habitats and are common and abundant in these habitats in Australia. They cannot be identified further at the present time because there is no taxonomist available.

Mollusca (Slugs and snails)

Three collections of minute gastropod shells were found in pitfalls, both on NEH and SWH. They were probably marine littoral species that had blown into the traps. No collections of terrestrial molluscs were made on these islands in 2007, nor in any previous samplings.

Collection records
2007
NEH, pitfalls beach, east, 16.vi.07
NEH, pitfalls, grass, 15.vi.07
SWH, pitfalls, beach

Discussion

The main weakness of the current collection as far as completeness was concerned was the brief time frame involved for the field work, which meant that only a small snapshot of invertebrate diversity was sampled. It was not possible to take into account the different life history strategies adopted by the invertebrate fauna such as a dry season diapause or the changes due to influxes of immigrants. Although the collections from Magdelaine and Coringa were valuable in providing some information on the status of their terrestrial invertebrate fauna, sampling was very limited compared to NEH and SWH. It was carried out at a different season so that strict comparison of faunas was treated with caution.

Ecological groups

In order to understand more fully the interrelationships of the different species of arthropod present, how their numbers are possibly regulated and the dynamics of the outbreaks of the *Pulvinaria* scale, *H. velox* (Hawk moth), *Ethmia* sp. and *Armectia columbina* moths, the species collected have been classified in terms of their feeding type or ecological grouping (Table 6). Although the overall species diversity is very low, there is a relative lack of predators and parasites in terms of diversity and numbers, especially those targeting Lepidoptera, suggesting that survival of lepidopterous eggs and larvae is relatively unchecked, leading on occasions to outbreaks. The Hawk moth, *H. velox*, and possibly the *Cordia* moth, *A. columbina*, are probably opportunistic migrants colonising islands and breeding up in large numbers before dispersing to other islands. Their periodic arrival in relatively large numbers means that the effectiveness of local populations of predators and parasites are overwhelmed (the predator/parasite escape paradigm). In addition there are no insectivorous vertebrates to control the moth larvae.

The interrelationships between the scale, the biological control agents, both parasitoids and predators, the scale-tending ants, and the *Pisonia* host are complex. Abiotic factors, such as the weather, as well as nesting birds, also have an influence (Greenslade, 2008). The dominant, that is controlling, positive influence on scale at present on NEH seems to be that of the ant, *T. bicarinatum*, while the predatory ladybird beetle, *C. montrouzieri*, has a negative influence. It was outside the scope of this project to investigate other possible negative or positive influences on the dynamic aspects of this interrelationship.

The term “functional group” is specifically avoided here as it implies that the total function of each organism is known absolutely and that no other functions are operating. Such assumptions are not warranted and can lead to erroneous conclusions concerning stability and sustainability of ecosystems.

Table 6. Classification of arthropods by feeding type

Feeding Groups#	Examples
Leaf Chewers	Lepidoptera: moth larvae *circa* 10 species Orthoptera (Grasshoppers): *Austracris, Ailopus, Polichne, Conocephalus*.
Sap-Feeders	Hemiptera (Bugs): Coccidae: *Ferrisia*. (Mealybug); *Pulvinaria*. (Scale); Miridae sp (plant bugs); Cicadellidae sp.(planthoppers), Lygaeidae
Wood-borers	?Lepidoptera larvae in *Argusia* stems (not collected) Coleoptera: Curculionidae (Weevils), Bostrichidae (Powderpost beetles)
Saprophytes	Collembola one species. Diptera (fly larvae)
Detritivores, Fungivores & Scavengers	Coleoptera:Tenebrionidae:*Gonocephalum*, Dictyoptera: Blattellidae sp. (Cockroach) Orthoptera:*Teleogryllus,* (Field Cricket), *Ornebius* (Scaled cricket). Isopoda: (Woodlice). Embioptera: *Oligotoma* sp. (Webspinner), most Collembola (Springtails). Thysanura (Bristletails), some Acarina (Mites), Pauropoda, Polyxenida
Necrophores (Carrion feeders)	Coleoptera: Cleridae , Dermestidae, Histeridae, Phycosecidae Diptera larvae
Pollen & Nectar Feeders	Hymenoptera: Apoidea (Carpenter Bee), Diptera, Lepidoptera (Moths & Butterflies)
Predators Above Ground	Araneae (spiders), Hymenoptera: *Tetramorium* sp. (Ant), Pompilidae (Wasps). Coleoptera Coccinellidae (ladybirds): (1 sp. introduced), Staphylinidae. Pseudoscorpionida, some Acarina, three species of Collembola
Predators below ground	Chilopoda (Centipedes), Symphyla, some Acarina
Parasitoids	Micro-Hymenoptera *Scelio* sp., *Coccophagus* sp. (Introduced) Ichneumonoidea sp.

Resilience and sustainability

The resilience of communities and ecosystems is believed to result from high species richness, high species equitability and a high proportion of rare species. An examination of Appendix 8 suggests that the fauna of the islands sampled in 2007 comprises about 150 species of terrestrial invertebrates. Although this appears to be a fairly high number, it is low in comparison with the number of species that might be expected to occur in the same size area with the same range of habitats as on the mainland.

The equitability of the faunas of the different islands varies considerably with two to three species being markedly numerically dominant on NEH and SWH, particularly on NEH. The fauna was much more equitable on Coringa and Magdelaine without a numerically dominant species. A statistical measure of equitability could be developed to indicate a measure of community sustainability as commonly used in ecology. In pristine or relatively undisturbed areas, equitability is normally higher than in disturbed, non-pristine areas because of the presence of a few, often only one, highly numerically dominant species in the latter. This is the case currently on NEH but not on any of the other three islands considered in this report. Alternatively a measure of the slope of the abundance curve could be used. This graph is obtained by plotting each species abundance individually from highest to lowest. In pristine habitats this curve is less steep than in disturbed habitats.

Diversity

Nearly every group major group, but not species, was found on NEH and SWH. All records are new for SWH and those taxa marked * in Appendix 8 are new for NEH.

Some significant catches were made. Of biological significance was the presence of the green lacewing, *Chrysopa* sp., (Neuroptera:Chrysopidae), whose larva is a predator on sap-feeding bugs including coccid scales such as *Pulvinaria*, and the range of parasitoid micro-Hymenoptera. Of taxonomic and ecological significance were the soil living groups of Symphyla, Polyxenida and Pauropoda, all new records for the region. The search for rare species of Collembola was successful in that both *Yuukianura* and *Dicranocentrus* species were found on or near the shoreline of SWH and NEH respectively but the *Psammisotoma* was not trapped. Other records of significance, because they had not been previously recorded from the Coral Sea, were the *Phytocecis* and unidentified Brenthid beetles. The former are wingless and could not have arrived by airborne migration unlike the supposed Brenthid.

It appeared that the surface-active soil and leaf litter fauna were much less abundant in 2007 than in 1993 to 1995 when Donaldson, and in 1997 when Anderson, visited NEH. They were the last to make a comprehensive effort to make a general invertebrate survey of NEH islet although some different methods were used. In 2007 this fauna was found to be mainly restricted to beach and deep soil, gravel and *Pisonia* leaf litter and humus where the ants (*T. bicarinatum)* appeared to be absent or low in number. Donaldson only collected small numbers of ants in pitfalls compared to our samples (100 compared to several thousand) according to Gunn (1995), indicating that ants have greatly increased in abundance over the past 12 years. They prey on small arthropods as well as successfully competing for habitat and so are likely to reduce and often eliminate other fauna. *Tetramorium bicarinatum* nests predominately under stones and in timber and not in, soil so true soil fauna is relatively unaffected by its predatory activities. However, the leaf litter and ground and vegetation faunas are much impacted. In Australia, *T. bicarinatum* is not an invasive species and is a poor competitor so is much less of a problem to the native fauna (B. Heterick, pers. comm.). The lack of ant competitors rather than the lack of predators appears to be the reason that it is invasive on the Coral Sea islets.

Fewer species of Lepidoptera and possibly also Coleoptera were collected on the current trip than by S. Donaldson in March and April 1994. There could be several reasons for this difference. Donaldson was camped on NEH for a longer time than the present collectors were able to spend on the island. He was also present when an influx of migratory species occurred. The Donaldson collections were not made after an extended period of drought likely to have caused extinction or reductions in species populations, unlike the present collections. The dominant *Tetramorium* ants have changed and seem to have increased in abundance and pervasiveness since 1997, possibly in response to hotter drier weather and, as mentioned above, may have been responsible for the elimination or reduction in species populations because of their predatory habits. The effect of these ubiquitous ants on NEH on ground-nesting birds, especially nestlings, is concerning because they seem to be causing irritation possibly resulting in a slower growth rate.

One particular feature of the depauperate arthropod fauna is that the same species are found in a wide range of habitats. For example the scaly cricket *Ornebius* and the unidentified cockroach are found in the foliage of a wide range of plants, as well as bird’s nests, possibly because there are virtually no predators such as insectivorous birds or reptiles to exploit them as a food resource.

Biogeographical affinity of the fauna

Comments here are confined to the Collembola, the group for which most species identifications could be made. Many of the other groups are represented by species not yet described or not able to be fully identified due to a lack of specialist assistance.

Of the 20 species recorded, one was adventitious that entered samples during extraction and the other eight were not identified to species as they are probably undescribed. Of the remaining 11, one is probably European in origin, two are pantropical and widespread and another is known to occur in Hawaii and Australia. Three are also known from New Caledonia and Vanuatu, two from the south west Pacific, and one from north Asia. The remaining species is undescribed and belongs to a new genus with four other species, two described, all marine littoral species found in Indonesia, Papua New Guinea and the Philippines.

The phylogenetic affinities of the fauna are not associated with a single region, but equally with several regions, as might be expected for an isolated group of islands very distant from neighbouring source areas. About a quarter of the species are from south west Pacific, a quarter from south east Asia and a quarter from north Asia, with an equally large pan tropical element and one possible exotic from Europe, which also occurs in Australia. It is considered that all species are native except for possibly the latter (*Lepidocyrtus* sp.) that may have been introduced accidentally by people landing on the island as is common in agricultural and horticultural situations on the mainland.

Among the Lepidoptera, in contrast, all species are also present on the Australian mainland with some in PNG as well and several are tropical cosmopolitan species.

Conservation status of the fauna

Comments can only be made on those taxa fully identified to species, which are the Formicidae, Collembola, Embioptera and a few species in other groups. In general the epigaeic fauna, that is the more mobile above-ground invertebrates, including the ants, are of little or no conservation significance *per se* because they belong to widespread species that seem to occur on all or many islands as well as being common on mainland Australia. There are however three species that do seem to be worthy of protecting as they are not known elsewhere except in the CSIT. One is a Collembolon, nr *Dicranocentrus* n. gen. n. sp., one a pseudoscorpion, *Nannochelifera paralius* and one a polyxenid, *Lophoturus* sp. Further comments on these species and their habitats are made in the relevant taxonomic sections.

Exotic and native species, immigration/emigration and natural versus human induced change

These islets are relatively young in evolutionary terms (from 2000 to 6000 years in age), so all arthropods present were originally immigrants and would have arrived by a variety of mechanisms. These could have included transport by: birds (phoresy by mites, false scorpions etc.), humans and their associated products (e.g. woodlice on wood products, ants, Collembola and other insects on fresh food), wind systems including passive transport for scale crawlers, spiderlings, active transport comprising downwind migration by Lepidoptera (butterflies and moths, winged reproductive stages of ants) and by species in many other Orders), and ocean currents and flotsam. It seems likely that extreme weather events, such as cyclones, can transport fairly large populations of invertebrates alive (Greenslade, 1963).

