

Bruny Island Tasmania

15–21 February 2016

Bush Blitz Species Discovery Program



Australian Government

Department of the Environment and Energy



bhpbilliton

Sustainable Communities



Australian
Biological
Resources
Study

What is Bush Blitz?

Bush Blitz is a multi-million dollar partnership between the Australian Government, BHP Billiton Sustainable Communities and Earthwatch Australia to document plants and animals in selected properties across Australia.

This innovative partnership harnesses the expertise of many of Australia's top scientists from museums, herbaria, universities, and other institutions and organisations across the country.

Abbreviations

ABRS

Australian Biological Resources Study

AFD

Australian Faunal Directory

ALA

Atlas of Living Australia

ANIC

Australian National Insect Collection

CA

Conservation Area

DPIPWE

Department of Primary Industries, Parks, Water and Environment (Tasmania)

EPBC Act

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

MPA

Marine Protected Area

QM

Queensland Museum

RTBG

Royal Tasmanian Botanical Gardens

TMAG

Tasmanian Museum and Art Gallery

TSP Act

Threatened Species Protection Act 1995 (Tasmania)

UNSW

University of New South Wales

Summary

A Bush Blitz expedition was conducted on Bruny Island, Tasmania, between 15 and 21 February 2016. The study area included protected areas on Bruny Island and parts of the surrounding marine environment.

Bruny Island includes a wide diversity of micro-climates and habitat types. It is home to a number of species that are found only in Tasmania, including several threatened plant and animal species. In addition to its significant natural heritage, the island is the traditional land of the Nununi people and contains many sites of cultural significance. The narrow D'Entrecasteaux Channel, which separates Bruny Island from the mainland, is also of interest to scientists as tannins stain the water, creating an environment similar to that of the deep ocean.

Despite the proximity of Bruny Island to some of Tasmania's larger population centres, access is limited and comprehensive invertebrate surveys have not been conducted on the island. While the D'Entrecasteaux Channel is relatively well studied and many of the larger species are well documented, areas such as the deeper, soft sediment areas of the Channel and the intertidal areas of the eastern shore of Bruny Island have not been surveyed as thoroughly. This was the first Bush Blitz to incorporate a marine component.

An Earthwatch TeachLive project was run in conjunction with the survey, in which teachers worked closely with scientists in the field and laboratory.

During this Bush Blitz, 848 species were recorded. At least 591 of these species are thought to be new records for the study area and, among these, 63 may be new to science (2 moths, 14 beetles, 46 spiders and 1 seaweed). One threatened animal species was recorded: the stag beetle, *Lissotes menalcas*, is listed as Rare under the TSP Act. The Tasmanian Seed Conservation Centre had collected on Bruny Island only twice before, making four collections. During this Bush Blitz, ten collections (of 10 taxa) were made, in total, 816,700 viable seeds.

Some highlights of the survey included:

- the collection of several uncommon species of moth, including a new record for Tasmania
- the discovery of the State-listed stag beetle, *Lissotes menalcas*, and several beetle species that have not been recorded in Tasmania since they were first collected over 50 years ago
- the discovery of 46 putative new species of spider, including an intertidal or marine spider.

Thirty exotic or pest invertebrate species were recorded, among them, two ascidians, one ant, nine moths, one true bug, three crustaceans, a marine earthworm and 13 molluscs. One exotic species of macroalgae was recorded.

Further survey work is encouraged and land managers are asked to consult with experts before taking management action that may disturb particular noteworthy sites. It is also recommended that land managers ensure that stands of the protected kelp-forest community along Bruny Island shores are identified accurately and mapped continuously in order to maximise their protection in a region currently subjected to the large commercial operations of wild fisheries and aquaculture industries.

Contents

What is Bush Blitz?	2
Summary	4
Introduction	6
The Bruny Island Bush Blitz	6
Acknowledgements	7
Reserve overview	8
Description	8
Conservation values	8
Methods	10
Taxonomic groups studied and personnel	10
Site selection	11
Survey techniques	11
Identification	13
Results	14
Species lists	15
Discussion	16
Putative new species	16
Threatened species	19
Exotic and pest species	20
Range extensions	24
Other points of interest	27
Glossary	38

Introduction

This is a report for the Bush Blitz program, which aims to improve our knowledge of Australia's biodiversity. Bush Blitz is an initiative of the Australian Government, through the Australian Biological Resources Study (ABRS), in partnership with BHP Billiton Sustainable Communities and Earthwatch Australia. Bush Blitz aims to:

- promote, publicise and demonstrate the importance of taxonomy through species discovery
- undertake a national species discovery program
- support the science of taxonomy in Australia through training of students and early career researchers, and by providing grants for species description and resolution of taxonomically problematic, nationally important groups
- promote partnerships between scientific institutions, government, industry and non-government organisations
- inform reserve managers and other stakeholders of the results of Bush Blitz projects.

The Bruny Island Bush Blitz

This Bush Blitz took place during February 2016. The months preceding the Bush Blitz were unusually dry and, despite some substantial rain falling prior to the Bush Blitz, the drier conditions probably had an impact on the diversity recorded for some of the target groups.

The area covered by this Bush Blitz included protected areas on Bruny Island as well as unprotected areas in the surrounding marine environment. Base camp was located at Murrayfield Station, North Bruny Island.

Five teachers from around Australia participated in Bush Blitz TeachLive, a collaborative program between the Bush Blitz partners and the Australian Science Teachers Association. The teachers, working alongside scientists, reinvigorated their love for science and generated new ideas and skills to take back to their schools. Bush Blitz information from the survey was shared with schools across Australia as teachers taught 'live' to their classrooms via the TeachLive website and Skype sessions, taking their students on a virtual expedition and inspiring the next generation. Bruce Paton from Earthwatch Australia coordinated the TeachLive activities.

Bush Blitz provided the logistical coordination and overall leadership for the survey. The Tasmanian Museum and Art Gallery (TMAG) was the host institution for this Bush Blitz, providing the core group of personnel and accessioning the specimens into their collection. Experts from the following organisations also conducted the field and laboratory work:

- Queensland Museum (QM)
- University of New South Wales (UNSW)
- Royal Tasmanian Botanical Gardens (RTBG).

Acknowledgements

The ABRS acknowledges the traditional owners of country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures and to their elders both past and present.

