Inner (West) Sister Island

Scientific Expedition • 2010

A partnership program between the
Hamish Saunders Memorial Trust, New Zealand and
the Resource Management and Conservation Division, DPIPWE, Tasmania

Editors: Dr Stephen Harris and Dr Anthony Reid

Department of
Primary Industries, Parks, Water and Environment

Tasmania
Explore the possibilities

Inner (West) Sister Island Scientific Expedition 2010

A partnership program between the Hamish Saunders Memorial Trust, New Zealand and the Resource Management and Conservation Division, DPIPWE, Tasmania.

Book ISBN: 978-0-7246-6572-3
Title: Inner (West) Sister Island Scientific Expedition 2010
Author(s): Stephen Harris and Anthony Reid (editors)
Publisher/Place: Department of Primary Industries, Parks, Water and Environment/Hobart

PDF format for Web publication ISBN: 978-0-7246-6573-0
Title: Inner (West) Sister Island Scientific Expedition 2010
Author(s): Stephen Harris and Anthony Reid (editors)
Publisher/Place: Department of Primary Industries, Parks, Water and Environment/Hobart

Cite as: Harris, S. and Reid, A. (2011).
Inner (West) Sister Island Scientific Expedition 2010.
Hamish Saunders Memorial Trust, New Zealand and
Resource Management and Conservation Division,
DPIPWE, Hobart, Nature Conservation Report Series 11/2

Cover photo: Panoramic view across the Inner Sister Island (photo: M. Visoiu)
Inside cover photos: Rolan Eberhard
Design and layout by the ILS Design Unit, DPIPWE

Inner (West) Sister Island

Scientific Expedition • 2010

A partnership program between the
Hamish Saunders Memorial Trust, New Zealand and
the Resource Management and Conservation Division, DPIPWE, Tasmania

Editors:
Dr Stephen Harris
Dr Anthony Reid

House Bay.

Photo by Asher Jones.

Contents

Phyllospora comosa.

Photo by Rolan Eberhard.

Foreword

Ten years ago the then Department of Primary Industries, Water and Environment conducted a land use study of leasehold islands in the Furneaux Group, in conjunction with leaseholders, NRM and the Outer Island Association. The study was to assess the sustainability of land use practices and determine how leasehold conditions should be framed. This work depends on basic information about the natural values of such islands, information which is often incomplete as it was in the case of Inner Sister Island, particularly in relation to fauna. A decade later this has been largely remedied. The results presented in this report not only generate a better understanding of threatened plants, animals, and vegetation communities, but provide knowledge that will contribute to good land management for conservation of natural values.

At the present time islands are also being examined as prospective locations for translocations for species threatened elsewhere by disease, and other threats, including climate change as mediated through altered fire regimes and other habitat shifts. Islands may indeed already provide refugia for biota that may potentially be disadvantaged elsewhere by environmental change.

I welcome a further report in the series that records the results of detailed scientific work on Tasmania's offshore islands. This program, supported by the Tasmanian Government is a joint initiative with the Hamish Saunders Memorial Trust in New Zealand which once again selected and supported the travel of two young New Zealand students to Tasmania. The opportunity was provided them to work with experienced Tasmanian scientists in the field. Asher Jones and Claire Taylor by all accounts gained a great deal from their experience. They will now join the expanding group of the nascent generation of natural history scientists who, benefitting from their experience with the Hamish Saunders Memorial Island Survey Program, will contribute to professional and personal connections between New Zealand and Tasmania in the coming years.

Alistair Scott

General Manager, Resource Management and Conservation Division.

Hamish Saunders

Hamish Saunders was a New Zealand volunteer who died tragically in 2003 while conducting survey work on a Tasmanian endangered species program. Hamish graduated from Waikato University with a First Class Honours and Masters degree in marine geology. He later completed a postgraduate GIS course with distinction. He also achieved qualifications as a scuba dive instructor, was a good sportsman and was talented, not solely academically, but as an all round individual.

As an explorer, Hamish achieved in his 26 years much of which most only dream. From Antarctica to the Galapagos, Central America, South America, South-East Asia, Europe and Australia, he combined his passion for the natural world and conservation with that of an interest in local cultures and people. Not only did he travel to these places, but he also took a great interest in the people around him. He touched many lives. Hamish was a remarkable and talented young man. The passion and enthusiasm he engendered in those whom he met and the gentle leadership he embodied is his legacy.

This island survey program is dedicated to the memory of Hamish Saunders and intended as a platform for emerging leaders in nature conservation. The Tasmanian Government's commitment and long-term support for the program is reaffirmed in the publication of each of the expedition reports.

Acknowledgements

Thanks is again due to the Hamish Saunders Memorial Trust for participating in the program, particularly Alan and David Saunders, and the Trust's travel award recipients Asher Jones and Claire Taylor. Sincere thanks to Kay and Robert Blyth of Flinders Island who were supportive of the study and provided background information as needed. James Luddington provided transport between Flinders Island and Inner Sister Island and we are grateful for his logistical support in this regard. Fionna Bourne and Mike Pemberton provided Agency support. We also thank Wayne Dick, the Parks and Wildlife Service Ranger on Flinders Island, and his staff for assisting in the logistical arrangements while the party were in the Furneaux Group.

Dr Sylvia Singh and her family of Whitemark were very helpful to the party in enabling extra equipment to be taken to the island from Launceston.

We thank the many people who provided their time and expertise, some in a volunteer capacity, across the range of specialties dealt with in this report – they are acknowledged separately in the individual reports herein.

The editors especially thank participants for writing up the results of their work promptly following the expedition. Thanks to Brett Littleton of Information and Land Services Division in the Department of Primary Industries, Parks, Water and Environment for his design and layout of the report.

Summary of Results

1. At the time of initial European contact with the island in the late eighteenth century, the island most likely supported a dense forest dominated in different places by *Allocasuarina verticillata, Eucalyptus globulus* and *Callitris rhomboidea.* (Harris, Jones and Taylor)

2. The bedrock geology is entirely granitic except for minor igneous dykes of probable dolerite. The island is mantled by gravelly colluvium and aeolian sands which in some sites have lithified to form calcarenite. Soils are well drained gritty loams and sandy loams. (Eberhard)

3. Features worthy of listing on the Tasmanian Geoconservation Database include the fabric of the granitic rock (mineral segregations and/or xenoliths) and presumed Pleistocene colluvial fans. (Eberhard)

4. There are no immediate threats to the integrity of the geodiversity as the island is mostly comprised of stable geological substrates. Human activities have had a limited effect. (Eberhard)

5. The diversity of marine fauna species observed around the coast of Inner Sister Island was very high. This is consistent with the character description for the Flinders Bioregion, where the diversity of fish and seaweed species is considered very high when compared with other Tasmanian marine bioregions. (Reid)

6. Despite a relatively low sampling effort, a total of 28 fish species were identified from the underwater surveys and 68 mollusc species were identified from the beach wrack surveys. (Reid)

7. Considerable diversity was also witnessed in the intertidal zones of the island, with molluscan, cnidarian, crustacean and echinoderm representatives, in addition to members from the three main algal groups - Phaeophyta, Chlorophyta and Rhodophyta. (Reid)

8. Revised vegetation mapping includes an extensive area of previously unmapped Lowland *Poa labillardierei* (GPL) grassland. The extent and type of other grasslands on the island has been refined. Four vegetation communities are listed as threatened at the State level. (Visoiu)

9. Native vegetation has been increasing particularly the extent of scrub and forest types over the last sixty years. (Visoiu)

10. The numbers and extent of threatened species were determined and new records of two threatened species were made. These are *Asperula minima* and *Solanum opacum.* Observations were made of most of the threatened species on the island including the rare lichen *Teloschistes flavicans.* (Visoiu)

11. In a survey of terrestrial mammals on the island, four of the five native mammals known to occur on the island were observed during this survey. Inner Sister Island is one of only two offshore islands in Tasmania that support populations of the southern brown bandicoot. (Driessen)

12. The first record was made of Tasmanian pademelons climbing and foraging in african boxthorns and other shrubs. (Driessen)

13. Remarkably no extant introduced mammal species were recorded on the island although an equivocal cat scat was observed by one of the party. (Driessen) Cat scats were also observed by others (Carlyon, Bryant)

14. The reptile fauna of the island was surveyed and six of the seven species known for the island were observed. Twelve species of reptile are known for the islands of the Furneaux Group. We observed and made observations on White-lipped snake, Tiger snake, White's skink, Blotched bluetongue, Metallic skink, and Three-lined skink. Only dead specimens of the last named of these were found. (Driessen and Visoiu)

15. The first detailed survey of burrow-nesting short-tailed shearwater and little penguin since 1986 is reported. While the spatial extent of colonies may have expanded since previous surveys, the estimated number of breeding shearwaters appears to have declined. (Carlyon)

16. Penguin numbers appear to have increased since previous surveys done on the island. (Carlyon)

17. An annotated list of seabirds observed on the island is included, along with a range of management recommendations. (Carlyon)

18. A total of 47 bird species was found of which 43 were native and 4 non-native species, representing good diversity. Twenty six species were breeding on the island and 17 of these were confirmed with nests, eggs or chicks. Two species, the White-browed Scrubwren and Silvereye, warrant further taxonomic investigation due to their differences from mainland Tasmanian birds. (Bryant)

19. Orthoptera (crickets and grasshoppers) and Phasmatodea (stick insects) were surveyed. No species of these taxa have previously been recorded on Inner Sister Island and they have not been well surveyed on the Furneaux Islands with the exception of the Rhaphidophoridae (cave and camel crickets) for which four species have been recorded from 10 islands. (Driessen)

20. One species of grasshopper, four species of cricket and one species of stick insect were recorded on Inner Sister Island. (Driessen)

21. A juvenile male stick insect was found at the eastern end of the island. This is believed to be the first record of a stick insect from the eastern Bass Strait islands. The specimen was identified to the genus *Candovia*; however it was not possible to identify the species and is possibly undescribed. (Driessen)

22. Freshwater habitats were sampled for invertebrates. The majority of species collected were widespread taxa with flying adult stages that are capable of colonising isolated ephemeral habitats. Eighteen different taxa were collected, almost all of which were insects, apart from a hydrobiid snail and a water mite. (Sloane)

23. Over 15,000 terrestrial invertebrate specimens were collected on the island. These were from 32 orders. The fauna was diverse with few exotic species. Many specimens could only be identified to order or class. (Sloane)

The expedition party.

Standing left to right: Mr Rolan Eberhard (DPIPWE), Mr Tom Sloane (University of Tasmania), Dr Anthony Reid (DPIPWE), Dr Stephen Harris (DPIPWE), Dr Sally Bryant (Tasmanian Land Conservancy), Mr Michael Driessen (DPIPWE).

Front seated: Mr Micah Visoiu (DPIPWE), Ms Asher Jones (Hamish Saunders Memorial Trust Award recipient), Ms Claire Taylor (Hamish Saunders Memorial Trust Award recipient), Mr Kris Carlyon (DPIPWE).

Photo by Michael Driessen.

View towards Outer Sister Island.

Photo by Asher Jones.

Introduction

Inner (or West) Sister Island is only 1.9 km to the north of Flinders Island, yet it is not as accessible as one might expect upon just looking at a map. The passage between the island and Flinders is subject to very strong tidal rips and surges. The rough seas in the Passage known as the "stone choppers" or "stern choppers" make a crossing in a small boat perilous. There is an airstrip on the island which is suitable for light aircraft in appropriate conditions.

Inner Sister Island, at 748 hectares, is one of the largest of the approximately one hundred outer islands in the Furneaux Group in eastern Bass Strait. The island occurs at 39°41'48" latitude, 147°54'56" longitude. The island is about 5 km from west to east and 2.7 km north to south at its widest.

The topography of the island is varied and high hills occur on the island which are bisected in the centre by a wide valley. It is here where the homestead occurs as well as a generator shed and an airstrip. The island is composed mainly of granite with a mantle of calcarenite, alkaline sandy soils, and acid soils formed directly over the granite exposures. Limey sands in the Furneaux Group were considered fairly fertile compared with siliceous soils derived from granite bedrock. Consequently the more fertile islands on the outer islands were settled from the early nineteenth century as farming assumed more importance following the demise of the sealing period in about the 1820s. The Inner Sister Island was occupied from the 1860s.

The island is a Conservation Area and is leased to Kay and Robert Blyth. Sheep grazing was an important land use up until recent years but now game bird shooting is carried out. The lessees also carry out infrastructure maintenance, weed control, game management and burning. The only vehicle tracks on the island are in the vicinity of the homestead and the old shearing shed.

Islands are significant for biological conservation and there have been many practical examples of the role played by islands in being refuges for scientifically important biota, sometimes free from feral or problem animals and as potential sites for translocations or reintroductions of endangered species that might otherwise be under pressure in the rest of their range.

Extensive studies on the flora and fauna of the Furneaux Islands by Jeanette Hope, Bob Green, Stephen Harris and Nigel Brothers and their colleagues have provided the foundation on which further work in the Group is carried out. The significant results from the present expedition illustrated the gaps that had existed in our knowledge of the island. The size, and geographic location of the island, together with government's joint management responsibility with a private lessee, was amongst the factors that made this island an ideal target of the Hamish Saunders Memorial Island Survey Program.

The expedition party landed on Flinders Island on 2 December 2010 thence to Inner Sister Island the same day. The team departed Inner Sister Island on 8 December 2010 and then Flinders Island on the same day. The expedition was led by Dr Anthony Reid (marine and intertidal fauna). The challenge in getting a party of scientists and their equipment to a remote island and back safely with results which are then compiled into a report, are considerable. He was joined by Dr Stephen Harris (leadership mentor), Mr Michael Driessen (mammals, reptiles, orthoptera), Mr Tom Sloane of the University of Tasmania (terrestrial invertebrates), Mr Rolan Eberhard (geomorphology), Mr Kris Carlyon (seabirds), Ms Asher Jones (Hamish Saunders Memorial Trust Travel Award Recipient 2010), Ms Claire Taylor (Hamish Saunders Memorial Trust Travel Award Recipient 2010), Mr Micah Visoiu (vegetation/flora) and Dr Sally Bryant of the Tasmanian Land Conservancy (avifauna).

Gully east of homestead with Bursaria *and* Allocasuarina *trees.*

Photo by Stephen Harris.

A Speculative Pre-European Vegetation of Inner Sister Island, Furneaux Group

Stephen Harris, Asher Jones and Claire Taylor

A speculative historical reconstruction of the vegetation on Inner Sister Island around the time of first European contact (1797–1798) is based on understanding vegetation processes and dynamics operating on most of the islands in Eastern and Western Bass Strait, information from fragmentary historical accounts and inferences about impacts of early sealers and settlers. The island was most likely covered by a sheoak (*Allocasuarina verticillata*) forest on exposed slopes and blue gum (*Eucalyptus globulus*) and oyster bay pine (*Callitris rhomboidea*) forest over much of the remainder of the island. The remnants of this forest today are a tiny patch of eucalypts, patches of *A. verticillata* and even patches of coast paperbark (*Melaleuca ericifolia*) and prickly box (*Bursaria spinosa*) – fire-hardy surviving undershrubs from the eucalypt forest. Some fringing grassland probably occurred on the north and west coasts.

INTRODUCTION

The present vegetation of Inner Sister Island was first described by Harris *et al.* (2001) and subsequently revised by Visoiu (this publication). The vegetation communities present are represented on many of the other 100 islands of the Furneaux Group in varying proportions and combinations. Knowledge of the flora and vegetation of all the islands has increased in the last two decades (for example Harris *et al.* 2001, Harris *et al.* 2009).

METHODS

This reconstruction is based on historical sources (Blyth 1992), discussion with the current lessees and documented processes of change on other islands (Harris *et al.* 2001). Detailed historical reconstruction of vegetation on another Furneaux island (Harris and McKenny 1999) invites generalisations applicable here. Observations of the processes acting on the vegetation and the expected vegetation and flora responses under different fire and grazing regimes inform the conclusions made. This paper originated in a discussion between the authors while on the island, about what the island may once have looked like.

RESULTS AND DISCUSSION

A sketch map (Figure 1) depicts extensive forest dominated by *C. rhomboidea, A. verticillata,* and *E. globulus*. No grassland dominated by *Poa labillardierii* existed at the time of European contact and that dominated by *Poa poiformis* was very much less extensive than occurs today. *Allocasuarina verticillata* forest formed a distinct zone around the island and was extensive on the western side of the island where it was separated from the coast by a zone of *Austrostipa stipoides*. *M. ericifolia* forest did not occur except perhaps for a small area at The Elbow. The current patches of *M. ericifolia* are likely to be derived from the understorey trees that formerly occurred in the *E. globulus* forest.

Melaleuca squarrosa tall shrubland occurred on the eastern end of the island around the wetlands. The *Melaleuca squarrosa* patches were adjacent to *Melaleuca ericifolia* swamp forest. *Myoporum insulare* shrubland may have been well developed and represented by a belt around the north of the island.

C. rhomboidea, recorded in 1986 as a small patch of trees, now appears to be extinct on the island, a consequence of fires closer than the 8 year intervals required to produce seed cones. It is an obligate seeder and does not have a soil stored seed bank.

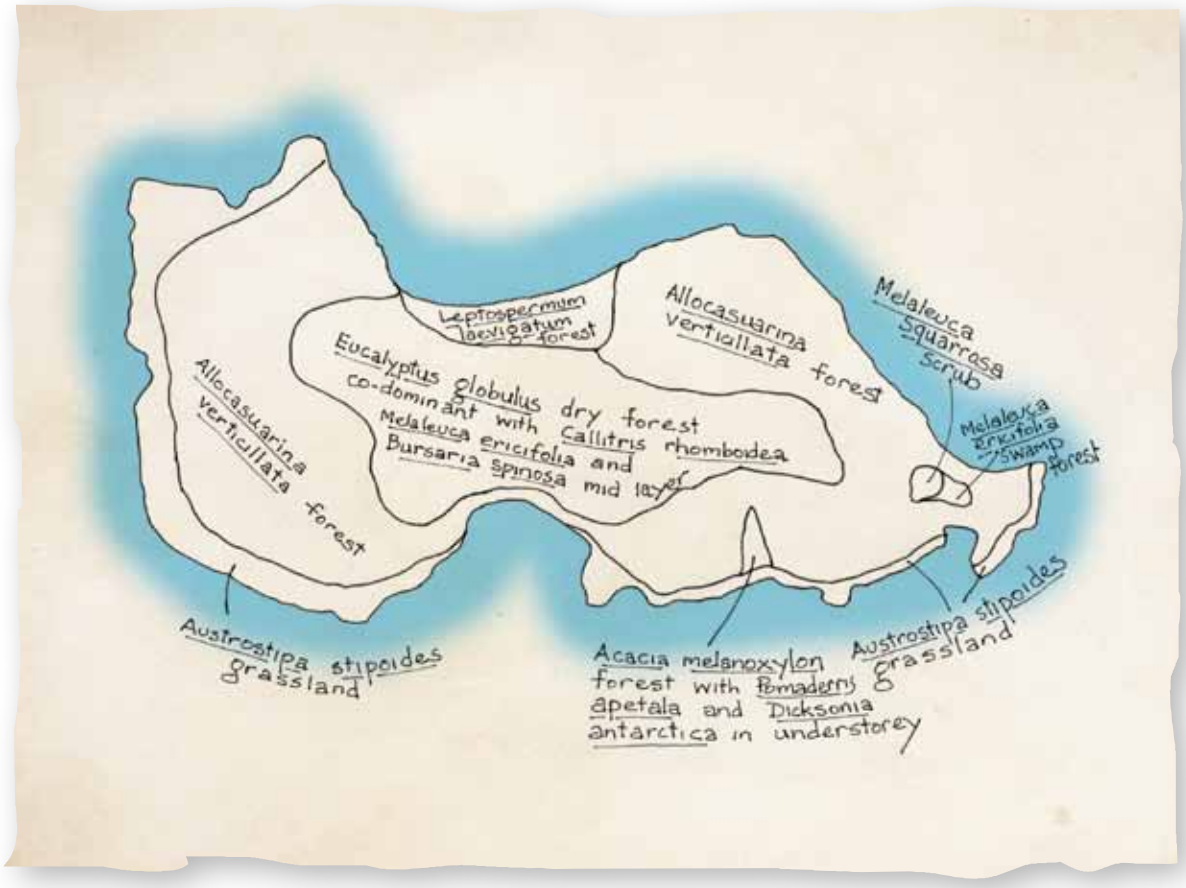


Figure 1. A sketch by the authors of the hypothesised vegetation pattern at the time of European discovery.

A. verticillata is similar in that it does not have soil stored seeds but the trees carry a considerable aerial seed bank. Both *Callitris* and *Allocasuarina* behave similarly ecologically in that they are both gap phase regenerators in the absence of fire with the fallen limbs producing "cages" that protect young seedlings from animal browsing.

Following fire, seedlings of both *Callitris* and *Allocasuarina* are often subject to animal browsing, but this does not usually prevent recruitment to older cohorts because mass germination overwhelms the capacity of browsing animals. If a parent cohort declines to low numbers then mass germination is not a defence and the path to local extinction is accelerated.

A. verticillata can become extinct due to a very high fire frequency as nearly happened on Preservation Island (Harris and McKenny 1999) the resilience of the species appears a little greater than *C. rhomboidea*. On Preservation Island, where *C. rhomboidea* had already disappeared, a lone surviving *A. verticillata* was present in 1999, although there was evidence it had once been much more extensive. Unrelenting human land use can extinguish the species on small islands. For example, there is now no trace of the *Allocasuarina* forests that were noted on East Kangaroo Island (144 ha) in 1828 (Harris and Summers 2000).

E. globulus is reduced to a relict patch of 2-3 trees on Inner Sister Island. Eucalypts are early departures from the island floras; they do not have soil stored seed, but rather are obligate seeders. The time a seedling takes to produce fruit varies from species to species. Eucalypt seed is heavy and is not dispersed very far. The eucalypts on the islands must therefore be survivors from a time of lower sea level. They require fire for their persistence but the frequency of lightning strikes has been sufficient to promote their persistence on the islands in the absence of anthropogenic fire.

Few other species occurring on the island are capable of forming forests but some can under particular conditions. *B. spinosa* is a forest mid-layer shrub species persisting after long periods of disturbance and a detailed explanation of the persistence of this species is given in Harris and McKenny (1999). *Leptospermum laevigatum* is not only an understorey remnant but also capable of dominating forest on sand. Some old trees are beginning to form patches of tall shrubland on sand just inland of North Beach.

Leptospermum scoparium is an understorey remnant and capable of dominating forests in their own right, the most notable examples being in southwest Tasmania, but examples are rare in the Bass Strait islands.

Species capable of forming tall shrublands on Inner Sister Island are *Myoporum insulare* and *Acacia longifolia*. *Myoporum* dominated shrubland is extensive along the northern coast on calcarenite slopes. The extent to which such *Myoporum* shrubland occurred prior to European disturbance is not known. It may have been a self-maintaining community or else it represents a disturbance disclimax of *A. verticillata* forest. *Myoporum insulare* certainly occurs as an undershrub in *A. verticillata* forests elsewhere in the Furneaux Group.

Small *Acacia melanoxylon* (blackwood) persist in Nettle Gully and is the remnant of what may have been a forest dominating most of this gully. The relative fire protection provided by the topography and the very moist ground conditions developed underneath are likely to have impeded many incursions by fire into the edge of the stand. The understorey would have been open with a ground cover of *Hypolepis rugosula*, and many mosses and liverworts. *Dicksonia antarctica* was most likely scattered throughout the gully. Spores of *D. antarctica* are anemophilous and germinate widely in suitable microsites (Neyland 1986) across the islands leading to the occurrence of single specimens or small

numbers of specimens in damp crevices or between boulders, for example on the slopes of Mt Chappell Island or Babel Island.

The remaining blackwood is probably a remnant of even more ancient rainforests occurring throughout the region. It is known to be one of the rainforest components that are survivors of frequent fires because of their prolific seed and their ability to resprout from roots and form clonal patches.

M. ericifolia forest is listed as a threatened vegetation community on Tasmania's *Nature Conservation Act 2002*. Some occurrences are derived communities in contrast to the *M. ericifolia* swamp forests of wetland habitats. On the Inner Sister Island we suggest the mapped community is of the derived form and is a remnant of what was originally *E. globulus* forest. The species occurs as a mid layer shrub in *E. globulus* forest throughout the Furneaux islands on sites that are not swamps and are mostly very dry. A very high fire frequency introduced to such forests will precipitate a degradation sequence that ultimately results in the elimination of all but the most fire resilient species. The chief of these is *M. ericifolia* which has both prolific seeding capacity as well as a strong resprouting habit.

Support for the above hypothesis is the historical record of extensive blue gum forests on Flinders Island on the western coastal plain. South of Whitemark this forest was swept by repeated fires in the early to mid twentieth century as the early landholders sought to clear the land for grazing. This regime of repeated firing effectively eliminated the blue gum forests with only *M. ericifolia* surviving and even advantaged by fires. The stands existing now along fence lines and in small shelterbelts on Flinders Island give the appearance of remnant *M. ericifolia* forest left from clearing. This is not quite the case. These stands are remnants – but not of *Melaleuca* forests, rather of *E. globulus* forests from which they have been sifted. A stage in the process is hinted at in photographs facing pages 210 and 211 in Porter (1936).

The original habitat of much of the *M. ericifolia* on Inner Sister Island is demonstrated in the remaining stands of *E. globulus* elsewhere in the Furneaux Group. For example the remnant patch at Blue Rocks on Flinders Island where *M. ericifolia* is a scattered mid layer shrub coexisting with other species including obligate seeders that would not survive the fire regime which has in other places allowed *M. ericifolia* to survive.

The vegetation has been considerably altered from its pre-European state. Most communities have been greatly reduced in extent with the exception of the *Austrostipa stipoides* grassland and the *P. poiformis* grassland, both of which have increased in extent. Some of the current communities are derived. That is, they are dominated by species that occurred as components of forest communities that formerly existed on the island but which have been favoured by post-European firing and grazing regimes and have come to dominate anthropogenically derived communities.

REFERENCES

Blyth, H. Stan (1992) *Reminiscences of the Furneaux Group*. Second Edition (revised). Published by the author. Launceston.

Harris, S., Buchanan, A. & Connolly, A. (2001) *One Hundred Islands: The Flora of the Outer Furneaux.* Department of Primary Industries, Water and Environment. Printing Authority of Tasmania. Hobart.

Harris, S., Driessen, M. & Bell, P. (2009) *Prime Seal Island Scientific Expedition 2008*. Hamish Saunders Memorial Trust, New Zealand and Biodiversity Conservation Branch, DPIPWE, Hobart, Nature Conservation Report Series 09/3.

Harris, S. & McKenny, H. (1999) Preservation Island, Furneaux Group: Two hundred years of vegetation change. *Papers and Proceedings of the Royal Society of Tasmania*, 133(1):85-101.

Harris, S. & Summers, S. (2000) The desertification of a Bass Strait Island and a plan for its recovery: the case of East Kangaroo Island, Furneaux Group. *Papers and Proceedings of the Royal Society of Tasmania.* 134:83-90.

Harris, S. & Kitchener, A. (1995) *From Forest to Fjaeldmark. Descriptions of Tasmania's Vegetation.* Department of Primary Industries, Water and Environment. Printing Authority of Tasmania, Hobart.

Neyland, M. (1986) Conservation and management of treeferns in Tasmania. Wildlife Division Technical Report 86/1. National Parks and Wildlife Service Tasmania.

Porter, G. (1936) *Wanderings in Tasmania*. Selwyn and Blount Ltd. London.

Photo by Rolan Eberhard.

Geodiversity

Rolan Eberhard

A reconnaissance-level investigation of the hitherto undescribed geodiversity of Inner Sister Island has been completed. The bedrock geology of the island is entirely granitic except for minor igneous dykes of probable dolerite. The Quaternary geology is dominated by gravelly colluvium derived from the granite. Aeolian sands are present but not widespread; in some cases these have lithified to form calcarenite. The landforms are strongly controlled by the structural features within the granite. The soils comprise well drained gritty loams and sandy loams. Features worthy of consideration for listing in the Tasmanian Geoconservation Database are identified.

INTRODUCTION

Inner Sister Island lies 1.9 km off the northern tip of Flinders Island and separated from it by a deep channel. The topography is dominated by two substantial hills – West Hill (162 m) and East Hill (196 m). The hills are separated by a wind gap (henceforth referred to as 'Hut Gap') which rises to an elevation of about 18 m and is bracketed by North Beach and House Bay on the north and south coasts respectively. This pattern repeats itself at smaller scale at the eastern extremity of the island, where East Hill connects to The Elbow via a low neck south of Elbow Bay. The island is about 5 km from east to west and about 2.7 km from north to south, narrowing to 1 km at the Hut Gap.

Only rudimentary information on the geodiversity (geology, geomorphology and soils) of Inner Sister Island was available prior to this survey. The island is mapped as 'dominantly adamellite/granite' on Mineral Resources Tasmania's digital geology of Tasmania map. The geomorphology is documented only insofar as shoreline geomorphic types are defined on the Tasmanian Shoreline Geomorphic Types Digital Line Map (Sharples 2006), in this case based on earlier air photo interpretation by Munro (1978). The soils are not referenced in the literature. Inner Sister Island was not visited during Dixon's (1996) geoconservation inventory of Tasmania's islands and is not mentioned in the resultant report. Nor is any feature on Inner Sister Island presently listed on the Tasmanian Geoconservation Database.

METHODS AND RESULTS

This reconnaissance-level investigation is based on an examination of satellite imagery and a ground traverse of most parts of the island including the entire coastline.

Geology

Granitic rocks (referred hereafter simply as granite) dominate, cropping out continuously around the coast and extensively elsewhere. The granite is characterised by frequent joints and localised mineral segregations of variable size, shape and texture, typically comprising rounded darkish masses from 0.1-1 m in diameter. In places the mineral segregations, probable autoliths and/or xenoliths associated with the emplacement and cooling of the granite, occur in clusters or trains tens of metres long. Clear examples are found west of House Bay for example (Figure 1). Dykes of fine grained weakly porphyritic igneous rock (probably dolerite) intrude the granite at two locations (Figure 2)[i].

Figure 1. Mineral segregations in granite. Photo by Rolan Eberhard.

The granite is locally overlain by Quaternary sediments, notably sandy to granular to pebbly slope deposits derived from weathering of the bedrock. The colluvium is weakly lithified in places and capable of forming crumbly cliffs. It crops out boldly on the south coast west of House Bay and forms a steep rampart around 15 m high at the western end of North Beach. Aeolian sands are present around Hut Gap. Thin bands of calcarenite crop out in a few places[ii]. At House Bay there is a localised lag of sizeable calcareous rhizomorphs.

Geomorphology

The bold domed form of the two principal hills and associated radial pattern of drainage is characteristic of granite terrain. In broad terms the island can be characterised as a structural landform developed in response to the presence of granite.

Granite slabs and tors are prominent throughout, but best developed on West Hill. The form of the tors generally shows strong joint control; some

Figure 2. Dyke (?dolerite) cutting across granite shore platform. Photo by Rolan Eberhard.

examples are surrounded by platey fragments indicative of exfoliation around residual core stones (Figure 3). The resultant detached rounded boulders are evidently prone to rapid downslope movement from the hills and ridges where they tend to form, potentially accounting for sizeable granite boulders at low elevations such as North Beach. Cavernous weathering associated with granular disintegration of the granite has produced localised tafoni, including alveolar weathering and a minor cave at the head of Nettle Gully. Granite boulders on the coast have weathered into bizarre shapes at a few locations (Figure 4). Evidence of solutional weathering is limited and mostly confined to the coast, where runnels and small gnammas have developed on granite slabs. Some of the pans are produced by the weathering out of mineral segregations within the granite.

The coastline of Inner Sister Island is 19.7 km in length (Tascoastgeo_v5gda) and dominantly rocky. Much of the coast comprises sloping bedrock slabs and broad shore platforms; offshore reefs and islets are common.

Figure 3. Platey exfoliation around granite tor, West Hill. Photo by Rolan Eberhard.

The presence of a broad terrace-like surface 5-10 m above present sea level between North Beach and Ketch Rock is suggestive of planation by a former higher sea level. Where colluvial fan deposits overlie granite on the coast, steeply sloping and sometimes cliffed backshore profiles have developed. The steep seaward faces are overlooked by lower gradient slopes representing the surface of colluvial fans above the level where they have been truncated by the Holocene marine transgression (Figure 5). Prior to this the sediments evidently extended some distance offshore of the present coastline. Burrowing seabirds have contributed to steepening of the exposed seaward margin of the colluvium, burrowing directly into it and otherwise causing erosion higher up en route to rookeries.

Some 3.0 km of the coast is sandy, mostly accounted for by North Beach and House Bay. At both locations broad sandy beaches back onto vegetated dunes reaching heights of 18 m. Dunes encroaching onto the lower slopes of East Hill have the deflected drainage

Figure 4. 'Dali Rock' (granite tafoni). Photo by Rolan Eberhard.

off the hill, pushing it west (producing the breach in the slope that provides convenient access between the beach and the house at the western end of House Bay). The dunes show signs of active erosion by wave erosion on their seaward slopes. A vegetated swale extending off the eastern end of House Bay close to present sea level implies a recent sand blow in response to westerly winds. Hut Gap and the low lying neck south of Elbow Bay are mantled by vegetated aeolian sand sheets and dunes.

Nettle Gully contained the only active watercourse of any significance at the time of the survey. However, numerous minor springs are present where seepage water discharges at the contact between the granite and more permeable overlying sediments. Mineral concretions (tufa) have been deposited at some of these sites. Drainage impounded behind aeolian sands has created a minor wetland near The Elbow.