It is often difficult to make a distinction between exotic and native species on these Coral Sea islets because of their extreme youth and the fact that all species present have arrived by long distance dispersal. For the purposes of this report the terms used to describe the origin of species are defined as follows. The normal definition of an introduced species is that it has arrived as a result of human intervention. A native species is defined as having arrived as a result of its own dispersal mechanisms without any human intervention. An endemic species is one that is only found in the area under investigation and it may have diverged from a previous immigrant or be endemic as a result of differential extinction from all other areas in which it previously occurred. An introduced species can be described as naturalised if it has arrived by human intervention and has been able to breed and otherwise survive in the area to which it has been introduced. The terms exotic and alien will not be used in this report because they do not distinguish unambiguously between the other terms used.

Only a small proportion of migrants can reproduce on the islets due to the lack of host plants and other environmental factors. Others may breed for a few generations before becoming extinct. Populations of some breeding species may be regularly "topped up" by immigrants. The timing of influxes of wind borne immigrants in relation to survey times will therefore have a major effect on species richness at the time of the survey. Batianoff (2007) emphasises the temporal nature of the flora of the reserve due to the balance between recruitment and extinction. It appears that the arthropod fauna turns over in the same manner depending on the time frame involved. There is some evidence for this in our data when species collected in the mid to late 1990s are compared to those not found in 2007.

The ethics of controlling or attempting eradication of an introduced species or a species that may have dispersed naturally is not clear cut. Lockwood and Latchininsky (2008) have discussed a justification for controlling a grasshopper on Nihoa Island, Hawaiian group, and justified action on a philosophical basis. This justification is based on a quantitative measure of equitability based on total species abundance, indicating an extreme change in dominance might be an adequate trigger for action.

Disturbance

Using the standard definitions above, it is likely therefore that *Pulvinaria urbicola* could be classified as native as it could have arrived naturally. It has a highly dispersible immature stage, a crawler that can travel hundreds of kilometers. Also it is known that it has been in the CSIT for over 20 years, well before any damage to *Pisonia* was obvious.

However *Tetramorium bicarinatum* could be considered introduced as it appears it was not present on NEH in 1995-7. The most likely scenario was that is was introduced by visitors to the island bringing in wooden objects and containers with food. The ant readily nests in such objects, and colonisation does not require a queen to be present - only workers and brood. Alternatively, as the ant nests in wood, a population could have arrived on floating tree trunks or branches but this would have to have been from Australia.

Both *T. bicarinatum* and *P urbicola* are considered exotic species to Australia. They have origins in Southeast Asia, but now have a near cosmopolitan distribution (all continents except Antarctica). However as the Coral Sea Islets are several magnitudes younger in age than Australia, to divide the faunas into either exotic and native based on their status in Australia is not valid.

Rather the same difficulty is encountered with regard to the terms pest and non-pest species. The official FAO definition of a "pest species" is one that damages plants. which by definition would include all herbivorous species as well as some that can indirectly damage plants through its effects on other organisms such as by feeding on mycorrhizal fungi or by enhancing the effects of herbivorous species. This definition is too broad in the present context and it is preferable to omit the term “pest” altogether to avoid ambiguity, although some use of it has been made in this report for clarity but only when qualifying a species.

Considering the above, possibly the most likely scenario was that the scale was relatively benign, at least on NEH, before *T. bicarinatum* arrived. Once it did, a population explosion of both species eventuated, impacting on the *Pisonia* forest, perhaps initiated by cyclonic damage opening the canopy. The past history on Coringa however does not fit this scenario as there is no information on the invertebrate fauna of the island pre or post elimination of *Pisonia*. Therefore the reason for the population explosion of scale on this island cannot be understood at present. The most likely current explanation is that the severe cyclone damage and water stress, particularly in winter, together with reduced numbers of nesting sea birds, put the trees under nutrient as well as water stress so facilitating attack by scale (Greenslade, 2008).

Observations on the effects of the introduced predators and parasitoids on non-target organisms.

The only interaction noted was the feeding by *Cryptolaemus montrouzieri* on the mealybug (*Ferrisia* sp.). This mealybug was found locally infesting *Argusia* buds, flowers and fruits, and *Achyranthes*, *Abutilon* and *Pisonia* stems and leaves.

Biological control agents

The interactions between prey, predator, parasites, non-target organisms and hosts are complex and have not been fully understood or described. From earlier collections, it has now been confirmed that both *Pulvinaria* scale and *Tetramorium* ants, but not *T. bicarinatum*, have been present on NEH for at least 25 years and probably much longer, together with some predators of the scale such as the green lacewing *Chrysopa* sp. and the coccid-feeding larva of the moth *Catoblemma* sp. (Donaldson,1994). The latter was not seen on the current trip although it was not thoroughly looked for on the mealybug host, *Ferrisia*.

The actual cause of the *Pulvinaria* outbreak on several islets first noted in the mid 1990s is not known but several scenarios are possible. Most likely a combination of factors operated. One hypothesis is that the outbreak was initiated by drought that reduced plant vigour and this, together with drier, warmer conditions, favoured *Tetramorium* ants and so allowed an increase in numbers of both ant and scale together. As noted earlier, the rainfall over the past 10 years in the region has been markedly lower than the average (BOM accessed 2007). Moreover, the resulting reduction in canopy could have reduced bird nesting numbers and so, concomitantly, reduced nutrient input, in particular phosphorus, to the soil and thereby facilitated further plant susceptibility to attack (Greenslade, 2008). In addition, it is known that numbers of Black Noddies have been decreasing consistently over the past 20 years on NEH, apparently due to shifting prey distribution as a result of sea surface warming (Congdon *et al.* 2007). These factors further emphasise the connectivity between terrestrial and marine ecosystems.

Cyclonic damage to *Pisonia* groves causing tree fall and breaches of the canopy creating gaps would also be favourable for *Tetramorium* to invade at the boundary as these ants are more abundant in clearing in the forest with grass and herbland cover. It is relevant that *Pisonia* retreat is continuing on NEH in spite of the presence of BCAs and that damage is first obvious at the edges of gaps (G. Batianoff, pers. comm. May 2008).

The survival of *Pisonia* forest on Magdelaine may have been connected with the fact that *Tetramorium bicarinatum* was not found there but an alternative species of *Tetramorium, T. lanuginosum,* was present. However *T. lanuginosum* is currently present on Coringa and not *T. bicarinatum,* and *Pisonia* was totally lost there in the mid to late 1990. However, heavy cyclonic damage was experienced on this latter island in the early 1990s (M. Hallam pers. comm. 2008). Further ecological research needs to address the causes of scale/ant outbreaks on NEH. Following this, protocols for monitoring ants need to be developed to indicate any threat posed to the key species, such as *Pisonia*, on Magdelaine and any increasing threat on NEH. Neville *et al*. (2005) also emphasise the need to monitor numbers of species of tramp ant species in the Cocos and Keeling Islands and the need for more stringent quarantine controls. Methods for monitoring ants could include one or more of any of the following: yellow pans, sticky traps, baiting, or pitfalls carried out in open habitats. Tests of possible methods need to be made in order to select the simplest, most rapid and most representative method.

The biological control program has been successful in that the predatory beetle, *Cryptolaemus montrouzieri*, appears to be established and seems to be exerting sufficient control on the scale to prevent serious outbreaks on the *Pisonia* trees. It has an alternative food source in the mealy bug, *Ferrisia malvestra*. It should be noted that this beetle was present on Tryon and Wilson Islands but did not prevent destruction of *Pisonia* there (J. Olds pers comm. 2008). One of the introduced hymenopterous parasitoids, *Coccophagus ceroplastae,* also seems to be established on *Pulvinaria*. Uncertainty therefore exists as to the necessity for further introductions of either the predator or parasitoid without future monitoring showing a need, especially as there may be as yet undetected, deleterious effects of such agents. For instance, further introductions of other hymenopterous parasitoids introduced to control the migrant Hawk moth *Hippotion velox*, which seems not to have established in spite of several introductions, should probably not be undertaken again. These parasitoids are not specific to Sphingidae and are likely to also parasitise the native Noctuidae.

There might be some advantages if scale numbers and spread could be reduced and other invertebrates increased by limiting numbers of the ant, but total elimination is probably impossible both practically because of the infrequent access, and environmentally because of damage to non target organisms. *Tetramorium bicarinatum* is polygynous, that is, it reproduces by budding. Therefore to eradicate this species would require the destruction of all of their nests and all brood. Moreover, there is no defensive behaviour exhibited against conspecifics, even those from different nest assemblages, which increases their invasive abilities (Astruc *et al.*, 2001). Poisoning of ants on an island in the Capricorn group seems to have resulted in a recovery, at least in part, of the invertebrate fauna in general. This was concomitant with a reduction in ant numbers, but different ant species were involved (J. Olds, pers. comm.).

During the fieldwork in May 2007, ground-nesting Tropic Birds along the shore under *Argusia* or coral rocks were observed to be infested with *T. bicarinatum* and were continually shaking their heads in attempts to rid themselves of these ants. It is not known what the ants were searching for but they were causing severe irritation to adults and chicks.

Comparison of data and results from this project with previous monitoring activities in the reserve

Information from collections made by Donaldson (1995/6) and by Anderson (1997) have been included in this report. All these collections for the most part have been curated, identified where possible, and databased, in particular the Collembola and Formicidae. The information from these collections has been incorporated in earlier relevant sections of this report and in the Appendices and has provided useful data on changes over time of the invertebrate community. As sampling methods varied between collectors, any comparison must be treated with caution.

Incorporation of other published information relevant to the project

There is very little published information on the terrestrial fauna of the CSIT apart from the paper by Farrow (1983). There are numerous unpublished reports as listed in the bibliography. All these documents have been read and relevant information used in this report in earlier sections and in the Appendices.

Conclusions

Details of outputs

1. Database of species collected in 2007 from four islets (Appendix 8).
2. All collections have been sorted into higher taxa and/or species, and labelled.
3. Species and morphospecies have been or are being identified either by specialists or by Penelope Greenslade and Roger Farrow except for two large groups (Araneae and Acarina).
4. All material has been deposited in the Australian National University museum (School of Botany and Zoology) or in another appropriate institution so that it is available for further taxonomic work if the opportunity presents itself (Appendix 7).

Outcomes

Key management recommendations from experience of implementing and evaluating the project

- There is a need to improve quarantine regimes to prevent or at least reduce the probability of future accidental introductions. Stricter quarantine controls should be imposed on visits to the islands because they are small islands, contain fragile ecosystems and are vulnerable to invasive species. Quarantine controls imposed by the Australian Antarctic Division for visitors to the Commonwealth Territory of Heard Island are also appropriate for the Coral Sea Island Territory and should be adopted. Day trips to the island from an inshore vessel are preferable than overnight camping because of quarantine concerns related to increased risk of introductions.

- Protection of gravel soak on SWH as a “Site of Special Scientific Interest”, as has been applied in the Antarctic, because of its unique and unusual fauna. This site on SWH harbours a community of invertebrates not found elsewhere on the islets visited as listed earlier in the report.