The Bush Blitz team consisted of Kate Gillespie and Bella Miras. They would like to thank all participants: including staff from Parks and Wildlife Service (Tasmania); Bruce Michaels and Lynne Michaels, Managers of Murrayfield Station, who provided accommodation and their shearing shed for a field lab; and Andrew Walsh and Claire Blitchfeldt from Woodbridge School Marine Discovery Centre, and the crew of the RV Penghana, who played a vital role in the dredging program.

Reserve overview

Study area: Bruny Island, Tasmania, including several protected areas and the surrounding marine environment.

Area: Bruny Island = 362 km² plus surrounding marine environment.

Description

Bruny Island is a large, narrow island that consists of two main landmasses connected by a narrow isthmus known as The Neck. The island is home to a wide diversity of microclimates, due in large part to its location off the south-east coast of Tasmania. The prevailing weather in southern Australia comes from the west, meaning that the northern half of the island is sheltered at least in part by the rugged mountains on the Tasmanian mainland. South Bruny, in contrast, is exposed to the full fury of the Southern Ocean and the accompanying wild weather.

The island has a great variety of habitat types, in natural and agricultural areas. Vegetation types include sub-alpine cloud forest, tall wet sclerophyll eucalypt-dominated forest, dry sclerophyll woodland and coastal vegetation.

Bruny Island also offers a variety of marine landscapes—from the sheltered waters of the D'Entrecasteaux Channel to the exposed rocky headlands of the southern and eastern coasts. These include seagrass meadows, kelp forests, rocky reefs, mud and sand flats, and intertidal rocky shores, each of which is home to its own community of marine organisms.

The narrow D'Entrecasteaux Channel separates Bruny Island from the main island of Tasmania. The channel is of particular interest to scientists due to the tannins that have leached into local rivers and streams from native plants. These stain the water, preventing sunlight from penetrating more than a few metres and creating an environment similar to that of the deep ocean. As a result, these areas are home to a range of deep-sea species, which have colonised areas that would normally be far too shallow for them. The deepest section of the channel is found at the southern boundary, and can reach approximately 55 m deep but most of the Channel is less than 10 m deep. A large number of recreational and commercial ventures access the waters, including, within the Channel, significant numbers of finfish and shellfish farms. Currently, 49 known introduced and potentially introduced marine species are recorded from the Channel area.

Conservation values

Evidence shows that Aboriginal people have lived in Tasmania continually for at least 37,000 years, with south-eastern Tasmania being the traditional land of the Mellukerdee (Huon River), Muwinina (Hobart and the area to its south) and Nununi (Bruny Island) bands of the south-eastern tribe of Tasmanian Aboriginal people. The Nununi people related to the environment of Bruny Island in complex and sophisticated ways, using the natural resources and also maintaining a spiritual connection to the landscape and its inhabitants.

Bruny Island and nearby areas of Tasmania are home to many sites of cultural significance, the most visible of which are the middens formed from shells, bone, stone tools and charcoal which are evidence

of living places. Other sites of cultural and archaeological significance include quarries, stone artefacts, stone arrangements and rock markings. It should be noted that cultural significance is not necessarily limited to individual sites, and may include collections of sites or entire landscapes. Aboriginal cultural heritage also includes places of spiritual and ceremonial significance or trade and travel routes as well as historic sites such as Mission Bay and *putalina*/Oyster Cove.

The wide variety of climates, the nearby ocean and variable topography—the highest peak on the island, Mount Mangana, is 571m high—means that the island supports a wide variety of habitats, including coastal scrub, wet and dry eucalypt forest, grassy forest and heathland. These habitats shelter a range of species found only in Tasmania, including the Tasmanian Bettong (*Bettongia gaimardi*), Tasmanian Pademelon (*Thylogale billardierii*), Ocellated Skink (*Niveoscincus ocellatus*), Yellow-throated Honeyeater (*Lichenostomus flavicollis*), Tasmanian Scrubwren (*Sericornis humilis*) and the endangered Tasmanian subspecies of the Wedge-tailed Eagle (*Aquila audax fleayi*). The occurrence of several threatened flora and fauna species on the island means that reserves are of high conservation value.

Methods

Taxonomic groups studied and personnel

A number of taxonomic groups were selected as targets for study. Table 1 lists the groups surveyed and the specialists who undertook the fieldwork.

Table 1 Taxonomic groups surveyed and personnel

Group	Common name	Expert	Affiliation
Ascidiacea	Ascidians, sea squirts	Kirrily Moore	TMAG
Hymenoptera	Ants	Lynette Forster	TMAG / UTas
Lepidoptera	Moths	Cathy Byrne	TMAG
	Butterflies	Abbey Throssell	TMAG
Coleoptera	Beetles (general)	Lynette Forster	TMAG / UTas
	Leaf beetles	David de Little	TMAG
Heteroptera	Heteroptera	Anna Namyatova	UNSW
Odonata	Dragonflies and damselflies	Abbey Throssell	TMAG
Arachnida	Spiders	Robert Raven	QM
Mollusca	Land snails	Kevin Bonham	Independent
	Marine molluscs	Simon Grove	TMAG
Macroalgae	Marine macroalgae	Fiona J. Scott	TMAG
Seeds	Seeds	James A. Wood	RTBG

In addition to the target groups, invertebrates of miscellaneous groups were collected.

The Bush Blitz team would also like to acknowledge the contributions of the following people:

- Natalie Tapson (RTBG) assisted with seed collection while Miguel De Salas and Matthew Baker from the Tasmanian Herbarium (TMAG) assisted with identification of the seed collections.
- Prof. Gerry Cassis undertook identification and data management while Serena Lam assisted with specimen curation and data management for Heteroptera (UNSW)
- Nicole Zehnter and Kath Sinkora, and volunteers Nic Merritt-Smith, Seb Young and Di Moyle, all from TMAG, assisted with identification, preparation, sorting, labelling and databasing of specimens
- Ted Edwards (ANIC) and Dr Peter McQuillan (UTas) assisted with moth identifications
- Robert Whyte from Queensland Museum assisted with the photography of spiders
- Dr Gerald T. Kraft (Tasmanian Herbarium) assisted with identification of marine macroalgae.

As part of the TeachLive program developed by Earthwatch Australia, five science teachers were paired up with scientists as field assistants. Teachers Jade Tinney, Louise Hoey, Mary-Anne Kefaloukos, Nicole

Saddler and Bruce Mills were accompanied by Bruce Paton and Ari Panagiotou from Earthwatch Australia.