Small scale solution weathering features in the form of pipes and pitting have developed on calcarenite

Figure 5. Truncated colluvium. Photo by Rolan Eberhard.

in a few places. The limited extent of this rock type on Inner Sister Island constrains the extent of karst development, which is common elsewhere within the Furneaux Group.

Soils

Well drained gritty brown soils have developed where the parent material is granite or colluvium derived from granite weathering. Soils of this type are common over most of the island. Loosely textured greyish brown to reddish brown sandy loams have developed on aeolian sands around Hut Gap. Soils of this type are subject to intense bioturbation in the vicinity of seabird rookeries, where they tend to assume a distinct reddish colour. Small patches of dark peat-like organic soils have developed around coastal seepages. Calcrete hardpans are present but infrequent on both granite and aeolian soil parent materials.

DISCUSSION

Islands within the Furneaux Group have been episodically connected to, and isolated from, each other and adjacent land masses as part of the eastern sill, the most elevated section of the land bridge that once connected Tasmania and the Australian mainland. Following the penultimate glaciation, the eastern sill was generally submerged from about 135 ka until about 43 ka, at which time sea level fell significantly lower in response to global cooling. The resultant land bridge remained exposed until rising sea level overtopped the eastern sill at about 14 ka (Lambeck & Chappell 2001). Sea level stabilised close to its present position around 6 ka.

The implication of these events for individual islands depends on the depth of the surrounding sea bed as this determines whether a rise or fall in sea level is sufficient to submerge or expose land connections. In the case of Inner Sister Island, the minimum depth of water between it and Flinders Island is 20-30 m (and of the same order of magnitude for a considerable distance offshore). This is considerably less than that of the eastern sill (60 m), and Inner Sister would have remained connected to Flinders until after 14 ka, although possibly not greatly so as the sea level rise was rapid (Sloss *et al.* 2007). The Furneaux Group is thought to have been tectonically stable in the latter part of the Pleistocene, so evidence of uplift can be discounted (Murrray-Wallace & Goede 1995).

In fact the depth of water around Inner Sister Island is far from uniform and includes deep troughs as well as shallow rises. The deepest of these troughs occupies the channel between Inner Sister and Flinders, which navigation charts indicate reaches 155 m below present sea level. Standing waves and other surface indications of frequent strong flows within the channel (and between Inner Sister and Outer Sister to the northeast) were observed during the recent expedition, indicating that the sea bed is likely scoured by tidal currents. This process was probably active during previous marine transgressions (Jennings 1959), suggesting the stark granite hills of Inner Sister Island would have overlooked a cluster of sizeable (saline?) lakes when the sea retreated during glacial lows. This in turn implies potential for a greater diversity of habitats and biota than may have been typical across the Bassian Plain, parts of which were occupied by mobile sand sheets and dunes (Bowden 1983).

Whereas aeolian deposits and landforms are prominent on Flinders and other islands within the Furneaux Group (Kershaw & Sutherland 1972), this is not the case on Inner Sister Island. Nothing comparable to the deep unconsolidated sandy piles that accumulated on the western slopes of Prime Seal Island from 38 ka onwards (Eberhard 2008) is found on Inner Sister Island. Admittedly, aeolian features are not entirely absent (the homestead is situated in the lee of a subdued transgressive dune) and aeolian sand may have been lost through other processes. Nevertheless the apparently limited extent of this class of sediment is curious. Linked to this is

the sparseness of calcarenite (limestone formed from lithified shell-rich sands); this rock type is otherwise common throughout the Furneaux Group.

The dominant element of the Quaternary geology of Inner Sister Island is gravelly colluvium derived primarily from the weathering and downslope movement of granite. Aprons of this material fan out on the lower slopes of the two principal hills and are truncated by marine erosion as they approach present sea level. This and the semi-lithified condition of the sediment, suggests a (probable late) Pleistocene age.

Coastal boulders. *Photo by Rolan Eberhard.*

CONCLUSIONS

The geodiversity of Inner Sister Island is relatively uniform and characterised by a limited suite of geological types, landforms and soils. Aspects of it are similar to other islands within the Furneaux Group. On the other hand Inner Sister also contains features which are particularly well developed, have potential for palaeoenvironmental studies or otherwise warrant consideration for listing in the Tasmania Geoconservation Database. These include aspects of the fabric of the granitic rock (mineral segregations) and the presumed Pleistocene colluvial fans.

Unlike Prime Seal Island, where highly erodible Quaternary sands are widespread and prone to deflation, Inner Sister Island is composed of more stable geological substrates, which has limited the effect of human activities on the geodiversity. On the other hand 15% of the coast formed in sandy materials, and have been identified as susceptible to erosion and significant recession due to sea level rise in response to greenhouse gas emissions (Sharples 2004). Qualitative observations during this survey suggest that this process may already be underway.

ACKNOWLEDGEMENTS

Input from Jason Bradbury on geological aspects was appreciated.

REFERENCES

Bowden, A.R. (1983) Relict terrestrial dunes: legacies of a former climate in coastal northeastern Tasmania. *Z. Geomorph*. N.F. 45: 153-174.

Dixon, G. (1996) *A reconnaissance inventory of sites of geoconservation significance on Tasmanian islands.* Report to Parks & Wildlife Service, Tasmania.

Eberhard, R. (2008) Geodiversity. In Harris, S., Driessen, M., and Bell, P. *Prime Seal Island Scientific Expedition 2008*. Hamish Saunders Memorial Trust, New Zealand, and Biodiversity Conservation Branch, DPIPWE, Hobart, Nature Conservation Report Series 09/3, pp. 11-25.

Kershaw, R.C. & Sutherland, F.L. (1972) Quaternary geomorphology of Flinders Island. *Records of the Queen Victoria Museum* 43: 1-28.

Lambeck, K. & Chappell, J. (2001) Sea level change through the Last Glacial Cycle, *Palaeoclimate* 292: 679-686.

Munro, R.A.A. (1978) Tasmanian Coastal Study; unpublished original 1:50 000 coastal geomorphology maps of Tasmania, Tasmanian Conservation Trust, Hobart (original maps held by Geodiversity Conservation Section, Nature Conservation Branch, DPIPWE, Hobart).

Murray-Wallace, C.V., & Goede, A. (1995) Aminostratigraphy and electron spin resonance dating of Quaternary coastal neotectonism in Tasmania and the Bass Strait Islands. *Australian Journal of Earth Sciences* 42: 51-67.

Sloss, C.R., Murray-Wallace, C.V. & Jones, B.G. (2007) Holocene sea-level change on the southeastern coast of Australia: a review. *The Holocene* 17:999-1014.

Sharples, C. (2004) *Indicative mapping of Tasmanian coastal vulnerability to climate change and sea level rise: explanatory report.* Report to the Department of Primary Industries, Water & Environment, Tasmania.

Sharples, C. (2006) *Data dictionary for the Tasmanian Quaternary Coastal Sediments digital polygon map version 4.0 (2006) (Tascoastsed_v4gda)*. Report to the Department of Primary Industries & Water, Tasmania.

The Gulch.

Photo by Rolan Eberhard.

Marine Habitats
of Inner Sister Island

Anthony Reid

The diversity of marine species observed around the coast of Inner Sister Island was very high. This is consistent with the character description for the Flinders Bioregion, where the diversity of fish and seaweed species is considered very high when compared with other Tasmanian marine bioregions. A high diversity of inshore fishes, mollusc shells and rock pool fauna were identified through targeted studies and opportunistic sampling. The targeted surveys uncovered many representatives from a variety of taxonomic classes, including Osteichthyes, Bivalvia, Gastopoda, Polyplacophora, Malacostraca, Cirripedia, Anthozoa and Asteroidia. Opportunistic observations also identified the presence of members of the Mammalian (Order Cetacea), Chondrichthyes, Echinoidia and Siphonophora classes. Given the relatively small sampling effort, the species diversity on the Island is considered to be relatively high and representative of the region.

INTRODUCTION

The strikingly different geological, ecological and biophysical histories experienced by Australian Marine environments, and the ongoing effects of dominant physical processes (e.g. winds, swell and tides) have together generated an amazing diversity of marine ecological communities. The attempt to classify and describe such diversity has resulted in the commonly used hierarchical classification system of large 'biogeographical provinces' and smaller 'bioregions'. A marine bioregion is a large area of the sea that, through the complex interaction of ocean currents, wave energy, seawater temperature, seafloor geology and geography, displays a distinct grouping or pattern of marine plant and animal communities and species (TPC 1997). A group of bioregions constitute a biogeographical province.

The Tasmanian coastline consists of three biogeographical provinces: (1) the Bassian bioprovince to the north west that supports warm and cool temperate fish species; (2) the south eastern bioprovince to the north east that includes the Furneaux and the Kent Groups of islands that supports species that are determined by warmer water that has penetrated down the east coast of Tasmania in the Eastern Australian Current; and (3) the Tasmanian bioprovince to the south that supports cold temperate species. In addition, the waters around subantarctic Macquarie Island are in the Insulantarctic bioprovince. Based on the distribution of plants and animals, the three bioprovinces are divided into nine broad Marine and Coastal Regionalisation of Australia (IMCRA) bioregions (Table 1) each with their own distinct characteristics.

Inner Sister Island, the island of study for the 2010 Hamish Saunders Memorial Island Survey Program falls within the Flinders bioregion of the Bassian province. The Flinders bioregion is characterised by a granitic coastline that is exposed to moderate to strong swells on the east-facing shores of Flinders Island and moderate to low swells elsewhere. It is further characterised by high tidal ranges, strong tidal currents, sandy beaches, with seagrass beds in shallow water (TPC 1997). The bioregion is also characterised by shallow reef systems dominated by a diverse array of seaweed species, particularly coralline algae and deeper reefs exhibiting sponges, sea whips and soft corals (TPC 1997). However, the Flinders Bioregion is most renowned for its regional affinities of fish and plant communities, where the diversity of fish and seaweed species is considered very high when compared with other Tasmanian marine bioregions. Given this, the fish communities and invertebrate communities were investigated using a variety of field techniques.

METHODS

Due to logistical restraints, the use of SCUBA diving to conduct surveys during the expedition was unrealistic. Therefore, all reconnaissance and surveys were restricted to the shallow sub-tidal and intertidal habitats of Inner Sister Island. The approach adopted involved a near shore reconnaissance of the reef fish species, beach scours for indications of local mollusc species, and qualitative surveys of randomly selected rock platforms and rock pools for invertebrates, fish and algae (Figure 1). This approach was considered likely to be most representative of the local marine faunal species. Additionally, opportunistic observations of species not recorded in the focussed surveys were also documented.

Table 1. Table illustrating the distinguishing characteristics of each of the Bioregions (from the State of the Environment Report 1997).

Bioprovince	Bioregion	Distinguishing biota
Bassian	Boags	presence of the seagrass *Posidonia australia*
	Otway	presence of species found in South Australian waters with significant similarities to intertidal invertebrate species at King Island and Cape Otway
	Flinders	regional affinities in the fish and plant communities
	Gippsland	shallow (<15m) reefs, encrusted by corralline algae and generally without macroalga; fish fauna from Victorian waters
Tasmanian	Franklin	low diversity compared with the rest of Tasmania
	Davey	distinct algal flora; low diversity of fish species
	Bruny	highest localised level of marine endemism in Tasmania (and probably Australia) leading to distinct reef and soft-sediment fauna assemblages
	Freycinet	several species, particularly fish, present there but not further south (fish include warm temperate species)
Insulantarctic	Macquarie	marine biota almost completely different from that found elsewhere in Tasmanian waters

Underwater Video Transects – Shallow Water Reef Fish Reconnaissance

To quantify the fish species richness of the shallow near-shore reef of the Island, underwater video transects were conducted along the 4 m depth contour at seven locations along the coastline. During the survey period, the island experienced strong winds, predominately from the North West, which precluded any successful video transects being undertaken on the far western side of the island (see Figure 1) due to reduced visibility in the shallows. Surveys were conducted in a timed swim manner, where each transect involved the collection of 10 minutes video footage. Consequently, transects were marginally different in length, but as the survey was designed as a presence/absence reconnaissance, and no effort was intended at determining species density data, this was not considered an issue. Species identifications were also recorded *in situ* as a validation method in the event that accurate species identification of fish was not achievable from the video footage alone. QA/QC of fish identifications was conducted using Edgar *et al.* (1982).

Figure 1. Map of Inner Sister Island detailing the locations of sampling sites.

Beach Wrack Surveys

All sandy foreshores were investigated for the presence of mollusc shells to gather information on the likely species present in the local vicinity. For all beaches other than Elbow Bay, the whole beach was traversed at the wrack line and shells collected and identified to species level (Figure 1). Some specimens were also collected and species identification verified with collections at the Tasmanian Museum and Art Gallery (TMAG) and in accordance with reference material provided by Grove (2011).

Rocky Foreshore and rock pool observations

A qualitative approach was used to sample the communities on rocky foreshores, both on exposed platforms and screes, together with those inhabiting rock pools. Communities occupying exposed platforms and screes were assessed qualitatively at 6 sites around the island (Figure 1, 2). These surveys were also complemented by opportunistic observations from other parts of the island. The surveys were intended to yield a basic description

Figure 2. An example of a coastal rock pool, 6 of which were surveyed for flora and fauna. Photo by Claire Taylor.

of species occupying the habitat(s) of interest, rather than a quantitative estimate of species diversity and abundance.

To quantify the species occupying shallow rock pools on the island, 6 rock pools were surveyed, predominately along the eastern and southern rocky intertidal areas of the island. As previously outlined, inclement weather conditions precluded the ability to conduct successful marine surveys on the far western side of the island (see Figure 1). The survey design for each rock pool involved initially taking a high resolution photo, then identifying first fish species (prior to disturbing the pool), then macro invertebrates (including mobile and sessile fauna) and finally the dominant algal species within the pool. Species identifications were recorded *in situ* and from photographs and depending on the size of the pool, surveys varied from 10 - 45 mins. The species within each of the pools was analysed separately and comparisons were made across the different areas of the island sampled.

RESULTS

The diversity of fauna species on around the island was very high. Despite a relatively low sampling effort, a total of 28 fish species (plus 3 opportunistic observations) was identified from the underwater surveys and 68 mollusc species were identified from the beach wrack surveys. Considerable diversity was also witnessed in the intertidal zones of the island, with molluscan, cnidarian, crustacean and echinoderm representatives, in addition to members from the three main algal groups - Phaeophyta, Chlorophyta and Rhodophyta.

Table 2. Fish species identified from the underwater video transects.

Species Name	Common Name
Atypichthys strigatus	Australian Mado
Apogon conspersus	Southern Cardinal Fish
Aracana aurita	Shaw's Cowfish
Arripis trutta	Eastern Australian Salmon
Caesioperca lepidoptera	Butterfly Perch
Caesioperca rasor	Barber perch
Cephaloscyllium laticeps	Draughtboard Shark
Cheilodactylus nigripes	Magpie Perch
Cheilodactylus spectabilis	Banded Morwong
Aplodactylus arctidens	Marble Fish
Enoplosus armatus	Old Wife
Girella zebra	Zebra Fish
Haletta semifasciata	Blue Weed Whiting
Latridopsis forsteri	Bastard Trumpeter
Meuschenia freycineti	Six-spined Leatherjacket
Meuschenia hippocrepis	Horseshoe Leatherjacket
Neoodax balteatus	Little Weed Whiting
Notolabrus fucicola	Yellow-saddled Wrasse
Notolabrus tetricus	Blue Throat Wrasse
Odax cyanomelas	Herring Cale
Parma victoriae	Scalyfin
Pentaceropsis recurvirostris	Long Snouted Boarfish
Pictilabrus laticlavius	Senator Wrasse
Sardinops neopilchardus, Sardinops sagax	Australian Sardine
Scorpis aequipinnis	Sea Sweep
Scorpis lineolata	Silver Sweep
Siphonognathus attenuatus	Slender Weed Whiting
Upeneichthys vlamingii	Southern Goatfish

Table 3. Mollusc species identified from the beach wrack surveys. The • symbol indicates presence at the relative beaches.

Mollusc Species	Northern Beaches	Southern Beaches	Mollusc Species	Northern Beaches	Southern Beaches
Acrosterigma cygnorum	•	•	*Haustrum vinosum*	•	
Amblychilepas javanicensis	•	•	*Hipponix australis*	•	
Argonauta nodosus	•	•	*Katelysia rhytiphora*	•	•
Astralium aureum	•		*Lasaea australis*	•	•
Austrocochlea porcata	•		*Limnoperna inconstans*	•	•
Austroginella johnstoni	•	•	*Macroschisma tasmaniae*	•	•
Austroginella muscaria	•	•	*Mactra (Austromactra) rufescens*	•	•
Austromytilus rostratus	•	•	*Mactra (Mactra) pura*	•	
Barbatia pistachia	•		*Maoricolpus roseus*	•	
Barbatia reticulata	•		*Merisca margaritina*	•	•
Barnea (Anchomasa) obturamentum	•		*Mimachlamys asperrima*	•	
Bembicium nanum	•		*Myllita (Myllita) tasmanica*	•	
Brachidontes erosus	•		*Notochlamys hexactes*	•	
Cellana solida	•	•	*Notocypraea angustata*	•	
Clanculus aloysii	•		*Notocypraea piperita*	•	
Clanculus flagellatus	•	•	*Paphies (Atactodea) cuneata*	•	•
Clanculus limbatus	•		*Patelloida alticostata*	•	•
Colpospira (Ctenocolpus) australis	•		*Patelloida profunda*	•	•
Cominella lineolata	•		*Phasianella ventricosa*	•	
Conus anemone	•		*Pseudarcopagia botanica*	•	
Dicathais orbita	•		*Pseudarcopagia victoriae*	•	
Diloma concamerata	•		*Scutus (Scutus) antipodes*	•	•
Divalucina cumingi	•	•	*Semipallium aktinos*	•	
Dosinia caerulea	•	•	*Sepia apama*	•	•
Electroma (Electroma) georgiana	•	•	*Serpulorbis sipho*	•	
Epicodakia tatei	•		*Siphonaria diemenensis*	•	
Equichlamys bifrons	•		*Solen (Solen) vaginoides*	•	
Fulvia (Fulvia) tenuicostata	•	•	*Tawera gallinula*	•	•
Gazameda gunnii	•		*Tawera lagopus*	•	•
Glycymeris (Glycymeris) radians	•	•	*Thalotia conica*	•	
Glycymeris (Veletuceta) grayana	•	•	*Timoclea (Chioneryx) cardioides*	•	
Granata imbricata	•		*Venericardia amabilis*	•	
Haliotis (Notohaliotis) rubra	•	•	*Venerupis (Venerupis) galactites*	•	
Haliotis (Schismotis) laevigata	•	•	*Vexillum australe*	•	
Haliotis rubra	•		*Wallucina assimilis*	•	•

Underwater Video Transects – Shallow Water Reef Fish Reconnaissance

Of the 28 fish species identified, the majority were carnivorous, likely feeding on small fish and / or invertebrates located within the reefs (Table 2). However, the Marble Fish (*Aplodactylus arctidens*) and Shaw's Cow Fish (*Aracana aurita*) are known to feeding directly on the reef algae. The majority of the species were local, in that they inhabit small patches of reef and rarely move large distances, although a few, such as the Australian Salmon (*Arripis trutta*) will travel much larger distances, and between different reefs.

Beach Wrack Surveys

Given the beach wrack surveys were essentially opportunistic observations of mollusc shells that had been washed up over time, it is difficult to identify a full array of species likely to inhabit the benthic habitats surrounding the island. The surveys do nonetheless provide some indication of the local mollusc species and allow some interpretation to be made as to the types of local mollusc communities. The surveys were conducted in a manner that allowed comparison of species found on the northern beaches (more exposed) and the southern beaches (more sheltered) (Table 3). While both the northern and south sides of the island shared similarities in the mollusc species, the northern beaches possessed a higher number of species (all 68 species). All species identified from southern beaches were also identified from those beaches in the North.

Rocky Foreshore and rock pool observations

The intertidal habitats of the island also exhibited relatively high species diversity across a number of taxonomic groups (Table 4). The more sheltered nature of the rock pools enabled the establishment of algal species as well as more mobile invertebrate fauna, whereas that exposed and extreme habitats

Table 4. Species of flora and fauna identified in intertidal habitat searches.

Rock Pool Species	Exposed rock platform species
Chlorophyta	Mollusca
Ulva australis	*Ischnochiton variegatus*
Codium fragile	*Ischnochiton cariosus*
Bryopsis vestita	*Phaxiphora albida*
Bryopsis gemellipara	*Chiton pelliserpentis*
Caulerpa brownii	*Nerita atramentosa*
	Bembicium nanum
Phaeophyta	*Nodilittorina unifasciata*
Dictyota dichotoma	*Siphonaria diemenensis*
Zonaria angustata	*Siphonaria tasmanica*
Hormasira banksii	*Xenostrobus pulex*
	brachidontes rostratus
Rhodophyta	*Patelloida alticostata*
Gloiosaccion brownii	*Austrocochlea porcata*
	Cellana solida
Cnidarians	
Actinia tenebrosa	Arthropoda
Aulactinia veratra	*Catomerus polymerus*
	Chthamalus antennatus
Arthropoda	*Leptograpsus veriegatus*
Catomerus polymerus	*Paragrapsus quadridentatus*
Chthamalus antennatus	
Palaemon serenus	
Machrobranchium intermedium	
Pagurixus handrecki	
Litocheira bispinosa	
Echinoderms	
pateriella calcar	
pateriella exigua	
Mollusca	
Clanculus flagellatus	
Turbo undatus	

of the platforms were dominated by mussels, limpets, periwinkles and barnacles (Table 4). Some rock pools contained many individuals of *Pateriella calcar,* a seastar species renowned for its polymorphic nature (Figure 3). It is not uncommon to find this species inhabiting rock pools, and it is likely a large contributor to the function of isolated rock pool communities.

Opportunistic observations

Opportunistic observations around the island also enabled identification of other marine species not identified in the targeted surveys. Among a plethora of invertebrate species witnessed subtidally, the southern rock lobster (*Jasus edwardsii*), eastern rock lobster (*Jasus verreauxi*), red bait crab (*Plagusia chabrus*), blacklip abalone (*Haliotis (Notohaliotis) rubra*), greenlip abalone (*Haliotis (Schismotis) laevigata*), trumpet shell (*Cabestana spengleri*), longspined sea urchin (*Centrostephanus rodgersii*), common urchin (*Heliocidaris erythrogramma*), seastar (*Nectria ocellata*) were the most conspicuous.

Figure 3. Pateriella calcar *specimens clearly displaying the polymorphic abilities that the species is renowned for. Photo by Asher Jones.*

During a scouting snorkel for suitable transect sites, amazing views of a huge 2 m ornate wobbegong (*Orectolobus ornatus*), a similarly large (~750 mm) eastern blue groper (*Achoerodus viridis*) a green moray eel (*Gymnothorax prasinus*) and a draughtboard shark (*Cephaloscyllium laticeps*) (Figure 4) were also obtained. Further, a small pod of whales were observed in the distance from the south eastern edge of the island. Inspection of the dorsal fin indicated that it was likely to be a small pod of killer whales (*Orcinus orca*) although the distance of observation precluded definitive identification.

Perhaps one of the most spectacular sites from a marine perspective came after huge easterly swells and wind washed millions Portuguese Man o'War (*Physalia physalis*), or bluebottles ashore. The southern beaches at the wrack line, along with the majority of rock crevices were covered in numerous individuals (Figure 5) and often layers deep in places.

*Figure 4. A view down the throat of a 1 m Draughtboard Shark (*Cephaloscyllium laticeps*), which was opportunistically sampled from House Beach.* Photo by Asher Jones.

DISCUSSION

The overall diversity of marine species around Inner Sister Island was found to be very high. This observation is consistent with the character description for the Flinders Bioregion, which is most renowned for its regional affinities of fish and plant communities, where the diversity of fish and seaweed species is considered very high when compared with other Tasmanian marine bioregions (TPC 2009). The reefs on the southern side of the island are dominated by granite boulders and outcrops, covered in a diverse array of brown and green algae, particularly *Phyllospora comosa*. The complexity of the reefs supports an abundance of small fish species such as *Caesioperca lepidoptera, Caesioperca razor* and *Siphonognathus attenuatus* using the interstices between and under rocks as well as more labile species such as *Latridopsis forsteri* and *Arripis trutta*. The species of fish observed at the island was similar to those identified by Barrett and Edgar (2004) who sampled the southern side of mainland Flinders Island. The northern aspect of the island was more exposed and while boulders, outcrops and ridges were present, due to the exposure, dense algal beds were much deeper (approx 6-8 m). The shallows were dominated by filamentous algae and areas of bare rock. While the majority of fish species were identified in the transects on the southern sides of the island, the most impressive specimens, including old wives (*Enoplosus armatus*), ornate wobbegong (*Orectolobus ornatus*) and a green moray eel (*Gymnothorax prasinus*) were observed on the north eastern reefs. Edgar *et al.* (1995) also observed more fish species in the passage than on the outside of Inner Sister Island in single transects conducted at each location.

*Figure 5. An accumulation of Portuguese Man o' War (*Physalia physalis*) on House Beach.* Photo by Asher Jones.

The mollusc diversity found on the shores was also considerably high. While both the northern and south sides of the island shared similarities in the mollusc species, the northern beaches possessed a higher number of species (all 68 species). All species identified from southern beaches were also identified from those beaches in the north. Moreover, all 68 species identified from the beach wrack surveys have been recorded from other nearby localities, such as Killiecrankie Bay (unlocalised) and Killiecrankie foreshore (Grove, 2011). It must be noted though, that while the beach wrack surveys allow some level of species identification of mollusc species from the region, they in no way represent a census of the species. None-the-less, the species diversity observed on Inner Sister Island can be considered to be quite high.

The species identified in rock pools, on rock platforms and during general reconnaissance snorkels also provided important observations on the diversity of flora and fauna from the Island. Certainly some observations, such as the ornate wobbegong (*Orectolobus ornatus*), green moray eel (*Gymnothorax prasinus*) and eastern blue groper (*Achoerodus viridis*), not only provided some spectacular sites, but may also be some of very few observations of these

species from the region. The mass scale beaching of millions of Portuguese Man o'War (*Physalia physalis*) was also a spectacular site. The interesting thing about this species is that despite its appearance, it is not a true jellyfish but a siphonophore, which differ from jellyfish in that they are not actually a single creature, but a colonial organism made up of many minute individuals (Edgar 1997). Although each of these individuals is structurally similar to other solitary animals, they are physiologically dependent on one another for survival. Each of these individuals are highly-specialized, with some explicitly undertaking food capture, others digestion, others reproduction and others in buoyancy control (producing the float) (Edgar 1997). Portuguese Man o'War is a common inhabitant of warm oceans, floating passively on the surface using its air bladder as a floatation device. It has no means of self-propulsion and is entirely dependent on winds, currents, and tides, and therefore mass strandings like the one observed at Iner Sister Island are not uncommon during rough weather conditions.

The diversity of the marine habitats of Inner Sister Island was nothing short of impressive. In the past, management of such diversity has been targeted through the use of Marine Reserves or Marine Protected Areas (MPAs). While marine reserves are a useful management tool, factors including spatial and temporal connectivity, and the specific design objectives of a MPA mean that careful planning and development of strong baseline information is paramount to designing an effective system of MPAs. Certainly the latter precludes any suggestion that Inner Sister Island deserves to be incorporated into an MPA, or moreover, that it requires any marine management at all. There are certainly a number of high diversity locations within the Furneaux Group, and other areas of Bass Strait (Barrett and Edgar 2002, DPIPWE 2000, Edgar *et al.* 1995), but whether any of these locations meet the criteria for development of an MPA remains to be fully assessed.

REFERENCES

Barrett, N.S. & Edgar, G.J. (2002) *A survey of potential marine reserve locations in Bass Strait.* Technical Report. Marine Research Laboratories, Tasmania.

Edgar, G.J., Last, P.R. & Wells, M.W. (1982) *Coastal Fishes of Tasmania and Bass Strait.* Cat & Fiddle Press, Hobart.

Edgar, G.J. (1984a) General features of the ecology and biogeography of Tasmanian rocky reef communities. *Papers and Proceedings of the Royal Society of Tasmania* 118:173-186.

Edgar, G.J. (1984b) *Marine Life and Potential Marine Reserves in Tasmania. Part 2.* National Parks and Wildlife Service, Tasmania, Occasional Paper No.7.

Edgar, G.J., Moverley, J., Peters D. & Reed C. (1995) *Regional Classification of Tasmanian Coastal Waters and Preliminary Identification of Representative Marine Protected Area Sites.* Report to Australian Nature Conservation Agency. Parks & Wildlife Service, Department of Environment & Land Management, Hobart, Tasmania.

Edgar, G.J. (1997) *Australian Marine Life: Plants and Animals of the Temperate Waters.* Reed Books, Victoria Australia.

Department of Primary Industries, Water and Environment, Tasmania (2000) *Tasmanian Marine Protected Areas Strategy: Background Report.*

Grove, S.J. (2011) *A Guide to the Seashells and other Marine Molluscs of Tasmania web-site and database*

Sustainable Development Advisory Council (1996) *State of the Environment Tasmania, Volume 1 - Conditions and Trends*, compiled by the State of the Environment Unit, Land Information Services, Department of Environment and Land Management, Tasmania.

Bursaria *woodland.*

Photo by Stephen Harris.

Present Vegetation

of Inner Sister Island with notes on Threatened and Biogeographically Significant Species

Micah Visoiu

The present survey resulted in identification and re-mapping of 13 TASVEG mapping units (Harris & Kitchener 2005). These are '*Allocasuarina verticillata* forest (NAV)'; 'Coastal scrub (SSC)'; 'Coastal scrub on alkaline sands (SCA)'; '*Bursaria – Acacia* woodland and scrub (NBA)'; '*Melaleuca ericifolia* swamp forest (NME)'; 'Lowland *Poa labillardierei* grassland (GPL)'; 'Coastal grass and herbfield (GHC)'; 'Lowland Grassland (GCL)'; 'Seabird rookery complex (SRC)'; '*Pteridium esculentum* fernland (FPF)'; 'Lacustrine herbland (AHL)'; 'Weed infestation (FWU)' and 'Lichen lithosere (ORO)'. Four of these are listed as threatened communities. Twenty eight taxa were recorded for the first time on the island bringing the known flora to 204 species including, ten listed threatened species. A number of lichen species were also identified, two of which have biogeographic significance. Population data on the threatened species and biogeographically significant species has been provided.

INTRODUCTION

The arrival of Europeans on the Bass Strait Islands in the late 18th and early 19th century portended the start of huge environmental changes on the majority of Furneaux Islands including Inner Sister Island (Harris *et al.* 2001, Harris and McKenny 1999). The vegetation on these outer islands had, up until this time, developed in the absence of human influence for thousands of years. Since European arrival, fire has been the most significant shaping influence on the vegetation. Clearing through burning and then the grazing of livestock has been a use of the island for well over a century, with the family of the present lessees having taken over management in 1884 (DPIWE 2001). The first vegetation map of Inner Sister Island was published in 2001 (Harris *et al.* 2001) as part of a volume that described and mapped the vegetation of islands in the Outer Furneaux Group.

In the first half of the 19th century the island was visited by at least one naturalist, namely J. Milligan whose specimen of *Sicyos angustissimus* (now *S. australis*) is lodged at the Tasmanian Herbarium (Tasmanian Herbarium data 2011). The first vascular plant survey for the island was compiled in the 1960s (Whinray 1972). In this paper it is stated that over 200 taxa were observed on the island however no complete list is given with less than 50 species mentioned in the text. A species list of 150 taxa resulting from a thorough ground survey was produced by Harris *et al.* (2001). Combining the lists and comparing them with other records held on the Natural Values Atlas (NVA 2011) provided a total known flora of 164 taxa, including 51 exotic taxa and two Tasmanian endemics.

Prior to the current survey six or possibly seven species listed under the Tasmanian *Threatened Species Protection Act 1995* (TSPA 1995) had been recorded from the island, all with only limited population data. These are *Cotula vulgaris* var. *australasica, Sicyos australis, Cyrtostylis robusta, Sporobolus virginicus,*

Parietaria debilis, and the lichen *Teloschistes flavicans*, the seventh possible species is *Eucalyptus globulus* subsp. *pseudoglobulus*. The uncertainty in this case lies in the taxonomy of the trees in question which have been variously identified as subsp. *globulus*, subsp. *bicostata* (Harris *et al.* 2001) and subsp. *pseudoglobulus* (TSPA 1995, rare)

The extensive ground survey work on the island during the 2010 expedition provided an invaluable opportunity to update the vegetation mapping and describe the communities. A search was made for new plant records for the island and an assessment made of the extent and numbers of threatened species and species of biogeographic significance.

METHODS

Historical air photos were used to gain an insight into changes in vegetation since the 1950s.

During the time on the island the ground was covered extensively by walking. Composition of floristic communities was noted at representative sites. Vegetation extent and boundaries were subsequently mapped using a variety of remotely sensed imagery. The most recent aerial photography (2003) was at 1: 42, 000 scale, the only 1:24, 000 coverage was black and white and was taken in 1951. Various satellite coverages held by DPIPWE post-date this and in several cases gives high enough resolution to allow accurate vegetation mapping. SPOT 5 natural colour imagery (ground resolution = 2.5 m) was found to be the highest resolution and most up to date (2009) imagery of the island. Using ArcMAP 9.3 this imagery was used in conjunction with ground observations and landscape photographs taken during the field trip to map the present vegetation mosaic. The resulting vegetation map was intersected with the bird rookery spatial data (Carlyon *this publication*) to give an accurate spatial cover for the *Seabird rookery complex* (SRC) vegetation mapping unit. The vegetation mapping units used are those described by Harris & Kitchener (2005).

A search was made along the walked transects, for new plant records for the island. Flora species were noted and threatened species and species deemed to be of biogeographic significance were collected along with relevant population data.