- A protocol for future monitoring of significant species, in this case *Tetramorium* ants, should be adopted. It would be aimed at detecting incipient threats to ecosystem status. Triggers could be set, based on equitability measures of the fauna collected, to initiate consideration of conducting a baiting program on NEH or manual nest and brood destruction for ants. This is because the *Tetramorium* species appears to be having a deleterious effect on ground living invertebrates and possibly also ground nesting birds as well as protecting scale. A risk assessment should be carried out on any control measures considered for ants before implementation included using the condition:pressure:response model.

- As the biological control programme is "on hold", a recommendation that the introduction of BCAs for Sphingidae moths should be subject to further scrutiny is possibly superfluous. If reintroducing BCAs is considered in the future, a risk assessment should be carried out before further introductions are instigated. Moreover a risk assessment should apply to any proposal to introduce BCAs to defoliators of *Cordia* trees for the same reason that the defoliators are regular migrants to the islets. Risk assessments are already required for BCAs from overseas being introduced to Australia

- As the *Cryptolaemus* appears established on NEH as well as several other islands, it does not seem essential that new releases need to be made. However consideration could be made to take batches of insects on visits to the island in case, after monitoring the scale, it is considered that they are needed. No environmental risks as a result of further releases could be predicted although there may be some that are as yet undetected.

- Only inert materials should remain or be left in the DEW depository on NEH. Timber and other plant material should not be introduced as it poses a quarantine risk and any timber still remaining should be removed or burnt on the leeward side of the island. Any new equipment for the store should be inspected before being taken to the island to ensure all exotic invertebrates and plant seeds are absent.

Recommendations for invertebrate work

- A greater attempt should be made to understand the underlying causes of the outbreak of scale on *Pisonia,* that is whether the insect is solely responsible for the dieback of the tree and discovering the cause of increases in abundance of ants. A comparison of the ecology of these species on more distant islands where *Pisonia* occurs could assist in understanding the phenomenon and as well as laboratory trials using microcosms.

- A further phase of the invertebrate project to include a budget item for species level identification by specialists should be initiated in 2008/9.

- A terrestrial invertebrate species database for the Nature Reserve should be prepared with public access.

- A policy for deposition of invertebrate collections from the Coral Sea Islands Territory should be developed. All collections should be deposited in institutions where they can be curated on a permanent basis.

Main lessons learnt

- Requirements surrounding the protection of genetic resources were not relevant to a purely ecological and taxonomic project such as this one and resulted in difficulties in collaboration with some key taxonomists.

- In order to obtain comparative data on invertebrates and maximise outcomes, standard collecting methods carried out by the same person at the same season on all islands under study are desirable.

- The impacts of exotic species introduced accidentally or deliberately to new ecosystems are frequently unpredictable, as found here, so that some objectives for fieldwork have to be modified after a brief assessment to be replaced by others not previously considered necessary.

- To enable good relations to persist between contracted scientists and their unpaid, honorary collaborators, contractual timelines must be adaptable and open to some modification as work proceeds. This applies to identifications from specialists on this project.

- Contractors have a much better understanding and hence can make more appropriate recommendations for adaptive management if they carry out the field work personally rather than “piggyback’ on other projects.

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Appendix 1. Details of sampling in the Herald Group, May 2007

Island	Lat Long	Date	Method	Vegetation type	Quantity	Comments
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Pitfalls	*Abutilon*	5	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Yellow pans	*Abutilon*	3	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	?	Leaf litter	*Abutilon*	?	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Pitfalls	Grassland	5	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Yellow pans	Grassland	3	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Pitfalls	*Argusia*	5	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	17.v.07 - 18.v.07	Yellow pans	*Argusia*	3	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Leaf litter	*Argusia*	1 L	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Pitfalls	*Gravel*	6	
South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Gravel sample	*Gravel*	2jars	

South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Pitfalls	Beach	6			
South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Yellow pans	Beach	3			
South West Herald	16o 59' 21.0" 149o 07' 58.9"	18.v.07	Interstitial sand	Beach	1 pit			
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Pitfalls	*Pisonia*	5	10.30 - 12.30	Nr transect 3	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Yellow pans	*Pisonia*	3	10.30 - 12.30	Nr transect 3	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07	Leaf litter	*Pisonia*	1	2:00 PM	N end of island, mainly guano covered leaf litter	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	16.vi.07	leaf litter humus	*Pisonia*	1-2 L		Nr DEWH cache, south end of island	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	May-07	Deep soil	*Pisonia*	5 kg	?	?	Leg. G. Batianoff
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Pitfalls	*Abutilon*	5	10.30 - 12.30	Nr transect 1	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Yellow pans	*Abutilon*	3	10.30 - 12.30	Nr transect 1	
North East Herald	16o 56' 36.9" 149o 11' 40.5"	16.v.07	Leaf litter	*Abutilon*				

North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Pitfalls	Grassland	5	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Yellow pans	Grassland	3	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	16.v.07	Leaf litter	Grassland			
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Pitfalls	Beach	5	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07	Yellow pans	Beach	3	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	15.v.07	Pit in sand	Beach	1	am	Nr transect 1 on east coast
North East Herald	16o 56' 36.9" 149o 11' 40.5"	16.v.07	Pitfalls	Beach	6	6 hours trapping	Nr transect 1 on west coast
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Pitfalls	*Argusia*	5	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	14.v.07 - 16.v.07	Yellow pans	*Argusia*	3	10.30 - 12.30	Nr transect 3
North East Herald	16o 56' 36.9" 149o 11' 40.5"	16.v.07	Leaf litter	*Argusia*			

Appendix 2. Details of sampling on Coringa and Magdelaine, pitfall traps October 2007

Island	Lat Long	Date	Collector	Vegetation type	Trap no.	Comments
South West Islet Coringa	16o 59' 149o 53'	7. 30.30.10.07 - 7 30.31.10.07	ns line 50m inland from shore 10m inland from grassland traps parallel to w edge of *Pisonia* forests and 10m inland from edge of forest.	*Abutilon*	1	
South West Islet Coringa	16o 59' 149o 53'	7. 30.30.10.07 - 7 30.31.10.07	ns line 50m inland from shore 10m inland from grassland traps parallel to w edge of *Pisonia* forests and 10m inland from edge of forest.	*Abutilon*	2	
South West Islet Coringa	16o 59' 149o 53'	7. 30.30.10.07 - 7 30.31.10.07	ns line50m inland from shore 10m inland from grassland traps parallel to w edge of *Pisonia* forests and 10m inland from edge of forest.	*Abutilon*	3	
South West Islet Coringa	16o 59' 149o 53'	7. 30.30.10.07 - 7 30.31.10.07	ns line 50m inland from shore 10m inland from grassland traps parallel to w edge of *Pisonia* forests and 10m inland from edge of forest.	*Abutilon*	4	
South West Islet Coringa	16o 59' 149o 53'	7. 30.30.10.07 - 7 30.31.10.07	ns line 50m inland from shore 10m inland from grassland traps parallel to w edge of *Pisonia* forests and 10m inland from edge of forest.	*Abutilon*	5	
South West Islet Coringa	16o 59' 149o 53'	7 .15 30.10.07 - 7 .15 31.10.07	ns line s ofparalleland20m inland from *Argusia* traps.	Grassland	1	
South West Islet Coringa	16o 59' 149o 53'	7 .15 30.10.07 - 7 .15 31.10.07	ns line s ofparalleland20m inland from *Argusia* traps.	Grassland	2	
South West Islet Coringa	16o 59' 149o 53'	7 .15 30.10.07 - 7 .15 31.10.07	ns line s ofparalleland20m inland from *Argusia* traps.	Grassland	3	
South West Islet Coringa	16o 59' 149o 53'	7 .15 30.10.07 - 7 .15 31.10.07	ns line s ofparalleland20m inland from *Argusia* traps.	Grassland	4	Seal lost
South West Islet Coringa	16o 59' 149o 53'	7 .15 30.10.07 - 7 .15 31.10.07	ns line s ofparalleland20m inland from *Argusia* traps.	Grassland	5	
South West Islet Coringa	16o 59' 149o 53'	7.00 30.10.07 - 7.00 31.10.07	ns line top of beach atn end of e shore	*Argusia*	1	

South West Islet Coringa	16o 59' 149o 53'	7.00 30.10.07 - 7.00 31.10.07	ns line top of beach atn end of e shore	*Argusia*	2	
South West Islet Coringa	16o 59' 149o 53'	7.00 30.10.07 - 7.00 31.10.07	ns line top of beach atn end of e shore	*Argusia*	3	
South West Islet Coringa	16o 59' 149o 53'	7.00 30.10.07 - 7.00 31.10.07	ns line top of beach atn end of e shore	*Argusia*	4	
South West Islet Coringa	16o 59' 149o 53'	7.00 30.10.07 - 7.00 31.10.07	ns line top of beach atn end of e shore	*Argusia*	5	
South East Magdelaine	16o 35' 150o 19'	7.30 25.10.07-6.45 27.10.07	ne-sw line 30 m from ne shore, 10 m from forest edge.	*Pisonia*	1	Trap 1 excavated, lying on side
South East Magdelaine	16o 35' 150o 19'	7.30 25.10.07-6.45 27.10.07	ne-sw line 30 m from ne shore, 10 m from forest edge.	*Pisonia*	2	
South East Magdelaine	16o 35' 150o 19'	7.30 25.10.07-6.45 27.10.07	ne-sw line 30 m from ne shore, 10 m from forest edge.	*Pisonia*	3	Seal lost
South East Magdelaine	16o 35' 150o 19'	7.30 25.10.07-6.45 27.10.07	ne-sw line 30 m from ne shore, 10 m from forest edge.	*Pisonia*	4	
South East Magdelaine	16o 35' 150o 19'	7.30 25.10.07-6.45 27.10.07	ne-sw line 30 m from ne shore, 10 m from forest edge.	*Pisonia*	5	
South East Magdelaine	16o 35' 150o 19'	7.15 25.10.07-6.30 27.10.07	ne-sw line 50 m inland from ne shore parallel to w edge of *Pisonia* forest and 10 m in from edge of forest	*Abutilon*	1	
South East Magdelaine	16o 35' 150o 19'	7.15 25.10.07-6.30 27.10.07	ne-sw line 50 m inland from ne shore parallel to w edge of *Pisonia* forest and 10 m in from edge of forest	*Abutilon*	2	
South East Magdelaine	16o 35' 150o 19'	7.15 25.10.07-6.30 27.10.07	ne-sw line 50 m inland from ne shore parallel to w edge of *Pisonia* forest and 10 m in from edge of forest	*Abutilon*	3	Partially dug up but remained upright, lip no longer flush to ground