Site selection

All scientists working on terrestrial groups surveyed two standard survey sites selected by Bush Blitz using modelling prepared by Commonwealth Scientific and Industrial Research Organisation (CSIRO). Each standard survey site was centred on a point (permanently marked), but the actual area surveyed varied between taxa. Standard methodologies were used to sample these sites.

The use of standard survey sites provides a unique opportunity to examine broad-spectrum biodiversity. Among other benefits, this will enable Bush Blitz's partners at CSIRO to test assumptions (e.g. about relationships between the diversity of different taxa) that underpin many conservation decisions. It will also allow comparisons between sites, and establish a basis for future monitoring by reserve managers.

Aside from standard survey sites, site selection and collection methods were at the discretion of the individual scientist. Site selection depended on access, suitability for trapping and time restrictions. Other considerations included:

Ant and beetle sites were located in currently reserved areas representing diverse habitats.

Moth sites were generally selected to maximise representation of different vegetation communities and land systems while avoiding recently burnt or logged sites.

Butterfly sites were mostly open ground and forest edges.

Leaf beetle sites were selected to give maximum geographic and potential host plant diversity.

Heteroptera sites were selected based on vegetation condition.

Dragonfly and damselfly sites were selected in areas near water, such as waterholes and creeks, and to cover a range of habitats, taking into account factors such as standing vs. flowing water and surrounding vegetation.

Spider sites were initially chosen using Google Earth and based upon accessibility, proximity to water and safe night access.

Land snail sites were selected with the aim of surveying previously unsurveyed reserves that were easily accessible, and covering some habitat types likely to contain unusual species.

Marine invertebrate and microalgae collection sites were chosen to maximise representation of different environments but these choices were restricted by access, weather and permissions. One collection method involved dredging from a boat, which resulted in other restrictions on site selection such as the distance the boat could reasonably travel and a minimum depth.

Seed collection sites were chosen where healthy populations of species were found to be at peak fruit maturity.

Site locations were recorded using global positioning systems.

Survey techniques

A standard suite of survey techniques was used:

Ant and beetle specimens were mostly hand collected opportunistically by examining a diversity of microhabitats at each site, including terrestrial substrates (such as coastal sand and forest litter), under

logs or rocks, under bark on trees and vegetation (including beating). By-catch from bark sprayed with knockdown pyrethrum for Heteroptera and from light traps for moths was also examined. Invertebrates from the two standard survey sites were sampled over five days with malaise, flight intercept traps (Triangular Window Intercept Traps), pitfall traps, and yellow pans. Rainy, cool and windy weather conditions reduced the effectiveness of traps, for example, yellow pans flooded or were blown around. Invertebrates would have been less active during such conditions, leading to lower numbers of specimens sampled.

Moths were collected at night using two types of light trap—portable bucket traps with MV black light; and a light sheet illuminated by a 160W MV lamp operated by portable generator. Portable bucket traps were distributed over as many different plant communities as possible. Day-flying moths were collected opportunistically during the day using hand-held butterfly nets. Live specimens were usually killed in an ammonium hydroxide killing jar before mounting them on setting boards. Once fully set (after at least one week), specimens were removed from the setting boards and stored in temporary storage boxes before moving to the TMAG collection store. Standard survey sites were surveyed at night, using a generator, MV light and sheet for approximately three hours and a portable, black light, bucket trap left running overnight.

Butterflies, dragonflies and damselflies were surveyed mainly by opportunistic aerial netting of active adults, with occasional sweeping of vegetation near water. The aims of collecting at each site were to maximise the diversity of species recorded in each reserve and in the reserve network as a whole. Surveying at each site was free-ranging over a small area (typically 50 m or so) around a central point. Search times varied from passing searches to around 90 minutes, depending on the interest value of the site and logistics. Butterflies were preserved by killing with ammonium hydroxide and pinning with wings set. Odonates were starved for approximately 24 hours before killing, to clear gut contents and help preserve colour. They were killed by immersion in acetone for a few minutes, before being pinned, with wings spread, on pieces of cardboard and immersed in acetone again for approximately 24 hrs, or in pure ethanol for approximately 48 hrs. Standard sites were surveyed by aerial netting for one hour per site, during the day. Day-flying moths were also targeted to complement the night-time light-trapping surveys.

Leaf beetles were collected by beating of foliage accessible from the ground onto a standard entomological beating tray from which leaf beetles were collected live into tubes, and by hand to collect beetles resting under bark. The latter method involved stripping of loose bark from tree trunks.

Heteroptera specimens were collected by beating or sweeping of vegetation, with particular focus on fruits and seeds. Specimens were also collected by light trapping, pyrethrum spraying and general collecting. The standard method for collecting on the standard survey sites is sweeping and beating vegetation for about one hour at each spot; however, this technique was used only at Standard Survey Site (SSS) 2. At SSS1, some specimens were collected using pyrethrum spray and hand collecting into ethanol. At SSS2, specimens were also collected at light and from litter and opportunistically.

Spiders were collected using a variety of methods depending on the habitat—eucalypt, creekside, intertidal or swamp. Methods included log-rolling, rock-rolling, bark-brushing, sorting through litter, bark-stripping, pitfall trapping and soil-brushing.

Snails were collected by hand, with the main aim being to record as many species as possible at each site. At one site a small sample of leaf litter was taken and sorted. Surveying at each site was free-ranging over a small area (typically 50 m or so, in some situations up to 100 m) around a central point. Search times per site varied from passing searches to up to 2 hours, depending on the interest value of the site and logistics. Opportunistic collecting by other members of the party produced one significant record. Both standard survey sites were surveyed by hand collection (searching litter, logs, bark, rocks, moss on trees and other available microhabitats) for two person-hours equivalent. Due to time and

transport constraints, each site was surveyed for the required two hours across two separate days, in one case partly by torchlight at night.