Nomenclature follows Baker & Duretto (2011).

RESULTS

Vegetation

Aerial photographs taken in the early 1950's show that woody vegetation at that time covered probably less than 10% of the island. More recent aerial photographs show that the cover of woody vegetation on the island has increased in the last 50 years to presently cover around 25% of the Island. It would appear from the available aerial photographs (1951, 1974, 1982, 1986, 1993, and 2003) that the vegetation is quite dynamic. The development from grassland to scrub and forest is rapid. An apparent reduction in the extent of sheep grazing on the island in recent years along with an associated reduction in burning of some areas has resulted in an increase in the cover of scrub communities on the northern side of the island.

The floristic communities have been described separately and shown in Figure 1.

Community Descriptions And Relation To TASVEG Mapping Units

The vegetation on Inner Sister has been categorised here into 13 TASVEG mapping units (Harris & Kitchener 2005). Within several of these mapping units there is more than one facies.

***Allocasuarina verticillata* forest (NAV)**

The high fire frequency on the island since European discovery has no doubt reduced the cover of trees

on the island. In 1951 *Allocasuarina verticillata* forest appears to be localised on East Hill with possible trees also present in the three other wooded areas, these being The Elbow, the north east coast and the northern slopes of West Hill. The species still persists at all of these sites. On the northern side of West Hill there are three small patches totalling less than two dozen mature trees and a few hundred square metres in extent. The Elbow supports a small patch of short regrowth trees, while a handful of trees survive on the north east coast. The largest areas of *Allocasuarina verticillata* forest on the island are on the summit of East Hill where some mature forest persists along with some re-growth which appears to be expanding in extent and invading tussock grassland. All the sites in which the forest occurs are in areas with some natural protection from fire.

In the long undisturbed areas on East Hill *A. verticillata* forest is 5-7 metres tall, where some of the more mature of which are beginning to break down allowing regeneration into the canopy gaps. The shrub layer is well developed with *Boronia anemonifolia* dominant; *Acacia mucronata, Monotoca elliptica* and *Pultenaea daphnoides* also present. The ground layer comprises mats of dense litter, with occasional *Senecio* species and other herbs. Although not surveyed the small remnants of *Allocasuarina verticillata* forest

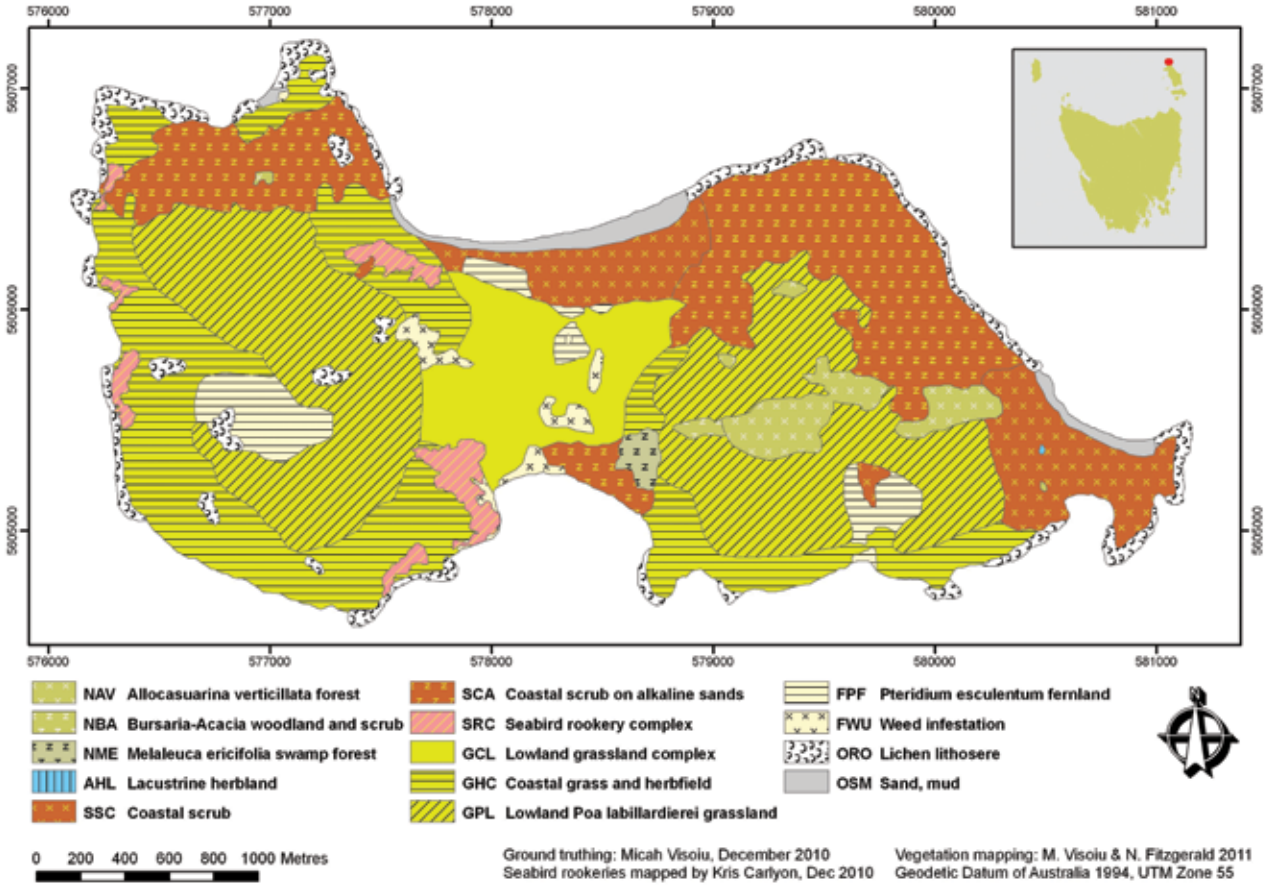


Figure 1. Vegetation of Inner sister Island

on the north slopes of West Hill appeared from a distance to be similarly mature with a well developed shrub layer.

The regenerating areas of *Allocasuarina verticillata* forest on East Hill (Figure 2) and at The Elbow (Figure 3) are very dense stands of even aged *Allocasuarina* 2-4 metres high with few or no other species present. In these areas the plants are so close together that walking through them is difficult. These areas have developed after fire has triggered mass germination events in areas which may have supported a handful of mature trees in the past.

Coastal scrub (SSC)

The scrub communities on the Bass Strait Islands can be troublesome to assign to TASVEG mapping units. This is a factor of species presence or absence on these islands resulting in some unusual species associations. Coastal scrub (SSC) on Inner Sister Island is at its most extensive at The Elbow on the eastern tip

Figure 2. Allocasuarina verticilata *regeneration in* Poa labillardierei *tussock grassland on East Hill.* *Photo by Micah Visoiu.*

of the island however small areas of similar vegetation occur around the coast within areas of *Myoporum insulare* dominated scrub which fit better into the category Coastal scrub on alkaline sands (SCA).

The Coastal scrub (SSC) on Inner Sister Island is associated with shallow sands overlying granite bedrock and some small dune areas. The vegetation is a mosaic of dense patches of alternating dominant species which is evidently an artefact of germination events associated with fire. *Leptospermum scoparium, L. laevigatum, Olearia ramulosa, Melaleuca ericifolia, Monotoca elliptica, Leucopogon parvifolius* variously dominate. Associated species which are present but never achieve dominance are *Correa alba, Exocarpos strictus* and *Bursaria spinosa.* Where thinning in the scrub allows a herbaceous layer *Pteridium esculentum, Lepidosperma concavum* and the occasional tussock grass occur. The community ranges between 1.5 and 2.5 metres in height. It is likely that in the absence of fire this community would develop away from the tight mosaic of monospecific stands.

Figure 3. Mosaic of coastal scrub facies on The Elbow, with Allocasuarina verticillata *regeneration.* Photo by Micah Visoiu.

Coastal scrub on alkaline sands (SCA)

The Coastal scrub on alkaline sands (SCA) incorporates much of the woody vegetation on Inner Sister Island. Since 1951 this vegetation type has increased significantly in extent, and represents the first woody vegetation to recolonise in the absence of fire over much of the island. Coastal scrub on alkaline sands (SCA) occurs extensively on the north east and north west coasts as well as behind House Beach. The scrub typically occurs on limey sands and at present generally occurs on northerly aspects; however this is likely to be an artefact of local fire effects.

The Coastal scrub on alkaline sands (SCA) unit has been applied to areas of *Myoporum insulare* scrub where it has started to invade tussock grassland. In these areas *Myoporum* shrubs occur with a cover of around 50% with *Poa labillardierei* or *P. poiformis* forming a dense ground layer. Herbaceous species such as *Acaena novae-zelandiae, Wahlenbergia* sp. and *Senecio* sp. occur sporadically. As it develops *Pimelea serpyllifolia* often forms a shrub layer with occasional other species including *Olearia phlogopappa, Leptospermum laevigatum* and *Olearia axillaris. Beyeria lechenaultii,* which is a typical component of this mapping unit on other islands in the Furneaux Group is apparently highly restricted on Inner Sister Island and was only seen around the eastern end of North Beach. The understorey of the community is usually grassy, with *Poa poiformis* the most common species along with occasional herbs. On the slopes of North Hill the herbaceous scrambler *Sicyos australis* is common, and forms dense mats in openings.

On the lower north western slopes of West Hill *Olearia axillaris* becomes dominant with over 80% cover. This is an unusual community in Tasmania, where this species is usually a scattered shrub in dune vegetation.

Bursaria – Acacia woodland and scrub (NBA)

Bursaria – Acacia woodland and scrub (NBA) occurs on the northern side of the gully running down towards the homestead from East Hill. In this area large flat topped trees of *Bursaria spinosa* form a woodland canopy over *Poa poiformis* and *P. labillardierei* tussock grassland with an assortment of occasional herbs. This differs from the typical *Bursaria – Acacia* woodland and scrub (NBA) facies on mainland Tasmania in grassland type and geology. The Inner Sister Island example is no doubt a disturbance artefact, and has resulted from the combination of the limited species present on the island and continuous firing depleting the soil seed bank in the area.

Melaleuca ericifolia swamp forest (NME)

Melaleuca ericifolia swamp forest (NME) includes the *Melaleuca ericifolia* scrub community that precedes the forest community. On Inner Sister Island *Melaleuca ericifolia* is quite widespread and forms monoculture scrub communities in a few places. The most extensive area is behind House Beach and up the gully which runs up East Hill. It is also likely that some of the small *Melaleuca ericifolia* dominated patches at The Elbow which have been mapped within Coastal scrub (SSC) will expand in the future.

In the area behind House Beach the *Melaleuca ericifolia* scrub is characterised by a dense canopy of *M. ericifolia* with very occasional *Leptospermum laevigatum.* The understorey is relatively open with fine litter covering the ground and abundant tussocks of *Poa labillardierei.* The threatened herbs *Sicyos australis* and *Solanum opacum* are the only two understorey plants observed and were only occasional. This lack of diversity is typical of the scrub facies of *Melaleuca ericifolia* swamp forest (NME) as a whole, however the prevalence of tussock grass is unusual and possibly an artefact of the relatively dry nature of this site in comparison to more characteristic sites.

Lowland *Poa labillardierei* grassland (GPL)

Lowland *Poa labillardierei* grassland (GPL) was found to be extensive on the island occupying the slopes and summits of the hill on the east and west of the island. This along with much of the other grassland on the island is a disclimax community which has been created through constant firing of the vegetation over the years. It is likely that the elimination of woody plant seeds out of the soil seed bank has now been achieved over much of the grassland area which is further reinforcing the disclimax.

Poa labillardierei grassland on Inner Sister Island is characterised by a dense sward of *Poa labillardierei* usually with nearly 100% cover with occasional *Austrodanthonia* species. On the tops of the hills common herbs that are often present are *Wahlenbergia* sp. *Acaena novae-zelandiae, Microtis uniflora, Epilobium sarmentaceum* and *Centaurium erythraea.* On the south facing slopes the grassland is more herb rich with grass cover down to ~70% and the above mentioned herbs joined by *Pteridium esculentum, Dianella brevicaulis, Carpobrotus rossii, Muehlenbeckia adpressa, Sambucus gaudichaudiana* and *Apalochlamys spectabilis.* These herb rich southern slopes, particularly on East Hill appear to be on the way to re-colonisation by woody species with occasional *Acacia longifolia* subsp. *sophorae* and *Olearia axillaris* beginning to appear.

The facies of Lowland *Poa labillardierei* grassland (GPL) on Inner Sister Island differs from the more typical types on mainland Tasmania in that it has a more coastal suite of herbaceous species. These species associations are shared with the *Poa poiformis* facies of Coastal grass and herbfield (GHC).

Coastal grass and herbfield (GHC)

Coastal grassland and herbfield is widespread along the coastal margins of Inner Sister Island where it is primarily located on coastal sands which are cemented in areas of the north west and west coasts. There are two main facies represented in this mapping unit, both with similar closed tussock grassland structure. The first and most widespread facies is characterised by large tussocks of *Poa poiformis* with varying amounts of *Austrodanthonia* sp. present in the inter-tussock spaces and occasional herbs. This facies is extensive around the lower slopes of the hills and also through the saddle in the middle of the island. In places there are extensive infestations of herbaceous weeds, including annual weed grasses such as *Parapholis incurva, Rostraria crinita, Vulpia* and *Bromus* species, and the extensive areas of the slender thistle, *Carduus tenuiflorus.* This *Poa poiformis* grassland is common on the Bass Strait islands being a fire disclimax over most of its range (Harris *et al.* 2001).

The second facies on the Inner Sister Island is closed *Austrostipa stipoides* tussock grassland which is the predominant type of the cemented sands on the north west and west coasts. There are few other species present in this community, with the most prevalent being an interesting, somewhat fleshy form of *Senecio linearifolius, Rhagodia candolleana* and *Euphorbia paralias* which has invaded in some areas.

Less common facies of the Coastal grass and herbfield (GHC) that occur in small areas in the dune systems behind House Beach and North Beach are *Lepidosperma gladiatum* sedgeland and sand binding communities that are variously dominated by *Spinifex sericea, Austrofestuca littoralis* or *Ammophila arenaria* subsp. *arenaria.*

Lowland grassland complex (GCL)

The flat area in the centre of the Island, previously noted to be exotic grassland and improved pasture (Harris *et al.* 2001, Whinray 1972), can now more accurately be included in the mapping unit Lowland grassland complex (GCL). In the past the area has been described as dominated by mostly introduced annual grasses with clover species and native wallaby grasses noted as present (Whinray

1972). The present composition of the grassland is up to 70% cover of native *Austrodanthonia* species, predominantly *A. racemosa* with lesser amounts of *A. penicillata*. Other native grasses occurring in this community are *Austrostipa flavescens, Dichelachne crinita, Elymus scaber, Poa labillardierei* and *P. poiformis*. Annual weed grasses are very common in places with *Catapodium rigidum, Lagurus ovatus, Poa annua, Vulpia* spp. *Aira caryophyllea* and *Bromus* spp. all widespread. Native herbs which are scattered throughout include *Cymbonotus preissianus, Dichondra repens, Oxalis perennans* and *Carex inversa*. Introduced herbs including *Acetosella vulgare, Galium murale* and *Polycarpon tetraphyllum* are also widespread. In areas of high disturbance extensive infestations of slender thistle – *Carduus tenuifolius* occur as do lesser infestations of horehound – *Marrubium vulgare* and spear thistle - *Cirsium vulgare*. This composition is a result of high grazing pressure, past clearing and possibly fertiliser application. The community is not dissimilar to other disturbance induced grasslands in coastal areas of Tasmania.

Seabird rookery complex (SRC)

Seabird rookery complex (SRC) occurs in several locations on Inner Sister Island (Carlyon, this publication). The relatively low density of bird burrows in these rookeries has meant that there is very little in the vegetation to differentiate it from the surrounding type. Nearly all of the *Austrostipa stipoides* tussock grassland (Coastal grass and herbfield – GHC) encountered on the island was occupied by sparse bird rookery, with both Short tailed shearwaters and Little penguin burrows prevalent in the community. Extensive areas of the *Poa poiformis* facies were also occupied by bird rookery. In the *Poa poiformis* rookery slender thistle was the most wide spread disturbance species, although *Rhagodia candolleana* also occurred in some areas.

Pteridium esculentum fernland (FPF)

On the southern slopes of East Hill *Pteridium esculentum* fernland occurs, predominantly in the area of Nettle Gully. Other small areas can be found in the dune swales behind North Beach and on West Hill. In these areas *Pteridium esculentum* has invaded areas previously cleared by fire. *Pteridium esculentum* dominates with close to 100% cover. This is a typical community of disturbed sandy areas throughout Tasmania (Harris *et al.* 2001, Harris and Kitchener 2005).

Lacustrine herbland (AHL)

There is a small wetland on The Elbow which can be mapped as Lacustrine herbland (AHL), Other areas of similar vegetation occur in small soaks around the coast, however these areas are too small to map. At the wetland on The Elbow there is a shortly cropped marsupial lawn which is dominated by *Lilaeopsis polyantha, Neopaxia australasica, Isolepis platycarpa, Schoenus nitens* and *Sporobolus virginicus*. The inundated centre of the wetland contained the same suite of species and also a small amount of *Crassula natans* and *Ruppia* sp. At other areas around the coast, these species also occur often with others such as *Lemna minor, Limosella lineata* and *Distichis distichophylla*. The composition of these communities is consistent with similar communities in coastal lacustrine herbfields elsewhere in Tasmania.

Weed Infestation (FWU)

There are weeds present in various places on Inner Sister Island. The only mappable weed infestations are african boxthorn – *Lycium ferocissimum* and yellow horned poppy – *Glaucium flavum*. *Lycium ferocissimum* is a very widespread weed on the Furneaux Islands, forming large dense stands on numerous islands. On Inner Sister Island the species is at its most widespread around the saddle at the centre of the island, with extensive infestations around the homestead and House Bay, with large scattered plants around the coast of the island. The understorey is usually limited

or absent in this community however occasional tussock grasses and *Rhagodia candolleana* occur.

The *Glaucium flavum* infestation occurs along the northwest coast of the island where it has invaded Coastal grass and herbfield (GHC) just above the high tide mark. In these areas it is growing with *Rhagodia candolleana, Carpobrotus rossii, Atriplex cinerea,* and *Euphorbia paralias.* This is the only known infestation of this weed in Tasmania to have achieved a mappable size.

Lichen lithosere (ORO)

Granite outcrops and sheets occur extensively on the hill and around the coast of Inner Sister Island. These areas are mapped as Lichen lithosere (ORO). Only limited observations were made of the lithophytic lichen flora on the island; however it was noted that fire has had a significant effect on the communities on many rock faces, particularly on West Hill. In fire-protected areas the lichen flora appears to be diverse and well developed.

Stephen Harris examines a new locality for Sicyos australis. *Photo by Sally Bryant.*

FLORA

An updated vascular plant species list for Inner Sister Island is located in Appendix one. It contains 204 taxa which include 62 introduced species and 142 native taxa of which 3 are endemic to Tasmania. Twenty eight species were recorded for the first time on Inner Sister Island during the 2010 survey, 22 of these were indigenous Tasmanian taxa, while 6 were exotics that have become naturalised in Tasmania. Several lichen species were also recorded.

Populations of seven threatened species were located during the 2010 survey; three other species have been recorded from the island in the past but were not located during the 2010 survey. Five species of biogeographic interest within the Furneaux Islands were also observed. The species for which population information is described are summarised in Table 1.

Notes on threatened species and biogeographically significant species (see Appendix for conservation status).

Asperula minima **(RUBIACEAE)**

Asperula minima is a tiny herb rarely exceeding 5 cm high, commonly forming small dense moss like cushions. The species also occurs in Victoria where it is listed as rare. In Tasmania it is distributed predominantly around the northeast with other occurrences in the Furneaux Islands on Badger, Vansittart and Flinders (Harris *et al.* 2001). Its small size means it could be under-reported.

The observation of this species on Inner Sister during the 2010 survey was the first record from the island. Two small populations were observed; the largest of these was amongst granite boulders in *Poa labillardierei* tussock grassland near the summit of West Hill. The fire regime appeared to be regular in this area, with many of the boulders being fire scarred. The population of *Asperula minima* occupied an area of three by three metres and was growing

predominantly on the burnt tussocks amongst the re-sprouting blades and at the base of tussocks and boulders. The population was estimated at 300 +/- 20%. Despite extensive surveying of similar areas on West Hill this was the only population observed at this locality. The second smaller population was found on a small cliff of cemented sand at the base of the Nettle Gully drainage line, just above the coastal rocks. At this site less than 50 plants occupied a one by one metre section of southerly facing cliff face, growing in association with *Galium australe* and *Plantago bellidioides*.

Cotula vulgaris var. *australasica* (ASTERACEAE)

Cotula vulgaris var. *australasica* is a small prostrate annual herbaceous button coastal daisy rarely more than a few centimetres high. It occurs from the Nullarbor coast in South Australia east along the Victorian coast and reaches its most easterly distribution in the Furneaux Islands. It is not

Table 1. Plant taxa for which population distributions and estimates were determined.

Threatened taxa	Common name	Family	Distribution	Status
Asperula minima	mossy woodruff	RUBIACEAE	VIC, TAS	Rare
Cotula vulgaris var. *australasica*	slender buttons	ASTERACEAE	SA, VIC. TAS	Rare
*Cyrtostylis robusta**	large gnat-orchid	ORCHIDACEAE	WA, SA, VIC, TAS	Rare
Eucalyptus globulus subsp. *pseudoglobulus*	gippsland blue gum	MYRTACEAE	SA, VIC, NSW, TAS	Rare
*Parietaria debilis**	shade pellitory	URTICACEAE	All states	Rare
Sicyos australis#	star cucumber	CURCURBITACEAE	QLD, NSW, VIC, TAS	Rare
Solanum opacum#	green berry nightshade	SOLANACEAE	QLD, NSW, VIC, SA, TAS	Endangered
Sporobolus virginicus	salt couch	POACEAE	all states	Rare
Teloschistes flavicans#	Golden hair lichen	TELOSCHISTACEAE	QLD, NSW, TAS	Rare
*Zygophyllum billardierei#**	coast twinleaf	ZYGOPHYLACEAE	WA, SA, VIC, TAS	Rare
Taxa of biogeographic significance				
*Callitris rhomboidea**	oyster bay pine	CUPRESSACEAE	SA, VIC, NSW, QLD, TAS	
Crassula natans#	floating stonecrop	CRASSULACEAE	WA, SA, VIC, TAS	Naturalised
Glaucium flavum#	yellow horned poppy	PAPAVACEAE	SA, VIC, TAS	Naturalised
Pseudocyphellaria aurata#	sometimes referred to as specklebelly lichens	LOBARIACEAE	QLD, NSW, VIC, TAS	
Threlkeldia diffusa#*	coast bonefruit	CHENOPODIACEAE	WA, SA, VIC, TAS	

* Taxa that were not observed during the survey
# Taxa with highly restricted distributions within Tasmania

threatened in South Australia or Victoria. Within Tasmania it is found in saline soaks and rock plates in close proximity to the coast along the north and east coasts and on numerous Bass Strait Islands.

Cotula vulgaris var. *australasica* was recorded on Inner Sister Island by Whinray (1972) and Harris *et al.* (2001), although no population estimates were made at these times. During the 2010 survey the species was only seen at one location just east of the outflow of the Nettle Gully drainage line. At this site *C. vulgaris* var. *australasica* was growing in a wet soak at the top of the granite outcropping along the coast. At this site less than 10 plants were growing in a small one by one metre area along with *Lilaeopsis polyantha* and *Isolepis* sp. Time constraints meant that only limited targeted searching could be conducted for this species. Although no other populations were located there appeared to be numerous small areas of suitable habitat scattered right along the south coast of the Island.

Cyrtostylis robusta (ORCHIDACEAE)

A herbarium specimen from an unrecorded collector assigned to Inner Sister Island from 1969 is held at the Tasmanian Herbarium. This specimen, which has been re-determined from *Acianthus reniformis* to *Cyrtostylis robusta,* presumably originated from the collections of J. Whinray who recorded orchids as only being present in the sand ridges around South Bay (Whinray 1972). The species was not observed in 2010; however this small orchid occurs in discreet patches that could easily have been overlooked. The timing of the survey was also slightly late for this species. It is likely that the species could be relocated with targeted surveys at a suitable time of year.

Eucalyptus globulus subsp. *pseudoglobulus* (MYRTACEAE)

Eucalyptus globulus occurs in Tasmania and Victoria and the southern edge of New South Wales; however it has been planted far more widely throughout Australia and the world. The subspecies *pseudoglobulus* (sometimes regarded as a distinct species) occurs in the coastal ranges of eastern Victoria and far southern New South Wales.

On Inner Sister Island there is a single stand of three large trees at the back of the dunes of House Beach. These three trees are all close enough to touch crowns, and are evident on aerial photographs as far back as February 1951. The trees are all around 60-70 cm in diameter and are widely branched nearly from the base with a decumbent growth habit. One of the trees in particular has two massive branches which grow down into the ground before emerging again and extending out horizontally. None of the three exceed 6 metres in total height; however they nevertheless give the impression of great age. There is evidence on all trees of the death of large branches in the past and epicormic growth is thick on some wind scarred branches, it is therefore reasonable to say the exposed situation is a limiting factor. Despite the obvious signs of stress, in 2010 the trees looked to be in good health with two out of the three fruiting heavily and the third also fruiting to a lesser extent. Despite the obvious surfeit of seed there is no evidence of present or past regeneration. The trees are growing in sand with only limited organic matter which would increase the likelihood of germinant death by desiccation. The high grazing pressure would also make regeneration difficult in this area.

Parietaria debilis (URTICACEAE)

Parietaria debilis was recorded on Inner Sister Island in the 1960's (Whinray 1972) and again in 1986 (Harris *et al.* 2001) No population estimates were made of this species at these times. The species was not observed on Inner Sister Island in 2010. This is not unexpected as it is an inconspicuous species which is commonly localised in its distribution. It is expected that *Parietaria debilis* is present in low numbers on the island.

Sicyos australis (CURCURBITACEAE)

Sicyos australis (Figure 4) is a vigorous scrambling herbaceous, short lived perennial coastal vine occurring on the eastern seaboard of Australia from Victoria to Northern Queensland where it is also on the margins of rainforest and scrub. It also occurs in New Zealand and on several Pacific Islands with other closely related species occurring in the Americas. In Tasmania the species is currently thought to be restricted to Inner Sister Island (Harris *et al.* 2001).

Sicyos australis is listed as vulnerable in Tasmania.

Sicyos australis was first collected from Inner Sister Island by J. Milligan in the first half of the 19th century, and has been collected regularly from the island in the intervening years. Historically the species has been collected from the east coast of Flinders Island however that population is now considered extinct (Harris *et al.* 2001), making Inner Sister Island the only known locality for this species in Tasmania and also the most southerly in Australia. In 1968 the

Figure 4. Sicyos australis *in flower and fruit.* *Photo by Micah Visoiu.*

species was only recorded from two places at the western end of North Bay (Whinray 1972). Wilson (2000), records the plant on the north western hills just west of North Beach. The 2010 survey found the species to be more widespread on the Island than has possibly been the case in the recent past. In the current survey *Sicyos australis* was found to be patchily distributed in the dune swales behind North Beach (Figure 5) and also to be locally common in *Myoporum insulare* scrub on the north facing slopes of the granite hills in the northwest of the Island. Populations were also located in *Melaleuca ericifolia* scrub at the eastern end of House Bay. Population estimates were difficult in some areas where *Sicyos* formed extensive mats, which was primarily the case in the vicinity of North Beach. In this area an estimate of upwards of 500 plants is reasonable however it may be higher. The hills to the west of this area which support numerous individuals, primarily occupying gaps in the scrub could support two or three times

Figure 5. Sicyos australis *dominates in a small gully southwest of North beach.* *Photo by Micah Visoiu.*

this number, however the area was not fully surveyed. Behind House Beach the population in much smaller with only a couple of dozen plants seen in a small area of suitable habitat. The total population for the Island is therefore 2000 plants +/- 20%.

A conservation seed collection was made of this species, which has been lodged at the Tasmanian Seed Conservation Centre at the Royal Tasmanian Botanic Gardens. Seed production for the species is high and seed production more or less continuous. The large leathery coated seeds are likely to be fairly long lived in the soil seed bank.

Solanum opacum (SOLANACEAE)

Solanum opacum is a sprawling herbaceous to slightly woody undershrub producing green edible peas sized berries which are bird dispersed. It is widespread but localised on mainland Australia from South Australia, through Victoria, New South Wales and Queensland. In Tasmania the species has been collected twice on the north coast in the 1840's and 1930's, once on King Island in 2009 (TSS data) and once from Prime Seal Island in 1988 (Tasmanian Herbarium data). *Solanum opacum* is not listed as threatened in other states of Australia. The Australian Virtual Herbarium indicates that this species may also have been collected from Erith and Deal Islands in Bass Strait in the 1970's (Herbarium of South Australia data). The collection of this species on Inner Sister Island during the 2010 survey was the first record of this species from the island.

On Inner Sister Island *Solanum opacum* was found growing under *Melaleuca ericifolia* scrub at the back of House Beach, at the time less than 10 plants were seen, however the area was not surveyed exhaustively. It occurs in an open understorey in dappled shade and was associated with *Sicyos australis*.

Sporobolus virginicus (POACEAE)

Sporobolus virginicus is a low creeping grass which can grow up to 40 cm high but is usually much lower. It is native to coastal areas throughout Australia, the Pacific, India and Africa. In Tasmania it is restricted to coastal areas predominantly on the northeast coast and on the Furneaux Islands. In the Islands it is known from Flinders, Cape Barren, Craggy, and Inner and Outer Sisters Islands (Harris *et al.* 2001). *Sporobolus virginicus* is not regarded as threatened in any other states of Australia.

On Inner Sister Island *Sporobolus virginicus* was first recorded in the 1960's (Whinray 1972) and was also observed in 1986 (Harris *et al.* 2001). During the 2010 survey the species was only observed around a small wetland at The Elbow although it is likely to occur in other localities around the coast in sandy areas above the high tidemark. No population estimates were made for this species although it is uncommon on the island.

Teloschistes flavicans (TELOSCHISTACEAE)

Teloschistes flavicans (Figure 6) is a distinctive bright orange fruiticose lichen having a more or less global oceanic distribution. Within Australia it has been recorded in New South Wales, Queensland and Tasmania. In Tasmania, the known distribution for this lichen in the state is from granite tors and faces on Inner Sister Island, Outer Sister Island and Babel Island. It has also recently been recorded form a single clump on a rock face on The Patriarchs on the east coast of Flinders Island (G. Kantvilas pers com. Tasmanian Herbarium data 2011). The species was also apparently collected from the Kent Group at the beginning of the 19th century by R. Brown, however subsequent searches have failed to relocate it (TSS data).

Teloschistes flavicans was first collected from Inner Sister Island in the late 1960's (Whinray 1972). Since this original collection it has apparently not been

re-collected. During the 2010 survey the lichen was specifically surveyed for in likely habitat and located at a number of sites. It was noted that on the island the lichen has a quite specific habitat preference. In all but one site the species was found growing on more or less vertical granite faces (Figure 7) with an aspect within 25° of due south. Exceptionally, one colony extended up over the vertical face of the bolder and onto a 45° face. All sites were also located away from the coastal rocks on slopes and hill summits, in well established lichen communities, often associated with *Cladia aggregate, Usnea rubrotincta, Xanthoparmelia* spp. and numerous other species. In areas where the granite was fire scarred *Teloschistes flavicans* was absent, despite early colonisation by other lichen species.

Teloschistes flavicans was recorded from four different populations during the survey on hills on the east and west of the island, three of the populations occupied areas of rock face of less than two square

Figure 6. Teloschistes flavicans *growing in well established lithophytic lichen community.* *Photo by Micah Visoiu.*

metres, with total number of individual clumps ranging from 50 to 200 in these areas. The fourth population which occupied a broken granite slope to the west of north beach was more extensive, with the species occurring on numerous rock faces in a 10 by 20 metre area with 500 to 600 clumps present. It is possible that other populations occur on the island as not all available habitat was surveyed. The total population estimated for the island from the 2010 survey is between 850 and 1100 clumps which ranged in size from less than 1 cm round to approximately 8 cm in circumference.

Zygophyllum billardierei (ZYGOPHYLLACEAE)

Zygophyllum billardierei is a sprawling succulent perennial herb with bright yellow flowers growing up to 40 cm high and one metre wide. It occurs along the southern coast of Australia from Western Australia through South Australia and along the Victorian coast. It is listed as rare in Victoria and

Figure 7. Teloschistes flavicans *habitat on the northern peaks of West Hill.* *Photo by Micah Visoiu.*

not threatened in the other states. In Tasmania *Zygophyllum billardierei* is confined to disturbed area on calcareous sands and limestones on the islands of eastern Bass Strait (Underwood 1998). On islands of the Furneaux, Kent and Hogan groups *Zygophyllum billardierei* can be locally very common after disturbance (Harris *et al.* 2001).

On Inner Sister Island *Zygophyllum billardierei* was collected in 1986 (Harris *et al.* 2001). It was not observed in 2010, at a time of year when it would have been flowering and relatively obvious. *Zygophyllum billardierei* is known to have fluctuating populations which are dependent on disturbance. It is likely that the species still occurs on Inner Sister but was in low numbers in 2010.

Species of Biogeographic significance

Callitris rhomboidea (CUPRESSACEAE)

Callitris rhomboidea was recorded from Inner Sister Island in 1986 from near the summit of East Hill (Harris *et al.* 2001). It has not been recorded since despite active searching for during the 2010 survey. If the species still occurs on the island it is a small remnant population.