South East Magdelaine	16o 35' 150o 19'	7.15 25.10.07-6.30 27.10.07	ne-sw line 50 m inland from ne shore parallel to w edge of *Pisonia* forest and 10 m in from edge of forest	*Abutilon*	4	Partially dug up but remained upright, lip no longer flush to ground
South East Magdelaine	16o 35' 150o 19'	7.15 25.10.07-6.30 27.10.07	ne-sw line 50 m inland from ne shore parallel to w edge of *Pisonia* forest and 10 m in from edge of forest	*Abutilon*	5	Partially dug up but remained upright, lip no longer flush to ground
South East Magdelaine	16o 35' 150o 19'	6.45 25.10.07-6.15 27.10.07	E W line parallel to 20m inland of *Argusia* traps	Grassland	1	
South East Magdelaine	16o 35' 150o 19'	6.45 25.10.07-6.15 27.10.07	E W line parallel to 20m inland of *Argusia* traps	Grassland	2	excavated and lying on its side on collection
South East Magdelaine	16o 35' 150o 19'	6.45 25.10.07-6.15 27.10.07	E W line parallel to 20m inland of *Argusia* traps	Grassland	3	
South East Magdelaine	16o 35' 150o 19'	6.45 25.10.07-6.15 27.10.07	E W line parallel to 20m inland of *Argusia* traps	Grassland	4	
South East Magdelaine	16o 35' 150o 19'	6.45 25.10.07-6.15 27.10.07	E W line parallel to 20m inland of *Argusia* traps	Grassland	5	
South East Magdelaine	16o 35' 150o 19'	6.30 25.10.07-6.00 27.10.07	E W line top of beach at end of north shore	*Argusia*	1	
South East Magdelaine	16o 35' 150o 19'	6.30 25.10.07-6.00 27.10.07	E W line top of beach at end of north shore	*Argusia*	2	
South East Magdelaine	16o 35' 150o 19'	6.30 25.10.07-6.00 27.10.07	E W line top of beach at end of north shore	*Argusia*	3	Seal lost, dried out
South East Magdelaine	16o 35' 150o 19'	6.30 25.10.07-6.00 27.10.07	E W line top of beach at end of north shore	*Argusia*	4	Seal lost
South East Magdelaine	16o 35' 150o 19'	6.30 25.10.07-6.00 27.10.07	E W line top of beach at end of north shore	*Argusia*	5	

Appendix 3. Fauna collected from pitfall traps from Herald group in May 2007

Island	Vegetation	Sample	Number	*Paraxenylla piloua*	*Oudemansia sp*	*Dicranocentrus sp.*	*Parisotoma sp.*	*Archisotoma sp.*	*Xenylla manusiensis*	*Folsomides exiguus*	Ascocyrtus sp. cf. kuakea	*Sphaeridia*sp.	Psocoptera	Blattodea	Orthoptera	Hemiptera	Imm scale	Diptera	Coleoptera	Lepidoptera	Hymenoptera (wasps)	Formicidae	Oribatida	Bdellidae	?Cheletidae	Eupodidae? Eyes	Nanorchestidae	Acari indet vs white	Orange Prostigmata	Mesostigmata	Pseudoscorpionida	Chilopoda	Polyxenida	Mollusca	Isopoda	Totals	
South West Herald	*Abutilon*	Pitfall	1													1						115														**116**	
South West Herald	*Abutilon*	Pitfall	2													1						24	10				1	8								**44**	
South West Herald	*Abutilon*	Pitfall	3						1						1							83	1	1				5	2	2						**96**	
South West Herald	*Abutilon*	Pitfall	4																																	**0**	Lost tube
South West Herald	*Abutilon*	Pitfall	5																																	**0**	Lost tube
TOTAL FOR VEGETATION				**0**	**0**	**0**		**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**222**	**11**	**1**		**0**	**1**	**13**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**256**	
South West Herald	Grassland	Pitfall	1												1	1	6		2		1	71						10								**92**	
South West Herald	Grassland	Pitfall	2												1	2						62						2								**67**	
South West Herald	Grassland	Pitfall	3														20		1			500						2								**523**	
South West Herald	Grassland	Pitfall	4												1	1						300													1	**303**	
South West Herald	Grassland	Pitfall	5																			310														**310**	
TOTAL FOR VEGETATION				**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**4**	**26**	**0**	**3**	**0**	**1**	**1243**	**0**	**0**		**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1295**	
South West Herald	Gravel	Pitfall	1						1													3				1										**5**	
South West Herald	Gravel	Pitfall	2																		1	7				1		1								**10**	
South West Herald	Gravel	Pitfall	3																		1	1														**2**	
South West Herald	Gravel	Pitfall	4																																	**0**	Empty pitfall
South West Herald	Gravel	Pitfall	5													1			2		1	2						1								**7**	
South West Herald	Gravel	Pitfall	6																								1	2								**3**	
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**3**	**13**	**0**	**0**		**2**	**1**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**27**	
South West Herald	*Argusia*	Pitfall	1				3								1	1						15					1									**21**	
South West Herald	*Argusia*	Pitfall	2																2			22														**24**	
South West Herald	*Argusia*	Pitfall	3												2				1			72														**75**	
South West Herald	*Argusia*	Pitfall	4													1			3			17														**21**	
South West Herald	*Argusia*	Pitfall	5												2				11			53						1								**67**	
TOTAL FOR VEGETATION				**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**2**	**0**	**0**	**17**	**0**	**0**	**179**	**0**	**0**		**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**208**	
South West Herald	Beach	Pitfall	1			1																						1								**2**	
South West Herald	Beach	Pitfall	2																			1														**1**	
South West Herald	Beach	Pitfall	3		2	4													1			1														**8**	
South West Herald	Beach	Pitfall	4		1																															**1**	
South West Herald	Beach	Pitfall	5			1		1														2						1						1		**6**	
TOTAL FOR VEGETATION				**0**	**3**	**6**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**4**	**0**	**0**		**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**18**	
TOTAL FOR ISLAND				**0**	**3**	**6**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**4**	**6**	**26**	**0**	**4**	**0**	**1**	**1469**	**11**	**1**		**0**	**1**	**29**	**2**	**2**	**0**	**0**	**0**	**1**	**1**	**1804**	
North East Herald	*Pisonia*	Pitfall	1								5	2	1		4			4	4			91		4			2	8								**125**	
North East Herald	*Pisonia*	Pitfall	2								6				3			1				34														**44**	
North East Herald	*Pisonia*	Pitfall	3								1			2	1			4	2	1		54					1	3								**69**	
North East Herald	*Pisonia*	Pitfall	4							1	10				1			6	2			103	1					5								**129**	
North East Herald	*Pisonia*	Pitfall	5						2		6			1	3			11	2		2	40					2	8								**77**	
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**0**	**2**	**1**	**28**	**2**	**1**	**3**	**12**	**0**	**0**	**26**	**10**	**1**	**2**	**322**	**1**	**4**	**0**	**0**	**5**	**24**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**444**	
North East Herald	*Abutilon*	Pitfall	1									2						1	2			125					3	2								**135**	
North East Herald	*Abutilon*	Pitfall	2															8	1			62						4		1						**76**	
North East Herald	*Abutilon*	Pitfall	3												2	4			3			79			1		3	7		1						**100**	

North East Herald	*Abutilon*	Pitfall	4													2		1				75					2	4		1						85
North East Herald	*Abutilon*	Pitfall	5											1		2		16	1			251					2	2								275
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**2**	**8**	**0**	**26**	**7**	**0**	**0**	**592**	**0**	**0**	**1**	**0**	**10**	**19**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**671**
North East Herald	Grassland	Pitfall	1								4				1	2		7	2			337					9	6	1							369
North East Herald	Grassland	Pitfall	2						3						1			11				190	2				48	31	1							287
North East Herald	Grassland	Pitfall	3						7						1	2		29	1	1		195					96	3								335
North East Herald	Grassland	Pitfall	4						3		2				5	1		6	1			670					1	7								696
North East Herald	Grassland	Pitfall	5												1			27	1			440														469
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**0**	**13**	**0**	**6**	**0**	**0**	**0**	**9**	**5**	**0**	**80**	**5**	**1**	**0**	**1832**	**2**	**0**	**0**	**0**	**154**	**47**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2156**
North East Herald	Argusia	Pitfall	1						7		1						11	9	3			105														136
North East Herald	Argusia	Pitfall	2	1											1			5				189	1				2	15								213
North East Herald	Argusia	Pitfall	3	1							1							19	2	1		227					44	33	1				1			329
North East Herald	Argusia	Pitfall	4						457						1	1		11	22		1	516					3	1		4						1017
North East Herald	Argusia	Pitfall	5						50							1		12				260					3		7							333
TOTAL FOR VEGETATION				**2**	**0**	**0**	**0**	**0**	**514**	**0**	**2**	**0**	**0**	**0**	**2**	**2**	**11**	**56**	**27**	**1**	**1**	**1297**	**1**	**0**	**0**	**0**	**52**	**49**	**8**	**4**	**0**	**0**	**1**	**0**	**0**	**2028**
North East Herald	Beach west	Pitfall	1			1		71								1											1									74
North East Herald	Beach west	Pitfall	2					46								1						4						1								52
North East Herald	Beach west	Pitfall	3			5		43								3								3												54
North East Herald	Beach west	Pitfall	4					78										1				1						1								81
North East Herald	Beach west	Pitfall	5					49										2				4			1				2	1						59
TOTAL FOR HABITAT					**0**	**6**	**0**	**287**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**3**	**0**	**0**	**0**	**9**	**0**	**3**	**1**	**0**	**1**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**320**
North East Herald	Beach east	Pitfall	1		3			1								1			1			5			1											12
North East Herald	Beach east	Pitfall	2		12			3														5														20
North East Herald	Beach east	Pitfall	3		29			1														9														39
North East Herald	Beach east	Pitfall	4		3																	2														5
North East Herald	Beach east	Pitfall	5		1													1				10														12
North East Herald	Beach east	Pitfall	6													1		3	3			12			1			3								23
TOTAL FOR HABITAT				**0**	**48**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**4**	**4**	**0**	**0**	**43**	**0**	**0**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**111**
TOTAL FOR ISLAND				2	48	6	0	292	529	1	36	4	1	4	25	22	11	195	53	3	3	4095	4	7	4	0	222	144	12	8	0	0	1	0	0	5730
TOTAL FOR ALL TRAPS				**2**	**51**	**12**	**3**	**293**	**530**	**1**	**36**	**4**	**1**	**4**	**29**	**28**	**37**	**195**	**57**	**3**	**4**	**5564**	**15**	**8**	**4**	**0**	**223**	**173**	**14**	**10**	**0**	**0**	**1**	**1**	**1**	**7534**

Appendix 4. Fauna collected in yellow pans and Tullgren funnel extractions on Herald group, May 2007