Marine invertebrates and macroalgae were collected using three methods over a five-day period:

- Intertidal collecting, using hand collection and occasionally a dive knife, took place at three sites. Collection time was around 60 minutes per site.
- Dredge sampling was undertaken in the D'Entrecasteaux Channel. All dredge tows were located in the upper (northern) part of the D'Entrecasteaux Channel within the operational area set by the vessel charterer. Samples were obtained using a small (1 m mouth) plastic mesh dredge, deployed from the RV Penghana and towed along the seabed. Collecting time was three minutes per tow. The dredge was deployed on two days only, and 13 tows were conducted at 11 different sites as two tows were empty so were repeated in a nearby location. Each day, two teachers from the TeachLive project, two selected students from Woodbridge School and one Bush Blitz representative joined Kirrily Moore, Fiona Scott, staff from the Marine Discovery Centre (Andrew Walsh & Claire Blichfeldt) and the crew of the RV Penghana. The contents of each tow were emptied onto a sorting table and personnel quickly sorted animals and algae into obvious groups. Any fish, live scallops and oysters, octopus, sea hares and other large taxa were recorded and quickly returned. An attempt was made to separate smaller taxa into species groups (and retain 10 specimens per species as per the permit) but often it was impossible to be sure of the species identification. Some taxa are colonial (bryozoans, hydroids) so counting those as individual specimens was impossible.
- Snorkelling took place at one location. This method allowed selective sampling of hand-picked sub-tidal algae. Collecting time was around 60 minutes.

Unseasonal bad weather hampered a number of the collecting efforts, with strong winds preventing both intertidal and snorkelling efforts at many potential sites. For the dredging, the combination of tide and strong winds at times caused the dredge to move too fast over the seabed, probably 'skipping' and not collecting effectively. Nevertheless, excellent collections were made overall and processed either in the makeshift laboratory at Murrayfield on Bruny Island, or subsequently at the Tasmanian Herbarium (TMAG). Known seagrass habitats were avoided; the collection of one seagrass represented a specimen no longer growing in the seabed but already in drift material.

Seed was collected following on-site visual inspections to determine viable target populations. Fruit sampling determined whether seed collection was possible.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria. Most specimens will be lodged at TMAG, with the exception of true bugs which are deposited with UNSW. All specimen data are available through the Atlas of Living Australia (ALA).

Results

Locational data for all flora and fauna records are available to reserve managers. At least 591 species were new records for Bruny Island—it was difficult to determine new records for some taxa, and marine invertebrate records were only counted as new if they were new for Tasmania. These new records included 63 putative new species which await formal identification. One threatened animal species, 30 exotic or pest animal species and one exotic species of macroalgae were recorded.

Table 2 provides a summary of the flora and fauna records for Bruny Island.

Table 2 Summary of flora and fauna records

Group	Common name	Total species recorded	Species newly recorded for study area	Putative new species	Threatened species*	Exotic and pest species**
Ascidiacea	Ascidians	9	2	0	0	2
Echinodermata	Echinoderms	4	0	0	0	0
Hymenoptera	Ants	24	23	0	0	1
Lepidoptera	Butterflies	4	3	0	0	0
	Moths	199	199	2	0	9
Coleoptera	Leaf beetles	7	7	0	0	0
	Other beetles	189	186	14	1	0
Heteroptera	Heteroptera	56	56	0	0	1
Odonata	Damselflies and dragonflies	6	6	0	0	0
General insects	Flies	1	N	0	0	0
	Lacewings	1	N	0	0	0
	Cicadas and leafhoppers	2	N	0	0	0
	Grasshoppers	1	N	0	0	0
Arachnida	Spiders and scorpions	86	86	46	0	0
Crustacea	Crustacea	47	7	0	0	3
Annelida	Segmented worms	2	1	0	0	1
Mollusca	Land snails and slugs	37	6	0	0	6
	Marine gastropods	52	5	0	0	1
	Chitons	5	0	0	0	1
	Bivalve molluscs	32	4	0	0	5
Bryozoa	Bryozoa	1	0	0	0	0

Group	Common name	Total species recorded	Species newly recorded for study area	Putative new species	Threatened species*	Exotic and pest species**
Cnidaria	Sea anemones and hydrozoans	6	0	0	0	0
Macroalgae	Seaweed	66	N	1	0	1
Magnoliophyta	Flowering plants	11	0	0	0	0
Total		848	591	63	1	31

* Species listed as Threatened under the Commonwealth EPBC Act or an equivalent listing under the TSP Act.

** Includes native species that at times are pests or are exotic to this region.

N Data was not provided on whether these species were newly recorded for the study area.

Species lists

Lists of all species recorded during the Bush Blitz are provided in [Appendix A](#). Species lists were compiled using data from participating institutions.

Some specimens have been identified only to family or genus level. This is partly because identification of specimens is very time-consuming, with detailed microscopic examination needed in many cases. Also, some groups are 'orphans': currently no experts are working on them, or are available to work on them, and the taxonomic literature is out of date; species-level identification is not possible for these groups. Unidentified Bush Blitz specimens are held in institutional collections where they are available for future study. Collections hold many such specimens, among them species not yet described (i.e. unnamed species) as well as described species that have not been identified. For example, ANIC holds tens of thousands of unidentified specimens. Specimens often wait decades before the resources become available for their study. A key component of Bush Blitz is the funding of studies of specimens collected on Bush Blitz surveys.

Nomenclature and taxonomic concepts used in this report are consistent with the Australian Faunal Directory (AFD), Australian Plant Name Index and Australian Plant Census.

Discussion

Putative new species

Here we use the term 'putative new species' to mean an unnamed species that, as far as can be ascertained, was collected for the first time during this Bush Blitz. It is confirmed as a new species once it is named and its description published. Specimens collected during the Bush Blitz also include unidentified taxa that are already known from museum and herbarium collections—these are not counted as putative new species.

Fauna

Invertebrates

Moths

Two species that have most likely never been collected before were recorded. The first, *Lichenaula* sp. BB Bruny CB11, belongs to a large genus of the xylocrine oecophorids. The larvae of many of these feed on lichen. Only one specimen of this species was collected in *Eucalyptus pulchella* woodland in South Bruny National Park (NP). The second, *Garrha* sp. BB Bruny CB15, is a member of a large genus of oecophorines that feed on, and construct cases from, dead eucalypt leaves. Only one specimen of this species was taken from *Eucalyptus obliqua* woodland at the Quarantine Station on North Bruny Island.

Beetles

Several small halophilic ground beetles (Carabidae) are among 14 putative new species collected during the Bush Blitz. A small (2.5 mm) predatory Staphylinidae, *Eumecognathus* sp. 'BBBrunyLF12', will be investigated further—it appears to be a distinct new member of the tribe Homalotini, whose members all have extraordinarily long mandibles. Others include two minute fungus beetles (Corylophidae) which are only a few millimetres long and two weevil species (Curculionidae: *Ethemaia*) collected in association with sedge and reed islands in lagoon sand.