Crassula natans (CRASSULACEAE)

Crassula natans is a tiny predominantly aquatic herb, with a characteristic orange colour. Native of South Africa, it has become naturalised in southern Australia in recent years, now occurring in all southern states. In Tasmania the species was first recorded in 2003 and is known from several coastal sites on the north and east coasts, as well as on King Island (NVA 2011). There are also two collections of this species from Flinders Island (AVH 2011).

The record from Inner Sister Island is the first record of this species from the Outer Furneaux Islands. *Crassula natans* was found in shallow water in a small wetland on The Elbow. While this is a new record for the outer islands, it is not unexpected. This species is spread by water birds and the wetland on Inner Sister Island is an obvious stopover point for birds crossing Bass Strait from Victoria, where the species is widespread.

Glaucium flavum (PAPAVACEAE)

Glaucium flavum is a distinctive large waxy herbaceous weed of coastal margins which produces large golden poppy flowers and is cultivated as a garden plant. It is native to Western Europe but has become naturalised elsewhere in the world including North America where it is recognised as a noxious weed. Within Australia it is naturalised in South Australia and Victoria and has been collected occasionally in Tasmania.

Glaucium flavum has been only sporadically collected in Tasmania, the first collection coming from Freycinet in the 1930's. Since then it has been collected once more from Freycinet, from northern Flinders Island and once recently from Prime Seal Island. There is also a herbarium specimen collected from Inner Sister Island in 1986 by S. Harris. The 2010 survey found this species to be well established in the rocky bay in the north west of the island. In places it is the dominant species with large 1 m high plants dominating above the high tide mark, with individuals located sporadically around the northwest and west coast of the Island. This population is likely to be the largest infestation of this weed in Tasmania, and possibly the only place in which it is fully established.

Pseudocyphellaria aurata (LOBARIACEAE)

Pseudocyphellaria aurata is a large foliose lichen that is grey blue when dry and bright green when wet with yellow soredia around the margins and on the bottom surface. It has a more or less global oceanic distribution, being found on coasts of Africa, Europe, Asia, North and South America, Australia and numerous small islands. Within Australia it occurs in Queensland, New South Wales, Victoria and Tasmania. Within Tasmania *Pseudocyphellaria aurata*

has previously been recorded only occasionally. It is known to occur in the far north west, King Island, the north east, Clarke and Flinders Islands (Tasmanian Herbarium data 2011).

The population of *Pseudocyphellaria aurata* on Inner Sister Island is the first record of this species in the outer Furneaux Group, although the record is not unexpected as the species has been recorded from Wilsons Promontory in Victoria (AVH 2011) and western Flinders Island (Tasmanian Herbarium data 2011). On the island *Pseudocyphellaria aurata* was found growing on one south westerly facing granite rock face with a slope of between 60 and 80 degrees about halfway up Nettle Gully. At this site the species was dominant over an area of around 10 square metres of rock face. It was not seen at any other site on the island. This is a slightly unusual situation for the species that has more often than not been collected growing epiphytically in coastal scrub and swamp forest (Tasmanian Herbarium data 2011).

Threlkeldia diffusa (CHENOPODIACEAE)

Threlkeldia diffusa was recorded from Inner Sister Island in 1986 (Harris *et al.* 2001). No population counts were made at the time, and the species was not observed in 2010. It is therefore assumed that this species is present in only small numbers on the island.

DISCUSSION

The TASVEG mapping has been considerably updated. For example, the previous mapping of the scrub communities on the island as "*Acacia longifolia* coastal scrub (SAC)" and "Heathland scrub mosaic on Flinders Island (SHF)" have been reallocated to "Coastal scrub on alkaline sands (SCA)" and "Coastal scrub (SSC)", which was deemed to be warranted by the floristics and substrate on which they occurred.

Acacia longifolia coastal scrub (SAC) is a distinct vegetation assemblage of *A. longifolia* and *Leucopogon parviflorus*. However, *A. longifolia* was found to be quite rare on the island, only being seen at a few sites. Heathland scrub mosaic on Flinders Island (SHF) is characterised by species that are not present on Inner Sister Island, including *Eucalyptus nitida, Xanthorrhoea australis, Banksia marginata,* and *Leptospermum glaucescens*.

The change in the classification of the grassland communities on the island is probably the most significant change in the new mapping. In previous mapping the grassland has been mapped as combination of *Poa poiformis* grassland, *Austrostipa stipoides* grassland and exotic pasture (Harris *et al.* 2001), or alternately as a single type 'Coastal grass and herbfield (GHC). Observations during the 2010 survey revealed the grassland types to be more heterogeneous than this. Most significantly the occurrence of *Poa labillardierei* dominated tussock grassland, was extensive and occupies much of the upper slope and hill top areas on the Island. Whilst it is no doubt a fire induced disclimax community it is nevertheless significant as it not been recorded on any of the Outer Furneaux Islands before, although it does occur on northern Flinders Island. The reversion of the partially improved grassland in the central part of the island to a predominantly native grass dominated system is also a significant change.

The shaping of the island's vegetation by fire in the

last 200 years has created in many instances quite species-poor vegetation assemblages, with the least diverse vegetation being those areas which are presently changing from tussock grassland to *Myoporum insulare* scrub. The exclusion of fire from the areas of woody vegetation would allow development of higher species diversity in these areas. This would be a good environmental outcome for the island's biodiversity and is recommended in the future if management practices are to be reviewed.

The dynamic nature of the vegetation on Inner Sister Island means that the vegetation map provided is a snapshot in time. It will continue to change and develop, and burn, and start again.

The flora of the Island is presently heavily dominated by a small group of less than 50 species of plants whilst the other 150 or so species recorded on the island are much more restricted, or fragmented in their occurrence. This is predominantly due to the extensive burning that has occurred on the island over the last 200 years. This has greatly advantaged a handful of fire adapted species or species able to quickly colonise disturbed areas. The regular burning of the same areas over and over again with only short periods in between has effectively excluded non fire adapted species from large areas of the island and reduced the soil seed bank. If fire frequencies decrease in the future many of these species will have to re-colonise from the small refuge areas in which they still persist, which in some cases may take many years.

Possibly the best example of the effect of repeated burning is the oyster bay pine – *Callitris rhomboidea,* which is thought to have been a common tree species on many of the larger Furneaux Islands prior to European arrival (Harris *et al.* 2001). This species is killed outright by fire, has a serotinous (seed stored in cones in the crown of the tree) adaptation and therefore does not survive long in the soil, and has a slow growth rate which means that seed is not produced until the plants are at least eight years old (Harris 1989). As each fire kills all trees and causes the mass germination of nearly all seed, fires less than eight years apart effectively remove this species from the system. This species is likely to have been a significant presence on Inner Sister Island in the past, however it has now not been seen on the island since 1986 (Harris collections). It was not re-located during the 2010 survey, but is likely to still persist somewhere on East Hill. There are many species with similar fire responses which are now highly restricted in occurrence on the island. The increase in woody vegetation cover on the island since the 1950s as evidenced by the aerial photographs of this time indicate that fire has become less regular in many areas of the island than it once was. If this continues, much of the woody vegetation on the island will become more diverse over time as these more fire sensitive species slowly re-colonise.

Several of the threatened species populations present are the most significant occurrences of these species in Tasmania. Namely the star cucumber – *Sicyos australis* and the golden hair lichen – *Teloschistes flavicans*.

As the only known locality in Tasmania, Inner Sister Island is vital for the conservation of *Sicyos australis* within the state. The population was estimated at 2000 plants +/- and 20% has possibly increased in the last 30 years although this may also be influenced by survey effort. The species was only found in woody vegetation which indicates that fire is a likely threatening factor at least in as much as it reduces habitat area. The low population and presence of threatening processes may warrant the up-listing of the species under the TSPA (1995) from rare to vulnerable.

Teloschistes flavicans would appear to have its southern Australian stronghold on Inner Sister Island, with available data indicating that populations elsewhere are highly restricted. The four populations

seen on the island appeared to be growing well, however overall the species was highly restricted and the habitat highly vulnerable to fire damage. Many areas of suitable habitat on granite boulders had obviously been baked numerous times by fire as it raced up the slopes through the surrounding tussock grassland, scarring these rock faces in many areas. Populations of this lichen on Outer Sister Island have also been noted to be highly susceptible to fire damage (TSS note sheet). The low fragmented populations of this species and threatening processes indicated the species may warrant up-listing from rare to vulnerable under the TSPA (1995).

Probably the other most significant plant find on the island during the 2010 survey was the discovery of a population of the green berry nightshade – *Solanum opacum*. This bird dispersed species is relatively common in Victoria and is likely to have arrived on the island via a bird stopping off whilst crossing Bass Strait. Whilst the species is listed as endangered under the TSPA (1995), it is likely that it is naturally

Figure 8. One of the three Eucalyptus globulus *trees in dunes behind House Beach.* Photo by Micah Visoiu.

rare due to it being at its environmental limits in Tasmania. It is also likely that this species has been overlooked elsewhere due to its resemblance to several weedy species of *Solanum*. In South Australia it is suggested that this species has been spreading from its native range in recent years and can become weedy (Solanum opacum fact sheet).

The three trees of *Eucalyptus globulus* (Figure 8) on the island are something of an ambiguity. The historical aerial photography of the island suggests that the stand of trees has not altered greatly in size in the last 60 years, although the extent of other vegetation in the area has increased in this time. The Blyth family who have maintained the lease since 1884 are unsure of the origin of the trees (DPIWE 2001). Given that the trees appear to be all around the same age and that there is no evidence of there being any recruitment it would be permissible to suggest that they are outside of their preferred habitat and have likely been planted. An alternative hypothesis is that the trees pre-date the present island vegetation and are a remnant of past vegetation on the central saddle of the island. The lack of active regeneration can be put down to alteration of micro-climate from land clearance and increase in browsing pressure due to increasing marsupial populations in the presence of increased grassland extent. The second ambiguity is down to the taxonomy. In the past these trees have been determined to be *Eucalyptus globulus* subsp. *bicostata* (Harris *et al.* 2001) but subsequent taxonomic work has determined that this taxon is confined to mountain slopes in south eastern Australia and that coastal material is better attributed to *E. globulus* subsp. *pseudoglobulus*. More recently it has been stated that this taxon only occurs on Rhodondo Island within Tasmania and that multiple fruited *E. globulus* from northern Flinders Island are closer to *E. globulus* subsp. *globulus*. They hold evolutionary significance (TSS note sheet). Although it should be noted that the Inner Sister Island trees are not mentioned and if they are indeed native to this site they would be the closest Tasmanian population to Rhodondo Island.

Weeds are a significant issue in part of the island. The most significant structural environmental weed is african box thorn – *Lycium ferocissimum*. The species has obviously been present for many years and has a significant presence, particularly through the central saddle of the island. The majority of the pasture weeds are present due to fire management practices and the disturbance from high marsupial grazing pressure and are unlikely to cause significant environmental issues. The yellow horned poppy – *Glaucium flavum* population on the north west coast is of concern due to the known weediness of this species in other parts of the world. An eradication program for this species should be considered as it presently would be quite manageable. If weed management is to be considered in the future the second priority after the yellow horned poppy would be to remove outlying plants of african box thorn from the eastern and western ends of the island, and gradually moving back to the more serious infestation through the central saddle.

REFERENCES

Baker, M.L. & Duretto, M.F. (2005) A Census of the Vascular Plants of Tasmania, 2011 edition. Internet publication, Tasmanian Museum and Art Gallery. Hobart http://www.tmag.tas.gov.au/__data/assets/pdf_file/0015/38013/Tasmanian_Vascular_Plant_Census_2011.pdf

Brothers, N., Pemberton, D., Pryor, H. & Halley, V. (2001) *Tasmania's Offshore Islands: Seabirds and Other Natural Features*. Tasmanian Museum and Art Gallery, Hobart, Tasmania.

Department of Primary Industries, Water and Environment (2001) Report on Sustainable Management of the Furneaux Outer Islands. Overview of sustainable management for leased/licensed grazed Furneaux Outer Islands. Report of a joint project of the Natural Heritage Trust, Tasmanian Outer Islands Association, Furneaux NRM Strategy and DPIWE. Hobart. (unpublished)

Harden G.J. (Ed) (1990) *Flora of New South Wales,* volume 1, UNSW press. Sydney

Harris, S. (1989) The Ecological Biogeography of *Callitris* Vent. In Tasmania. MSc Thesis, University of Tasmania. (Unpublished)

Harris, S. & Kitchener, A. (2005) *From Forest to Fjaeldmark: Descriptions of Tasmania's Vegetation.* Department of Primary Industries, Water and Environment. Printing Authority of Tasmania. Hobart.

Harris, S., Buchanan, A. & Connolly, A. (2001) *One Hundred Islands: The Flora of the Outer Furneaux,* DPIWE, Printing Authority of Tasmania, Hobart.

Harris, S. & McKenny, H. (1999) Preservation Island, Furneaux Group: two hundred years of vegetation change. *Papers and Proceedings of the Royal Society of Tasmania* 133(1):85-101.

Solanum opacum fact sheet, Australian Solanum Species fact Sheets, Electronic flora of South Australia: http://www.flora.sa.gov.au/efsa/lucid/Solanaceae/Solanum%20species/key/Australian%20Solanum%20species/Media/Html/Solanum_opacum.htm

Underwood, S. (1998) Synecology & Conservation of Vegetation on Aeolian Calcarenite, Flinders Island, Bass Strait, BSc (Hons) thesis, University of Tasmania. (Unpublished)

Whinray, J.S. (1971) A note on Prime Seal Island, *The Tasmanian Naturalist,* No. 27, Hobart, Tasmania.

Wilson, R. (2000) Inner Sister Island (West Sister Island), Furneaux Group Fire Management Plan. Unpublished report to Department of Primary Industries, Water and Environment.

Appendix 1: Vascular Flora Species List for Inner Sister Island

Based on Harris *et al.* (2001) and Whinray (1972). Additional records were sourced from the Natural Values Atlas (DPIPWE 2011) and the Australian Virtual Herbarium (AVH 2011).

Species newly recorded as a result of the present survey are marked with an asterisk and highlighted in **bold**.
* taxa recorded for first time during 2010 survey
# taxonomy updated from previous records
• taxa recorded from the island previously but not observed during the present survey
Nomenclature follows Baker & Duretto (2011)
Status denotes: introduced (i), endemic (e), rare (r) and Endangered (e)

Family	Name	Common Name	Status
	DICOTYLEDONS		
AIZOACEAE	*Carpobrotus rossii*	native pigface	
AIZOACEAE	***Disphyma crassifolium* subsp. *clavellatum* ***	**roundleaf pigface**	
AIZOACEAE	*Tetragonia tetragonoides*	new zealand spinach	
AMARANTHACEAE	*Hemichroa pentandra*	trailing saltstar	
APIACEAE	*Apium insulare*	island sea-celery	
APIACEAE	*Apium prostratum* subsp. *prostratum* var. *prostratum*	creeping sea-celery	
APIACEAE	***Daucus glochidiatus*** *	**australian carrot**	
APIACEAE	*Hydrocotyle hirta*	hairy pennywort	
APIACEAE	*Hydrocotyle sibthorpioides*	shining pennywort	
APIACEAE	*Lilaeopsis polyantha*	jointed swampstalks	
APOCYNACEAE	*Alyxia buxifolia*	seabox	
ASTERACEAE	*Apalochlamys spectabilis*	sticky firebush	
ASTERACEAE	***Arctotheca calendula*** *	**capeweed**	**i**
ASTERACEAE	*Carduus tenuiflorus*	winged thistle	i
ASTERACEAE	***Cassinia aculeata*** *	**dollybush**	
ASTERACEAE	*Cirsium vulgare*	spear thistle	i
ASTERACEAE	*Cotula australis*	southern buttons	
ASTERACEAE	*Cotula coronopifolia*	water buttons	i
ASTERACEAE	*Cotula vulgaris* var. *australasica*	slender buttons	r
ASTERACEAE	***Cymbonotus preissianus*** *	**southern bears-ears**	
ASTERACEAE	*Euchiton collinus* #	common cottonleaf	
ASTERACEAE	***Euchiton involucratus*** *	**star cottonleaf**	
ASTERACEAE	*Gnaphalium indutum* subsp. *indutum* #	tiny cottonleaf	
ASTERACEAE	*Helichrysum luteoalbum* #	jersey cudweed	
ASTERACEAE	*Hypochoeris glabra*	smooth catsear	i

Family	Name	Common Name	Status
ASTERACEAE	*Hypochoeris radicata*	rough catsear	i
ASTERACEAE	*Lagenophora stipitata* #	blue bottledaisy	
ASTERACEAE	*Leontodon taraxacoides subsp. taraxacoides* #	hairy hawkbit	i
ASTERACEAE	*Leucophyta brownii*	cushionbush	
ASTERACEAE	*Olearia axillaris*	coast daisybush	
ASTERACEAE	*Olearia phlogopappa*	dusty daisybush	
ASTERACEAE	*Olearia ramulosa*	twiggy daisybush	
ASTERACEAE	*Olearia viscosa*	viscid daisybush	
ASTERACEAE	***Ozothamnus ferrugineus*** *	**tree everlastingbush**	
ASTERACEAE	*Ozothamnus turbinatus*	coast everlastingbush	
ASTERACEAE	*Senecio biserratus*	jagged fireweed	
ASTERACEAE	*Senecio hispidulus*	rough fireweed	
ASTERACEAE	*Senecio linearifolius* var. *linearifolius*	common fireweed groundsel	
ASTERACEAE	*Sonchus asper*	prickly sowthistle	i
ASTERACEAE	*Sonchus hydrophilus*	native sowthistle	
ASTERACEAE	*Vellereophyton dealbatum*	white cudweed	i
BRASSICACEAE	*Cakile edentula*	american searocket	i
BRASSICACEAE	*Hornungia procumbens* #	oval purse	i
BRASSICACEAE	*Lepidium desvauxii*	bushy peppercress	
BRASSICACEAE	*Nasturtium officinale* #	two-row watercress	i
CAMPANULACEAE	*Lobelia anceps*	angled lobelia	
CAMPANULACEAE	*Wahlenbergia gracilis*	sprawling bluebell	
CAPRIFOLIACEAE	*Sambucus gaudichaudiana*	white elderberry	
CARYOPHYLLACEAE	*Cerastium glomeratum*	sticky mouse-ear	i
CARYOPHYLLACEAE	***Colobanthus apetalus* var. *apetalus*** *	**coast cupflower**	
CARYOPHYLLACEAE	*Polycarpon tetraphyllum*	fourleaf allseed	i
CARYOPHYLLACEAE	*Sagina maritima*	sea pearlwort	i
CARYOPHYLLACEAE	*Stellaria media*	garden chickweed	i
CASUARINACEAE	*Allocasuarina verticillata*	drooping sheoak	
CHENOPODIACEAE	*Atriplex cinerea*	grey saltbush	
CHENOPODIACEAE	*Atriplex prostrata*	creeping orache	i
CHENOPODIACEAE	*Chenopodium album*	fat hen	i
CHENOPODIACEAE	*Chenopodium glaucum*	pale goosefoot	i
CHENOPODIACEAE	*Chenopodium murale*	nettleleaf goosefoot	i
CHENOPODIACEAE	*Dysphania pumilio* # •	small crumbweed	i
CHENOPODIACEAE	*Rhagodia candolleana* subsp. *candolleana*	coastal saltbush	
CHENOPODIACEAE	*Salsola tragus* # •	prickly saltwort	i
CHENOPODIACEAE	*Sarcocornia quinqueflora* subsp. *quinqueflora*	beaded glasswort	
CHENOPODIACEAE	*Threlkeldia diffusa*	coast bonefruit	
CONVOLVULACEAE	*Dichondra repens*	kidneyweed	
CRASSULACEAE	***Crassula natans* var. *minus*** *	**floating stonecrop**	**i**
CRASSULACEAE	*Crassula sieberiana*	rock stonecrop	
CRASSULACEAE	*Crassula tetramera* # •	wiry stonecrop	
CUCURBITACEAE	*Sicyos australis*	star cucumber	r
EPACRIDACEAE	*Leptecophylla juniperina* subsp. *oxycedrus* #	coastal pinkberry	
EPACRIDACEAE	*Leucopogon parviflorus*	coast beardheath	
EPACRIDACEAE	*Monotoca elliptica*	tree broomheath	

Family	Name	Common Name	Status
EUPHORBIACEAE	*Beyeria lechenaultii* var. *latifolia*	pale turpentine-bush	
EUPHORBIACEAE	*Euphorbia paralias*	sea spurge	i
EUPHORBIACEAE	*Phyllanthus gunnii*	shrubby spurge	
FABACEAE	*Medicago polymorpha*	burr medick	i
FABACEAE	*Melilotus indicus*	sweet melilot	i
FABACEAE	*Pultenaea daphnoides* var. *obcordata*	heartleaf bushpea	
FABACEAE	*Swainsona lessertiifolia*	coast poisonpea	
FABACEAE	*Trifolium dubium*	suckling clover	i
FABACEAE	*Trifolium tomentosum*	woolly clover	i
FUMARIACEAE	*Fumaria muralis* subsp. *muralis* #	wall fumitory	i
GENTIANACEAE	*Centaurium tenuiflorum*	slender centaury	i
GERANIACEAE	*Erodium cicutarium*	common heronsbill	i
GERANIACEAE	*Geranium molle* var. *molle* #	soft cranesbill	i
GERANIACEAE	*Geranium solanderi*	southern cranesbill	
GERANIACEAE	*Pelargonium australe*	southern storksbill	
GERANIACEAE	***Pelargonium littorale*** *	**coast storksbill**	
GOODENIACEAE	*Selliera radicans*	shiny swampmat	
LAMIACEAE	*Marrubium vulgare*	white horehound	i
MALVACEAE	*Malva sylvestris*	tall mallow	i
MIMOSACEAE	*Acacia longifolia* subsp. *sophorae*	coast wattle	
MIMOSACEAE	*Acacia melanoxylon*	blackwood	
MIMOSACEAE	*Acacia mucronata* subsp. *dependens* •	blunt caterpillar wattle	e
MIMOSACEAE	*Acacia mucronata* subsp. *mucronata*	erect caterpillar wattle	e
MYOPORACEAE	*Myoporum insulare*	common boobialla	
MYRTACEAE	*Eucalyptus globulus* subsp. *pseudoglobulus*	gippsland blue gum	r
MYRTACEAE	*Leptospermum laevigatum*	coast teatree	
MYRTACEAE	*Leptospermum scoparium var. scoparium*	common teatree	
MYRTACEAE	*Melaleuca ericifolia*	coast paperbark	
ONAGRACEAE	*Epilobium billardierianum*	willowherb	
ONAGRACEAE	***Epilobium sarmentaceum*** *	**mountain willowherb**	
OXALIDACEAE	*Oxalis corniculata* subsp. *corniculata* # •	yellow woodsorrel	i
OXALIDACEAE	*Oxalis perennans*	grassland woodsorrel	
PAPAVERACEAE	*Glaucium flavum*	yellow poppy	i
PITTOSPORACEAE	*Bursaria spinosa* subsp. *spinosa* #	prickly box	
PLANTAGINACEAE	***Plantago bellidioides*** *	**herbfield plantain**	**e**
PLANTAGINACEAE	*Plantago varia*	variable plantain	
POLYGONACEAE	*Acetosella vulgaris*	sheep sorrel	i
POLYGONACEAE	*Muehlenbeckia australis* #	climbing lignum	
POLYGONACEAE	*Rumex brownii*	slender dock	
POLYGONACEAE	*Rumex pulcher* subsp. *pulcher* # •	fiddle dock	i
PORTULACACEAE	***Calandrinia calyptrata*** *	**pink purslane**	
PORTULACACEAE	***Montia australasica*** *	**white purslane**	
PRIMULACEAE	*Samolus repens*	creeping brookweed	
RANUNCULACEAE	*Clematis microphylla*	small-leaf clematis	
RHAMNACEAE	*Pomaderris apetala*	dogwood	
ROSACEAE	***Aphanes arvensis*** *	**parsley piert**	**i**
RUBIACEAE	***Asperula minima*** *	**mossy woodruff**	**r**
RUBIACEAE	***Coprosma quadrifida*** *	**native currant**	

Family	Name	Common Name	Status
RUBIACEAE	*Galium australe*	coast bedstraw	
RUBIACEAE	***Galium murale*** *	**small bedstraw**	i
RUTACEAE	*Boronia anemonifolia* subsp. *variabilis* #	stinky boronia	
RUTACEAE	*Correa alba* var. *alba*	white correa	
RUTACEAE	*Correa backhouseana* var. *backhouseana* # •	velvet correa	
RUTACEAE	*Correa reflexa* var. *reflexa*	common correa	
SANTALACEAE	*Exocarpos cupressiformis*	common native-cherry	
SANTALACEAE	*Exocarpos strictus*	pearly native-cherry	
SCROPHULARIACEAE	*Limosella australis*	southern mudwort	
SCROPHULARIACEAE	*Veronica calycina*	hairy speedwell	
SOLANACEAE	*Lycium ferocissimum*	african boxthorn	i
SOLANACEAE	***Solanum laciniatum*** *	**kangaroo apple**	
SOLANACEAE	***Solanum opacum*** *	**greenberry nightshade**	e
SOLANACEAE	***Solanum vescum*** *	**gunyang**	
STACKHOUSIACEAE	*Stackhousia monogyna*	forest candles	
THYMELAEACEAE	*Pimelea serpyllifolia* subsp. *serpyllifolia*	thyme riceflower	
URTICACEAE	*Parietaria debilis* •	shade pellitory	r
URTICACEAE	*Urtica incisa*	scrub nettle	
URTICACEAE	*Urtica urens* •	stinging nettle	i
ZYGOPHYLLACEAE	*Zygophyllum billardierei* •	coast twinleaf	r
	GYMNOSPERMS		
CUPRESSACEAE	*Callitris rhomboidea* •	oyster bay pine	
PINACEAE	*Pinus radiata*	radiata pine	i
	MONOCOTYLEDONS		
CENTROLEPIDACEAE	*Centrolepis strigosa* subsp. *strigosa*	hairy bristlewort	
CYPERACEAE	*Carex inversa*	knob sedge	
CYPERACEAE	*Eleocharis pusilla* •	small spikesedge	
CYPERACEAE	*Ficinia nodosa* #	knobby clubsedge	
CYPERACEAE	*Isolepis aucklandica* •	slender clubsedge	
CYPERACEAE	*Isolepis cernua*	nodding clubsedge	
CYPERACEAE	*Isolepis platycarpa*	flatfruit clubsedge	
CYPERACEAE	*Lepidosperma concavum*	sand swordsedge	
CYPERACEAE	*Lepidosperma gladiatum*	coast swordsedge	
CYPERACEAE	*Schoenus nitens*	shiny bogsedge	
JUNCACEAE	***Juncus bufonius*** *	**toad rush**	
JUNCACEAE	*Juncus pallidus* •	pale rush	
JUNCACEAE	*Juncus procerus*	tall rush	
JUNCAGINACEAE	*Triglochin striatum*	streaked arrowgrass	
LEMNACEAE	*Lemna disperma*	common duckweed	
LILIACEAE	*Allium ampeloprasum*	wild leek	i
LILIACEAE	*Dianella brevicaulis* #	shortstem flaxlily	
LILIACEAE	*Hypoxis glabella var. glabella* #	tiny yellowstar	
ORCHIDACEAE	*Caladenia latifolia* •	pink fairies	
ORCHIDACEAE	*Cyrtostylis reniformis* •	small gnat-orchid	
ORCHIDACEAE	*Cyrtostylis robusta* •	large gnat-orchid	r
ORCHIDACEAE	***Microtis arenaria*** *	**notched onion-orchid**	
ORCHIDACEAE	*Microtis unifolia*	common onion-orchid	
POACEAE	*Aira caryophyllea subsp. caryophyllea* #	silvery hairgrass	i

Family	Name	Common Name	Status
POACEAE	*Ammophila arenaria subsp. arenaria* #	marram grass	i
POACEAE	***Austrodanthonia penicillata*** *	**slender wallabygrass**	
POACEAE	*Austrodanthonia racemosa var. racemosa* #	stiped wallabygrass	
POACEAE	*Austrofestuca littoralis*	coast fescue	
POACEAE	*Austrostipa flavescens*	yellow speargrass	
POACEAE	*Austrostipa stipoides*	coast speargrass	
POACEAE	*Avena barbata* •	bearded oat	i
POACEAE	*Avena sativa* •	cereal oat	i
POACEAE	***Briza minor*** *	**lesser quaking-grass**	**i**
POACEAE	*Bromus diandrus*	great brome	i
POACEAE	*Bromus hordeaceus*	soft brome	i
POACEAE	*Catapodium rigidum*	ferngrass	i
POACEAE	*Dichelachne crinita*	longhair plumegrass	
POACEAE	*Distichlis distichophylla*	australian saltgrass	
POACEAE	***Elymus scaber*** *	**rough wheatgrass**	
POACEAE	*Holcus lanatus*	yorkshire fog	i
POACEAE	*Lagurus ovatus*	harestail grass	i
POACEAE	***Lolium loliaceum*** *	**stiff ryegrass**	**i**
POACEAE	*Lolium perenne*	perennial ryegrass	i
POACEAE	*Pennisetum clandestinum* •	kikuyu grass	i
POACEAE	*Poa annua*	winter grass	i
POACEAE	*Poa labillardierei*	tussockgrass	
POACEAE	*Poa poiformis*	tussockgrass	
POACEAE	*Polypogon monspeliensis*	annual beardgrass	i
POACEAE	*Rostraria cristata*	annual catstail	i
POACEAE	*Spinifex sericeus*	beach spinifex	
POACEAE	*Sporobolus virginicus*	salt couch	r
POACEAE	*Vulpia bromoides*	squirreltail fescue	i
POACEAE	*Vulpia myuros forma megalura* #	foxtail fescue	i
	PTERIDOPHYTES		
ADIANTACEAE	*Pellaea falcata*	sickle fern	
ASPLENIACEAE	*Asplenium flabellifolium*	necklace fern	
ASPLENIACEAE	***Asplenium obtusatum* subsp. *northlandicum*** *	**shore spleenwort**	
DENNSTAEDTIACEAE	*Hypolepis rugosula*	ruddy groundfern	
DENNSTAEDTIACEAE	*Pteridium esculentum*	bracken	
DRYOPTERIDACEAE	*Polystichum proliferum*	mother shieldfern	
DRYOPTERIDACEAE	*Rumohra adiantiformis*	leathery shieldfern	
POLYPODIACEAE	*Microsorum pustulatum subsp. pustulatum*	kangaroo fern	
PTERIDACEAE	*Pteris tremula*	tender brake	

Pacific Gull nest.

Photo by Sally Bryant.

Avifauna

of Inner Sister Island, Furneaux Group

Sally Bryant

A comprehensive bird survey of Inner Sister Island in December 2010 resulted in the identification of 47 species, of which 43 were native and 4 non-native. At least 26 species were breeding on the island and 17 of these were confirmed with nests, eggs or chicks. The bird fauna was surprisingly diverse given the island's few structurally complex habitats but relatively large size. The lack of mature forest and paucity of free standing water meant some key bird groups were absent; however, the island's close proximity to mainland Flinders enabled others to visit on a regular or seasonal basis. Several marine species dominated the coastal habitats especially Short-tailed Shearwater, Little Penguin and Pacific Gull. Raptors foraged widely across all eco-tones and some species probably maintained territories on both sides of the water channel. Brown Quail were widespread and abundant in grassland whereas other small seed eating and insectivorous species occupied scrub and woodland. White-browed Scrubwren and Silvereye warrant further investigation due to their potential taxonomic differences from mainland Tasmania or southeast Australian birds. An estimate of population size and status was made for all species and monitoring points were identified for future visits. A range of management recommendations are provided.

INTRODUCTION

Tasmania's glacial history has helped shape the bird fauna of the Furneaux region. Prior to the formation of Bass Strait, many species maintained regular passage between southeastern Australia and mainland Tasmania. When the land bridge finally flooded during the late Pleistocene period, the water channel posed an obstacle to local bird movement. Some species quickly died out, some established permanently in what was to become the most southerly part of their natural range, while others continued their regular migration often using the newly created islands as stepping stones. Over time the Furneaux region developed its own unique faunal diversity reflecting its intermediate position between two larger islands.

The early European settlement of Flinders and its offshore islands has also impacted on the region's avifauna through clearing of mature eucalypt forests, agriculture and changing land management practices. In 1884 Robert and Arthur Blyth took up a lease on Inner Sister Island to graze sheep. The island was periodically burnt and sown to enhance and expand grassland and to promote winter pick. Rough pasture containing exotic grasses and weeds such as scotch thistle and african boxthorn became established. In the late 1880s Robert Blyth released Brown Quail onto the island, as a source of food and also for recreational shooting by visiting boat captains (Kay Blyth pers. com). Muttonbird (Short-tailed Shearwater) were another important source of food and the chicks and eggs were regularly eaten (Edgecombe 1986). Muttonbird were also harvested to supplement the families' meagre income and up until 1906 about 20,000 birds were sold annually. In July 1957 a large portion of Inner Sister Island was proclaimed a Muttonbird Reserve. Sheep grazing continued until 2001 but stopped shortly thereafter (Harris *et al.* 2001). In 1986, Nigel Brothers spent three days on Inner Sister Island mapping the seabird colonies and collecting other incidental fauna sightings. Brothers recorded 29 bird species and made notes

on nests, eggs and chicks (Brothers *et al.* 2001). Since then, there has been little targeted survey work on the island, however, it is still managed by the Blyth family and remains a popular destination for the recreational shooting of Brown Quail.