Island	Vegetation	Sample	*Acherontiella prominentia*	*Paraxenylla piloua*	*Oudemansia sp*	*Friesea sp. cf pins*	*Yuukianura sp.*	*Isotoma sp.*	*Folsomina onychiurina*	*Archisotoma sp.*	*Xenylla manusiensis*	*Folsomides exiguus*	*Pseuedosinella sp.*	*Ascocyrtus kuakea*	*Lepidocyrtus sp. blue*	*Megalothorax sp*	*Sphaeridiasp.*	*Bourletiella viridesens.*	Thysanura	Psociptera	Blattodea	Orthoptera	Hemiptera	Imm scale	Thysanoptera	Diptera larvae	Diptera	Coleoptera	Lepidoptera	Hymenoptera (wasps)	Formicidae	Oribatida	Bedellidae	?Cheletidae	Eupodidae? Eyes	Nanorchestidae	Acari indet	Orange Prostigmata	Mesostigmata	Araneae	Pseudoscorpionida	Chilopoda	Symphyla	Pauropoda	Polyxenida	Mollusca	Enchytraedae	Isopoda	Totals	
South West Herald	*Abutilon*	Yellow pans																			3	14	49				5				52						12			1									136	
South West Herald	*Abutilon*	Leaf Litter	1																													2																	2	
TOTAL FOR VEGETATION			**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**14**	**49**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**52**	**2**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**138**	
South West Herald	Grassland	Yellow pans	1																				2	250			3			3	25						30												313	
TOTAL FOR VEGETATION			**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**250**	**0**	**0**	**3**	**0**	**0**	**3**	**25**	**0**	**0**	**0**	**0**	**0**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**313**	
South West Herald	Gravel	funnel extraction	18	8		8	1	14	2		37			1	1	1									4	2		1				400	30					2	300	1	5				11			43	864	
TOTAL FOR VEGETATION			**18**	**8**	**0**	**8**	**1**	**14**	**2**	**0**	**37**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**2**	**0**	**1**	**0**	**0**	**0**	**400**	**30**		**0**	**0**	**0**	**2**	**300**	**1**	**5**	**0**	**0**	**0**	**11**	**0**	**0**	**43**	**864**	
South West Herald	*Argusia*	Yellow pans																				12	22				57		1	45	27						7			1						1			173	No *Argusia* leaf litter was collected from SWH
TOTAL FOR VEGETATION			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**22**	**0**	**0**	**0**	**57**	**0**	**1**	**45**	**27**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**173**	
South West Herald	Beach	Interstitial Sand			79																		2																										81	
South West Herald	Beach	Yellow pans																					3				6				6																		15	
TOTAL FOR HABITAT			**0**	**0**	**79**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**96**	
TOTAL FOR ISLAND			**20**	**8**	**79**	**8**	**1**	**14**	**2**	**0**	**37**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**14**	**56**	**250**	**0**	**0**	**14**	**0**	**0**	**3**	**83**	**2**	**0**	**0**	**0**	**0**	**42**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1584**	
North East Herald	*Pisonia*	Flotation deep soil	16															2							3		1		1								2					5	10						24	
North East Herald	*Pisonia*	Yellow pans																			1	9	6				80	2	2	11	173									1									285	
North East Herald	*Pisonia*	Transect 3	31	8					2			1		2			1								1	6						500					40				1	2		1	1		37	32	627	
North East Herald	*Pisonia*	DEWHA cache	100	2					11				1	6											1			13				200	5	1	10		13		5	1				3			30	16	316	
TOTAL FOR VEGETATION			**147**	**10**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**1**	**1**	**8**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**9**	**6**	**0**	**5**	**6**	**81**	**15**	**3**	**11**	**173**	**700**	**5**	**1**	**10**	**0**	**55**	**0**	**5**	**2**	**1**	**7**	**10**	**4**	**1**	**0**	**67**	**48**	**1252**	
North East Herald	*Abutilon*	yellow pans												1						1	1	2	37			37	37	2		2	168	1																	289	
North East Herald	*Abutilon*	Leaf litter																	1	1			1		6	1		1			4						20											1	36	
TOTAL FOR VEGETATION			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**2**	**1**	**2**	**38**	**0**	**6**	**38**	**37**	**3**	**0**	**2**	**172**	**1**	**0**	**0**	**0**	**0**	**20**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**325**	
North East Herald	Grassland	Yellow pans																			18	7			1		287	4	7	5																			329	
TOTAL FOR VEGETATION			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**7**	**0**	**0**	**1**	**0**	**287**	**4**	**7**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**329**	
North East Herald	Argusia	Yellow pans												1									43	200		7	96		2	23	249									1									622	
North East Herald	Argusia	Leaf litter																		1			1	36	3			1		1	1	9								1									54	
North East Herald	Argusia	Leaf litter guano site																							1	2	2	25	1			4							9										44	
TOTAL FOR VEGETATION			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**44**	**236**	**4**	**9**	**98**	**26**	**3**	**24**	**250**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**720**	
North East Herald	Beach west	Interstitial sand			13																																												13	
North East Herald	Beach west	Yellow pans																				1	2	4			11				3																		21	
TOTAL FOR HABITAT			**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**4**	**0**	**0**	**11**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**34**	
North East Herald	Beach east																																																**0**	
TOTAL FOR HABITAT			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
TOTAL FOR ISLAND			147	10	13	0	0	0	13	0	0	1	0	10	0	1	1	2	1	3	20	19	90	240	16	53	514	48	13	42	598	714	5	1	10	0	75	0	14	4	1	7	10	4	1	0	67	49	2660	
TOTAL FOR BOTH ISLANDS			**167**	**18**	**92**	**8**	**1**	**14**	**15**	**0**	**37**	**1**	**1**	**11**	**1**	**1**	**1**	**2**	**1**	**3**	**23**	**33**	**146**	**490**	**16**	**53**	**528**	**48**	**13**	**45**	**681**	**716**	**5**	**1**	**10**	**0**	**117**	**0**	**14**	**5**	**1**	**7**	**10**	**4**	**1**	**0**	**67**	**49**	**4244**	

Appendix 5. Fauna collected by pitfalls on Coringa and Magdelaine, October 2007

Island	Vegetation	Sample	Number	*Xenylla manusiensis*	*Seira* sp.	Psocoptera	Dermaptera	Orthoptera	Hemiptera	Coleoptera	Lepidoptera larvae	Hymenoptera (wasps)	Formicidae	Acari (star shaped)	Acari: Prostigmata Tydeidae?	Acari: Prostigmata Bdellidae?	Nanorchestidae	Acari indet vs white	Large trombid mite	Araneae	Pseudoscorpionida	Chilopoda	Crustacea (crab)	Isopoda	Totals
Coringa	*Abutilon*	Pitfall	1								1		3	3	2	2									**11**
Coringa	*Abutilon*	Pitfall	2			1			1				9					18		2					**31**
Coringa	*Abutilon*	Pitfall	3							1			3			1		4			1				**10**
Coringa	*Abutilon*	Pitfall	4			1			1	2			7	5											**16**
Coringa	*Abutilon*	Pitfall	5							1			1	1											**3**
TOTAL FOR VEGETATION				**0**	**0**	**2**	**0**	**0**	**2**	**4**	**1**	**0**	**23**	**9**	**2**	**3**	**0**	**22**	**0**	**2**	**1**	**0**	**0**	**0**	**71**
Coringa	Grassland	Pitfall	1									1	1					5		1					**8**
Coringa	Grassland	Pitfall	2										1					24		1					**26**
Coringa	Grassland	Pitfall	3					1					3			1		6							**11**
Coringa	Grassland	Pitfall	4										2					30				1			**33**
Coringa	Grassland	Pitfall	5						1				4			2		2		1					**10**
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**11**	**0**	**0**	**3**	**0**	**67**	**0**	**3**	**0**	**1**	**0**	**0**	**88**
Coringa	*Argusia*	Pitfall	1									1	11					21					1		**34**
Coringa	*Argusia*	Pitfall	2							2			6					18							**26**
Coringa	*Argusia*	Pitfall	3						2				10					27							**39**
Coringa	*Argusia*	Pitfall	4						1				8			1		2		1					**13**
Coringa	*Argusia*	Pitfall	5										27					6							**33**
TOTAL FOR VEGETATION				**0**	**0**	**0**	**0**	**0**	**3**	**2**	**0**	**1**	**62**	**0**	**0**	**1**	**0**	**74**	**0**	**1**	**0**	**0**	**1**	**0**	**145**
TOTAL FOR ISLAND				**0**	**0**	**2**	**0**	**1**	**6**	**6**	**1**	**2**	**96**	**9**	**2**	**7**	**0**	**163**	**0**	**6**	**1**	**1**	**1**	**0**	**304**

Magdelaine	*Pisonia*	Pitfall	1		18											1		1	2	1					**23**
Magdelaine	*Pisonia*	Pitfall	2		33													2							**35**
Magdelaine	*Pisonia*	Pitfall	3		281		1									1		1	3						**287**
Magdelaine	*Pisonia*	Pitfall	4		102													13	1						**116**
Magdelaine	*Pisonia*	Pitfall	5		53		4													1					**58**
TOTAL FOR VEGETATION				**0**	**487**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**17**	**6**	**2**	**0**	**0**	**0**	**0**	**519**
Magdelaine	*Abutilon*	Pitfall	1										3					1	3					1	**8**
Magdelaine	*Abutilon*	Pitfall	2										2			2		3	1		1				**9**
Magdelaine	*Abutilon*	Pitfall	3		2								3								1				**6**
Magdelaine	*Abutilon*	Pitfall	4		1							1	4					30	1						**37**
Magdelaine	*Abutilon*	Pitfall	5		5								12					8	5						**30**
TOTAL FOR VEGETATION				**0**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**24**	**0**	**0**	**2**	**0**	**42**	**10**	**0**	**2**	**0**	**0**	**1**	**90**
Magdelaine	Grassland	Pitfall	1										8					10	1						**19**
Magdelaine	Grassland	Pitfall	2										64												**64**
Magdelaine	Grassland	Pitfall	3	47									19				2	1			1				**70**
Magdelaine	Grassland	Pitfall	4	71									7						1						**79**
Magdelaine	Grassland	Pitfall	5	110	2				1	1			12					1	3		2				**132**
TOTAL FOR VEGETATION				**228**	**2**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**110**	**0**	**0**	**0**	**2**	**12**	**5**	**0**	**3**	**0**	**0**	**0**	**364**
Magdelaine	Argusia	Pitfall	1	220		1			3	1			3					54		1					**283**
Magdelaine	Argusia	Pitfall	2	200		1			1	2			4					300	1			1			**510**
Magdelaine	Argusia	Pitfall	3									1	2					114							**117**
Magdelaine	Argusia	Pitfall	4	2					3	1			4					80							**90**
Magdelaine	Argusia	Pitfall	5			6			3	1			1					79	1						**91**
TOTAL FOR VEGETATION				**422**	**0**	**8**	**0**	**0**	**10**	**5**	**0**	**1**	**14**	**0**	**0**	**0**	**0**	**627**	**2**	**1**	**0**	**1**	**0**	**0**	**1091**
TOTAL FOR ISLAND				650	497	8	5	0	11	6	0	2	148	0	0	4	2	698	23	3	5	1	0	1	**2064**
TOTAL FOR ALL TRAPS				**650**	**497**	**10**	**5**	**1**	**17**	**12**	**1**	**4**	**244**	**9**	**2**	**11**	**2**	**861**	**23**	**9**	**6**	**2**	**1**	**1**	**2368**

Appendix 6 List of species in collections from sweeps, beats and hand collections on NEH and SWH in 2007.