Spiders

The 46 undescribed taxa collected during the Bush Blitz are likely to be new species; however, their descriptions cannot be published until more male specimens are collected.

Snails

No clearly new species were discovered. It is possible that the *Allocharopa* sp. recorded at Bruny Island Neck Game Reserve is a putative new species; however, only a single dead shell was collected and more material is required. In addition, *Scelidoropa* sp "Trial Bay" was newly recognised based on this survey, but there has been one previous collection.

Flora

Marine macroalgae

It is possible that the record of *Micropeuce* BRUNY sp. 1 from Lennonville Point represents a new species; however, only vegetative material was collected and this was insufficient to verify a species name. Reproductive material is required for further identification.

Table 3 Putative new species

Family	Species
Moths	
Oecophoridae	<i>Garrha</i> sp. BB Bruny CB15
Oecophoridae	<i>Lichenaula</i> sp. BB Bruny CB11
Beetles	
Carabidae	<i>Agonocheila</i> sp. 'BBBrunyLF10'
Carabidae	<i>Bembidion</i> sp. 'BBBrunyLF05'
Carabidae	<i>Sarothrocrepis</i> sp. 'BBBrunyLF15'
Carabidae	<i>Setodyschirius</i> sp. 'BBBrunyLF06'
Carabidae	<i>Trigonothops</i> sp. 'BBBrunyLF02'
Corylophidae	<i>Holopsis</i> sp. 'BBBrunyLF07'
Corylophidae	<i>Holopsis</i> sp. 'BBBrunyLFSSS2'
Curculionidae	<i>Ethemaia</i> sp. 'BBBrunyLF05A'
Curculionidae	<i>Ethemaia</i> sp. 'BBBrunyLF05B'
Latridiidae	<i>Corticaria</i> sp. 'BBBrunyLF17'
Scirtidae	<i>Pseudomicrocara</i> sp. 'BBBrunyLF05'
Staphylinidae	<i>Eumecognathus</i> sp. 'BBBrunyLF12'
Staphylinidae	<i>Eupinella</i> sp. 'BBBrunyLF04'
Staphylinidae	<i>Rybaxis</i> sp. 'BBBrunyLF12'
Spiders	
Amaurobiidae	<i>Manjala?</i> sp1
Amaurobiidae	<i>Tasmarubrius</i> sp1
Anyphaenidae	<i>Amaurobioides</i> spnov2
Clubionidae	<i>Clubiona</i> sp1_smNospi
Clubionidae	<i>Clubiona</i> sp2_lgePale
Clubionidae	<i>Clubiona</i> sp3_sam_tiscop
Clubionidae	<i>Clubiona</i> sp3A_lgechel
Clubionidae	<i>Clubiona</i> sp4_mygchel
Clubionidae	<i>Clubiona</i> sp4A_lglgs
Desidae	<i>Badumna</i> spnov

Family	Species
Desidae	<i>Desidae</i> spnov2
Desidae	<i>Forsterina</i> sp1
Gnaphosidae	Gnaphosidae bgbllck_shinyHd
Gnaphosidae	Gnaphosidae sm_irid
Gnaphosidae	Gnaphosidae sp_bgfrey_smRTA
Idiopidae	<i>Arbanitis</i> sp1
Lamponidae	<i>Pseudolampona?</i> sp1
Linyphiidae	<i>Laetesia</i> nsp1
Linyphiidae	<i>Laperousea</i> sp1
Lycosidae	<i>Artoria</i> sp1
Miturgidae	<i>Argoctenus</i> sp_ptas
Miturgidae	<i>Elassoctenus</i> spngfem
Miturgidae	<i>Hestimodema</i> sp_h5
Miturgidae	<i>Hestimodema</i> sp1
Miturgidae	<i>Hestimodema</i> sp2
Physoglenidae	<i>Tupua</i> sp
Salticidae	<i>Holoplatys</i> sp1
Salticidae	<i>Prostheclina?</i> sp
Salticidae	Salticidae cf_Marat_brindle
Salticidae	Salticidae SP_Brda
Salticidae	Salticidae sp_iridBlk
Salticidae	Salticidae sp10_dkflnks
Salticidae	Salticidae sp2_foliate
Salticidae	Salticidae spBgiies
Selenopodidae	<i>Karaops</i> sp
Tetragnathidae	Metinae sp1
Theridiidae	<i>Crustulina</i> sp1
Theridiidae	<i>Dipoena</i> sp1
Theridiidae	<i>Phoroncidia</i> sp1
Theridiidae	<i>Proboscidula</i> spnov2

Family	Species
Theridiidae	Theridiidae Sp2_bglobes
Thomisidae	<i>Synalus</i> sp1
Toxopidae	<i>Toxopsoides</i> sp2
Toxopidae	<i>Toxopsoides</i> sp3
Zodariidae	<i>Habronestes</i> sp1
Zodariidae	<i>Neostorena?</i> sp1
Marine macroalgae	
Rhodomelaceae	<i>Micropeuce</i> BRUNY sp. 1

Threatened species

Australia is home to an estimated 580,000–680,000 species, most of which have not been described. Approximately 92% of Australian plants, 87% of mammals, 93% of reptiles and 45% of birds are endemic. Changes to the landscape resulting from human activity have put many of these unique species at risk. Over the last 200 years, many species have become extinct; many others are considered to be threatened, i.e. at risk of extinction.¹

Fauna

Invertebrates

Beetles

The stag beetle *Lissotes menalcas* is associated with large diameter logs in a mid-stage of brown rot decay, commonly referred to as mud-guts. This association confines the stag beetle to wet sclerophyll forest on the island. Populations are also confined to wet sclerophyll forest near Geeveston and a few other patches in SE Tasmania. The stag beetle has not been found in apparently suitable wet sclerophyll forest in other parts of the state, so would be vulnerable to loss of suitable habitat replenished by an ongoing supply of large, old, rotting logs. This has led to its listing as Rare under the TSP Act.

Elytra (forewings) from a male beetle found in leaf litter at SSS1 were an indication that the species continues to inhabit the area. Proximity to a road reduced the shading effect of canopy cover such that, combined with the dry summer, the habitat was drier than expected; this was particularly noticeable in the dryness of the mosses covering logs. Under sustained dry conditions the moisture level of rotting wood may become too low to prevent desiccation of larvae. Otherwise, there appeared to be a supply of large diameter logs at the appropriate stage of decay to support the species in the short term.