Field naturalist expeditions to the Furneaux islands began in the late 1880s and these produced the first lists of avifauna in the region. Over time these lists have been expanded and updated by visiting and local naturalists (e.g. Whinray), particularly for Deal, Clarke, Goose, Cape Barren and Prime Seal islands (Green 1969; Bryant 1998, 2000; Brothers *et al.* 2001; Magnus & Harris 2004; Harris *et al.* 2009). Bird species such as the Short-tailed Shearwater, Little Penguin, Pacific Gull, Sooty Oystercatcher, Cape Barren Goose, Brown Quail and White-fronted Tern, all occur in their highest densities in eastern Bass Strait and have attracted much scientific and commercial interest (Marchant & Higgins 1990). Due to its vast coastal beaches and tidal mudflats, the Furneaux region is also important for shorebirds, many of which breed in the northern hemisphere and annually migrate down through the East Asian Flyway.

METHODS

Bird surveys were undertaken from 2 to 9 Dec 2010. Methodology included 10 minute bird counts and two hectare searches as used for the Birds Australia Atlas of Australian Birds Project (www.birdsaustralia.com.au). Two hectare searches involved recording all species by sight and sound within (or flying over) the search area during a 20 minute period. The recommended search shape was 100 m x 200 m (about 2 ha) with the centre of each search area being at least 400 m apart.

The coastline of the island was walked to count seabirds and search for nests along rock shelves. Sandy beaches were surveyed for shorebirds by walking slowly along their entire length on the waterline. A follow up walk and sweep with binoculars was made above the high tide mark to detect nests, taking care not to unduly disturb breeding birds. Targeted searches were made for Wedge-tailed Eagle nests in forest gullies across the eastern sector and for White-bellied Sea-eagle nests around the entire coast especially the rock ledges and tors of the western sector.

Coverage of all habitats and vegetation communities was thorough and systematic using 8 x 32 binoculars and a 30x scope. Other team members contributed sightings during the course of their work. Species nomenclature and taxonomy follows Christidis and Boles (2008). Site locations were marked using GPS in UTM / UPS WGS 84 datum.

RESULTS

A total of 47 bird species was recorded for Inner Sister Island, 43 of these were native and 4 non-native (Table 1). Seventeen species were positively confirmed with nests, eggs or chicks and a further 9 species were inferred as breeding due to their paired behavior or sedentary nature; making a total of 26 breeding species.

Eight sandy beaches were surveyed for shorebirds and three resident species were recorded. No migratory shorebird species were seen. Six beaches contained breeding pairs and 2 beaches had active nests. One Pied Oystercatcher was identified with a leg band.

Species Observations

1. Brown Quail
Coturnix ypsilophora
Adults, chicks and eggs were recorded in exotic grassland, *Poa* tussock and on the edges of low scrubby vegetation across the island. Birds were constantly calling and commonly flushed individually or in small coveys of 2-3 birds. Single eggs were occasionally observed on exposed ground. The population could be in the order of several thousand birds.

Transect western sector = total 15 birds flushed by 3 people in 2.0 hours
Transect eastern sector = total 7 birds flushed by 3 people in 2.5 hours

2. Cape Barren Goose
Cereopsis novaehollandiae
Variable sized flocks were seen in exotic pasture and *Poa* tussock across the island. No nests, eggs or small chicks were seen but 6 runners [non-flying juveniles] were accompanying adults which confirmed breeding on the island. Highest densities occurred around the homestead and airstrip and in *Poa* tussock grassland around the western half of island. Small flocks of 1 to 6 birds roamed in coastal bays and along beaches. The population estimate was 120 to 140 birds.

Home Paddock = 30 birds
North Beach grasslands and headlands = 18 birds
West Hill grassland = 70 birds
East Hill grasslands = 20 birds

3. Australian Shelduck
Tadorna tadornoides
Three birds were seen flying over the eastern end of House Bay. This species is likely to be a regular visitor to the island during spring when pasture is plentiful.

4. Little Penguin
Eudyptula minor
Burrows and runways were common around the coast in tussock, scrub and rock cavities as well as under outbuildings and discarded timber. Birds were regularly sighted swimming inshore and several broken and intact eggs were seen near burrow entrances. More detailed information on this species is provided in the seabird report.

5. Short-tailed Shearwater
Puffinus tenuirostris

All breeding colonies were surveyed following the census of Brothers *et al.* (2001), the most active being above North Beach and around the western sector of the island. Numerous beach washed carcasses were strewn along the tide-line. More detailed information on this species is provided in the seabird report.

6. Shy Albatross
Thalassarche cauta
One beach washed carcass was found in a western gulch at E0576284 / N5606791 with a wing length 67.0 cm and head-bill length 21.0 cm. No leg band. This species probably forages regularly around the Furneaux islands and has a breeding site on Albatross Island, in western Bass Strait.

7. Australasian Gannet
Morus serrator
Small numbers (1 to 7 birds) were regularly flying around the coastline and foraging close inshore in late afternoon. One beach washed bird was found. A large breeding colony once occurred on Cat Island, but is no longer active.

8. Great Cormorant
Phalacrocorax carbo
Only two individuals were seen roosting on near inshore rocks off the southwest coast. A small population of potentially up to 10 birds may occur in the area.

9. Black-faced Cormorant

Phalacrocorax fuscescens

Commonly seen in small groups of 5 to 8 birds roosting on near inshore rocks on the southwest and southeast coast. Population number possibly around 20 birds.

10. Little Black Cormorant

Phalacrocorax sulcirostris

One bird seen flying down the west coast. It's possible that birds use onshore rocks for communal roosting at times. Population estimate is unknown.

11. Australian Pelican

Pelecanus conspicillatus

Two sightings of a single bird flying over Little Horseshoe Bay and northwest coast. Breeding sites occur below Cape Barren Island.

12. White-faced Heron

Egretta novaehollandiae

Single bird flying over the southwest coast. This species is likely to be a regular visitor to Inner Sister but probably in small numbers due to the sparseness of wetlands and tidal mudflats.

13. White-bellied Sea-eagle

Haliaeetus leucogaster

One adult female and one immature female (head buff and mottled brown feathering) were regularly seen foraging together. The prey remains of a large boney fish were found at the ephemeral wetland below East Hill. One adult male was seen on consecutive days 'rock hopping' in a gulch on the southwest coast. The male was unable to fly and presumably was injured. The male was in good plumage and was feeding on Little Penguin and other beach washed carcasses. On one occasion the adult male and immature female were together in the gulch.

All major rocky outcrops, tors and hillocks around the western sector of the island were searched but no nest was found. The eastern sector requires more searching.

14. Wedge-tailed Eagle

Aquila audax fleayii

One adult female was occasionally foraging over the eastern sector of the island. A nest search of the major wooded gullies to the north of East Hill (most likely potential habitat) was unsuccessful. It is possible that this bird is one of a pair maintaining a territory that includes part of Inner Sister, maybe Outer Sister and the nearby mainland of Flinders Island.

A dilapidated nest was highly visible in a large *Pinus* sp. behind the homestead. Although the tree was dead and burnt, the nest was unlikely to have been viable for decades due to its closeness of the homestead. The nest is currently used by Sparrows and Starling as a nest site and for nesting material.

Forested gully sites checked for Wedge-tailed Eagle nests (none found)
E0577525 / N5605747, E0577708 / N5605764, E0577310 / N5606672, E0577118 / N5606462, E0576792 / N5606448, E0576657 / N5606471, E0576825 / N5606127, E0576689 / N5605845, E0576565 / N5605710

15. Swamp Harrier

Circus approximans

One pair of Swamp Harrier foraged daily over paddocks around House Bay, especially the eastern and western slopes surrounding the homestead. Extensive breeding habitat occurs in tussock and bracken areas across the island, but no nest was found. The population estimate was 2 birds (1 pair).

16. Brown Falcon

Falco berigora

One bird regularly foraged over the tussock grassland and more widely over woodland and coastally. It was regularly harassed. Marginal breeding habitat exists on the island for this species which is likely to be a limiting factor.

17. Nankeen Kestrel

Falco cenchroides

One pair of Kestrel was observed on several occasions foraging and hovering over tussock in the western sector. The extensive grassland habitat on the island is likely to sustain one breeding pair and the population estimate was 2 birds (1 pair).

18. Australian Pied Oystercatcher

Haematopus longirostris

Only four birds (two pairs) were seen during the survey. North Beach, North Bay Beach Shingle (eastern end) and Elbow Beach contained suitable breeding habitat but did not contain birds. Although no aggressive behavior or active nests were detected, birds were still in pairs and may have either not yet commenced or had completed breeding. One bird of the Little Horseshoe Bay pair had a leg band: left leg white/ teal /black [tri colour band], right leg silver metal + yellow colour band. The total population was estimated at 4 birds (2 pairs).

House Bay Beach (800m) Start E0578037/N5605169, End E0578735/N5604919
Count = 2 birds [1 pair]
Little Horseshoe Bay (250m) Start E0580812/ N5605063, End E0580615/N5605085
Count = 2 birds [1 pair]

19. Sooty Oystercatcher

Haematopus fuligonosus

This species was observed in pairs as well as small groups of 3 to 6 birds. Birds were regularly spaced around the coastline with small clusters on the headlands of rocky shorelines. A total of 34 individuals were counted which could include breeding and non-breeding birds. No nests or chicks were seen although one pair exhibited aggressive calling and swooping behaviour on Un-named sandy shingle beach E0577012 / N5606931 (100m), which suggested an active nest site.

The total number counted was 34 birds, or possibly 12 - 14 pairs.

20. Hooded Plover

Thinornis rubricollis

Hooded Plover were recorded on four beaches and one active nest was found. One pair was incubating eggs on House Bay Beach and one pair was sitting on North Beach but no nest was found. No birds were detected on Little Horseshoe Bay or on three unnamed sandy beaches at E0576289/ N5606061 (50m), E0577012/ N5606931 (100m), and E0576816/ N5606830 (100m). Other smaller unnamed beaches were unsuitable for breeding due to their narrow width, steep marram grass profile and lack of nesting habitat above the high tide mark. The total population estimate was 12 birds [6 pairs].

North Beach (1,500m) Start E0577563/N5606509, End E0578869/N5606458
Count = 5 birds [2 pairs]

North Bay Beach Shingle [500m] Start E0579521/ N5606681, End E0579266/N5606655
Count = 2 birds [1 pair]

House Bay Beach (800m) Start E0578037/N5605169, End E0578735/N5604919
Count = 2 birds [1 pair]
Nest at E0578604 / N5605110
3 Dec 2010 – 2 eggs, 4 Dec 2010 – 3 eggs

Elbow Bay Beach (800m), Start E0580465/N5605688, End E0580993/N5605357
Count = 2 birds [1 pair]

21. Masked Lapwing

Vanelles miles

Masked Lapwing concentrated in the disturbed areas near the homestead with flocks of 20+ birds clustered on the airstrip and around the home paddocks. Smaller flocks of 1 to 5 birds were dotted around the coast and along beaches. Abundant nesting habitat exists on the island but no nests or eggs were found. As birds were congregating in flocks, it is likely the breeding season had finished. The total population estimate was 80+ birds.

22. Pacific Gull

Larus pacificus

Commonly seen in pairs around the coast and over 10 active nests were found each containing 1 to 3 eggs. No banded birds were seen. The population estimate was about 50 birds (22+ pairs). More detailed information on this species is provided in the seabird report.

23. Silver Gull

Larus novaehollandiae

Regularly seen foraging around the coast or flying overhead. Flocks of 10+ birds roosted on near offshore rocks and beaches. The breeding colony, previously reported by Brothers *et al.* (2001), could not be re-located. More detailed information on this species is provided in the seabird report.

24. Caspian Tern

Sterna caspia

Only one bird was seen flying off the southwest coast. A large shell nest was found on a western rock shelf at E0576250 / N5606859 containing 1 egg [tan with dark black blotches] which potentially could have been Caspian Tern but this could not be confirmed.

25. Crested Tern

Sterna bergii

Only one bird was seen flying and trailing behind the Caspian Tern off the southwest coast. No other evidence of the species being on the island was recorded.

26. Feral Pigeon

Columba livia

One individual bird was seen on several occasions flying around the southwest coast then darting inland to rock boulders. The rocky outcrops could possibly be a nest or roost site, but this was not confirmed.

27. Yellow-tailed Black-Cockatoo

Calyptorhynchus funereus

A small flock of three birds was feeding on *Allocasuarina verticillata* cones in a wooded gully below East Hill overlooking the homestead. Several birds were later seen flying over East Hill. No suitable breeding habitat exists on the island.

28. Galah

Eolophus roseicapillus

One incidental finding of a pile of fresh pink and grey feathers from this species were found near the homestead, most likely remnants from a recent bird of prey attack.

29. Fan-tailed Cuckoo

Cacomantis flabelliformis

One bird heard calling on a single occasion in *Allocasuarina verticillata* forest above House Bay. Otherwise noticeably absent during the survey period.

30. Horsefield's Bronze-Cuckoo

Chalcites basalis

One bird heard calling on consecutive days in *Allocasuarina verticillata* forest above the homestead. Otherwise noticeably absent during the survey period.

31. Southern Boobook

Ninox novaeseelandiae

One individual was heard calling and seen at dusk hawking above the Short-tailed Shearwater colony at House Bay and around the shearing shed. The bird is possibly roosting in nearby sheds or the forest grove. Limited breeding habitat exists on the island.

32. White-browed Scrubwren

Sericornis frontalis flindersi

Common, widespread and abundant in most types of scrub, woodland and disturbed habitats across the island. Small groups were nesting in african boxthorn, bracken and other shrubby vegetation providing sufficient cover and shelter. Many sightings of birds foraging on open ground. Significant colour variation was noted between individuals and within flocks.

Many birds had strong yellow throat markings, others were grading from lemon to pale cream and heavily striated.

33. Tasmanian Thornbill
Acanthiza ewingii
Abundant and widespread in native and disturbed woody and shrubby habitats across the island. Commonly co-occurring with the Brown Thornbill and White-browed Scrubwren and often foraging and nesting in the same african boxthorn or shrubby copse. Regularly carrying grasses to and from nest sites. The white vent was a key distinguishing feature from Brown Thornbill.

34. Brown Thornbill
Acanthiza pusilla
Description of habitat and habits as above for the Tasmanian Thornbill, including nest building.

35. Crescent Honeyeater
Phylidonyris pyrrhopterus
This species was relatively widespread but low in number, and more frequently heard calling but seldom sighted. Identified in shrub west of Elbow Bay and in african boxthorn above Woolshed Point. No evidence of breeding was detected and possibly a more seasonal visitor to the island during spring and summer.

36. White-fronted Chat
Epthianura albinfrons
Abundant and widespread in grassland and bracken across the island, including *Poa* above beach tide-lines. Birds were typically flushed from low vegetation with adults often exhibiting distractive broken wing or tumbling displays. Nest found in *Poa* tussock at E0576343 / N5605334 containing 2 eggs and 1 newborn chick.

37. Golden Whistler
Pachycephala pectoralis
One individual making single calls of short duration in shrubby vegetation near the wetland on the northeast coast at E0580494 / N5605369. Uncommon and likely to be seasonal visitor to the island during spring and summer.

38. Grey Fantail
Rhipidura fuliginosa
Widespread in wooded and shrubby vegetation but not visually or vocally conspicuous, suggesting a small population size. No nests were found but breeding habitat exists in woodland and denser scrub.

39. Black Currawong
Strepera fulinosa
This species was conspicuous in most habitats across the island or as sentinels on rocky outcrops or foraging along tide-lines. Despite being large and noisy the total population was likely to be small due to the limited amount of woody trees available for nesting. Birds were often moving in flocks of 1 to 4 birds and frequently mobbing raptors. Six nests were identified with parent birds in attendance. The abundance of active nests in the eucalypt grove near the homestead confirms the preference of mature trees for nesting. The population estimate was 20 birds [8-10 pairs].

1. Active nest 6 m high at E0578919 / N5605440 in *Bursaria spinosa*

2. Five active plus two dilapidated nests in small *Eucalyptus globulus* grove in the flat gully east of the homestead at E0578384 / N5605382

40. Forest Raven

Corvus tasmanicus

Widespread but relatively few in number. Seen in most habitats including foraging under seaweed along tide-lines and crossing the channel to mainland Flinders Island. Regularly observed mobbing raptors and highest numbers were recorded around the homestead and on disturbed pasture. The remains of one egg [large pale blue-green blotched brown] was found by Tom Sloane. The population estimate was 4 to 6 birds [2 - 3 pairs] though this could increase seasonally.

41. Australasian Pipit

Anthus novaehollandiae

Identified singularly or in pairs and most frequently seen on the airstrip, rough pasture and thistle paddocks around the homestead. No nests were found.

42. Eurasian Skylark

Alauda arvensis

Birds were commonly seen hovering over degraded pasture and tussock areas, especially around the homestead and airstrip. Frequently heard calling and seen performing aerial displays. No nests were found.

43. Beautiful Firetail

Stagonopleura bella

One individual calling in woody vegetation and african boxthorn near the homestead. Heard on three separate occasions and possibly nesting in this area.

44. House Sparrow

Passer domesticus

One small flock congregated around the farmhouse and home paddock area and birds were using the dilapidated eagle nest and nearby african boxthorn to nest in. The population estimate was about 20 birds.

45. Welcome Swallow

Hirundo neoxena

A small number of pairs were seen. There were 3 disused nests in the rafters of the shearing shed. Three to four birds were observed flying around the homestead, one pair was seen at the ephemeral wetland below East Hill and a further 2 to 3 pairs were using the slopes of Nettle Gully at E579632 / N5604860. The population estimate was about 20 birds (6 - 8 pairs).

46. Silvereye

Zosterops lateralis

One of the most conspicuous species on the island and abundant in woody and scrubby vegetation, including african boxthorn. Small flocks of 4 to 6 birds were frequently seen or larger mixed flocks with thornbill and scrubwren. Nest building and nest attendance were frequently seen. Calls were tuneful and melodic and often included mimicry. Birds appeared larger and more robust in body size than Tasmanian birds and were dark brown and tan in colour, with a definite wing stripe.

47. Common Starling

Sternus vulgaris

Starlings were surprisingly uncommon and sighted in only two locations during the survey period. A small flock of 6 to 8 birds was regularly collecting sticks and grasses from the dilapidated eagle nest at the homestead and relaying them to nearby rocks at the beginning of House Bay. A second flock of 2 birds was seen on two occasions carrying nesting material into a rock cavity below West Hill 50 m east of E0576486 / N5605705. Population estimate was 10 birds (5 pairs).

DISCUSSION

Tasmania's avifauna comprises over 220 resident and migratory species. The finding of 47 species on Inner Sister Island represents good diversity and is comparable to other islands in the Bass Strait region (Green 1969, Bryant 1998, Harris *et al.* 2009). Although smaller in size than Prime Seal Island (1,221ha, Inner Sister 748 ha), the species diversity of these two islands is similar with a direct overlap of 32 species (Harris *et al.* 2009). The absence of some key groups on Inner Sister was due to the island's low elevation (<200 m), lack of permanent water and few structurally complex vegetation types especially mature forest. Absences included waterfowl and other wetland species, larger sized insectivorous and trunk gleaning species, hollow nesting species and migratory shorebirds.

At least 26 bird species were breeding on Inner Sister, 17 of these were confirmed with nests, eggs or chicks and a further 9 species were inferred as breeding due to their behavior or sedentary nature. Due to the close proximity of mainland Flinders Island (2 km), a component of Inner Sister's avifauna is likely to be seasonal and therefore this number will fluctuate at various times of the year.

The main difference between Brothers *et al.* (2001) list and this survey was the finding of two additional species of birds of prey and a greater number of bush birds. The most notable absence was the lack of re-sighting of the Silver Gull breeding colony in its former location. The reasons for this are unclear as the habitat remained intact but contained no visible evidence of breeding activity in recent years. Seabirds are discussed in a separate chapter of this report.

Species of Interest

Brown Quail

Surveys of Brown Quail are undertaken annually on 9 islands in the Furneaux Group, including Inner Sister (Game Tracks 2010, 2011). Since the surveys began in 1998, Inner Sister Island has produced the most variable results and, due to the large number of quail occurring there, exerts the most influence over the population trends when averaged over the 9 surveyed islands. Quail densities are influenced by rainfall patterns and localized activities such as grazing pressure or burning of the tussock grass. Quail numbers generally increase following good rainfall or a reduction in stock levels and typically decrease in the year following a substantial fire, due to the lack of suitable cover to protect birds from predators. Over many years the lessee's have regulated access to Inner Sister and during periods of drought have closed the island to quail shooters. Inner Sister generally attracts around 20 licensed quail shooters per season over a three day period (PWS Ranger Wayne Dick pers. com). Assuming the bag limit of 20 birds per day per licensed shooter is obtained then this would equate to 1, 200 quail shot annually. Due to the extensive habitat and the regularity of birds sighted and heard calling, it is evident that hunting pressure is not significantly limiting quail numbers at this time and that the total population could be several thousand birds.

White-browed Scrubwren and Silvereye

Two of the most interesting species scientifically were the White-browed Scrubwren and Silvereye and both warrant further investigation. The White-browed Scrubwren *Sericornis frontalis* occurs mainly down the east coast of Australia from southern Queensland and NSW, along the slopes of the Great Divide through Victoria to southeastern South Australia (Higgins & Peter 2001). It is a sedentary species and does not undertake large scale movements. Although the

taxonomy of this species is 'unsettled' (Christidis & Boles 2008), a subspecies of the nominate form *S. f. flindersi* is widespread throughout the Furneaux region. The Tasmanian Scrubwren *S. humilis* occurs throughout Tasmania but does not extend north into this region. The birds seen on Inner Sister displayed considerable variation in body colour ranging from a strong yellow throat and yellowish underbody to pale cream body and streaked throat. This variation confirms that *S. f. flindersi* is roughly intermediate between *S. frontalis* and *S. humilis* and is therefore unique to this area. Inner Sister is an ideal location to further study the taxonomy of this variation as it represents a population of birds isolated for thousands of years since the flooding of Bass Strait.

Silvereye are well known Bass Strait migrants and display high level speciation into island forms (Christidis & Boles 2008). The strong buff colouring on the Inner Sister birds could not be used as a distinguishing feature between the Tasmanian sub-species *lateralis* and the south-eastern mainland subspecies *westernensis* (Peter 2011). However, the Silvereye on Inner Sister appeared noticeably larger in body size, more robust and their call was distinctly different from that more commonly heard by Silvereyes on mainland Tasmanian (i.e. more tuneful, melodious and a novel range of mimicry). These differences suggest the population on Inner Sister may be more strongly aligned with the Victorian subspecies than Tasmanian or even be developing into a unique island form.

Shorebirds

The island contained three resident species of shorebird (Hooded Plover, Pied Oystercatcher and Sooty Oystercatcher), all in low number and all of conservation concern (Bryant & Jackson 1999; Bryant 2002). Suitable breeding habitat existed for Red-capped Plover, Fairy Tern and Little Tern, especially the shingle section of North Beach, though these species were not sighted. Encroachment by marram grass *Ammophila arenaria* and coastal sea spurge *Euphorbia paralias* was rapidly removing breeding habitat on most beaches and causing a raised dune profile above the high tide mark. There is limited tidal mudflat habitat on Inner Sister and no migratory shorebird species were sighted during this visit. It is more likely that these species stopover south of Inner Sister and use the vast areas of tidal mudflat at Camerons Inlet, Long Point, Logans Lagoon and the Patriarchs.

Birds of Prey

Six of Tasmania's 12 species of raptor were seen on Inner Sister which represents a high diversity. The island's vast areas of tussock grassland are attractive for low foraging species like Kestrel, Swamp Harrier and Brown Falcon and they contain an abundance of ground nesting birds and small mammals such as Brown Bandicoot. Although no nests were found it is highly likely that a White-bellied Sea-eagle nest occurs somewhere in the western sector.

Table 1 Bird species observed on Inner Sister according to broad habitat types.

Species	Status	Abundance & Pop. Estimate		Sandy Beaches	Marine & Coast	Tussock Grassland	Scrub & Woodland	2 ha Zone
Brown Quail	N, BC	Abundant, 1000s	X			X		1,2,4,8
Cape B. Goose	N, BC	120–140	X	X	X	X		1
Aust. Shelduck	N	Flying over	X					
Little Penguin	N, BC	Abundant		X	X	X		
S-t Shearwater	N, BC	Abundant		X	X	X		8
Shy Albatross	N	Beach washed			X			
Aust. Gannet	N	5+ birds			X			
Great Cormorant	N	< 10 birds			X			
Black-fd Cormorant	N	<20 birds			X			
L. Black Cormorant	N	unknown			X			
Australian Pelican	N	unknown			X			
White-faced Heron	N	5+ birds		X	X			
White-b Sea-eagle	N, BC	1 pair	X	X	X	X	X	4
Wedge-tailed Eagle	N	1 territory				X	X	4
Swamp Harrier	N, BS	1 pair	X			X		
Brown Falcon	N	1 territory				X	X	3
Nankeen Kestrel	N, BS	1 pair	X			X		4
Pied Oystercatcher	N, BS	2 pairs		X				
Sooty O'Catcher	N, BS	12-14 pairs		X	X			
Hooded Plover	N, BC	6 pairs		X				
Masked Lapwing	N, BS	80+	X	X				1
Pacific Gull	N, BC	22+ pairs		X	X	X		
Silver Gull	N	50 birds		X	X			
Caspian Tern	N	unknown			X			
Crested Tern	N	unknown			X			
Feral Pigeon	Ex	? 1-2 birds			X	X		
Y-t Black Cockatoo	N	visitor					X	
Galah	N	feathers	X					
Fan-tailed Cuckoo	N	unknown					X	
Horsefd's B-Cuckoo	N	unknown					X	3
Southern Boobook	N	1 – 2 birds	X					
White-b Scrubwren	N, BC	abundant	X			X	X	1,2,3,4, 5,7,8
Tas. Thornbill	N, BC	abundant	X				X	1,2,3,5, 6,7
Brown Thornbill	N, BC	abundant	X				X	1,2,3,4, 5,6,7,8
Crescent H'eater	N	uncommon	X				X	1,2,4,5
White-fronted Chat	N, BC	abundant	X	X	X	X		1
Golden Whistler	N	uncommon					X	5
Grey Fantail	N, BS	widespread					X	1,2,3,4, 5,6,7
Black Currawong	N, BC	8–10 pairs	X	X	X	X	X	1,2,3, 5,6,8
Forest Raven	N, BC	2–3 pairs	X	X	X		X	1,2,3
Australasian Pipit	N, BS	common	X					1
Eurasian Skylark	Ex, BS	abundant	X			X		1
Beautiful Firetail	N, BS	uncommon	X				X	1,2
House Sparrow	Ex, BC	20 birds	X					1
Welcome Swallow	N, BC	6 – 8 pairs	X			X		1,4
Silvereye	N, BC	abundant	X				X	1,2,3,4, 5,6,8
Common Starling	Ex, BC	5 pairs	X		X			1

N native, Ex exotic, BC breeding confirmed, BS breeding suspected.
Two hectare search zones (1) Homestead / eucalyptus grove E0578380 / N5605380, (2) *Allocasuarina* gully E0578885 / N5605466 (3) *Allocasuarina* forest E0579691 / N5605621 (4) wetland/shrubbery E0580494 / N5605369 (5) *Allocasuarina* forest E0579171 / N5605424 (6) *Allocasuarina* forest E0579593 / N5605627 (7) *Leptospermum* scrub E0580087 / N5605462 (8) boobyalla scrub E0577420 / N5606598

Management recommendations

1. Due to the high diversity and density of ground nesting species it is essential to maintain Inner Sister free of feral cats and other introduced predators. A regular trapping and spotlighting surveillance program would help to determine if or where an incursion occurred.

2. African boxthorn provides important habitat for many bird species and any future removal program should be staged and its replacement by native species offering a similar woody structural complexity.

3. A fire management plan needs to ensure a patchwork burning regime maintains the long term viability of tussock grassland for breeding seabirds and many ground nesting birds especially Brown Quail.

4. Marram grass and coastal sea spurge should be removed from the fore and back dunes of sandy beaches to its encroachment and conversion of important shorebird breeding habitat.

5. Continue searching for raptor nests and ensure visitation to the island does not pose a threat or disturbance to these species during the breeding season.

6. Support the Parks and Wildlife Service to continue collecting Brown Quail harvesting figures to ensure sustained management of this species into the future.

7. Inner Sister is an important site to further investigate the taxonomy of Silvereye and White-browed Scrubwren as two potentially unique island subspecies.

Black Currawong nest in eucalypt *near the homestead.*
Photo by Sally Bryant.

REFERENCES

Bird Australia Atlas of Australian Birds Project www.birdsaustralia.com.au.

Brothers, N., Pemberton, D., Pryor, H. & Halley, V. (2001) *Tasmania's Offshore Islands: Seabirds and other Natural Features.* Tasmanian Museum and Art Gallery, Hobart.

Bryant, S.L. (1998) Birds of Clarke Island, Banks Strait. *Tasmanian Bird Report* 27, 13-16.

Bryant, S.L. (2000) Brief overview of significant terrestrial fauna of the Bass Strait region. In Bass Strait Forum 2000. Launceston, Tasmania.

Bryant, S.L. (2002) Conservation assessment of beach nesting and migratory shorebirds in Tasmania. Natural Heritage Trust Project NWP 11990, Department of Primary Industries, Water and Environment, Hobart.

Bryant, S.L. & Jackson, J. (1999) *Tasmania's Threatened Fauna Handbook: What, Where and How to Protect Tasmania's Threatened Animals.* Threatened Species Unit, Parks and Wildlife Service, Hobart.

Christidis, L. & W.E. Boles. (2008) *Systematics and Taxonomy of Australian Birds.* CSIRO Publishing, Melbourne.

Edgecombe, J. (1986) *Flinders Island and Eastern Bass Strait.* Published by author, Thornleigh, Sydney, NSW.

Game Tracks (2010) Department of Primary Industries, Parks, Water and Environment, Tasmania. Issue 15.

Game Tracks (2011) Department of Primary Industries, Parks, Water and Environment, Tasmania. Issue 16.

Green, R. H. (1969) The Birds of Flinders Island. *Records of the Queen Victoria Museum* No. 34.

Harris, S. & Kitchener, A. (2005) *From Forest to Fjaeldmark: Descriptions of Tasmania's Vegetation.* Department of Primary Industries, Water and Environment. Printing Authority of Tasmania, Hobart.

Harris, S., Buchanan, A. & Connolly, A. (2001) *One Hundred Islands: The Flora of the Outer Furneaux.* Department of Primary Industries, Water and Environment. Printing Authority of Tasmania, Hobart.

Harris, S. Driessen, M. & Bell, P. (2009) Prime Seal Island scientific expedition 2008. Hamish Saunders Memorial Trust, New Zealand and Biodiversity Conservation Branch, DPIPWE, Hobart, *Nature Conservation Series Report 09/3.*

Higgins, P.J. & Peter, J.M. (2002) (Eds) *Handbook of Australian, New Zealand and Antarctic Birds. Vol 6. Pardalotes to Shrike-thrushes.* Oxford University Press, Australia.

Magnus, Z. & Harris, S. (2004) Source documents for a management framework: Goose, Clarke and Cape Barren Islands. Nature Conservation Branch, Department of Primary Industries, Water and Environment, Tasmania.

Marchant, S. & Higgins, P.J. (1990) (Eds) *Handbook of Australian, New Zealand and Antarctic Birds. Vol 1 Part A&B.* RAOU. Oxford University Press, Australia.

National Parks & Wildlife Service (1980) 1979-1980 Annual Report. Government Printer, Tasmania.

Peter, J. (2011) The sunny side of the Strait. *Wingspan* 21(1), 38-41.

Pizzey, G. & Knight, F. (2007) *The Field Guide to the Birds of Australia.* 8th edition. Harper Collins Publishing Pty Ltd, NSW.

Assessing burrow occupancy in muttonbird rookery.

Photo by Rolan Eberhard.

Seabirds

Kris Carlyon

The Furneaux Group of islands in eastern Bass Strait, Tasmania, provide important habitat for a variety of seabird species, in particular the burrow-nesting short-tailed shearwater and little penguin. This paper describes the first detailed survey of these two species conducted on Inner Sister Island since 1986. All colonies were mapped and surveys of burrow density allowed population numbers to be estimated. Whilst the spatial extent of colonies may have expanded since previous surveys, the estimated number of breeding shearwaters may have declined. Penguin numbers appear to have increased. An annotated list of additional seabird species observed on this island is also included, along with a range of management recommendations.

INTRODUCTION

Approximately 18 million short-tailed shearwaters (*Puffinus tenuirostris*) arrive in Tasmania each September from feeding areas in the North Atlantic, occupying over 200 breeding colonies (Skira *et al.* 1996). Breeding colonies have been confirmed on 39 of the 52 islands in the Furneaux Island Group in eastern Bass Strait and this region remains an important stronghold for the species. The tussock communities and sandy soils common to these islands also support significant populations of another burrow-nesting species, the little penguin (*Eudyptula minor*), and rich waters and isolated coastlines provide excellent habitat for a range of other seabird species.

The short-tailed shearwater was one of the first Australian birds subjected to long-term scientific study, with work commencing in the Furneaux Islands in 1947 (Guiler *et al.* 1958) and continuing today. Research and monitoring is restricted to only a handful of islands in the region, although all islands in the Furneaux Group have previously been surveyed at least once (Brothers *et al.* 2001).

Inner (West) Sister Island, 2 km north of Flinders Island, supports substantial numbers of breeding shearwaters and it is currently one of 14 colonies in the Furneaux Group open for legal recreational harvesting of shearwater chicks during a declared open season. Harvesting of shearwaters and their eggs has been conducted on Inner Sister Island since settlement in 1870, and residents even dug extra burrows each year in the belief that this would increase the number of birds (Blyth 1986).