Tube	Islet	Date	Method	Location	Habitat	TOTAL SPECIES 64	COLEOPTERA 13	Lathridiidae Sp 1	Bostrichidae Sp 1	Coccinellidae Sp 3 ?Scymnus	Coccinellidae Sp 4 Cryptolaemus	Curculionidae sp 1	?Brentidae Sp 1	Tenebrionidae Gonocephalum torridum	Cleridae Sp 1	Staphylinid Sp 1	?Cucujoid Sp 1	Anthicidae Sp 1	Histeridae Sp 1	Histeridae Sp 2	Phycosecidae Phycocecis Sp	HEMIPTERA 16	Cicadellidae Sp 1 Med mottled	Cicadellidae Sp 2 green/yellow	Cicadellidae Sp 3 Idotted head	Cicadellidae Sp 4 Pointed frons	Cicadellidae Sp 5 Green hairy wings	Cicadellidae sp 6 long frons	Cicadellidae sp 7 large line on forns	Miridae Sp 1 small pale	Miridae Sp 2 Large pale	Lygaeidae Geocorine sp 1	Lygaeidae Geocorine sp 2	Delphacid sp 1 pale round	Delphacid sp 2 slender	Delphacid sp 3 black	Reduviidae Emesinae Sp 1	Coccidae Sp 1	ORTHOPTERA 7	Gryllidae Teleogryllus oceanicus	Gryllidae Ornebius sp	Gryllidae Trigonidium	Acrididae Ailopus thalassinus	Acrididae Valanga/Austracris	P
1	NEH	15.5.08	SW	S	Lepidium	3																																			1			
2	"	"	"	S	Sporobolus	8																										1										1	1		
3	"	"	"	S	Abutilon	4																			1					1											1				
6	"	"	"	CW	Abutilon	6					1																														1				
7	"	"	"	N	Sporobolus	10			1															1						1	1			1							1	1			
8	"	"	"	SW	Lepidium	4																	1							1															
9	"	"	"	CW	Tribulus	9				1														1						1		1										1			
10	"	"	"	CW	Sporobolus	9																	1	1			1																		
14	"	"	"	SW	Abutilon	5																								1													1		
15	"	"	"	CW	Tribulus	13				1													1	1						1	1	1	1								1	1			
17	"	"	"	CW	Argusia	9					1	1																													1				
18	"	"	"	CW	Tribulus	4																		1																		1			
20	"	"	"	CW	Achyranthes	9																		1						1	1										1			1	
21	"	"	"	NW	Sporobolus	6																		1																					
22	"	"	"	SE	Tribulus	17		1															1	1						1	1	1									1	1			
28	"	16.5.08	"	SW	Achyranthes	9																		1		1				1	1										1	1			
29	"	"	"	SW	Achyranthes	15																	1	1		1				1	1										1	1			
4	"	15.5.08	HC	CW	Plants	1																																			1				
5	"		"	CW	Litter	1								1																															
11	"		"	CW	Plants	1																																			1				
12	"		"	S	Timber Stack	3						1		1																							1								
13	"		"	CW	Turtle Carcas	2									1																									1					
19	"		"	CW	Achyranthes	1																																1							
23	"		"	CW	Litter	2								1																											1				
25	"		"	E	Cordia	1																																							
26	"		"	CW	Turtle Carcas	1									1																														
27	"		"	CW	Ground	1																																							
30	"		"	S	Timber Stack	1																																		1					
31	"		"	S	Log	1																																							
12a	"	16.5.08	"	SE	Lumber	2								1																										1					
17a	"		"	E	Argusia Litter	1													1																										
31a	"		"	C	Pisonia branch	2						1		1																															
31b	"		"	C	Noddy Nest	1																																		1					
51	"		Tulgren	se	Argusia Litter	1														1																									
52	"		Tulgren	SE	Argusia Litter	1							1																																
32	SWH	18	SW	SE	Tribulus/Boerh	9																	1	1						1												1			
33				SW	Sporobolus	6																								1				1	1										
34				SW	Spor/Trib/Boerh	11																	1	1				1		1													1		
35				SW	Abutilon	6																								1	1														
36				SW	Trib/Sporob	12																	1	1						1	1			1	1							1			
38				NW	Lepidium	9																	1	1					1	1	1														
39				SE	Sporobolus	5																								1				1											
40				NE	Sporobolus	8																	1	1						1	1					1					1				

41				NE	Sporobulus	**4**																		1				1	
42				E	Rock Pools	**2**																							
37		18	HC	SE	Sand	**1**																							
43				S	Turtle Nest	**6**		1							1	1													
44				S	Soak	**1**																							
45				S	Soak	**1**											1												
46		19		S	Turtle Nest	**1**																							
47				S	Soak	**1**																							
48				S	Soak	**3**																							
49				SE	Sand	**1**																							
50				SE	Branch	**1**																						1	
26a				E	Tern Carcass	**2**														1								1	
50				SW	Soak Gravel	**2**																							

						DIPTERA SP		**LEPIDOPTERA**			**HYMENOPTERA**	**parisitoids**							**non parasitoids**		**THYSANURA**	**ARANEAE SP**	**ISOPODA**
Tube	Islet	Date	Method	Location	Habitat	**5**	Larvae	Ethmia	Narrow winged	UNK larva	**9**	Scelio sp 1	Scelionidae Sp 2	Parasitoid Sp 1	Parasitoid Sp2 GreenHairyAnt	Parasitoid Sp 3	Parasitoid Sp 4 Med Yellow Abd	Parasitoid Sp 5 Small	Pompildase Black	Apoidea	1	**5**	**1**
1	NEH	15.5.08	SW	S	Lepidium	2																	
2	"	"	"	S	Sporobulus	3																	
3	"	"	"	S	Abutilon																		
6	"	"	"	CW	Abutilon	1																2	
7	"	"	"	N	Sporobolus								1										
8	"	"	"	SW	Lepidium	2																	
9	"	"	"	CW	Tribulus	1																2	
10	"	"	"	CW	Sporobolus	4						1							1				
14	"	"	"	SW	Abutilon																	2	
15	"	"	"	CW	Tribulus																	2	
17	"	"	"	CW	Argusia									1								3	
18	"	"	"	CW	Tribulus	1																	
20	"	"	"	CW	Achyranthes	1		1															
21	"	"	"	NW	Sporobolus	3																	
22	"	"	"	SE	Tribulus	3																3	
28	"	16.5.08	"	SW	Achyranthes										1								
29	"	"	"	SW	Achyranthes	1										1						3	
4	"	15.5.08	HC	CW	Plants																		
5	"		"	CW	Litter																		
11	"		"	CW	Plants																		
12	"		"	S	Timber Stack																		
13	"		"	CW	Turtle Carcas																		
19	"		"	CW	Achyranthes																		
23	"		"	CW	Litter																		
25	"		"	E	Cordia			1															
26	"		"	CW	Turtle Carcas																		
27	"		"	CW	Ground					1													
30	"		"	S	Timber Stack																		
31	"		"	S	Log																		1
12a	"	16.5.08	"	SE	Lumber																		

17a	"		"	E	Argusia Litter																			
31a	"		"	C	Pisonia branch																			
31b	"		"	C	Noddy Nest																			
51	"		Tulgren	se	Argusia Litter																			
52	"		Tulgren	SE	Argusia Litter																			
32	SWH	18	SW	SE	Tribulus/Boerh	1			1								1	1						
33				SW	Sporobulus			1														2		
34				SW	Spor/Trib/Boerh			1									1			1		2		
35				SW	Abutilon	1																2		
36				SW	Trib/Sporob	1		1																
38				NW	Lepidium	1																2		
39				SE	Sporobolus										1							1		
40				NE	Sporobolus								1											
41				NE	Sporobulus	1																		
42				E	Rock Pools	1																1		
37		18	HC	SE	Sand							1												
43				S	Turtle Nest																1	1		1
44				S	Soak																	1		
45				S	Soak																			
46		19		S	Turtle Nest		1																	
47				S	Soak																1			
48				S	Soak																1	1		
49				SE	Sand																1			
50				SE	Branch																			
26a				E	Tern Carcass																			
50				SW	Soak Gravel																	1		

Appendix 7. Allocation of taxa from Coral Sea collections as at April 2008

Taxa	Total no. of tubes (	Taxonomist	Comments	
Acarina			Cannot be further determined	Payment required for identifications
Araneae			Cannot be further determined	CSIRO have refused to sing Stat. Dec. or work on specimens from DEWHA. Payment required for identifications from an alternative specialist.
Blattodea	9	J. Walker, NAQS, Cairns	Contacted 14 April 08	To be delivered to taxonomist in June.
Chilopoda			Cannot be further determined	No taxonomist available even overseas
Coleoptera	106	R. Farrow (in part)	In progress	Complete species identification requires payment
Collembola	25	P. Greenslade	Completed	Paper in preparation
Dermaptera	4	G. Cassis, UNSW	Contacted 14 Apr 08 Agreed 15 Apr 08	Specimens sent in April
Diptera	?	D. Bickel, AM	Contacted 14 Apr 08 Agreed 15 Apr 08	Specimens sent in April
Formicidae	26	P. Greenslade, R. Taylor, B. Hetterick Curtin Univ.	Completed	
Hemiptera	Ca 100	R. Farrow (in part)	Completed	Detailed identifications from CSIRO not possible as they have refused to sing Stat. Dec. or work on specimens from DEWHA. Other specialists could be contacted.
Hymenoptera	About 70	R. Farrow (in part)	In progress	CSIRO have refused to sing Stat. Dec. or work on specimens from DEWHA
Isopoda	15	B. Wilson, AM	To be sent	Sent in April
Isoptera	2	–	Cannot be further determined	No soldiers present in old collections. May now be extinct on the island
Lepidoptera	18	R. Farrow (macrolepidoptera only)	In progress	CSIRO have refused to sing Stat. Dec. so identification of many species of microlepidoptera not possible
Neuroptera	2	R. Farrow	Completed	
Orthoptera	36	R. Farrow	Completed	
Pauropoda	3	P. Greenslade		Can be determined later in the year
Polyxenida	3	M Short, Deakin Univ.	Completed	
Pseudoscorpionida	8	M. Harvey, WAM	Completed	Specimens sent in April 2008
Psocoptera	5	C. Smithers, AM	Contacted 14 Apr 08	New regulations concerning the protection of genetic material have deterred taxonomic assistance

Symphyla	1	P. Greenslade		To be determined further later in the year.
Thysanoptera	9	L. Mound, CSIRO	Contacted 14 Apr 08	New regulations concerning the protection of genetic material have deterred taxonomic assistance
Thysanura	1	G. Smith, Sydney	Completed	

Appendix 8. Taxa collected in 2007 by all methods from Coringa Herald group with some comments on earlier collections