¹ Chapman, A. D. 2009, Numbers of Living Species in Australia and the World, 2nd edn. Australian Biological Resources Study, Canberra.

Table 4 Threatened invertebrate species

Family	Species	Status	Comments
Lucanidae	<i>Lissotes menalcas</i>	Rare (TSP Act)	Elytra found in leaf litter at SSS1, Mt Mangana.

Flora

Marine macroalgae

No Threatened species were collected during the Bush Blitz; however, there are large stands of the brown alga Tasmanian Giant Kelp (*Macrocystis pyrifera*) at several locations around Bruny Island and the D'Entrecasteaux Channel, both inside and outside designated marine reserves. This species is the critical component of the southern giant kelp communities, currently listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) as a "Threatened Ecological Community". These locations were not sampled because of their existing conservation status.

Exotic and pest species

Conservation reserves help to protect Australia's Rare and Threatened Ecosystems and provide refuge for species at risk. Invasive species can have a major impact on already vulnerable species and ecosystems, as well as economic, environmental and social impacts. The inclusion of exotic and pest species records as part of this report is designed to provide land managers with baseline information to assist with further pest management programs.

Fauna

Invertebrates

Ants

A single specimen of the introduced Argentine Ant, *Linepithema humile*, was caught in a yellow pan at SSS1, which is in a location frequented by the public to access the Mt Mangana walking track. The small 3 mm ant is easily missed; however, non-detection of the species in other reserves on the island suggests that it is not a dominant component of the ant fauna of the island although it is possible that it was present. Outside areas of human habitation, the species is not expected to have a major impact on the biodiversity of the island. The species has been in Tasmania since the 1970s and its high abundance in urban areas can be difficult to control. The Argentine Ant is no longer a notifiable pest.

Moths

Nine pest species of moth were observed or collected during the survey. All were native species apart from Diamondback Moth (*Plutella xylostella*) which is ubiquitous throughout Australia. Four of the pest species are noctuids, including Southern Armyworm (*Persectania ewingii*), which is often present as a vagrant in Tasmania.

Heteroptera

One heteropteran pest species was collected, belonging to the family Lygaeidae. Rutherglen Bug (*Nysius vinitor*) is a pest of many crops in Australia, including sunflower, sorghum, canola and safflower.

Snails and slugs

No listed pest species were recorded but six exotic species were observed.

Marine invertebrates

Known invasive marine pest species are common in the D'Entrecasteaux Channel and the surrounds of Bruny Island. This survey collected numerous specimens of the New Zealand Screwshell (*Maoricolpus roseus*) during the dredging program. Many specimens, almost all empty shells, were returned to the water during the initial sort of dredge samples. This species has been recorded in very high densities in the D'Entrecasteaux Channel and recent studies have shown it to have significant detrimental impacts on the benthic habitats of the area.

The invasive clams *Corbula gibba*, *Theora lubrica* and *Raeta pulchella*, were collected in many trawls. Blue mussel (*Mytilus* sp) was collected at Variety Bay. Given the relatively sheltered habitat here, this is likely to be the European species, *M. galloprovincialis*, rather than the locally native clade *M. planulatus*, which prefers coasts that are more open. The two clades interbreed and pure *M. planulatus* is now a rarity; in any event, they are not reliably distinguished morphologically. Two further known invasive mollusc species in the area, Pacific Oyster (*Crassostrea gigas*) and New Zealand Green Chiton, *Chiton glaucus*, were seen but not collected.

Two of the recorded ascidian species, *Asciidiella aspersa* and *Ciona intestinalis* are known invasive species. Both have been recorded previously from multiple places in Australia, centred near port and shipping areas; *C. intestinalis*, particularly, is known to be a pest, growing over aquaculture and boating infrastructure.

Among the sections of the crustacean collection that were identified to species, *Petrolisthes elongatus* is considered to be an introduced species from New Zealand and occurs in very large numbers, particularly in the intertidal zones of the D'Entrecasteaux Channel. It is likely to have caused some displacement of local species. *Halicarcinus innominatus* and *Metacarcinus novaezelandiae*, also collected during the survey, similarly are introduced from New Zealand but do not occur in such large numbers.

Table 5 lists the pest invertebrate species that were collected or observed in the study area.

Table 5 Exotic or pest invertebrate species

Family	Species	Common name	Comments
Tunicates			
Ascididae	<i>Asciidiella aspersa</i>		
Cionidae	<i>Ciona intestinalis</i>		
Ants			
Formicidae	<i>Linepithema humile</i>	Argentine Ant	1 seen at Mt Mangana
Moths			
Noctuidae	<i>Agrotis munda</i>	Brown Cutworm	1 specimen from Mt Mangana; native; agricultural pest on a wide variety of plants

Family	Species	Common name	Comments
Noctuidae	<i>Bathytricha truncata</i>		1 specimen from Big Lagoon, Neck Game Reserve; native; caterpillars are an agricultural pest on Poaceae; common and widespread along E seaboard and South Australia
Noctuidae	<i>Helicoverpa punctigera</i>	Native Budworm	1 specimen from Neck Reserve; native; agricultural pest feeds on foliage of many crops and garden flowers
Noctuidae	<i>Persectania ewingii</i>	Southern Armyworm	Widespread and fairly abundant; native; migratory; agricultural pest that feeds on a variety of crops
Nolidae	<i>Uraba lugens</i>	Gumleaf Skeletoniser	Common and widespread; native; pest in eucalypt plantations
Plutellidae	<i>Plutella xylostella</i>	Diamondback Moth	1 specimen each from nr Mt Mangana and South Bruny NP; serious pest of brassicas and other crops
Tineidae	<i>Monopis ethelella</i>		1 specimen and 1 observation (photo) from Fluted Cape Reserve and South Bruny NP; native; can be a pest of animal fibre such as wool
Tortricidae	<i>Strepsicrates ejectana</i>	Guava Bud Moth	3 specimens from Lutregala Creek Forest Reserve and Waterfall Reserve; native; can be a pest of Myrtaceae, incl. guava, and of Victorian Laceflower
Tortricidae	<i>Strepsicrates macropetana</i>	Eucalyptus Leafroller	5 specimens; Lutregala Creek Forest Reserve, South Bruny NP and Big Lagoon, Neck Game Reserve; moderately widespread; native; can be a pest of eucalypt plantations, particularly outside Australia, e.g. in NZ
Heteroptera			
Lygaeidae	<i>Nysius vinitor</i>	Rutherglen Bug	22 specimens collected from South Bruny NP