The island was surveyed in December 1986 (Brothers, unpublished data 1986; Brothers *et al.* 2001), the first and only known investigation to provide an estimate of shearwater and penguin numbers for this island (44,367 and 50 breeding pairs respectively). These surveys also listed five additional seabird species. Skira *et al.* (1996) provides an estimate of 49,440 shearwater burrows within 7.73 ha of colony based on the same 1986 surveys.

METHODS

Shearwaters and penguins:

Surveys were conducted during 3rd-8th December 2011. Methodology followed that set out in the *Establishment Report for DPIPWE Wildlife Monitoring Program - Short-tailed Shearwater (muttonbird)* (Wildlife Management Branch, DPIPWE 2010). This technique, established by Skira and Wapstra (1980), has been used by DPIPWE for long-term monitoring of recreationally-harvested shearwater colonies in the Furneaux Islands since the 1990's.

The entire coast of Inner Sister Island was initially surveyed for the presence of shearwater and penguin colonies, evident from the obvious burrows and flattening of vegetation and, where penguins were present, clear paths or 'runways' leading from the water. All shearwater colonies were mapped by walking the edge of the colony with a hand-held GPS unit and their size (area) calculated (Figure 1; Table 1). The location of penguin presence was also noted (Figure 1).

Linear transects (up to 100 m in length) were established in the three main shearwater colonies ('Home Beach', 'North Beach' and 'Main West') (Table 2) to allow estimates of burrow-occupancy rates and density of occupied burrows in each colony. Transect sampling was stratified within each colony to compensate for clear intra-colony variation in burrow density and occupancy levels.

Figure 1. Location of shearwater and penguin colonies and seabirds on Inner Sister Island. Red shading indicates shearwater colony, blue circles indicate main penguin colonies, yellow circles indicate pacific gull nests, green circle indicates cormorant roost, red circle indicates shy albatross carcass.

The presence of a shearwater chick in a burrow was used as a proxy for the occurrence of a breeding pair. All burrows within one metre of each transect line were searched for the presence of a shearwater chick by gently probing each burrow as completely as possible with a thin wooden stick. A burrow was included in the survey if its centre was within one metre of a transect line. The presence of a little penguin was identified by its distinct vocalisation and more aggressive attitude.

An estimate of the number of breeding shearwater pairs in each colony was derived by determining the density of occupied burrows and then extrapolating across the entire colony area. Estimates for the smaller colonies ('South', 'West 2' and 'West 3') were derived using the mean density of occupied burrows from the three main colonies. The estimate for total population size on Inner Sister Island was calculated by summing the estimates for each colony.

Taxonomy generally follows that set out in Christidis and Boles (2008), however the widely accepted generic name of *Puffinus* has been retained for the short-tailed shearwater.

Other seabirds:

The occurrence of other seabird species (i.e. birds that feed primarily at sea in their natural state) was determined by experienced observers using binoculars during several complete navigations of the Inner Sister Island coast by foot. Birds were included in the census if species could be identified with certainty, regardless of its distance from land. Active nests were mapped and eggs measured to aid in identification where species identity was uncertain.

RESULTS

Shearwater colony descriptions:

Six shearwater colonies were located on Inner Sister Island (Figure 1). No colonies were found on the eastern half of the island, consistent with Brothers *et al.* (2001). Total colony area covered 19.9 ha (2.7% of island), with the largest occupying 7.8 ha near Home Beach on the south coast (Table 1).

Home Beach Colony: This colony is the largest on Inner Sister Island and extends from the coast to over 60 m in altitude on the southern slope of West Hill. This colony is associated with thick *Poa poiformis* grassland, although areas with higher burrow density and reduced slope closer to the coast are devoid of vegetation with unstable substrate. Large stands of african boxthorn (*Lycium ferocissimum*) are located in the south of the colony, and much of the colony area is infested with slender thistle (*Carduus pycnocephalus*), presumably associated with recent burning. Several tiger snakes (*Notechis scutatus*) were seen within the colony limits, with some directly observed entering shearwater burrows.

South Colony: This colony is located in dense, tall *Poa poiformis* grassland on a gentle slope. Substantial patches of scrub nettle (*Urtica incisa*) are found along the southern margins.

Main West Colony: This colony occupies a narrow strip of land on the west coast. It is bisected by an eroded break in the slope that forms a vertical wall 1.5 m in height. Penguin and shearwater burrows have been dug into this bank. Vegetation is dominated by *Austrostipa stipoides* grassland, however there are patches of *Poa labillardieri* and grey saltbush (*Atriplex cinerea*), as well as native pigface (*Carpobrotus rossii*) closer to the coast. There are well-used penguin tracks on the steeper slope immediately adjacent to the coast.

West 2 Colony: This small colony is situated around

the margins of a small gulch on the west coast. Burrows are in steep terrain stabilised by dense pigface, with *Austrostipa stipoides* tussock dominating the flatter areas.

West 3 Colony: This colony occupies a gently sloping strip of land between coastal rock and thick common boobyalla (*Myoporum insulare*) scrub. Vegetation within the colony is dominated by *Austrostipa stipoides*.

North Beach Colony: This large colony appears to be made up of two colonies reported by Brothers *et al.* (2001) that have since merged. The colony has a northerly aspect and rises steeply behind coastal sand dunes, before flattening out at its southern margin. Vegetation here is sparser than in the other colonies but is again dominated by *Poa poiformis*. Sea spurge (*Euphorbia paralias*) is found throughout the colony area, although it is most dense along the northern margin closer to the coast. Several large boxthorn are scattered within the colony area, along with a belt of common boobyalla towards the eastern margin. Common boobyalla is also found in a gully that bisects the colony.

Shearwater and penguin population estimates:

Survey effort varied between colonies due to time constraints and inter-colony variation in burrow density. No surveys were conducted in the three smallest colonies; results for these colonies are extrapolations based on mean survey results from the three largest colonies.

Table 1: Colony size, survey effort and estimation of short-tailed shearwater (STSH) numbers on Inner Sister Island. Note: estimates of breeding pairs in South, West 2 and West 3 colonies are calculated using the mean burrow density figures for the other three colonies.

Colony	Area (ha)	Number of Transects	Total transect length (m)	Occupied burrows (STSH)	Occupied burrows (penguins)	Total burrows surveyed	Avg. occupied burrow density (Burrows/m2)	Avg. burrows occupied by STSH (%)	Est. Number of breeding pairs ± SE
Home Beach	7.79	7	690	216	14	462	0.16	45.07	12,272 ± 2,756
North Beach	6.39	3	300	27	0	63	0.05	43.10	2,875 ± 319
Main West	2.33	4	210	99	18	209	0.24	47.20	5,657 ± 743
South	1.65	-	-	-	-	-	-	-	2,607 ± 445
West 2	0.90	-	-	-	-	-	-	-	2,194 ± 243
West 3	0.88	-	-	-	-	-	-	-	2,144 ± 237
Inner Sister Island	**19.94**	**14**	**1200**	**657**	**50**	**943**	**0.16**	**45.26**	**27,753 ± 790**

A total population estimate for short-tailed shearwaters of approximately 27,750 (± 790) breeding pairs was determined for Inner Sister Island. Estimates for each individual colony are presented in Table 1. There was substantial variation in burrow density between the three surveyed colonies, however the percentage of burrows occupied by shearwaters remained consistent across the island.

Ten separate little penguin colonies were located on the island, mostly associated with shearwater colonies and all on the western half of the island. Burrows were often allied with tussock, thick shrub-land and rock cavities and several birds were sighted under disused outbuildings and discarded timber.

Total penguin numbers were difficult to estimate as surveys were designed specifically for shearwater population assessments and penguins are unlikely to be distributed evenly throughout shearwater colonies. Most penguins were located in burrows close to the coast, although some birds were found in burrows up to 80 m from the water.

Extrapolating penguin occupancy results obtained from the shearwater surveys provides a population estimate for little penguins of 2, 256 (±146) breeding pairs on the island. This result does not include several small rookeries that were not associated with shearwater colonies (approx. 10-40 burrows each) as these were not surveyed to establish occupancy levels.

Other seabird species:

Pacific gull
Larus pacificus
Up to 22 pairs and one juvenile sighted, mostly on west coast. One old bird, unable to fly, was found on North Beach. Ten nests were located (see Figure 1), the majority grass-lined on coastal rock with 2-3 eggs. One nest consisted of scattered shells and contained only one egg. Eggs 7.5-9.0 cm in length.

Silver gull
Larus novaehollandiae
Relatively common around coast in groups of up to 23. No nests found and no evidence of nesting activity in area where nesting was previously recorded by Brothers *et al.* (2001).

Australasian gannet
Morus serrator
Several individuals sighted off west coast flying predictable path approx. 200 m offshore.

Great cormorant
Phalacrocorax carbo
New record. Six individuals on daytime boulder roost off southwest coast.

Black-faced cormorant
Phalacrocorax fuscescens
Two birds sighted on southwest boulder roost with great cormorants. Commonly seen flying offshore.

Little black cormorant
Phalacrocorax sulcirostris
One individual sighted flying south 50 m off west coast.

Crested tern
Sterna bergii
Several individual birds sighted fishing off west and south coasts. No nests found.

Caspian tern
Sterna caspia
One individual sighted fishing off west coast. No nests found.

Shy albatross
Thalassarche cauta
One recently deceased adult bird found among rocks on the northwest coast, likely washed in on tide. No leg bands.

GENERAL DISCUSSION AND MANAGEMENT RECOMMENDATIONS

Shearwaters

Six individual shearwater colonies were located, one less than previously reported (Brothers *et al.* 2001). The discrepancy is most likely a result of two colonies at the western end of North Beach merging into one as the colonies expanded.

In addition, all colonies appear to have expanded significantly since the previous survey, with total colony area at least 250% larger than that reported by Skira *et al.* (1996). Mean burrow density (0.34/m^2) however has decreased to approximately half that estimated by previous surveys (0.64/m^2; Skira *et al.* 1996).

The population estimate for short-tailed shearwaters on Inner Sister Island (27, 753 breeding pairs) resulted from the first detailed surveys of shearwater colonies conducted on Inner Sister Island since 1986.

The population estimate was considerably reduced from that reported by Brothers *et al.* (2001) resulting from surveys in 1986. It is unclear however whether this result reflects an actual decline in breeding birds or simply provides an updated estimate based on more comprehensive surveys and improved mapping technology. Encouragingly though, burrow- occupancy levels of breeding shearwaters (approx. 45%) were consistent with colonies surveyed on other islands within the Furneaux Group in December 2010 (DPIPWE, unpublished data). Based on the estimated number of burrows listed by Skira *et al.* (1996), it is likely that Brothers *et al.* (2001) assumed or obtained a burrow-occupancy level of approximately 90% when estimating population numbers, twice the level recorded during this survey.

Whether the latest survey results reflect an actual decline in shearwater numbers or not, there are a number of potential mechanisms for decline and management issues on Inner Sister Island (most equally relating to little penguins), particularly relative to the Home Beach colony that is closest to human habitation:

1. *Fire*: The presence of charred tussock and dense thistle in the Home Beach colony indicates that this area has recently been burnt. Thistle was also documented within several colonies in 1986 (Brothers, unpublished data), indicating that the island may have a long fire history. The short-tailed shearwater's highly synchronous breeding habits make it particularly vulnerable to fire, with the timing of a burn determining the impact it may have on a population. For example, a fire that occurs in December when breeding birds are incubating in burrows can wipe out half a population, whereas a fire that kills chicks may have little impact on the overall population. Even when fires occur when shearwaters are in the northern hemisphere, over a prolonged period winter fires can decrease burrow density through increased soil instability (Brothers and Harris 1999). In addition, frequent burning of tussock grassland is likely to result in other undesirable outcomes, including increased thistle prevalence. If burns are necessary for other management reasons they should only be undertaken infrequently and during the winter months immediately after chicks have fledged or prior to adult birds arriving on their southward migration (i.e. May-August).

2. *Predation*: Evidence of feral cat presence was detected in all shearwater colonies, with suspicious shearwater carcasses and scat detected. Predation pressure by cats has the potential to impact heavily on seabird populations, including shearwaters (e.g. Martinez-Gomez and Jacobsen, 2004). It is recommended that an eradication attempt be undertaken on the feral cat population on Inner Sister Island,

likely requiring several years of sustained effort. Eradication should be feasible as cat numbers did not appear high; only several scats were found and no cats were detected during spotlight and trapping surveys targeting other mammal species.

3. *Livestock and fencing*: Whilst no livestock was observed on the island during this expedition, a lease allowing grazing remains current and the island has been heavily grazed in the past. Hard-hoofed animals have potential to cause burrow destruction and erosion within the fragile rookeries and there is evidence that intensive grazing has occurred in the Home Beach colony in particular. Should livestock be reintroduced to the island, it is recommended that stock be totally excluded from all shearwater colonies through the erection of fencing. Fences should ideally be constructed from just a single or double strand of wire to limit the potential for fence-strike by shearwaters returning to or leaving from the colony.

4. *Boxthorn and other weeds*: African boxthorn is prevalent in the Home Beach colony, particularly along the southern margins. Whilst the presence of boxthorn does not directly impact on shearwater population numbers, its continued expansion may limit available space for burrows. At this stage the boxthorn actually provides good protection for shearwaters and penguins, however some form of boxthorn control that limits it to its current extent is desirable. Should boxthorn be removed it should be done in stages and replaced by native shrubs to maintain structural complexity and cover. Other weeds such as sea-spurge may impact on colonies if allowed to spread.

5. *Recreational harvest*: Residents annually harvested and sold 20,000 shearwaters from Inner Sister Island until 1906 (Edgecombe 1986). In 1957 over 1,000 ha on the Outer and Inner Sister Islands were proclaimed a Muttonbird Reserve. Shearwater chicks may still be harvested for recreational purposes on Inner Sister Island during a declared open season, typically during the first weeks of April. Daily bag limits are imposed on licence holders, however there is currently no limit on the number of licensees allowed to access this island. Information from licence returns suggests the current take on Inner Sister Island is small, however a regular shearwater population monitoring program, specific to this island, could be established to help ensure harvest sustainability.

Penguins:

The population estimate for little penguins on Inner Sister Island was far greater (45x) than that reported by Brothers *et al.* (1986). This estimate was based on extrapolation of results from shearwater surveys and is likely an over-estimate given that only 50 occupied burrows were found during surveys island-wide and penguins are unlikely to be distributed evenly throughout shearwater colonies. Nevertheless, these results indicate that penguin numbers have increased substantially in the 24 years between surveys. This is consistent with recent studies and anecdotal evidence on other Tasmanian islands (e.g. Wedge Island; C. Vertigan, unpublished data), although the causes for such an increase is unknown. In contrast, little penguin numbers appear to be declining in some areas of mainland Tasmania, likely due to increased anthropogenic pressures, making these island populations even more important.

North Beach.
Photo by Asher Jones.

Other seabirds:

The nine other seabird species observed on the island were predicted to occur here, however four were additional to those recorded by Brothers *et al.* (2001; unpublished data, 1986). Of these nine species, only seven are likely to use the island for nesting and/or roosting; the pelagic Australasian gannet and shy albatross are restricted to just a few breeding colonies in Tasmania and only use nearby waters for foraging. No additional burrowing seabird species (e.g. prions, burrowing petrels, etc) were observed or heard during surveys.

The island supports a healthy number of pacific gull nests (at least 10), more than previously recorded. Interestingly though, no evidence of nesting by silver gulls was found, a dramatic result given that 32 breeding pairs in four separate colonies were observed in 1986 (Brothers *et al.* 2001). No reason for this lack of nesting activity was observed and there was an abundance of suitable habitat available.

ACKNOWLEDGEMENTS

Thanks to my fellow expeditioners for their assistance with surveys, great company and excellent culinary skills.

REFERENCES

Blyth, S. (1986) *These Days Have Gone Forever: A Narrative of the Early Days of the Furneaux Islands as I Knew Them*. Published by the author, Prospect, Tasmania.

Brothers, N. & Harris, S. (1999) The effects of fire on burrow-nesting seabirds particularly short-tailed shearwaters (*Puffinus tenuirostris*) and their habitat in Tasmania. *Papers and Proceedings of the Royal Society of Tasmania*, 133: 15-22.

Brothers, N., Pemberton, D., Pryor, H. & Halley, V. (2001) *Tasmania's Offshore Islands: Seabirds and Other Natural Features*. Tasmanian Museum and Art Gallery, Hobart.

Christidis, L. & Boles, W.E. (2008) *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Melbourne.

Edgecombe, J. (1986) *Flinders Island and eastern Bass Strait*. Published by author, Thornleigh, Sydney, NSW.

Guiler, E.R., Serventy, D.L. & Willis J.H. (1958) The Fisher Island field station – with an account of its flora and fauna. *Papers and Proceedings of the Royal Society of Tasmania*, 92: 165-174.

Martinez-Gomez, J.E. & Jacobsen, J.K. (2004) The conservation status of Townsend's shearwater *Puffinus auricularis auricularis*. *Biological Conservation*, 116: 35-47.

Skira, I.J., Brothers, N.P. & Pemberton, D. (1996) Distribution, abundance and conservation status of short-tailed shearwaters *Puffinus tenuirostris* in Tasmania, Australia. *Marine Ornithology*, 24: 1-14.

Skira, I.J. & Wapstra, J.E. (1980) Occupation of burrows as a means of estimating harvest of short-tailed shearwaters in Tasmania. *Emu* 80:233-238.

Pademelon in african boxthorn.

Photo by Michael Driessen.

Terrestrial Mammals

Michael Driessen

Tasmanian pademelons climbing and foraging in african boxthorns and other shrubs is one of the remarkable features of the terrestrial mammal fauna on Inner Sister Island. This habit of climbing into shrubs, up to heights of 3 m, has not previously been reported for this species. Five native terrestrial mammal species are known to occur on the island and four were recorded during this survey. Inner Sister Island is one of only two offshore islands in Tasmania that support populations of the southern brown bandicoot. Also remarkably, no extant introduced mammal species were recorded on the island although there is some concern that cats may be present and this needs to be investigated further.

INTRODUCTION

A total of five native terrestrial mammal species has previously been recorded from Inner Sister Island (Table 1). Apart from domestic stock, the only introduced mammal species reported from the island was the European hare which was introduced to the island before the early 1900s (Barrett 1909; Whinray 1972). Le Souef (1929) reported the presence of the native yellow-footed antechinus *Antechinus flavipes* on Inner Sister Island but Hope (1972) stated that it was incorrectly identified and that the specimen, lodged with the Australian Museum, was a white-footed dunnart. Brothers *et al.* (2001) reported that eastern barred bandicoots occur on Inner Sister Island but this was a mistake and the listing in their book should read southern brown bandicoot.

The presence of the southern brown bandicoot is perhaps the most significant feature of the terrestrial mammal fauna of Inner Sister Island. This species occurs widely on the Tasmanian mainland but only occurs on two offshore islands; Inner Sister Island and Bruny Island. Subfossil bones of this species have been found on Flinders Island, Cape Barren Island and Passage Island, and in western Bass Strait from Three Hummock Island (Hope 1972). Extant

Table 1. Terrestrial mammal species previously reported from Inner Sister Island

Species		Source
Tasmanian pademelon*	*Thylogale billardierii*	1, 2, 3, 4, 5, 7
Southern brown bandicoot	*Isoodon obesulus*	3, 4, 5, 7
White-footed dunnart	*Sminthopsis leucopus*	3, 4, 5, 6
Water rat	*Hydromys chrysogaster*	4
Lesser long-eared bat	*Nyctophilus geoffroyi*	5
European hare	*Lepus europaeus*	1, 4, 5, 7
Goat	*Capra hirca*	1
Sheep	*Ovis aries*	7

1=(Barrett 1909), 2=(Ashby 1927), 3=(Le Souef 1929), 4=(Whinray 1971), 5=(Whinray 1972), 6=(Green 1969), 7=(Brothers *et al.* 2001)

*species occurs only in Tasmania

populations of southern brown bandicoots also occur on two islands off the coast of South Australia. It appears that the Inner Sister Island population is a relic of a more widespread population. The absence of southern brown bandicoots from Flinders Island is puzzling. Hope (1972) suggests that the southern brown bandicoot may have previously occurred on Flinders Island based on an observation in 1832 of a bandicoot caught by a dog. Green (1969) mentioned observations of bandicoot diggings from 1909 but he believed they were more likely to be due to echidnas. No other post-European settlement accounts of bandicoots occurring on Flinders Island exist. It is difficult to explain why southern brown bandicoots would have disappeared from Flinders Island if they occurred there at the time of European settlement. Flinders Island is a very large island with significant areas of suitable habitat for the southern brown bandicoot. Indeed the island supports populations of long-nosed potoroos which often co-occur with southern brown bandicoots on the Tasmanian mainland. Whether or not the southern brown bandicoot was present on Flinders Island at the time of European settlement their absence remains puzzling. Perhaps the past occurrence of quolls is linked with the decline of southern brown bandicoots on Flinders Island.

The aim of the present study is to survey terrestrial mammals on Inner Sister Islands for the first time in over 24 years.

METHODS

Mammals on the island were surveyed using the following methods: direct observation, observation of tracks, scats and diggings, and live trapping using cage, box and bat traps.

Sixteen cage traps (25x25x56 cm, Mascot Wireworks), 50 collapsible aluminium box traps (11x11x33 cm, Elliott Scientific) and one bat trap (Austbat) were taken to the island. Cage traps were baited with peanut butter sandwiches laced with fish oil and covered with hessian sacks. Box traps were baited with balls of peanut butter and rolled oats, and covered with vegetation. Placement of traps was restricted to habitats within a half hour walk from the homestead to ensure that the traps could be cleared in the morning. The homestead and shearing shed were targeted for native and introduced animals. Trapping effort is summarised in Table 2.

A line of 10 cage traps were set for two nights in a lowland grassland complex and *Pteridium esculentum* fernland immediately to the west of the airstrip with a trap spacing of 25 m (traps 1–5: 578420E 5605900N–578567E 5606061N; traps 6–10: 578371E 5605926N–578213E 5606016N). These traps were then moved to a lowland grassland complex with african boxthorn to the south of the airstrip and set for two nights in two lines, 200 m apart with 50 m between traps (traps 1-5: 578327E 5605595N–578418E 5605757N; traps 6-10: 578572E 5605701N–578506E 5605539N). Six cage traps were set for three nights in a clearing around the homestead and adjacent to african boxthorn in two haphazard lines with two of these traps placed up against the walls of the house. Five box traps and six cage traps were placed around the shearing shed for four nights and one night respectively. Five box traps were set inside and outside the house for two nights. Behind and parallel with House Bay beach, two lines of 10 box traps were set for two nights; one line of 10 traps was set in *Lepidosperma gladiatum* sedgeland (traps 1-10: 578201E 5605313N–578344E 560308N) and a second line of 10 traps was set further north in a mosaic of *Melaeluca ericifolia* swamp forest, *Myoporum insulare* scrub and *Poa* grassland (traps 11-20: 578560E 5605336N–578671E 560303N). On Northeast Hill, twenty traps were placed in *Myoporum insulare* scrub in two lines of 10 traps for 2 nights (traps 1-10: 579173E 5606259N–579314E 560309N; traps 11-20: 579318E 560369N–579161E 560374N).

The bat trap was placed to the shearing shed (578018E 5605184N) for three nights adjacent and in a gully with a damp creek line lined with *Melaleuca ericifolia* (578965E 5605448N) for one night.

Spotlighting was conducted on two nights. The route on both nights started at the house, headed down the airstrip, turned west for 300 m and then back towards the house. On the second night the spotlighting continued down to the shearing shed.

Three camera traps were taken to the island, however one failed to operate. Of the remaining two, one was placed next to the shearing shed (578018E 5605184N; set 2030, 3/12/10 and collected 0800, 7/12/10) and the other was placed in coastal scrub on alkaline soils on the northern eastern side of the island (579645E 5606077N, set 1445, 3/12/10 and collected 1100, 6/12/10).

RESULTS

Four native terrestrial mammal species were recorded during the survey. No introduced mammal species were recorded apart from the skull of a European hare and possible signs of cats. These and other observations are discussed below.

White-footed dunnart

One female white-footed dunnart was caught in a box trap adjacent to the shearing shed. Although a range of habitats were trapped with box traps, no other specimens were caught. Several members of the survey team reported seeing 'mouse-like' animals in *Poa* tussock grassland in the shearwater colony near North Beach and on the west coast. The leaseholders also regularly see 'field mice' in grasslands (K. Blyth, pers. comm. 31/3/11). Given that the leaseholders

Table 2 Number of animals live trapped and released at each location

Location	Vegetation*	No. of trap nights			No. of animals caught			
		Cage	Box	Bat	SBB	WFD	WR	WS
West of Airstrip	GCL/FPF	32	0	0	0	0	0	0
Homestead	GCL/FWU	18	10	0	2	0	0	0
South of Airstrip	GCL/FWU	32	0	0	2	0	0	0
House Bay Beach 1	GHC	0	30	0	0	0	0	1
House Bay Beach 2	NME/GPL	0	20	0	0	0	0	0
Shearing Shed	FWU	6	20	3	0	1	1	0
NE Hill (coast)	SCA	0	20	0	0	0	0	1
NE Hill (gully)	NME/GPL	0	0	1	0	0	0	0
Total		**82**	**100**	**4**	**4**	**1**	**1**	**2**

GCL = lowland grassland complex, FPF = *Pteridium esculentum* fernland, FWU = weed infestation (african boxthorn), GHC = Coastal grass and herbfield (predominantly *Lepidosperma gladiatum*), NME = *Melaeluca ericifolia* swamp forest, GPL = lowland *Poa labillardierei* grassland, SCA = coastal scrub on alkaline sands. SBB = southern brown bandicoot, WFD = white-footed dunnart, WR = water rat, WS = White's skink.
*TASVEG map units: for detailed description of vegetation types see Visoiu (2011, this publication).

have never seen house mice on the island (K. Blyth pers. comm., 31/3/11) and no house mice were caught during the present survey, it is possible that these observations were of the white-footed dunnart. In 1968, Whinray (1972) collected a dead white-footed dunnart on the homestead bathroom floor. Green (1969) reported that a specimen resembling this species was found in the pocket of an old coat hanging in a shed. The white-footed dunnart is infrequently recorded in Tasmania despite being widely distributed in most vegetation types (Rounsevell *et al.* 1991). It has also been recorded on Cape Barren Island, Clarke Island, North East Islet and Outer Sister Island (Hope 1972; Whinray 1972; Rounsevell *et. al.* 1991, Brothers *et al.* 2001). Whinray 1972 states that the white-footed dunnart was introduced to Outer Sister Island by a former lessee.

White-footed dunnart.
Photo by Michael Driessen.

Tasmanian pademelon

The Tasmanian pademelon population on Inner Sister Island is remarkable on two counts. Firstly, they are abundant. Several hundred pademelons were observed during the spotlight surveys which covered an area of no more than 20 ha. Pademelons were observed in most vegetation types throughout the island but were most abundant in grasslands and african boxthorns in the central part of the island. The second remarkable feature, which appears peculiar to Inner Sister Island, is their habit of climbing african boxthorns to feed on leaves and fruit. Pademelons were commonly observed in the boxthorns at various heights up to 3 m above the ground. When disturbed they would bound through the boxthorns along established routes and onto the ground, although sometimes they would simply take a direct route to the ground. They were also observed in *Myoporum insulare* and the leaseholder has observed them in 'Manuka' (K. Blyth pers. comm., 31/3/2010). Parts of boxthorns that were not accessible to pademelons were well covered with leaves and berries whereas accessible parts were stripped almost bare of leave and berries. It is not clear whether the pademelons are climbing the boxthorns to feed on the foliage

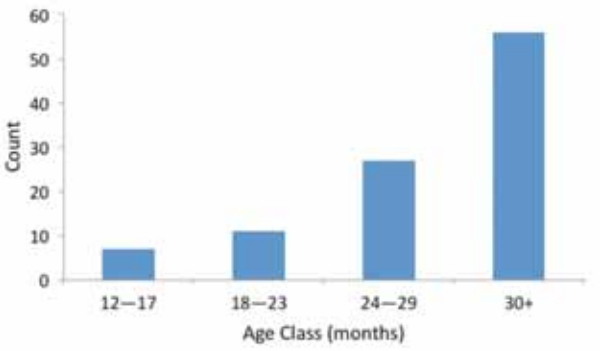


Figure 1. Age structure of a Tasmanian pademelon skulls collected from the central area of Inner Sister Island (sample size=101). Skulls aged by molar eruption and converted to months using the formula in Driessen and Hocking (1996).

and berries because of their high densities and competition for food or because they are a preferred food item. This shrub-climbing behaviour has not previously been reported by previous visitors to the island (Whinray 1971, 1972; Brothers *et al.* 2001) or in populations elsewhere in Tasmania. However, Whinray (1972) reported observations by employees of the leaseholder that during the severe drought of late summer and autumn of 1967, weak pademelons fed on african boxthorn clumps during daylight. Pademelon carcasses were common on the island, particularly in the central part. These probably died as a result of culling, drought or old age. The age structure of a sample of skulls collected from the central part of the island is biased towards old animals, perhaps suggesting low predation or harvest pressure (Figure 1). This age structure is consistent with either a shot sample where larger animals are targeted (which is often the case) or animals dying of old age. Pademelons are regularly shot on the island to reduce competition with the sheep and the carcasses are usually collected and buried in a pit (K. Blyth, pers. comm., 31/3/2011). In 2010/2011, 2056 pademelons were shot on the island. This total is less than in previous years as the leaseholders were unable to spend the usual amount of time on the island during that year (K. Blyth, pers. comm., 31/3/2011). In 1988/89 and 1999/2000, 4, 100 and

Table 3. Details of animals trapped.

Date	Location	Vegetation	Species	Sex	Wt (g)	HL (mm)	FL (mm)	Comments
3/12/10	Homestead	FWU /GCL	SBB	F	410	68.0	50.4	Trap set adjacent to homestead wall. No pouch young. Orange particles encrusted around and inside pouch. No ticks or fleas. In good condition.
4/12/10	West of airstrip	GCL	SBB	M	960	86.0	64.0	No ticks or fleas. Lost part of tail.
5/12/10	South of airstrip	GCL	SBB	F	660	80.3	57.1	4 pouch young (crown-rump length about 12 mm), 3 large non-lactating teats, 1 small teat. 3 ticks on ears. Lost part of tail.
6/12/10	South of airstrip	GCL	SBB	M	800	80.3	59.3	No ticks or fleas. Testes dimensions = 31 x 22 mm.
4/12/10	Shearing shed	FWU	WFD	F	16.5	22.1	17.2	No pouch young.
6/12/10	Shearing shed	FWU	WR	M	430	-	-	
5/12/10	House Bay 1	GHC	WS	-	-	-	-	
7/12/10	NE Hill	SCA	WS	-	-	-	-	

GCL = lowland grassland complex, FWU = weed infestation (african boxthorn), GHC = coastal grass and herbfield (predominantly *Lepidosperma gladiatum*), SCA = coastal scrub on alkaline sands. SBB = southern brown bandicoot, WFD = white-footed dunnart, WR = water rat, WS = White's skink. Wt = body weight, HL = head length, FL = hind foot length.

45, 000 pademelons were culled respectively (DPIWE 2001). Poisoning by 1080 was last used on the island in 2003.

Southern Brown Bandicoot

Based on the evidence of diggings, southern brown bandicoots occurred over most of the island; however diggings were most common in the central part of the island. Whinray (1972) also noted that this species occurs over much of Inner Sister Island but is common only in the central pasture area. Six bandicoots were seen during the first night of spotlighting and two were seen on the second night. Four bandicoots, two males and two female, were trapped in the central part of the island (Tables 2–3). One of the female bandicoots had three pouch young and based on the presence of one large unoccupied teat it had bred earlier in the season. The only previous trapping of bandicoots was in August 1986 by Peter Mooney (unpublished data). He set 12 cage traps for three nights and caught eight southern brown bandicoots, four males and four females. Although the sample sizes are small, the mean weights for male and female southern brown bandicoots are considerably smaller than those reported elsewhere in Tasmania and mainland Australia but similar to the Franklin Island (South Australia) population (Table 4).

Bats

No bats were caught in bat traps or observed during the evenings around the house or while spotlighting. The locations where the bats traps were set were not ideal for catching bats. Whinray (1972) collected a lesser long-eared bat from under peeling wallpaper in the homestead in 1968. He also reported that the leaseholders often see bats in the homestead. An unidentified bat was observed in the homestead several years ago (K. Blyth, pers. comm., 31/3/2011).

Water Rat

One male water rat was trapped near the shearing shed and 13 images of one or more water rats were taken by the remote camera that was set next to the shearing shed. Water rats were also observed foraging in the early evening on House Bay Beach near the shearing shed. Whinray (1971) reported that in 1960 two water rats were caught in gin traps set by fisherman for Tasmanian pademelons. Whinray also mentions that a water rat from the island was lodged with the South Australian Museum in late 1929 or early 1930. K. Blyth (pers. comm., 31/3/11) observed five water rats at one time on House Bay beach feeding on fish carcasses dumped by fisherman.

Table 4. Comparison of mean body weights of southern brown bandicoots from different locations in Australia.

Location	Male	Female	Source
Inner Sister Island	647 (6)	537 (6)	Present study, P. Mooney unpub. data
Southern Tasmania	1245 (49)	1001 (78)	Mallick *et al.* (1998)
Northern Tasmania	1166 (8)	947 (5)	Heinsohn (1966)
Western Australia	1230 (49)	880 (29)	Cooper (1998)
Cranbourne, Victoria	614 (31)	476 (36)	Stoddard and Braithwaite (1979)
Franklin Island, South Australia	595 (189)	528 (143)	Copley *et al.* (1990)

Values in parentheses are sample sizes. Weights obtained by P. Mooney were: males: 685, 695, 720,670; females: 650, 676, 675, 690.