	Class	Order	Family	Genus	Species	Common Name	Authority	Comments	NEH	SWH	Coringa	Magdelaine	Habitat and habits	Notes
Annelida	Enchytraeidae													
Arthropoda	Arachnida	Acarina	Acaridae	unidentified	one sp.?	mite			X				scavenger in leaf litter	
Arthropoda	Arachnida	Acarina: Mesostigmata	Uropodidae	unidentified	one sp.?	mite			X				detritivore in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Mesostigmata	other	unidentified	one sp.?				X	X			predator in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Oribatida	Not identified		About 10 spp.	mite			X	X			detritivore in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Prostigmata	Bdellidae	unidentified	one sp.?	mite			X	X	X	X	predator in leaf litter, soil and humus	
		Acarina: Prostigmata	Rhaphignathidae	unidentified					X				predator in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Prostigmata	Cheyletidae	unidentified	one sp.?	mite			X				predator in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Prostigmata	Eupodidae	unidentified	one sp.?	mite			X		X		predator in leaf litter, soil and humus	
		Acarina: Prostigmata	Trombiididae	unidentified						X		X	predator in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Prostigmata	Nannorchestidae	unidentified	one sp.?	mite			X	X		X	feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Arachnida	Acarina: Prostigmata	unidentified		About 10 spp.	mite			X	X	X	X	predator in leaf litter	
Arthropoda	Arachnida	Araneae	Araneidae	gen.	sp.	spider		All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Araneae	Clubionidae	*Cheiracanthium*	sp.	spider		All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Araneae	Lycosidae	gen.	sp.	spider		All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Araneae	Oonopidae	cf. *Gamasomorpha*	sp.	spider		All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Araneae	Salticidae	*Plexippus*	*paykullii*	spider	(Audouin)	All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Araneae	Syctodidae	*Syctodes*	sp.	spider		All from 1997 collections on NEH	X				predator in leaf litter	Only from the 1997 collections so far
Arthropoda	Arachnida	Pseudoscorpionida	Atemnidae	*Oratemnus*	sp.	spider			X		X	X	predator in leaf litter and soil	
Arthropoda	Arachnida	Pseudoscorpionida	Cheliferiidae	*Nannochelifer*	*paralius*	spider	Harvey			X			predator in leaf litter and soil	
Arthropoda	Arachnida	Pseudoscorpionida	Cheiridiidae	*indet gen*	sp.	spider			X				predator in leaf litter and soil	
Arthropoda	Collembola	Arthropleona	Entomobryidae	*Ascocyrtus*	kukua	springtail	Christiansen and Bellinger	white	X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Entomobryidae	*Dicranocentrus*	sp. nov.	springtail			X	X			feeding on microorganisms in marine littoral habitats	
Arthropoda	Collembola	Arthropleona	Entomobryidae	*Lepidocyrtus*	sp. cf.*cyaneus* grp.	springtail		blue		X			feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Entomobryidae	*Pseudosinella*	sp.	springtail		1 + 1 ocellus, white	X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Entomobryidae	*Seira*	sp.	springtail						X	feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Hypogastruridae	*Acherontiella*	sp. cf. *prominentia*	springtail	Thibaud and Weiner, 1997		X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Hypogastruridae	*Paraxenylla*	*piloua*	springtail	Thibaud and Weiner, 1997	Previously recorded as *P. affiniformis* (Stach, 1929)	X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Hypogastruridae	*Xenylla*	*manusiensis*	springtail	da Gama, 1967		X	X	X	X	feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Isotomidae	*Archisotoma*	sp.	springtail			X	X			feeding on microorganisms in marine littoral habitats	
Arthropoda	Collembola	Arthropleona	Isotomidae	*Folsomides*	*exiguus*	springtail	Folsom		X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Isotomidae	*Folsomina*	*onychiurina*	springtail	Denis		X	X			feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Isotomidae	*Isotoma*	sp.	springtail				X			feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Arthropleona	Neanuridae	*Friesea*	sp.	springtail				X			feeding on rotifers in marine littoral and other habitats	
Arthropoda	Collembola	Arthropleona	Neanuridae	*Friesea*	sp. cf. *pins*	springtail	Arthropoda			X			feeding on rotifers in marine littoral and other habitats	
Arthropoda	Collembola	Arthropleona	Neanuridae	*Oudemansia*	schoetti	springtail	Denis		X	X			saphophytic in marine littoral habitats	
Arthropoda	Collembola	Arthropleona	Neanuridae	*Yuukianura*	sp. cf. *halophila*	springtail	Yosii			X			external digester in marine littoral and saline habitats	
Arthropoda	Collembola	Neelipleona	Neelidae	*Megalothorax*	sp.	springtail				X			feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Collembola	Symphypleona	Bourletiellidae	*Bourletiella*	*viridescens*	springtail		stray					feeds on live plant material	Stray specimens
Arthropoda	Collembola	Symphypleona	Sminthurididae	*Sphaeridia*	sp.	springtail			X				feeding on microorganisms in leaf litter, soil and humus	
Arthropoda	Crustacea	Decapoda	Coenobitidae	*Coenobita*	*perlatus*	hermit crab		Not confirmed	X				feeding on dead organic matter in marine littoral habitats	
Arthropoda	Crustacea	Isopoda	Coenobitidae		sp. 1	hermit crab			X	X	X	X	feeding on dead organic matter in marine littoral habitats	
Arthropoda	Crustacea	Isopoda	Coenobitidae		sp. 2	hermit crab				X			feeding on dead organic matter in marine littoral habitats	
Arthropoda	Crustacea	Isopoda	Coenobitidae		sp. 3	hermit crab				X			feeding on dead organic matter in marine littoral habitats	
Arthropoda	Insecta	Coleoptera	?Cucujoidea		Sp 1	beetle			X	X			?Fungivore	
Arthropoda	Insecta	Coleoptera	Anthicidae		Sp 1	beetle				X			Fungivore in litter	
Arthropoda	Insecta	Coleoptera	Bostrichidae		Sp 1	beetle			X				Adults and larvae are borers in dead wood	
Arthropoda	Insecta	Coleoptera	Cleridae		Sp 1	beetle			X				Adults and larvae feed in cadavers	
Arthropoda	Insecta	Coleoptera	Coccinellidae	?*Scymnus*	sp 3	Ladybird			X				Adults and larvae are predators of scales	
Arthropoda	Insecta	Coleoptera	Coccinellidae	*Cryptolaemus*		Ladybird			X				Adults and larvae are predators of scales	
Arthropoda	Insecta	Coleoptera	Curculionidae	Unidentified	sp 1	Weevil			X				Adults and larvae are borers in dead wood	

Arthropoda	Insecta	Coleoptera	Dermestidae	*Dermestes*	*ater*	Carcass Beetle	X	X			Adults and larvae feed in cadavers	
Arthropoda	Insecta	Coleoptera	Histeridae	Unidentified	Sp 1	beetle	X				Adults and larvae are predators of larvae in cadavers	
Arthropoda	Insecta	Coleoptera	Histeridae	Unidentified	Sp 2	beetle	X				Adults and larvae are predators of larvae in cadavers	
Arthropoda	Insecta	Coleoptera	Lathridiidae	Unidentified	Sp 1	beetle		X			Fungivore in litter and on plants	
Arthropoda	Insecta	Coleoptera	Phycosecidae	*Phycocecis*	sp	Carcass Beetle		X	X		Adults and larvae feed in cadavers	
Arthropoda	Insecta	Coleoptera	Staphylinidae	Sp 1		Rove Beetle		X			Adults and larvae are predators in litter	
Arthropoda	Insecta	Coleoptera	Tenebrionidae	*Gonocephalum*	*torridum*	Darkling Beetle	X	X	X	X	Adults and larvae feed on decomposing wood and plant material	
Arthropoda	Insecta	Dermaptera	indet.	Unidentified	Sp 1	Earwig			X		Adults and nymphs are omnivores in litter	
Arthropoda	Insecta	Dictyoptera	indet.	Unidentified	Sp 1	Cockroach	X	X	X	X	Adults and nymphs are omnivores in plants canopy	
Arthropoda	Insecta	Diptera	indet larva	Unidentified	Sp 1	Maggot					?Predator in soil	
Arthropoda	Insecta	Embioptera	Oligotomidae	*Oligotoma*	*saundersii*	Web-Spinner		X			Adults and larvae feed on decomposing wood and plant material	
Arthropoda	Insecta	Hemiptera	Cicadellidae	Med mottled	Sp 1	Plant-Hopper	X	X	X		Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	green/yellow	Sp 2	Plant-Hopper	X	X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	dotted head	Sp 3	Plant-Hopper	X				Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	Pointed frons	Sp 4	Plant-Hopper	X				Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	Green hairy wings	Sp 5	Plant-Hopper	X				Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	long frons	Sp 6	Plant-Hopper		X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Cicadellidae	large line on frons	Sp 7	Plant-Hopper		X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Coccidae	Crawler		Scale	X				Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Delphacid	pale round	Sp 1	Plant-Hopper	X	X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Delphacid	slender	Sp 2	Plant-Hopper	X	X			Sap-feeder on grass and forb stems	
	Insecta	Hemiptera	Delphacid	black	Sp 3	Plant-Hopper		X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Lygaeidae	Geocorine	Sp 1	Seed-feeding bug	X	X			Seed-feeder on grass and forbs	
	Insecta	Hemiptera	Cicadellidae	Geocorine	Sp 2	Seed-feeding bug	X				Seed-feeder on grass and forbs	
Arthropoda	Insecta	Hemiptera	Miridae	Sp 1 Large pale		Capsid Bug	X	X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Miridae	Sp 2 small pale		Capsid Bug	X	X			Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Miridae	sp 3 black		Capsid Bug	X				Sap-feeder on grass and forb stems	
Arthropoda	Insecta	Hemiptera	Reduviidae	Emesinae Sp 1		Assassin Bug	X				Predator in litter	
Arthropoda	Insecta	Hymenoptera	Formicidae	*Cardiocondyla*	*nuda*	ant	X	X	X	X		
Arthropoda	Insecta	Hymenoptera	Formicidae	*Monomorium*	*pharaonis*	pharaoh ant		X	X	X		
Arthropoda	Insecta	Hymenoptera	Formicidae	*Tetramorium*	*lanuginosum*	ant			X	X		
Arthropoda	Insecta	Hymenoptera	Formicidae	*Tetramorium*	*bicarinatum*	ant	X	X				
Arthropoda	Insecta	Hymenoptera	?Pompilidae	Unidentified		bee	X				Spider predator (stores stung spiders in tunnels for larvae	
Arthropoda	Insecta	Hymenoptera	Scelionidae	*Scelio*	sp	wasp	X	X			Parasite of eggs of Grasshoppers	
Arthropoda	Insecta	Hymenoptera	Scelionidae	Scelionidae	sp 2	wasp	X	X			Parasite of eggs of Grasshoppers	
Arthropoda	Insecta	Hymenoptera	Unidentified Family	Parasitoid	Sp 1	wasp	X				Parasitoid - host unknown	
Arthropoda	Insecta	Hymenoptera	Unidentified Family	Parasitoid Green HairyAnt	Sp 2	wasp	X	X			Parasitoid - host unknown	
Arthropoda	Insecta	Hymenoptera	Unidentified Family	Parasitoid	Sp 3	wasp	X				Parasitoid - host unknown	
Arthropoda	Insecta	Hymenoptera	Unidentified Family	Parasitoid Med Yellow Abd	Sp 4	wasp	X	X			Parasitoid - host unknown	
Arthropoda	Insecta	Hymenoptera	Unidentified Family	Parasitoid Small	Sp 5	wasp		X			Parasitoid - host unknown	
Arthropoda	Insecta	Hymenoptera	Anthophoridae	Unidentified		Carpenter Bee	X				Pollen collector and pollinator	
Arthropoda	Insecta	Isoptera	indet.			termite	X				Attacks timber	
Arthropoda	Insecta	Lepidoptera	Noctuidae	*Achaea*	*janata*	moth	X				Adult nectar feeder & migrant; larva polyphagous	
Arthropoda	Insecta	Lepidoptera	Noctuidae	*Armectia*	*columbina*	moth	X	X			Adullt nectar feeder, larval host *Cordia*	
Arthropoda	Insecta	Lepidoptera	Sphingidae	*Agrius convolvuli*	*convolvuli*	Convolvulus Hawk Moth	X				Adult nectar feeder and immigrant larval host Ipomea	
Arthropoda	Insecta	Lepidoptera	Sphingidae	*Hippotion*	*velox*	Hawk Moth	X				Adult nectar feeder and migrant, larval host, Ipomea	
Arthropoda	Insecta	Lepidoptera	Ethmiidae	*Ethmia*	sp		X				Adullt nectar feeder, larval host *Cordia*	
Arthropoda	Insecta	Lepidoptera	Pterophoridae	Unidentified	Sp	Plume wing Moth		X			Larval host possibly Boerhavia	
Arthropoda	Insecta	Lepidoptera	Unknown	Unidentified larva			X					
Arthropoda	Insecta	Mallophaga	Unknown	Not identified		Bird Louse					Blood-sucking parasite of Birds	Not collected in 2007
Arthropoda	Insecta	Mantodea	Mantidae	Not identified		Praying Mantis					Predator in plant canopy	Not collected in 2007
Arthropoda	Insecta	Neuroptera	Chrysopidae	*Chrysopa* sp.		Lacewing	X				Adult and larva predator on scale	
Arthropoda	Insecta	Orthoptera	Acrididae	*Valanga/Austracris*		Giant Grasshopper	X				Plant feeder on trees and shrubs	
Arthropoda	Insecta	Orthoptera	Acrididae	*Ailopus*	*thalasssinus*	Grasshopper	X	X	X		Grass feeder	
Arthropoda	Insecta	Orthoptera	Acrididae	Unidentified nymph		Grasshopper				X		
Arthropoda	Insecta	Orthoptera	Gryllidae	*Ornebius*	sp	Scaly Cricket	X	X			Omnivore in canopy and litter	