Family	Species	Common name	Comments
Crustaceans			
Cancridae	<i>Metacarcinus novaezealandiae</i>	Pie-crust Crab	
Hymenosomatidae	<i>Haliscarcinus innominatus</i>		
Porcellanidae	<i>Petrolisthes elongatus</i>		
Annelid worm			
Megascolecidae	<i>Pontodrilus litoralis</i>		Introduced marine earthworm; possible first record for Tasmania; Coal Point
Snails and slugs			
Arionidae	<i>Arion intermedius</i>	Hedgehog Slug	
Helicidae	<i>Cornu aspersum</i>		Cloudy Bay in South Bruny NP
Hygromiidae	<i>Candidula intersecta</i>	Wrinkled Snail	Cloudy Bay in South Bruny NP
Limacidae	<i>Lehmannia nyctelia</i>	Striped Field Slug	Dennes Hill Nature Reserve
Limacidae	<i>Limax maximus</i>	Leopard Slug	Lutregala Marsh Reserve
Zonitidae	<i>Oxychilus cellarius</i>	Cellar Snail	
Marine gastropods			
Turritellidae	<i>Maoricolpus roseus</i>		
Chiton			
Chitonidae	<i>Chiton glaucus</i>		
Bivalve molluscs			
Corbulidae	<i>Corbula gibba</i>		
Mactridae	<i>Raeta pulchella</i>		
Mytilidae	<i>Mytilus galloprovincialis</i>		
Ostreidae	<i>Crassostrea gigas</i>	Japanese Oyster, Pacific Oyster	
Semelidae	<i>Theora lubrica</i>		

Flora

One introduced macroalgae species was recorded during the survey. Substantial populations of two additional introduced species are known to occur at various locations in the D'Entrecasteaux Channel—a brown alga, Japanese Wakame (*Undaria pinnatifida*), and a red alga, Japanese Slipperyweed (*Grateloupia turuturu*).

Table 6 Non-gazetted weeds

Family	Species	Common name
Macroalgae		
Phylloporaceae	<i>Schottera nicaeensis</i>	Shaded Weed

Range extensions

Fauna

Invertebrates

Ants

A range extension was not surprising for *Camponotus hartogi*, as there was only a single previous record of its occurrence. It was collected by Bede Lowery in 1992 near Lennon Rd in North Bruny in dry *Eucalyptus* forest. During the Bush Blitz a specimen was collected from similar dry *Eucalyptus* forest litter at Dennes Hill Nature Reserve, 7 km further north.

The Southern Michelin Ant, *Amblyopone australis*, was recorded previously from nearby Partridge Island off the tip of Labillardiere Peninsula, and from Green Island which is 2 km offshore from Soldiers Point.

Moths

The collection of *Nola porrigens* represents a new record for the state and a significant range extension for the species. It also occurs in Victoria.

Beetles

Range extensions are recorded for two species: a leaf beetle, *Eurispa vittata*, larvae of which feed on cutting grass (including *Gahnia grandis*), and a flighted darkling beetle, *Ecnolagria rufescens*. This is not unexpected since previously there were only one or two records of these fairly common beetles from more populated parts of the island. It is possible that many more species have been encountered but not formally recorded. Nearly half of the species recorded previously were larger, colourful jewel beetles (Buprestidae) which are more likely to be noticed.

Heteroptera

As there were no previous Heteroptera records for Bruny Island, the distribution records for all taxa identified represent range extensions; however, these are not considered significant at this time because of a lack of any existing baseline data.

Land snails

Four significant range extensions are included in Table 7. In addition, three species occurring on the Tasman Peninsula and in the far south of the Tasmanian mainland were recorded from South Bruny for the first time. These records are considered to be significant infills rather than range extensions. Should the unidentified *Allocharopa* from Bruny Island Neck Game Reserve prove to be an already known species, then it will be an additional range extension.

Marine invertebrates

A specimen of *Agnezia glaciata*, an ascidian, was found at one site (Northwest Bay: 350 m off Tinderbox Point). Current Australian records for the species include only Moreton Bay in Queensland and the Victorian waters of Bass Strait. It is also known from a variety of international sites such as the Antarctic Peninsula, the Patagonian shelf, Kerguelen Island, New Zealand and Japan. This record constitutes a new record for Tasmania but the known distribution suggests this is not a result of a range expansion, more an indication of an under-studied taxa.

Flora

No range extensions for marine macroalgae or seagrasses were recorded.

Table 7 Range extensions

Family	Species	Common name	Nearest previous record / Comments
Ants			
Formicidae	<i>Camponotus hartogi</i>		7 km range extension
Moths			
Nolidae	<i>Nola porrigens</i>		New record for Tasmania; approx. 1000 km extension; South Bruny NP
Beetles			
Chrysomelidae	<i>Eurispa vittata</i>		Collected from Mabel Bay; approx. 21 km from previous record at Simpson's Bay in 1984
Tenebrionidae	<i>Ecnolagria rufescens</i>		Collected from Jetty Beach; approx. 18 km from previous records near the neck and Grass Pt
Dragonflies and damselflies			
Coenagrionidae	<i>Austroagrion watsoni</i>		55 km from nearest known record; South Bruny NP
Coenagrionidae	<i>Ischnura aurora</i>		45 km from nearest known record; South Bruny NP

Family	Species	Common name	Nearest previous record / Comments
Coenagrionidae	<i>Ischnura heterosticta</i>		30 km from nearest known record; Bruny Island Neck Game Reserve
Spiders			
Hexathelidae	<i>Plesiothele fentoni?</i>		Taken at Mt Mangana; most primitive spider in Australia
Land snails			
Charopidae	<i>Discocharopa mimosa</i>		29 km infill; first record for Bruny Island; common statewide; Mt Midway CA
Charopidae	<i>Elsothera ricei</i>		18 km range extension; new record for Bruny Island; Mt Mangana CA
Charopidae	<i>Scelidoropa</i> sp "Trial Bay"		35 km extension; new record for Bruny Island (distance is to sole previous record between Trial Bay and Kettering); South Bruny NP
Punctidae	<i>Pedicamista</i> sp "Chisholm"		32 km range extension; Mt Mangana CA; new record for Bruny Island and southernmost record for the species (closest record was at Esperance River); common statewide wet forest species
Punctidae	<i>Punctidae</i> sp "Micro Cripps"		18 km infill and first record from South Bruny; common statewide species; Mt Mangana CA
Rhytididae	<i>Prolesophanta dyeri</i>	Dyer's Carnivorous Snail	36 km range extension; new record for Bruny Island; widespread but uncommon species; Mt Bruny CA