European Hare

A skull of the European hare was found on the island near the *Eucalyptus* trees behind House Bay. No live hares were observed. Hares were introduced to the island by the leaseholder during the early 1900s (Whinray 1972) and were present in 1909 (Barrett 1909). Whinray (1971, 1972) saw hares on Inner Sister Island during a number of visits from 1966 to 1969. In 1966 there were between 10 and 20 hares in the pasture between the homestead and South Bay (=House Bay) Sand Ridges. The population appeared to be affected by the 1967 drought because in 1968 and 1969 only three or four were seen (Whinray 1972). Hares were present on the island during the 1980s when 6–8 animals were seen (C. Arthur, pers. comm., 11/2/2011). The leaseholders have not observed any hares since they took over the lease for the island in 1988 (K. Blyth, pers. comm., 31/3/2011).

Introduced Rodents

No introduced rats or mice were caught or observed during the survey. The homestead and the shearing shed were specifically targeted for these species. If house mice were present there would be a high chance of catching them in the box traps or observing their presence in the homestead. Whinray (1971) reports seeing or trapping house mice on several islands in the Furneaux group, including West Sister Island and noted that it was one of the most successful introductions to the Furneaux group and is probably more widespread than the records indicate. Notably he spent a month on Inner Sister Island and caught no rats or mice (trapping effort not specified). No rats or mice have ever been observed by the leaseholders (K. Blyth, pers. comm., 31/3/2011), other than 'field mice' which, given no mice were trapped at all on the island, are probably white-footed dunnarts.

Cats

No cats were observed, trapped or recorded by remote cameras on the island. However, possible cat scats and fur balls were observed by S. Bryant and K. Carlyon during the survey. A number of shearwater carcasses were observed that possibly could have been eaten by cats, although this may have been due to water rats. Macropods have also been observed foraging on bird carcasses. Whinray (1971) noted that cats had been successfully introduced to a number of islands in the Furneaux Group, including Outer Sister Island, however he did not observe them on Inner Sister Island. The leaseholders have never seen cats on the island and thought they would have been seen during quail shooting when hunters traverse over the island (K. Blyth, pers. comm., 31/3/2011). Further surveys are required to confirm the presence of cats on the island and if confirmed present then a cat eradication program should be developed.

Sheep and Goats

Up to 700 sheep can be stocked on Inner Sister Island but none were present during the survey. Sheep were taken off the island in spring 2010 (K. Blyth, pers. comm., 31/3/2011). Barrett (1909) reported goats on the island. No goats currently occur on the island.

Southern Brown Bandicoot.
Photo by Michael Driessen.

REFERENCES

Ashby E. (1927) Islands in Bass Strait upon which kangaroo and wallaby are found. *Transactions of the Royal Society of South Australia* 51, 414.

Barrett C. (1909) Island Life. Birds and Man in Bass Strait. *Life* 1/8/2009, 143–8.

Brothers N., Pemberton D., Pryor H. & Halley V. (2001) *Tasmania's Offshore islands: Seabirds and Other Natural Features.* Tasmanian Museum and Art Gallery, Hobart, Australia.

Cooper M. L. (1998) Geographic variation in size and shape in the southern brown bandicoot, *Isoodon obesulus* (Peramelidae : Marsupialia), in Western Australia. *Australian Journal of Zoology* 46, 145-52.

Copley P. B., Read V. T., Robinson A. C. & Watts C. H. S. (1990) Preliminary studies of the Nuyts Archipelago bandicoot *Isoodon obesulus nauticus* on the Franklin Islands, South Australia. In: *Bandicoots and Bilbies* (ed P. R. B. J. H. Seebeck, R. L. Wallis, and C. M. Kemper) pp. 345–56. Surrey Beatty & Sons Pty Limited, Chipping Norton, New South Wales, Australia.

Driessen M. M. & Hocking G. J. (1996) Age estimation of the Tasmanian pademelon, *Thylogale billardierii*, by molar eruption. *Australian Mammalogy* 20, 107—10.

Green R. H. (1969) The birds of Flinders Island. *Records of the Queen Victoria Museum* 34.

Heinsohn G. E. (1966) Ecology and reproduction of the Tasmanian bandicoots (Perameles gunnii and Isoodon obesulus). *University of California Publications in Zoology* 80, 1–107.

Le Souef A. S. (1929) Notes on some mammals from Bass Strait islands including a new subspecies of *Pseudochirus*. *Australian Zoologist* 5, 329–32.

Mallick S. A., Driessen M. M. & Hocking G. J. (1998) Biology of the southern brown bandicoot (*Isoodon obesulus*) in south-eastern Tasmania. II. Demography. *Australian Mammalogy* 33, 339–47.

Rousevell D. E., Taylor R. J. & Hocking G. J. (1991) Distribution records of native terrestrial mammals in Tasmania. *Wildlife Research* 18, 699–718.

Stoddard D. M. & Braithwaite R. W. (1979) A strategy for utilization of regnerating heathland habitat by the southern brown bandicoot (*Isoodon obseulus:* Marsupialia, Peramelidae). *Journal of Animal Ecology* 48, 165–79.

Whinray J. S. (1971) The present distribution of some mammals in the Furneaux Group, Bass Strait, Tasmania. *Victorian Naturalist* 88, 279–86.

Whinray J. S. (1972) Notes on West Sister island, Furneaux Group Tasmania. *Victorian Naturalist* 89, 4–14.

Austroicetes vulgaris. *Photo by Michael Driessen.*

Crickets, Grasshoppers and Stick Insects of Inner Sister Island

Michael Driessen

INTRODUCTION

The aim of this report is to document the Orthoptera (crickets and grasshoppers) and Phasmatodea (stick insects) observed during the scientific survey of Inner Sister Island. No species of these taxa have previously been recorded on Inner Sister Island and they have not been well surveyed on the Furneaux Islands with the exception of the Rhaphidophoridae (cave and camel crickets) for which four species have been recorded from 10 islands (Driessen 2009; Richards 1971; 1974).

Sixty three described species of Orthoptera in ten families have been recorded in Tasmania (Semmens *et al.* 1992). For the eastern Bass Strait islands, 12 species of Orthoptera, including one undescribed species of raspy cricket, have been recorded (Driessen 2009).

Only three species of Phasmatodea are recorded in a catalogue of Tasmanian insects by Semmens *et al.* (1992); however only two of these species were recorded as occurring in Tasmania in a recent field guide to Australian stick insects (Brock and Hasenpusch 2009). No records of Phasmatodea from the eastern Bass Strait islands were found in other literature during the preparation of the present report.

METHODS

Orthoptera and Phasmatodea were collected opportunistically by hand or listening for calls while undertaking other activities during the scientific survey. Pitfall traps and beating of vegetation were undertaken as part of the general invertebrate survey. Juvenile *Bobilla* crickets were live collected and reared to adults to enable identification.

RESULTS AND DISCUSSION

One species of grasshopper, four species of cricket and one species of stick insect were recorded on Inner Sister Island (Table 1). Further survey effort, particularly later in summer and in autumn, may reveal further species.

Stick Insects

A juvenile male stick insect was found on one of the members of the survey team who was resting beneath a *Myoporum insulare* shrub at the eastern end of the island. This is believed to be the first record of a stick insect from the eastern Bass Strait islands. The specimen was identified to the genus *Candovia*; however it was not possible to identify the species. This genus was not listed as present in Tasmania in Brock and Hasenpusch's (2009) guide to stick insects of Australia but Semmens *et al.* (1992) list

Table 1. Orthoptera and Phasmatodea recorded from Inner Sister Island

Species	
Orthoptera	
Acrididae	
Austroicetes vulgaris	southeastern austroicetes
Gryllacrididae	
Kinemania ambulans	raspy cricket
Gryllidae	
Buangina diminuens	field cricket
Bobilla sp.	swamp cricket
Gryllotalpidae	
Gryllotalpa australis	mole cricket
Phasmida	
Diapheromeridae	
Candovia sp.	stick insect

Parasipyloidea tener = *Candovia peridromes* (Sydney stick insect) in Tasmania. I could not confirm whether the specimen collected was *C. peridromes* or an undescribed species. Earlier in the year I collected an adult female specimen of *Candovia* from the Binalong Bay area of northeast Tasmania. It was superficially similar to *Candovia peridromes* but the eggs collected from it were different from those of the Sydney stick insect suggesting it was an undescribed species.

Grasshoppers

Only one species of grasshopper (family Acrididae) was recorded on Inner Sister Island. The southeastern austroicetes (*Austroicetes vulgaris*) was observed in grassland on East Hill and in particular in grassland areas that had been recently burnt. This species has previously been recorded from islands in eastern Bass Strait.

Crickets

All four species of cricket are most likely new records for the Furneaux Group although locals would no doubt be aware of the calls of mole crickets and field crickets.

Kinemania ambulans

A male and female raspy cricket was collected from the sheoak forest at the top of East Hill. Both were in a sheoak tree about one metre above the ground where a branch had broken off the tree but had remained attached to the trunk. One was collected from heart wood and the other was from behind bark. A juvenile raspy cricket was collected among *Poa* tussocks at the eastern end of the island while preparing an area for setting camera traps.

Bobilla sp.

Many *Bobilla* swamp cricket nymphs (about 2 mm long) were observed on the margins of the small pond at the eastern end of the island. No adults were observed which is unusual given my experience with other *Bobilla* spp. on the Tasmanian mainland where both adults and nymphs are usually present at any time of year. Five nymphs were collected and reared to adults for the purposes of identification. The number of files on the stridulatory files for two adult males was 201 and 226. Based on the keys provided by Otte and Alexander (1983), this would place the male with a file count of 201 in *Bobilla victoriae*, a species not previously recorded in Tasmania but present in southern Victoria. The file count for the second male falls between the ranges given for *B. victoriae* and *B. tasmani*. *B. tasmani* has previously been recorded from Cape Barren Island as well as from mainland Tasmania. Further investigations are required to confirm the identity of the Bobilla on Inner Sister Island.

Gryllotalpa australis

A thorax and a set of front legs of a mole cricket were found in a gully above the west end of North Beach. One mole cricket was heard calling from under a piece of tin near the shearing shed.

Buangina diminuens

This species of field cricket was heard calling from within soil cracks within the pasture and several individuals were collected.

Buangina diminuens.
Photo by Michael Driessen.

REFERENCES

Brock P. D. & Hasenpusch J. W. (2009) *The Complete Field Guide to Stick and Leaf Insects of Australia.* CSIRO Publishing, Collingwood.

Driessen M. M. (2009) The Orthoptera. In: *Prime Seal Island Scientific Expedition 2008* (eds S. Harris, M. Driessen and P. Bell) pp. 115–8. Department of Primary Industries, Parks, Water and Environment, Hobart.

Otte D. & Alexander R. D. (1983) *The Australian Crickets (Orthoptera: Gryllidae).* The Academy of Natural Sciences Philadelphia. Monograph 22, Philadelphia.

Richards A. M. (1971) The Rhaphidophoridae (Orthoptera) of Australia. Part 9. The distribution and possible origins of Tasmanian Rhaphiophoridae, with descriptions of two new species. *Pacific Insects* 13, 575–87.

Richards A. M. (1974) The Rhaphidophoridae (Orthoptera) of Australia. Part II. *Pacific Insects* 16, 245–60.

Semmens T. D., McQuillan P. B. & Hayhurst G. (1992) Catalogue of the Insects of Tasmania. Department of Primary Industry Tasmania.

Kinemania ambulans.
Photo by Michael Driessen.

Drysdalia coronoides.

Photo by Asher Jones.

Reptiles

Michael Driessen and Micah Visoiu

Reptiles were recorded opportunistically while undertaking other surveys on the Inner Sister Island. Previously, seven reptile species have been recorded on the island (Table 1). We encountered six of these seven species. We did not observe Bougainville's skink. This species has only been recorded once in December 1966 when a single specimen was found buried in loose soil on the upper part of the eastern side of West Hill (Whinray 1972). During the recent trip this area was observed to be heavily impacted on by fire, with low diversity vegetation and largely mineral soils. The few exfoliated granite slabs overturned were not on the loose soil substrates considered suitable for this species. Relocation of Bougainville's skink would require more targeted surveying in suitable habitat.

The granite slabs on West Hill did reveal the presence of one live three-lined skink; two further dead specimens were also found, one in shearwater colony above north beach and another in sand at the top of the un-named beach east of North Beach. White's skink was regularly observed across all parts of the island and two specimens were caught in box traps and one was captured on a camera trap located at the eastern end of the island. Numerous metallic skinks were observed in rocky areas, both coastal and inland, and small skinks observed regularly in tussock grassland were assumed to most probably be this species. Three blotched bluetongues were observed; one in *Lepidosperma gladiatum* sedgeland behind House Beach, one near the stand of *Eucalyptus* and one in tussock grassland 150 m west of the homestead. Thirty-five tiger snakes were observed throughout the island by the survey team. This included two juveniles that were approximately 25 cm long. Tracks most likely made by a tiger snake were observed on the un-named beach immediately to the east of North Beach. Four white-lipped snakes were recorded; one in the gully leading up to East Hill, one in grassland on east Hill between two sheoak stands, one in a shearwater colony above North Beach and one on the southwest coast.

Table 1. Reptiles recorded from Inner Sister Island

Species		Source
White-lipped snake	*Drysdalia coronoides*	1, 2, 3
Tiger snake	*Notechis scutatus*	1, 2, 3
White's skink	*Egernia whitii*	1, 2, 3
Blotched bluetongue	*Tiliqua nigrolutea*	1, 3
Bougainville's skink	*Lerista bougainvillii*	1
Metallic skink	*Niveoscincus metallica*	1, 3
Three-lined skink	*Bassiana duperreyi*	1, 2, 3

1 = Whinray (1972), 2 = Brothers *et al.* (2001), 3 = present survey in December 2010

Tiliqua nigrolutea.
Photo by Micah Visoiu.

Twelve species of reptile are known to occur on islands in the Furneaux Group (Hutchinson *et al.* 2001; NVA 2011). The largest islands, Flinders and Cape Barren have the largest numbers of species (11 and 12 respectively). In a survey of the reptile fauna of Prime Seal Island, van Winkel (2009) recorded eight reptiles species which is the greatest diversity of reptiles recorded for any of the smaller outer islands of the Furneaux Group. However, the low diversity on other islands may be an artefact of limited sampling. Although, Inner Sister Island (747 ha) is about a third the size of Prime Seal Island (1, 221 ha), the species diversity is similar with a small difference in composition. The lowland copperhead and the mountain dragon have not been recorded on Inner Sister Island and Bougainville's skink has not been recorded on Prime Seal Island.

No amphibians were observed on the island or are known to have been observed in the past. This is no doubt a result of the lack of permanent freshwater bodies.

REFERENCES

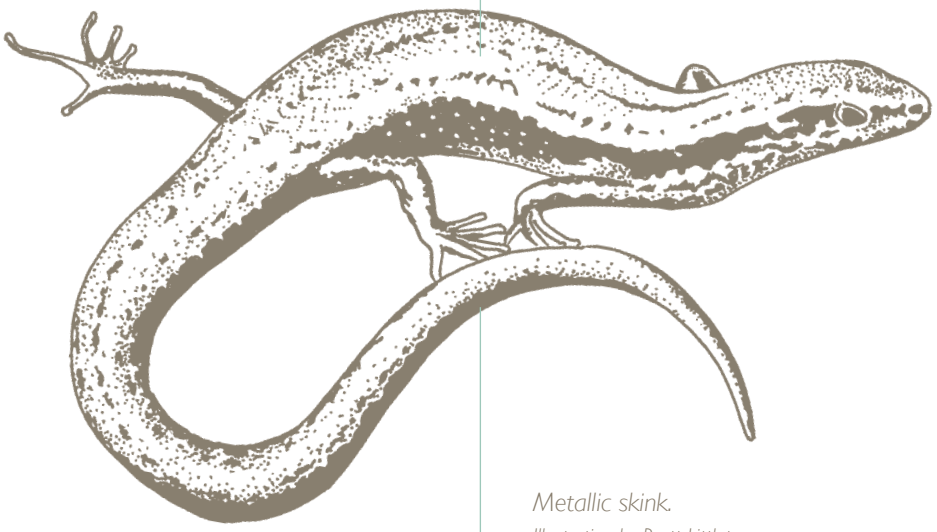
Brothers N., Pemberton D., Pryor H. & Halley V. (2001) T*asmania's Offshore islands: Seabirds and Other Natural Features.* Tasmanian Museum and Art Gallery, Hobart, Australia.

Hutchinson M., Swain R. & Driessen M. (2001) *Snakes and Lizards of Tasmania.* Department of Primary Industries, Water and Environment and University of Tasmania, Hobart.

NVA. (2011) Natural Values Atlas - database of plant and animal distribution records managed by the Department of Primary Industries Parks Water and Environment, Tasmania. www.naturalvaluesatlas.tas.gov.au. Last accessed 15 April 2011.

van Winkel D. (2009) The Reptiles. In: *Prime Seal Island Scientific Expedition 2008* (eds S. Harris, M. Driessen and P. Bell) pp. 66–75. Department of Primary Industries, Parks, Water and Environment, Hobart.

Whinray J. S. (1972) Notes on West Sister island, Furneaux Group Tasmania. *Victorian Naturalist* 89, 4–14.



Metallic skink.
Illustration by Brett Littleton.

Elbow Pond.

Photo by Stephen Harris.

Freshwater Invertebrates

of Inner Sister Island

Tom Sloane

Three freshwater habitats were sampled on Inner Sister Island. All habitats were ephemeral to varying degrees and only the creek site at the base of East Hill appeared to remain moist year round. A total of 18 different taxa were collected, almost all of which were insects, apart from a hydrobiid snail and a water mite. The fauna was dominated by Diptera (6 species) and Coleoptera (5 species), with smaller numbers of Odonata (2 species) and Heteropteran Hemiptera (2 species). The majority of species collected were widespread taxa, with flying adult stages that are capable of colonising isolated ephemeral habitats.

INTRODUCTION

This report gives the results from a survey of freshwater invertebrates conducted on Inner Sister Island in December 2010.

As far as can be determined, no similar study has previously been conducted. The aim of the survey was to collect the greatest possible diversity of freshwater invertebrates in as many suitable habitats as could be identified.

METHODS

Site Descriptions

A total of three predominately freshwater habitats were identified on Inner Sister Island. The first of these was a small (40 cm wide) boggy creek on the western slope of East Hill (here after referred to as House Creek). The substratum included gravel and/or sand over *Melaleuca ericifolia* roots, along with overlying silt and detritus. Surface flow was barely evident. The creek was shaded by *M.ericifolia* and was bordered by small patches of *Lilaeopsis polyantha.* Some green algae were also present (Figure 1).

The second freshwater habitat was a circular depression about 20 m wide in coastal scrub on the eastern side of the base of East Hill (hereafter referred to as Elbow Pond). The watered area consisted of approximately 10 m diameter and appeared to be rapidly evaporating. Maximum depth throughout was approximately 20 cm. The substratum was firm with fine gravel /sand and some clay present. The pond contained *Ruppia* sp and *Crassula* over a continuous mat of *Neopaxia australasica* and *Limosella lineata* (Figure 2).

The last of the freshwater habitats was a crack in a granite outcrop at the eastern end of the northern beach (hereafter referred to as Rain Pool). The pool was approximately 40 cm long, 20 cm wide and 10 cm deep at its widest point. The substratum was

solid granite with a small amount of interstitial sand. The pool contained a small amount of the green algae *Enteromorpha intestinalis*.

Sampling regime

For House Creek, samples were collected by hand from the underside of instream woody debris. Sampling commenced at the lower altitudes and progressed upstream in order to collect from undisturbed habitat. Samples for Rain Pool were also collected by hand.

For Elbow Pond, samples were collected with a 1 mm mesh FBA net. Two 5 m long FBA net sweeps were taken throughout the pond and the net contents emptied into a white tray. Specimens were then picked out by hand. Sampling for freshwater invertebrates was also conducted concurrently to sampling for terrestrial invertebrates. Therefore, any invertebrate fauna associated with freshwater habitats (i.e. requiring aquatic habitats for some life history stages) were also documented as part of this report, particularly observations of flying adults and insects collected from light traps. For methodology used in terrestrial invertebrate sampling, refer to Sloane, this publication).

All specimens were picked into vials of 70% ethanol with 5% glycerol. Collection was aimed at maximising biodiversity, and specimens were not collected in proportion to their abundance.

Figure 1. A snapshot of House Creek sampling site on the western slope of East Hill. Photo by Tom Sloane.

RESULTS

A total of 21 freshwater taxa were identified from the survey. Of this, the majority were larval forms of Colleoptera and Diptera although representatives of Odonata, Hemiptera, Trichoptera, Acarina and Gastropoda were also detected (Table 1).

Odonata

Nymphs of the widespread tau emerald (*Hemicordulia tau*) (Figure 3) were collected in Elbow pond. This species is well known for colonising ephemeral habitats and has considerable thermal and salinity tolerance. Adults of the blue spotted hawker (*Adversaeschna brevistyla*) were seen around the

*Figure 3. A tau emerald (*Hemicordulia tau*) nymph which were the most abundant of the freshwater invertebrate fauna on the Island*

Figure 2. Elbow Pond sampling site at the base of East Hill on the eastern side of the island. It was named Elbow Pond for this report as it was located in close proximity to Elbow Bay. Photos by Tom Sloane.

central part of the island, and smaller dragonflies seen in the same area were possibly adults of *Hemicordulia tau.*

Hemiptera

Waterboatmen (*Sigara* sp.) and small backswimmers (*Anisops* sp.) were abundant in Elbow pond. Both of these species disperse widely and were also collected at the light trap at the homestead.

Coleoptera

Diving beetles (Dytiscidae) *Antiporus femoralis, Onychohydrus scutellaris* and *Liodessus amabilis* were collected in Elbow Pond. Both adult and larval *A. femoralis* were collected, and a single last instar larvae of *O. scutellaris* was found on land after leaving the water to pupate. The tiny *Liodessus amabilis* was the only species collected both in Elbow Pond and House Creek. Larvae of the water scavenger beetle (Hydrophilidae) *Berosus* sp. were present in Elbow Pond and larvae of an unidentified marsh beetle (Scirtidae) were collected from House Creek.

Trichoptera

Adult leptocerid caddisflies were collected from the light trap at the homestead. No larval caddisflies were found

Table 1. Freshwater taxa were identified from the survey.

Class/Order	Family	Species	House Creek	Elbow Pond	Rain Pool	Flying adults	Light trap
Odonata	Hemicorduliidae	*Hemicordulia tau*		•		•*	
	Aeshnidae	*Adversaeshna brevistyla*				•*	
Hemiptera	Corixidae	*Sigara* sp		•			•
	Notonectidae	*Anisops* sp		•			•
Coleoptera	Dytiscidae	*Liodessus amabilis*	•	•			
		Antiporus femoralis		•			
		A. femoralis larvae		•			
		Onychohydrus scutellaris larvae		•			
	Hydrophilidae	*Berosus* sp. *larvae*		•			
	Scirtidae	*Unid larvae*	•				
Trichoptera	Leptoceridae	*Adults*					•
Diptera	Stratiomyidae	*larvae*	•				
	Culicidae	*larvae*			•		
		Adults				•	•
	Sciomyzidae	*Unid larvae*	•				
	Chironominidae	*Chironomus* sp. larvae		•			
		Polypedelium sp. Larvae		•			
		Dicrotendipes sp. Larvae		•			
		Chironomid adults					•
Acarina	Hydracarina			•			
Gastropoda	Hydrobiidae	*Austropyrgus sp.*	•				

* Adult dragonflies seen but not collected

on the island. These specimens may have originated in the old underground water tank at the homestead.

Diptera

Fly larvae were the most diverse group of freshwater insects collected on Inner Sister Island. Chironomid midge larvae from 3 species were very common in Elbow Pond and adult chironomids were taken at the light trap. Larval Stratiomyidae and snail feeding Sciomyzidae were found in House Creek. Larvae of the mosquito *Aedes australis* (Culicidae) were collected from the rain pool, and were the only animals present. This species is associated with coastal habitats and can breed in saline pools (Dobrotworsky, 1965). Adults of *Aedes rubrithorax* were common around (and inside!) the house and at the light trap. *A. rubrithorax* breeds in fresh water, often in man-made containers in shaded situations (Dobrotworsky, 1965). These mosquitoes may also have originated in the old water tank.

Gastropoda

The hydrobiid snail *Austropyrgus* sp. was found in House Creek. Many freshwater snails cannot withstand prolonged dry spells and the presence of hydrobiids indicates relatively constant moisture at this site. No snails were recorded from Elbow Pond.

Acarina

A single unidentified water mite was collected from Elbow pond. Water mite nymphs are ectoparasitic on aquatic insects especially Hemiptera, and use the dispersal ability of their hosts to colonise new habitats. Parasitised *Sigara* sp. (Corixidae) were observed at this site (Figure 4).

Figure 4. A Sigara *sp. (Corixidae) from Elbow Pond parasitised by unidentified water mites. This level of parasitism was not uncommon in the Elbow Pond sampling site.*

Photo by Tom Sloane.

DISCUSSION

Freshwater habitats are often rare on small islands due to limited catchment areas for creeks and free draining often sandy or gravelly substrata. Consequently any streams or ponds which do form are ephemeral, often relatively saline as a result of close proximity to the sea, and contain limited fauna. Inner Sister Island is a good example of this, with only three freshwater habitats identified. Most adult aquatic insects can fly and nocturnal flights are the main way these animals colonise ephemeral habitats. The freshwater fauna was found to be dominated by insects with flying adult stages, and many of these were collected at the light trap as well as in the water. The Elbow Pond site was in the later stages of drying up and many insects had completed their life cycles and were actively dispersing. This site would probably have contained a richer fauna when more water was present. The House Creek site appears to retain some moisture year round as indicated by the presence of hydrobiid snails, but is too small to support a varied stream fauna.

ACKNOWLEDGEMENTS

Thanks to Mike Driessen for accompanying me on the trek to Elbow Pond, Micah Visiou for assistance with aquatic plant identifications, Steve Harris and Anthony Reid for organising the trip, all the other expeditioners, and the Hamish Saunders Trust and the Saunders family.

REFERENCES

Dobrotworsky, N.V. (1965) *The Mosquitoes of Victoria.* Melbourne University Press, London.

Jewel bug nymphs (Scutelleridae).

Photo by Asher Jones.

Terrestrial Invertebrates
of Inner Sister Island

Tom Sloane

Inner Sister Island was sampled for terrestrial invertebrates with a range of techniques including hand collection, pitfall traps, light traps, bash and sweep sampling. The island has not previously been surveyed for invertebrates. A total of 15, 283 specimens from 32 orders were collected. Results are given for selected groups only, and many small and difficult specimens of some major groups (Hymenoptera, Diptera, Coleoptera, Heteroptera) were not identified further than that of order.

INTRODUCTION

This report details the results of an invertebrate survey conducted on Inner Sister Island in December 2010. Results for Orthoptera, Phasmatodea and the freshwater fauna are given elsewhere in this report by Mike Dreissen and Tom Sloane. The aim of the survey was to sample as many different kinds of invertebrate as possible. Habitat types expected to provide a diverse range of specimens were deliberately targeted.

METHODS

Site Description

A variety of different habitats and vegetation types were sampled for terrestrial invertebrates using a number of different methods. Habitats were identified, separated primarily on the basis of vegetation types, and respectively sampled with the endeavour to maximise the estimate of species richness from the island. The different sampling techniques were employed on the basis of which was considered to most appropriately capture the most individuals from each habitat type (Table 1).

Sampling methodology

Three sampling methodologies were employed across the island depending on the habitat type being sampled. These included pitfall traps, sweep samples and beat/bash samples. Incidental observations and collections were also conducted using a light trap as well as leaf litter samples and opportunistic hand collections.

Pitfall traps

Six pitfall trap sites of five traps each were set on Inner Sister Island. The five traps were set up in a line approximately 10 m apart. To minimise vertebrate captures, each trap was covered by a circular plastic lid set about 2 cm above the trap, and secured with

stakes. The traps were ¾ filled with 70% ethanol with ethylene glycol and some glycerol added. Sites P2, P3, P4, and P5 were set up across the interface between different kinds of vegetation. Sites P1 and P6 were placed in areas of more continuous habitat. Sites were situated to include as many microhabitats as possible to maximise biodiversity in samples. The pitfall traps were all set in the low central area of the island around the homestead. Traps also were positioned to avoid the many pademelon runs on the island.

Sweep samples

Three sites were sampled by sweeping with a butterfly net for approximately 5 minutes. Samples were retained for further sorting.

Table 1. The different habitat types sampled for terrestrial invertebrates and the respective sampling methodologies employed.

	Sample Method		
Habitat type	**Sweep**	**Beat**	**Pitfall**
Eucalyptus globulus		B1	
Allocasuarina		B7	
Leptospermum		B3	
flowering Leptospermum		B4	
Melaleuca		B5	
Pteridium	S3		
Bursaria spinosa		B2	
Coastal low scrub		B6	P1
Leptospermum/ Pteridium			P3
Myoporum/Poa			P2
Bursaria/Pteridium			P4
Melaleuca/Poa	S2		P5
Allocasuarina/Poa/ Melaleuca	S5		
Beach strandline			P6

Bashing samples

Seven sites were sampled by beating low branches of shrubs with a suitable stick for approximately 5 minutes. A butterfly net was held underneath to catch dislodged invertebrates, and the sample preserved for later analysis. Where possible beating was conducted in the morning, while flying insects were still sluggish. At all sites apart from B6, sampling was restricted to the dominant species of tree or shrub.

Light trap

An 8 watt fluorescent tube and a 160 miliamp ultraviolet LED array were deployed on a 1×1.5 m white sheet hung from the outside wall of the Homestead. The trap was set up on the wall out of the prevailing wind over two nights and specimens were collected by hand. Lepidoptera were collected into an ethyl acetate killing jar and then frozen, to be pinned on return to Hobart.

Litter samples

Leaf litter was collected from underneath different tree species. The litter was placed in a large 5 mm mesh plastic sieve over a white tray. The tray was then shaken and the fine fraction obtained was inspected for invertebrates. Specimens were picked out by hand into 70% ethanol and the process repeated for the coarse fraction. Two litter samples were taken at each site. Not all vegetation types produce enough litter for sampling in this way, and only those with litter of suitable thickness to support a reasonable fauna were examined.

Hand collection

Hand collection was undertaken throughout the central and eastern part of Inner Sister Island. Opportunistic sampling was undertaken constantly, as well as the capture and observation of flying insects. Hand collection was specifically targeted towards bark, pademelon carcasses, under wood and debris and along the beach strandline. As with

the litter sampling, not all trees have bark suitable for effective hand collection, and some tree species were deliberately targeted.

Invertebrates were identified to at least family, with some to genus and species level. Some groups were not identified further than class or order level, and others were referred to specialists (Crustacea, Lepidoptera).

RESULTS

A total of 15, 283 specimens were collected by combined sampling methods other than opportunistic hand collection on the expedition. This included representation from 32 orders of invertebrates, not including orders from groups such as mites which were not identified further than class. Two additional insect orders with aquatic life history stages (Trichoptera and Odonata) were also recorded although these are discussed in a separate paper (Sloane, this publication).

Results at all levels for all collecting techniques are given in Appendix 1. With the exception of pitfall traps, sweeping and bashing samples, all collecting techniques employed were biased towards the larger, more conspicuous invertebrates. In most cases only one or two of the largest adult specimens of each invertebrate were sampled. This was to minimise the number of specimens collected and preserved as well as to aid in identification. Many other large and readily identified animals were not collected at all, but their presence was noted at the different sites. As a result of this all results tables show only presence/absence data for these methods and all can be considered to be effectively hand collection.

Of the 30 pitfall traps set, 3 were knocked over or dug up, presumably by pademelons. Samples from Pitfall site 1 contained over 10, 000 ants. Numbers of ants from this site were estimated by counting ants in a 5% subsample. Where represented in graphs this total number has been reduced to aid in interpretation.

Pitfall traps

A total of 14, 053 specimens from 23 orders were collected in the 30 pitfall traps. Pitfalls in coastal scrub and *Myoporum/ Poa* contained the highest number of specimens while the beach strand line and *Leptospermum/Pteridium* traps the lowest (Figure 1). The pitfall samples were found to contain mainly Hymenoptera, Diptera and Coleoptera, with lesser numbers of Araenae, mites and Dermaptera (Figure 2).

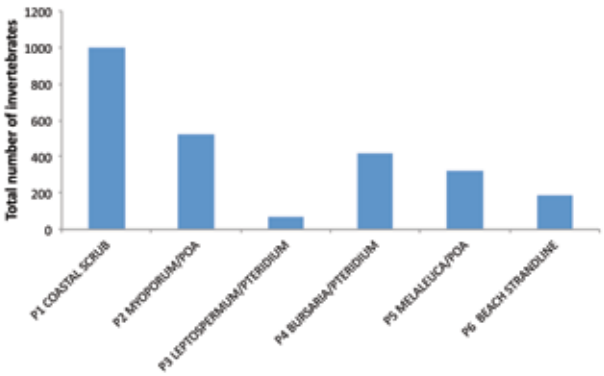


Figure 1. Total number of specimens collected in pitfall traps across the different habitat types sampled.

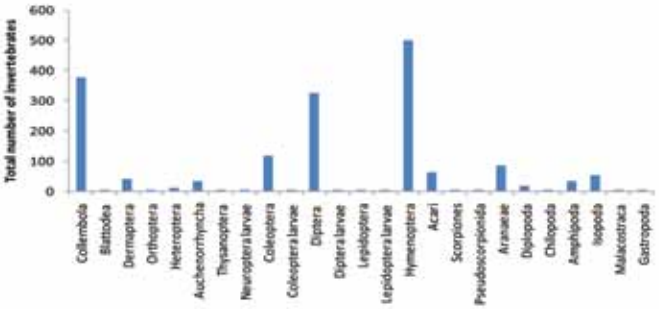


Figure 2. Number of specimens collected in pitfall traps.