Arthropoda	Insecta	Orthoptera	Gryllidae	*Teleogryllus*	*oceanicus*	Black Field Cricket		X	X			Omnivore under logs
Arthropoda	Insecta	Orthoptera	Gryllidae	*Trigonidium*	sp	Leaf-Running cricket		X	X			Omnivore in canopy
Arthropoda	Insecta	Orthoptera	Tettigoniidae	*Conocephalus*	sp	Conehead		X	X			Grass feeder
Arthropoda	Insecta	Orthoptera	Tettigoniidae	*Polichne*	sp	Bush katydid		X	X			Omnivore in grass and forbs
Arthropoda	Insecta	Psocoptera	Unknown	*wingless*	Sp 2	Plant Louse		X		X	X	Omivore on plants
Arthropoda	Insecta	Psocoptera	Unknown	Mottled wings	Sp 1	Plant Louse		X	X			Omivore on plants
Arthropoda	Insecta	Thysanoptera	Unknown	Not identified		Thrips		X	X	X		Pollen feeder
Arthropoda	Insecta	Thysanura	Lepismatidae	*Heterolepisma*	sp.	Silverfish		X	X			Omnivore in litter and soil
Arthropoda	Insecta	Trichoptera		Not identified		caddisfly						Immigrant
Arthropoda	Myriapoda	Chilopoda	Geophilidae			centipede		X		X	X	
Arthropoda	Myriapoda	Diplopoda	Polyxenidae			hairy millipede		X	X			
Arthropoda	Myriapoda	Pauropoda						X				
Arthropoda	Myriapoda	Symphyla	Scutigellidae	cf. *Scolopendrellopsis*	sp.			X				
Arthropoda	Tardigrada						1995 collections only	X				
Mollusca	Gastropoda					snail	Probably marine or marine littoral species	X	X			
Annelida	Oligochaeta		Enchytraeidae			worm		X				

Appendix 9. Timetable of Australia based work on project.

Penelope Greenslade

Date	*Activity*
February	Contract signed
March	Sorting of samples, pitfalls, yellow pans, leaf litter samples from 2007.
April	Identification of specimens, data basing of collections and species Postage of specimens to specialist taxonomists
May	Compiling data Writing text of report. Workshop on Coral Commonwealth Territory management
May 14th	Draft report submitted (due May 15th)
May 28th	Comments on draft report received.
May 28th to June 4d	Revision of draft report.
June 4rd	Binding of report
June 5th	Submission of report

Total time spent on contract work – 7 weeks at on average 55 hours p.w.= 375 hours

Appendix 10 Identifications of Formicidae from samples taken in 2007

Island	Method	Description	Formicidae *Tetramorium lanuginosa*	*Tetramorium bicarinatum*	*Cardiocondyla nuda*	*Monomorium pharaonis*	Total Formicidae	Total species	Sp.?	
South West Herald	Pitfalls	*Abutilon*		221			221	1	1 black stray,dead *Oecophylla smaragdina*	
South West Herald	Yellow pans	*Abutilon*		50	12		62	2		
South West Herald	Leaf litter	*Abutilon*					0	0		
	TOTALS		**0**	**271**	**12**	**0**	**283**	**2**		
South West Herald	Pitfalls	Grassland		1241	2		1243	2		
South West Herald	Yellow pans	Grassland		21	4		25	2		
	TOTALS		**0**	**1262**	**6**	**0**	**1268**	**2**		
South West Herald	Pitfalls	*Argusia*		174	5		179	2		
South West Herald	Yellow pans	*Argusia*		27			27	1		
South West Herald	Leaf litter	*Argusia*					0	0		
	TOTALS		**0**	**201**	**5**	**0**	**206**	**2**		
South West Herald	Pitfalls	*Gravel*			9	2	11	2		
South West Herald	Gravel sample	*Gravel*					0	0		
	TOTALS		**0**	**0**	**9**	**2**	**11**	**2**		
South West Herald	Pitfalls	Beach		7			7	1		
South West Herald	Yellow pans	Beach		6			6	1		
South West Herald	Interstitial sand	Beach					0	0		
	TOTALS		**0**	**13**	**0**	**0**	**13**	**1**		
	TOTALS FOR ISLAND		**0**	**1747**	**32**	**2**	**1781**	**3**		
North East Herald	Pitfalls	*Pisonia*		322			322	1		
North East Herald	Yellow pans	*Pisonia*		173			173	1		
North East Herald	Leaf litter	*Pisonia*					0	0		
North East Herald	leaf litter humus	*Pisonia*					0	0		
North East Herald	Deep soil	*Pisonia*					0	0		
	TOTALS		**0**	**495**	**0**	**0**	**495**	**1**		
North East Herald	Pitfalls	*Abutilon*		591	3		594	2		2
North East Herald	Yellow pans	*Abutilon*		165	3		168	2		
North East Herald	Leaf litter	*Abutilon*		4			4	1		
	TOTALS		**0**	**760**	**6**	**0**	**766**	**2**		
North East Herald	Pitfalls	Grassland		1732	8		1740	2		

North East Herald	Yellow pans	Grassland		471	2		473	2
	TOTALS		**0**	**2203**	**10**	**0**	**2213**	**2**
North East Herald	Pitfalls	Beach west		9			2210	1
North East Herald	Yellow pans	Beach west		3			3	1
North East Herald	Pitfalls	Beach east		43			43	1
	TOTALS		**0**	**55**	**0**	**0**	**55**	**1**
North East Herald	Pitfalls	*Argusia*		1296	1		1297	2
North East Herald	Yellow pans	*Argusia*		249			249	1
North East Herald	Leaf litter	*Argusia*		1			1	1
	TOTALS		**0**	**1546**	**1**		**1547**	**2**
	TOTALS FOR ISLAND		**0**	**5059**	**17**	**0**	**5076**	**2**
Coringa	Pitfalls	*Argusia*	5		42	1	62	3
Coringa	Pitfalls	Grassland	1		9		11	2
Coringa	Pitfalls	*Arbutilon*			11	12	23	2
	TOTALS FOR ISLAND		**6**	**0**	**62**	**13**	**96**	**3**
Magdelaine	Pitfalls	*Abutilon*	2			2	24	3
Magdelaine	Pitfalls	Grassland	5		3	72	110	3
Magdelaine	Pitfalls	*Argusia*	5		6	3	14	3
Magdelaine	Pitfalls	*Pisonia*					0	0
	TOTALS FOR ISLAND		**12**	**0**	**9**	**77**	**148**	**3**

Appendix 11 Data for material collected by A. Anderson in June 1997

Island	Method	Trap number	Description	Formicidae				
				Tetramorium lanuginosa	*Cardiocondyla nuda*	*Monomorium pharaonis*	Total Formicidae	Total species
North East Herald	Yellow pans	A1	Lower foredune, grass, herbs,coral sand		3		3	1
North East Herald	Yellow pans	A2/B1	Upper foreduen, vine,*Tribulus, Argusia* shrubs, coral sand		1		1	1
North East Herald	Yellow pans	B2	Upper foredune II, grasses, A*rgusia* shrubs		3		3	1
North East Herald	Yellow pans	C1	Dune crest, *Abutilon,Argusia*, grasses, *Tribulus*		2		2	1
North East Herald	Pitfalls	D1	Hind dune, *Lepturus,* grasses, herbs,		3	5	8	2
North East Herald	Pitfalls	D2	Hinddune, *Lepturus* grasses,	7	6	6	19	3
North East Herald	Pitfalls	D3	Hinddune, *Lepturus* grasses, leaf litter, twigs	4	3	8	15	3
North East Herald	Pitfalls	E1	Grssland and *Pisonia* forest, *Abutilon, Tribulus* and *Pisonia* leaf litter	4	2	8	14	3
North East Herald	Pitfalls	E2	Ecotone, grassland *Abutilon, Tribulus* herbland and *Pisonia* forest	7	8	13	28	3
North East Herald	Pitfalls	E3	Ecotone, grassland Abutilon, Tribulus herbland and Pisonia forest	6	2	7	15	3
North East Herald	Pitfalls	F1	*Pisonia* forest leaf litter, rotten wood, guano	10		2	12	2
North East Herald	Pitfalls	F2	*Pisonia* forest leaf litter, rotten wood,	3			3	1
North East Herald	Pitfalls	F3	*Pisonia* forest leaf litter, rotten wood,				0	0
North East Herald	Funnel extraction		*Pisonia* forest leaf litter,		5		5	1
North East Herald	Funnel extraction		*Pisonia* leaf litter, transect A 60m	3			3	1
North East Herald	Yellow pans		Edge of Pisonia forest		5		5	1
North East Herald	Hand		On *Argusia*		4		4	1
		TOTALS		**44**	**47**	**49**	**140**	**3**

Appendix 12 Identifications of Formicidae from samples taken in 1995/6

Island	Method	Description		Formicidae						
				Tetramorium lanuginosa	*Tetramorium bicarinatum*	*Cardiocondyla nuda*	*Monomorium pharaonis*	Total Formicidae	Total species	Sp.?
Coringa	LT	Clearing in Pisonia					1			
Coringa	LT 10						1			
Coringa	LT 11	Clearing in *Pisonia*				1				
Coringa	PF 27	Shrubland				1				
Coringa	PT 24	Herbfield				4				
Coringa	PT 24	Herbfield					1			
Coringa	PT 24	Herbfield		2						
Coringa	PT 25					12	1			
Coringa	PT 26	Clearing in *Pisonia*		1						
Coringa	PT 27	Shrubland				1				
TOTALS				**3**	**0**	**19**	**4**			
Magdelaine	LT	Shrubland								1damaged specimen
Magdelaine	PT 22									1damaged specimen
TOTALS				**0**	**0**	**0**	**0**			**2**
ISLAND/	PT 29					1	6			
NEH	1		1996				69			
NEH	3	Herbfield		8		1	1			
NEH	5			1						
NEH	6		1996	28						
NEH	7	Herbfield		8		1				
NEH	7			1						
NEH	9					3	4			
NEH	10	Herbfield		4		14	10			
NEH	11	Herbfield		5		2	5			
NEH	LT 2			1						
NEH	PT			23		3	25			
NEH	PT 1			14		2				
NEH	PT 1			1						
NEH	PT 13						1			
NEH	PT 14			1						
NEH	PT 14			1						

NEH	PT 15				1		
NEH	PT 15					1	
NEH	PT 16		1				
NEH	PT 17					3	
NEH	PT 17		2				
NEH	PT 18				1		
NEH	PT 18				1		
NEH	PT 18				1		
NEH	PT 18					1	
NEH	PT 18		14				
NEH	PT 18		3				
NEH	PT 18		1				
NEH	PT 19				1		
NEH	PT 2					2	
NEH	PT 2				1		
NEH	PT 20	Herbfield	3				
NEH	PT 20				1		
NEH	PT 20					1	
NEH	PT 21				1		
NEH	PT 21		7				
NEH	PT 3				3		
NEH	PT 3		3		3		
NEH	PT 3		1				
NEH	PT 3		13				
NEH	PT 3					3	
NEH	PT 3		3				
NEH	PT1					1	
NEH	PT13		1				
NEH	PT16		1				
	TOTALS		**149**	**0**	**40**	**127**	**0**