Bashing samples

Bashing accounted for 958 specimens from 17 orders. Bash samples from coastal scrub and *Melaleuca* produced the most specimens while boxthorn and *Allocasuarina* samples had the fewest (Figure 3). The fauna of the bash samples was dominated by Araenae, Diptera, Sternorrhyncha and Heteroptera, with a lesser component of Coleoptera, Collembola and Hymenoptera (Figure 6).

Sweep samples

Sweeping provided 272 specimens from 11 orders. The sweep sample from *Poa* sp grassland contained the largest number of animals and the *Pteridium* sp. fernland the smallest number (Figure 5). Sweeps produced mainly Heteroptera, Diptera and Hymenoptera with lower numbers of Araenae, Lepidoptera , Coleoptera and Collembola (Figure 6).

Earthworms: Oligochaeta

Earthworms were collected at L2 only, in thick *Allocasuarina* sp litter. More earthworms would have been collected had they been deliberately targeted.

Land snails: Gastropoda

Only two land snail species were collected on Inner Sister Island. The introduced garden snail *Helix aspersa* was very common between the homestead and House Beach. Large numbers were seen in the early morning on sea spurge and horehound. Many empty shells were seen underneath african boxthorn bushes. *Theba pisana*, also introduced, was collected in coastal scrub and sand dune vegetation behind House Beach both by hand and in pitfalls. Some were also seen on horehound along the track to House Beach.

Sand hoppers: Amphipoda

Amphipods were common in the beach strandline samples and in a small freshwater seep over granite.

Millipedes: Diplopoda

Polydesmid millipedes were very common on the island and were found in almost all pitfall sites and by hand collection under bark and in litter. Two species of tiny Polyxenid millipedes were also collected. *Unixenus* sp. in the flowering *Leptospermum* sp. bash sample and *Propolyxenus forsteri* ? (poor specimen) in one pitfall trap.

Centipedes: Chilopoda

Three species of centipedes from two families were collected in pitfalls and by hand collection. *Cryptops* sp. and *Henicops maculatus* were collected in litter and under bark of *Allocasuarina* sp. on East Hill. *Lamyctes emarginatus* was taken in pitfalls at sites 2 and 6.

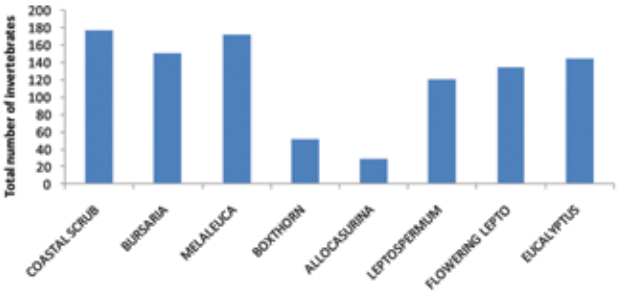


Figure 3. Total number of specimens collected in bash samples across the different habitat types.

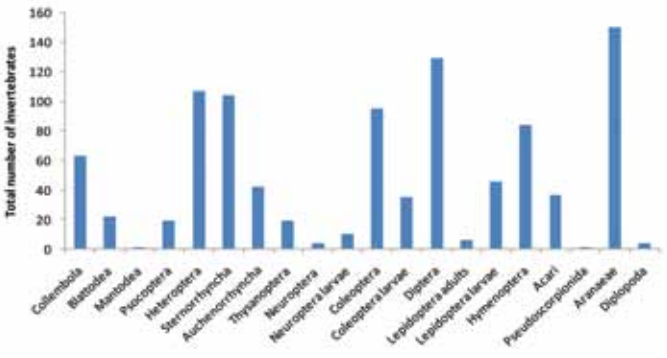


Figure 4. Total number of specimens collected in bash samples across the different taxonomic groups.

Pseudoscorpions: Pseudoscorpiones

Pseudoscorpions were reasonably abundant on Inner Sister Island, and were collected from pitfalls, under bark and in litter samples (Figure 7). Pseudoscorpions were not identified further, but possibly two species may be present.

Scorpions: Scorpiones

Tasmania's only scorpion species *Cercophonius squama* was collected both by hand under wood and debris and in pitfall traps. It was particularly common around the stand of blue gums (HC1), and in pitfalls from the beach strand line.

Spiders: Aranaeae

A total of 14 families of spiders were collected on the island. The families Lycosidae, Salticidae and Gnaphosidae were the most common spiders and were taken in pitfall traps and by hand. The specimens from sweep and beat samples were predominantly Araenidae, Clubionidae and Thomisidae. The family Sparassidae were rare on Inner Sister Island. A very large colony of the huntsman spider *Delena cancerides* was found in a fallen branch under the small stand of blue gums. This species was not found anywhere else on the island. One specimen of the badge huntsman *Neosparassus* sp. was collected by hand from a *Poa* sp. tussock. Other less common spiders from the families Nicodamidae, Zoariidae and Oonopidae were collected from pitfalls. The large black house spider *Badumna insignis* (Desidae) was hand collected from the outside of the homestead building.

Bristletails: Archaeognatha

The bristletail *Malochilodes* sp. was common under blue gum bark (Figure 8) and collected only once under rocks near the shearing shed at the western end of House Beach. Archaeognatha are a poorly known group and this species may be the same as that collected from Prime Seal Island.

Cockroaches: Blattodea

Three genera of cockroaches from two families were collected on Inner Sister Island. *Molytria* sp., *Platyzosteria* sp. and *Polyzosteria* sp. were found under bark and debris with one *Polyzosteria* sp. from the grassland sweep sample. A large number of tiny cockroach nymphs were present in the *Melaleuca* sp. bash sample.

Praying mantids: Mantodea

One egg case of the common green garden mantid *Orthodera ministralis* was collected from *Allocasuarina* bark from the western slope of East Hill. One

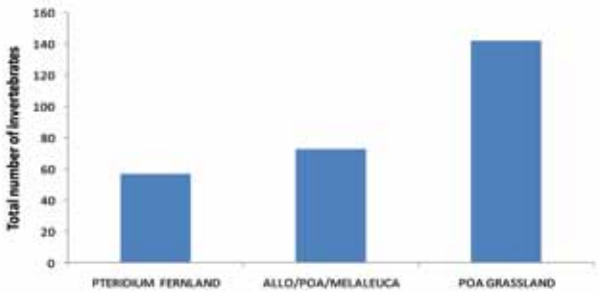


Figure 5. Total number of specimens collected in sweep samples across the different habitat types.

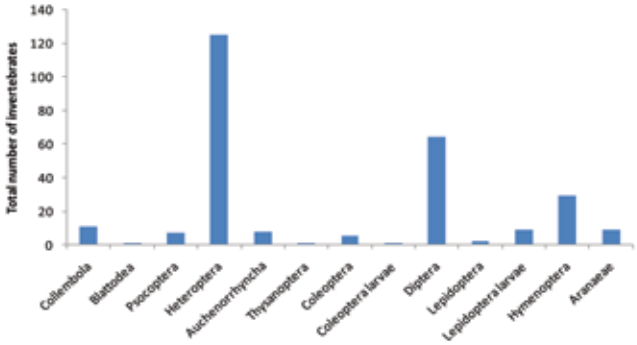


Figure 6. Total number of specimens collected in sweep samples across the different taxonomic groups.

O.ministralis nymph was also collected in the flowering *Leptospermum* sp. bash sample.

Earwigs: Dermaptera

Earwigs from the family Anisolabiduridae were widespread and common on the island, and were found in almost all pitfall sites as well as hand collection in pademelon carcasses and under wood and debris. One specimen of *Labidurus* sp. (Labiduridae) was collected under a log near the homestead.

Web spinners: Embioptera

The web spinner *Metoligotoma* sp. was collected from blue gum (*Eucalyptus globulus*) bark and litter behind House Beach. Embiids were not collected anywhere else on the island and appear to be restricted to the immediate area around the small stand of blue gums.

True bugs: Heteroptera

A total of 8 families of Heteroptera were found on the island. The two most common families, Pentanomidae and Miridae were captured mostly in bash samples. The strikingly coloured jewel bugs (Scutellaridae) especially *Scutiphora pedicellata* (Figure 9) were uncommon but conspicuous, and were found in bash samples and by hand collection. Predatory assassin bugs (Reduviidae) were taken by all methods but were not common. Thaumastocoridae were found only in bash samples from the stand of blue gums. Burrowing bugs from the family Cydnidae were collected in pitfalls and by hand collection. Many small unidentified Heteroptera were collected, particularly in *Poa* sp. and *Pteridium* sp. sweep samples.

Lacewings: Neuroptera

Lacewings from two families, Chrysopidae (green lacewings) and Hemerobiidae (brown lacewings) were collected on the island in sweep and bash samples and at the light trap. Larval lacewings were common in the bash sample from *Bursaria spinosa*.

Beetles: Coleoptera

A total of 24 families of beetles were collected on Inner Sister Island. Scarabaeidae and Staphylinidae were the most common families. Staphylinidae were collected from all pitfall trap sites as well as pademelon carcasses. Scarabs, particularly the dung

Figure 7. Pseudoscorpions were reasonably abundant, particularly on the underside of bark on gum trees.

Figure 8. The bristletail Malochilodes *sp. was also common under blue gum bark.* Photos by Tom Sloane.

feeding *Onthophagus* sp. were also collected mainly from pitfalls. Examination of pademelon carcasses revealed a typical fauna of carrion associated beetles, including the Stapylinid, *Creophilus* sp, the Silphid *Ptomaphila* sp. and the Histerid *Saprinus cyanus*. Beetles from the families Dermestidae, Cleridae and Trogidae were also found in carcasses. Less common beetle groups included Curculionidae, Anobiidae and Tenebrionidae from pitfalls and hand collection, and Mordellidae, Nitidulidae and Meylandridae from bash and sweep samples. Carabid beetles were relatively rare and were collected mainly by hand.

Tiger beetles (Carabidae, Cincindelidae) were collected from under a log near the homestead. One very large Carabid from the subfamily Scaritinae was taken in a pitfall on the beach strand line. A single specimen of the Phycosecid beetle *Phycosecus* sp. was also taken in a pitfall at this site. The family Chrysomelidae was represented only by a few specimens of the shining black *Paropsisterna* sp. from the stand of blue gums. The Trogissitid *Lepidopteryx* sp. was also only found in the stand of blue gums. Many tiny unidentified coleoptera were also collected, mainly from sweep and beat samples.

Figure 9. The conspicuous Scutiphora pedicellata *were one of the 8 Heteropteran families on Inner Sister Island.*

Hanging flies: Mecoptera

The large orange hanging fly *Harpobittacus* sp. was common around the central part of the island and the western slope of east hill. *Harpobittacus* sp. was observed in most vegetation types apart from *Poa* sp. grassland and the sand dune grasses. A mating pair (Figure 10) was photographed on East Hill. The male holds a captured crane fly (Diptera:Tipulidae) which he offers as a "mating gift" to the female.

Figure 10. A large male hanging fly Harpobittacus *sp. as he offers as a "mating gift" to the female.* Photos by Tom Sloane.

True flies: Diptera

Flies were abundant on Inner Sister Island and were collected by all methods. The families Tipulidae, Therividae and Platysomatidae were found mainly in sweep samples. Larger and more conspicuous flies such as the parasitic Tachinidae, marsh flies (Tabanidae) and robber flies (Asilidae) were collected by hand. Large numbers of minute unidentified diptera were present in pitfall bash and sweep samples with the largest numbers found in the pitfalls.

Butterflies and moths: Lepidoptera

Butterflies were rare on Inner Sister Island with only two species collected. Flying butterflies were not extensively targeted, and specimens from samples which were bulk preserved in ethanol were not suitable for identification. Moths were only collected from the light trap. Larval Lepidoptera were common in bash samples from *Bursaria* sp. and *Leptospermum* sp.

Ants, bees and wasps: Hymenoptera

Small ants were very common on Inner Sister Island, particularly in pitfall traps. Pitfall site 1 in coastal scrub yielded an estimated 12, 500 specimens. Four out of 5 traps from this site were completely filled with ants. Large ants were rare, only the inchman *Myrmecia forficata*, and the sugar ant *Camponotus* sp. were recorded. Tiny parasitoid wasps were very common in bash and sweep samples, but further identification was not attempted. Larger parasitoid wasps from the families Ichneumonidae and Braconidae were less common, and were collected from sweep and bash samples as well as from the light trap. The large orange Ichneumonid *Netelia* sp. was collected in the *Poa* sp. sweep and at the light trap. Flower wasps (Tiiphidae) were captured in pitfalls in coastal scrub, and sand wasps (Sphecidae) by hand collection. One specimen of the European honeybee *Apis melifera* was hand collected on the track to house beach.

Groups notably absent

Several invertebrate groups requiring moist conditions were absent from the island. These include mygalomorph spiders, harvestmen (Opiliones), Onychophora and flatworms. The terrestrial gastropod fauna was very limited, with only two introduced species recorded. This is in contrast to nearby Prime Seal Island. The redback spider *Latrodectes hassleti* was not collected, despite the abundance of man-made habitat such as tyres and sheets of corrugated iron.

Interesting aspects of the fauna

The stand of 3 blue gums (*Eucalyptus globulus*) between the homestead and south beach supported a unique fauna. Web spinners (Embioptera), beetles from the families Chrysomelidae, and Trogissitidae, Thaumastocorid Heteroptera, the Auchenorrhyncan family Flatidae, the spider family Lamponidae , and the huntsman spider *Delena cancerede*s were found only on these trees. Bristletails (Archaeognatha) were not restricted to the blue gums but were only recorded once elsewhere. These trees were excellent places to find invertebrates, and more effort spent on hand collection at this site could prove productive.

The beach strand line also displayed a distinctive fauna dominated by Crustacea. Amphipods were a major component of the samples, with some isopods and one grapsid crab. The beach samples also contained surprising numbers of spiders and beetles. The specialist strand line beetle *Phycosecus* sp. (Phycosecidae) was taken in a pitfall trap, as was an impressive ground beetle (Carabidae, Scaritinae).

Dung beetles from the genus *Onthophagus* (Scarabaeidae) were common on the island, presumably feeding on dung from the large numbers of resident pademelons. Many dung beetles were taken in pitfalls under stands of *Bursaria spinosa*, *Leptospermum* sp. and *Melaleuca* sp. where pademelons were seen resting during the day.

DISCUSSION

The survey results show that Inner Sister Island supports a diverse invertebrate fauna with few exotic species. No specific hypotheses were tested however, as the survey was focused on invertebrate diversity. Inner Sister Island has been grazed and extensively burnt for many years, resulting in an increase in tussock grass at the expense of trees and woody vegetation. Due to the grazing and fire history of the island, there may well have been a richer invertebrate fauna in the past, when more vegetation and invertebrate habitats may have been present. Grazing on the island has now ceased, and the vegetation and invertebrate fauna will no doubt respond to this in time. The invertebrate sampling survey revealed a reasonable fauna considering the small size, dryness and exposed nature of the island, and the limited nature of the survey.

ACKNOWLEDGEMENTS

Thanks to Dr. Celia Symonds, University of New South Wales for identification of invertebrates in two photographs.

Agonoscelis rutila (Pentatomidae).
Photo by Michael Driessen.

	Order	family	genus/species	Pitfall	Bash	Sweep	HC Beach	HC Light	HC Carcass	HC Debris	HC E Bark	HC A Bark	HC E Litter	HC A Litter	HC L Litter	HC Opportunistic
ENTOGNATHA	Collembola			378	63	11							X			
INSECTA	Archaeognatha	Meinertellidae	*Machiloides* sp.								X		X			
	Blattodea	Blaberidae	*Molytria* sp.							X						
		Blattidae	*Platyzosteria* sp.			1				X						
		Blattidae	*Polyzosteria* sp.							X						
			unid blatto nymph	1	21							X				
	Mantodea	Mantidae	*Orthodera ministralis*		1							X				
	Dermaptera	Anisolabiduridae		40			X		X	X					X	
		Labiduridae	*Labidurus* sp.							X						
	Orthoptera	Acrididae	nymph.	1												
	Embioptera	Australembiidae	*Metoligotoma* sp.										X			
	Psocoptera				19	7							X			
	Heteroptera	Cydnidae		6									X			
		Acanthastomatidae			7											
		Pentanomidae			4	3						X				X
		Pentanomidae	*Agonoscelis rutila*													X
		Scutellaridae	*Scutiphora pedecillata*									X				X
		Scutellaridae			6											
		Reduviidae	*Gnimatus australis*		1											
		Reduviidae		3	1	2										
		Miridae			42	2		X								
		Thaumastocoridae			6											
		lygaidae						X							X	
		unid		1	27	118										
	Sternorrhyncha	Psyllidae			49											
		Aphidae			16											
		"scale insects"			39											
	Auchenorrhyncha	Membracidae			3											
		Cicadidae	*Diemeniana* sp.													X
		Cicadelidae		32	31	6										
		Flatidae	*Siphanta* sp.		1											
		Fulgromorpha				2										
		unid			7											

	Thysanoptera			1	19	1										
	Neuroptera	Chrysopidae			1			X								
		Hemerobiidae			3			X								
	Neuroptera larvae			1	10											
	Coleoptera	Carabidae	*Scaratinae*	1												
		Carabidae	*Cincindelinae*							X						
		Carabidae						X					X	X		
		Anobiidae		7												
		Staphylinidae		45	1		X	X								
		Staphylinidae	*Creophilus* sp.						X							
		Silphidae	*Ptomaphila* sp.						X							X
		Histeridae	*Saprinus cyanus*						X							
		Scarabaeidae		3				X			X					
		Scarabaeidae	*Onthophagus* sp.	19												X
		Scarabaeidae	*Dynastinae*					X								X
		Scarabaeidae	*Diphucephala* sp.		1											X
		Coccinellidae			3											
		Bostrichidae						X								
		Elateridae		9				X				X				X
		Lycidae	*Porrostoma* sp.													X
		Dermestidae	*Dermestes* sp.					X	X							
		Dermestidae			2											
		Cleridae	*Eleale* sp.		2											
		Cleridae			3				X							
		Tenebrionidae	*Ecnolagria* sp.													X
		Tenebrionidae		14				X	X				X	X		X
		Odomeridae														X
		Trogidae							X							
		Phycosecidae	*Phycosecus* sp.	1												
		Nitidulidae		6												
		Melyridae			4											
		Melyandridae			10											
		Mordellidae		2	1	1										
		Chrysomelidae	*Paropsisterna*		1											
		Trogosittidae	*Lepidopteryx* sp.								X					
		Cerambycidae				1										
		Curculionidae		6	3	1										X
		unid Coleoptera		4	62	2										
	Coleoptera larvae	Elateridae										X				
		Coccinellidae			2											
		Tenebrionidae								X						

	Order	family	genus/species	Pitfall	Bash	Sweep	HC Beach	HC Light	HC Carcass	HC Debris	HC E Bark	HC A Bark	HC E Litter	HC A Litter	HC L Litter	HC Opportunistic
		Dermestidae							X							
		Curculionidae			1											
		Silphidae							X							
		unid		4	32	1									X	
	Mecoptera	Bittacidae	*Harpobittacus* sp.													X
	Diptera	Asilidae		1	1											X
		Tachinidae														X
		Tabanidae				1										X
		Tipulidae			1	2										
		Therividae				5										
		Platysomatidae				30										
		Calliphoridae														X
		Muscidae						X								
		Bibionidae		2	3	3										X
		unid		323	124	23		X								
	Diptera larvae			1					X							
	Lepidoptera	moths						X								
		Nymphalidae	*Vanessa itea*													X
		Nymphalidae	*Heteronympha merope*													X
		unid		2	6	2										
	Lepidop larvae			1	46	9										X
	Hymenoptera	Formicidae		12827	14	7		X	X			X			X	X
		Formicidae	*Myrmecia* sp.	2												
		Formicidae	*Camponotus* sp.	12				X								
		Apidae	*Apis melifera*													X
		Braconidae		1	2	1							X			
		Unid tiny		27	65	20										
		Ichneumonidae	*Netelia* sp.			1		X								X
		Anthophoridae														X
		Tiphiidae		3	2											
		Sp.hecidae														X
		Apocrita			2											
ARACHNIDA	Acari			63	37								X			

	Scorpionida		*Cercophonius squama*	3						X			X			
	Pseudoscorpionida			1	1							X	X		X	
	Aranaeae	Lycosidae		26			X						X		X	
		Araneidae	*Gasteracantha* sp.		3											X
		Araneidae	other	1	75	5										
		Corinnidae	*Supunna* sp.							X						X
		Clubionidae			25							X				
		Desidae	*Badumna insignis*													X
		Nicodamidae		6												X
		Gnaphosidae		15				X		X						
		Sp.arassidae	*Neosp.arassus* sp.													X
		Sp.arassidae	*Delena canceredes*													
		Lamponidae	*Lampona* sp.													X
		Lamponidae								X			X			
		Oonopidae	*Oonops pulcher*	3												
		Thomisidae		3	19	4										X
		Theriidae			6			X				X				
		Salticidae		8	1		X			X						
		Zoariidae		3												
		unid		21	16											
MYRIAPODA	Diplopoda	Polydesmidae		17						X		X	X		X	
		Polyxenidia	*Unixenus* sp		4											
		Polyxenidia	*Propolyxenus forsteri*	2												
	Chilopoda	Lithobiomorpha	*Henicops* sp	1										X		
		Lithobiomorpha	*Lamyctes emarginatus*	1												
		Scolopendromorpha	*Cryptops* sp									X				
CRUSTACEA	Amphipoda	Talitridae		34			X						X	X		
	Isopoda			51						X		X	X	X		
	Malacostraca	Grapsidae		2												
MOLLUSCA	Gastropoda	Helicidae	*Helix asp.ersa*													X
			Theba pisana	5												X
ANNELIDA	Oligochaeta								X						X	X

Photo by Stephen Harris.

Asher Jones

Travel Award Recipient Report

I first heard of the Hamish Saunders Memorial trust when an email was sent around the ecology group at the University of Auckland. Being right in the middle of writing up my Master's thesis, I didn't have the time to write the application letter or devote much serious thought to it. However my thesis was due on the 15th of October, coincidently the same day that applications were due for the expedition! Having handed in my thesis in the morning I was rereading some emails, and saw the HSMT email again. I had a big read about the past expeditions, the reason for the trust and the upcoming expedition and wrote the application letter. It sounded like an amazing opportunity, and I found out a week or so later that I was lucky enough to have been selected, much to the envy of my fellow Masters students!

I met up with Hamish's father, David Saunders before the trip which was really worthwhile. Talking to him gave me some more insight into who Hamish was, how the trust got started and the reasons behind it. It was a humbling feeling knowing I was going to be part of the expedition, and to in a small way to hopefully be carrying on the spirit of Hamish.

Organisation for the trip on our part included reading safety forms and reports from previous years, booking flights to Hobart and getting gear organised including "snake-proof" gaiters which was mildly concerning! I met Claire at the airport in Auckland, and we clicked straight away, it was great to have another New Zealander in the same position! After a three hour flight to Sydney and a one hour flight to Hobart we had finally arrived in Tasmania. Steve Harris picked us up from the airport, having recognised our conspicuous New Zealand accents. We had a bit of a tour of the DPIPWE offices and met Anthony Reid and Sally Bryant. It was then off to Sally's house for the night, where we had a delicious meal and our first experience of seeing a pademelon. Very exciting for us New Zealanders!

We were up very early the next morning to be picked up by Steve and the others at 4.30 to begin the journey. We drove to Launceston where we boarded a small plane to Flinders Island. A bit of a setback was that we had too much gear for the small plane and had to leave a few things behind! At the main centre of Whitemark on Flinders we stocked up on supplies at the supermarket, including the all-important wine and Boag's beer, and had our last espresso coffees and pies. It was then a short drive to Killiecrankie where we boarded the boat that eventually took us to our destination of Inner Sister Island. The island was beautiful and rugged, with white sand and clear blue water, and teeming with pademelons! It was very different to any islands I had been to in New Zealand, and a strange and exciting feeling to think that we were now on an uninhabited island in Tasmania when we had been in urban New Zealand just the day before!

Photo by Claire Taylor.

Loading the dinghy. *Photo by Stephen Harris.*

Each day on the island Claire and I tried to spend with different people from our team of ten. I wanted to get the most out of the trip by having a go at everything, and learning about different aspects of an ecological survey. The first day we spent with Mike and Steve exploring the Eastern tip of the island. A slight miscalculation in our location by someone in the group (I won't name names) meant that what should have been a couple of minutes, turned into over half an hour of scrub bashing, and getting to intimately know boxthorn. A highlight of that day was finding a stick insect and learning about a plant that Aborigines used as an abortifacient.

Another day I spent with Chris estimating seabird burrow density and occupancy. Our basic method was to poke a stick down their burrows; if the bird attacked the stick and hissed it was a penguin, and if it was just a gentle tap then it was a shearwater.

The first few times I put my arm down a burrow up to my elbow was a little nerve-wracking, as anything could be down there! It was a really enjoyable day and I learnt a lot about seabirds, including where to step to avoid crushing their delicate burrows. It was this day that I saw my first snake- a large tiger snake gliding through the tussock grass. We saw a couple more during the trip too, including another tiger snake coming out from under the house, and a white-lipped snake entering a seabird burrow, fortunately not while my hand was down it!

Another bird related highlight was watching the shearwaters and penguins come in from the ocean at dusk. We sat up on a big rock on the hill and watched them crash-land and miraculously find their burrows again. It was also interesting to see a chat feigning injury to draw attention away from its nest. I was fooled, but Chris wasn't and he showed me the nest which contained two eggs and a newly hatched chick. Other birds that I hadn't seen before in New Zealand included the Cape Barren goose, wedge-tailed eagle and black currawong with its distinctive call.

I also really enjoyed learning about how to trap mammals using Mascot and Elliot traps and how to set a camera trap. Unfortunately I missed seeing the white footed dunnart that was captured, but we did catch a couple of bandicoots which was a great experience; even more so because one was a female with pouch young. They were at an early stage, tiny pink little "jellybeans" as the Aussies call them. It was nice to view mammals in a different light to the negative one that we usually see them under in New Zealand. Although as a New Zealander I don't think I will ever adjust to it being so noisy at night in Australia, with pademelons bouncing all over the place!

Our evenings were spent taking turns cooking, hearing about everyone's day, drinking our well-earned allocated wine/beer, watching Anthony and Tom catch fish and abalone at the beach, and of course

some obligatory accent teasing. In addition to the amazing wildlife, scenery, learning and adventure; what really made the trip for me was the diverse bunch of people in the team who I shared the experience with. Everyone was incredibly knowledgeable and it was great to be able to listen to their stories and experiences, and learn about their research and careers. The hospitality of the Tasmanians, both on the island and in Hobart, was amazing. It was great to make some overseas contacts, and to foster our trans-Tasman relationship. I would really like to work in Australia in the future, something I had not considered much before the trip. I learnt a lot from everyone, and I came away from the trip with a renewed sense of adventure, inspiration for conservation and a feeling that my goals are achievable.

Up until the trip all my first-hand ecological knowledge had been from within the New Zealand context. It was really great to gain some more field experience in a different setting and to expand my knowledge, of plants, animals and landscapes. The Inner Sister Island expedition really served to broaden my perspective of ecology in general and reinforce my love of the environment and nature, and for travel. The experience has propelled me to continue my career in conservation biology, and to seek more overseas volunteer positions, and to share the love of conservation with others. I think that a little bit of Hamish's passion has been instilled in me from this experience, and I really hope that I can pass this on to others throughout my career. The HSMT is a really unique and valuable project, and I feel honoured to have been a part of this year's expedition.

I had a long hard think about what could be improved about the expedition for future volunteers, and it was really difficult to come up with anything! It was really good to meet up with Hamish's dad before the trip, and I think if possible this should continue. One potential improvement could be for the volunteers to be in charge of their own small project on the island.

Before we arrived on the island we did not know much about the team members and their various expertise. Having more knowledge of this, it might be possible for the volunteers to either come up with their own project, or be assigned one by the team. This would depend on the amount of time available, but could be a good way of involving volunteers in the whole process of a scientific expedition, from the initial researching right through to writing a report.

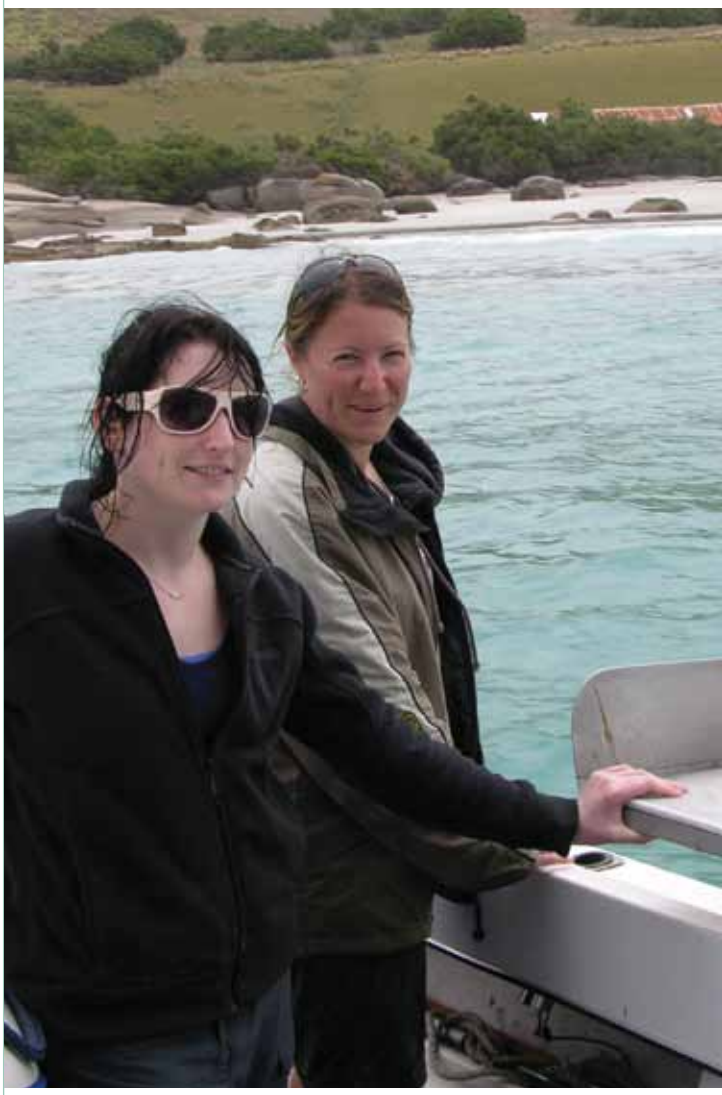


Photo by Stephen Harris.

Photo by Asher Jones.

Claire Taylor

Travel Award Recipient Report

Being chosen to take part in the Hamish Saunders Memorial Trust Scientific Expedition to Inner Sister Island was a wonderful privilege that has benefited me in a number of ways. It will be hard to top such a wonderful experience that allowed me to travel to and survey a beautiful remote environment for an extremely worthy cause.

Firstly, as a tribute to the late Hamish Saunders, this expedition is a meaningful way to preserve his memory as well as gaining a greater understanding of the unique flora and fauna of Tasmania's many offshore islands. He was a young, passionate conservationalist and I can not think of a more fitting way to remember him than to continue carrying out the same work that he dedicated his life to.

From a career perspective, the benefits of being included in this extensive survey have been plentiful. Having recently completed my MSc, and on the verge of entering the work force, this experience has truly given me direction by helping me to realise that my passion lies within conservation work and being able to actively contribute to the preservation of the flora and fauna that we share this environment with. Inner Sister Island was the perfect place to survey in order to form a comprehensive inventory of inhabiting species and I was able to gain insight and experience in the use of many field techniques that I had not yet learned. The many highlights included small mammal trapping, invertebrate collection, bird and plant surveying, and exploration of rock pools and marine life surrounding the island. Taking part in the collection of such a wide range of data allowed me to experience first hand the true undertakings of a field ecologist and the many benefits and challenges that are associated with this sort of work. Being surrounded by other scientists who were passionate and willing to share their knowledge, regarding their various disciplines of expertise, acted to further encourage me along this career path with more informed outlooks and expectations.

Photo by Stephen Harris.

Evening meal. *Photo by Michael Driessen.*

On a more personal, overall level, the expedition to such a unique and isolated environment with a new bunch of people was wonderfully refreshing and confidence building. Many laughs were shared, tales were told, and challenges were faced (i.e., bad weather marooning us on the island for an extra day with caffeine as our main source of food)! I thoroughly enjoyed getting to know everyone and making friends. I was also able to extend my stay in Tasmania and took the chance to explore parts of the north east coast and Hobart with my fellow kiwi volunteer. I would love to travel extensively around Tasmania and explore more of the beauty it has to offer. I would personally like to thank everyone on the team for making this such an enjoyable experience for me. I would especially like to thank Sally, Steve and Anthony for putting themselves out in order to allow me to enjoy the full 'Tasmanian' experience.

And lastly, I would like to thank the Hamish Saunders Memorial Trust for choosing me to take part in such a well organised, inspiring and meaningful cause. I hope that this annual expedition will continue for many years and will persist in inspiring other emerging scientists like myself. Most importantly, I hope the implications of this survey serve as a valuable conservation tool and act to keep the memory of Hamish Saunders alive for many years to come.

Photo by Stephen Harris.

Resource, Management and Conservation Division
Department of Primary Industries, Parks, Water and Environment
GPO Box 44 Hobart TAS 7001
www.dpipwe.tas.gov.au

Tasmania
Explore the possibilities

10596BL