Family	Species	Common name	Nearest previous record / Comments
Rhytididae	<i>Prolesophanta nelsonensis</i>	Mount Nelson Carnivorous Snail	6 km significant infill because it is the first record from Bruny Island; species occurs on adjacent mainland at Tinderbox Hills; Dennes Hill Nature Reserve

Other points of interest

Fauna

Invertebrates

Ants

Prior to this Bush Blitz, only six ant species were recorded for Bruny Island on the ALA and no published surveys of the island's ants were known. Given the prevalence of ants in a diversity of habitats, it was anticipated that a number of new records of species for Bruny Island would be collected.

Only one of the 24 species recorded was among the six previously known to occur on Bruny Island; this Bush Blitz increased the named ant fauna for Bruny Island from six to 26 species. A further two taxa, determined only informally, have been lodged with the TMAG, along with the other specimens, for further taxonomic work. Visits to other collections will be undertaken to confirm identities of species where necessary.

Despite the short time frame and poor weather conditions, the Bush Blitz results indicate that knowledge of the diversity of island's ant fauna would benefit from dedicated sampling for these taxa.

Moths

The Lepidoptera (moths and butterflies) are one of the four most advanced and mega-diverse insect orders. Australia has approximately 10,400 named moth species, but about twice as many species are already deposited in Australian insect collections. Tasmania has around 300 known species and is estimated to have around 1000 species.

Data on specimen-based distribution of Lepidoptera is important for our understanding of the diversity of geographical areas. These taxa are important bio-indicators for monitoring of environmental effects such as climate change, which may alter the constitution of vegetation communities. Geometridae in particular are widespread and abundant in southern Australia. Usually each species is closely associated with one host plant species. The diversity of this group, therefore, can be a direct indicator of the biodiversity of a geographical region.

In total, 568 moth specimens were collected over eight days and eight nights in 33 collection events. These moths were referred to 26 different families, and 199 taxa, most identified to species—thus about 20% of the Tasmanian fauna.

The family with the highest species richness and abundance, by far, was the Geometridae with 67 species. This is not surprising as, numerically, this family dominates among Australian macro-moths and is widespread across most ecosystems. Tortricidae were the next highest, with 28 species, followed by Oecophoridae, with 26 species.

Crambidae, numbering 14 species in 10 genera, may be relatively over-represented in the survey area as Scopariinae were targeted deliberately by A. Throssell as part of her PhD research. Species in this group are believed to feed mostly on non-vascular plants such as mosses and therefore are often found in wet eucalypt forests and rainforest.

The two most abundant moth species collected were from the family Arctiidae, and more particularly the lichen-feeding subfamily the Lithosiinae. The most frequently taken species, at 17 specimens, was the common species *Palaeosia bicosta*, which was widely distributed, and collected mostly at night. This species extends right down the eastern seaboard of Australia from Queensland to Tasmania; the larvae feed on lichen. The second common arctiid was the closely related *Castulo doubledayi*, another lichen-feeder; the 15 specimens were taken at a range of sites, but most were collected at Big Lagoon in the Neck Game Reserve in swampy, coastal eucalypt woodland. This species is also widespread along the Australian eastern seaboard.

Another abundant and widely collected moth (14 specimens) was the hadenine noctuid, Southern Armyworm (*Persectania ewingii*), a native pest species in many agricultural crops. This species is widespread and common in southern Australia and extends north to Queensland. Caterpillars feed on Pea (*Pisum sativum*), Common Flax (*Linum usitatissimum*), *Hordeum* species (cereal grain) and other plants. This moth was the most common species collected on the Southwest National Park Bush Blitz that directly preceded this one, in early February 2017; it was found to be very widespread in the far south and was also collected on several mountaintops at high altitude. It is notorious for its migratory nature and often is 'blown over' Bass Strait from the Australian mainland. In this case, the abundance of this species on both surveys corresponds with a spike in larval records and observations in northern Tasmania in spring 2015. The adults collected here are probably imagos of these larvae that have dispersed southward.

Five major sub-families of the Geometridae were represented in this survey: the Ennominae, the Geometrinae, the Larentiinae, the Oenochrominae and the Sterrhinae. The most species-rich geometrid sub-family was the Ennominae with 22 species in 16 genera. Within this sub-family, the ennomine tribe, the Boarmiini, was found to be the richest in terms of generic diversity, with 10 species in eight genera. This is not surprising as Boarmiini are well-represented in many ecosystems and are widespread in Australia. A commonly collected species from this tribe was *Phelotis cognata*, which feeds on Native Cherry (*Exocarpos cupressiformis*), a species often found on Bruny Island in dry sclerophyll forest. Ten specimens of *P. cognata* were collected from five sites. Fifteen specimens of another common and widespread geometrid, *Taxeotis intextata* (sub-family the Oenochrominae *sensu lato*), were taken at a variety of sites, although most were taken from Big Lagoon, Neck Game Reserve. Little is known of the biology of this species—its food plant may be *Leptospermum*, which would explain its abundance at the Big Lagoon, as this plant dominates in the area. Nacophorini, usually the most abundant indigenous ennomine tribe, was under-represented in this survey—probably because its peak flying time, at low elevations, is in autumn. Another tribe from a different geometrid sub-family was notably rich, with 13 species in ten genera. This was the Geometrini, a tribe of the Geometrinae (emeralds), a group of striking, green-coloured geometrids. The *Leptospermum*-feeding *Chlorocoma cadmaria* was the most commonly collected species in this group, with, again, most records from Big Lagoon, Neck Game Reserve.

Oecophoridae are extraordinarily diverse in Australia, constituting the largest moth family and the second largest family of organisms in the country with 5500 known species, of which less than half are named; most of these are endemics. Their larval foodplants are diverse but many species feed on dead eucalypt leaves and play a very important part as decomposers in forests. Oecophorids are generally small and weak fliers and thus are less likely than other groups to come to light so are probably under-represented in collections. The Oecophorinae in turn is by far the largest subfamily in the Oecophoridae and this is reflected in this collection with over 75% of the species from this group. One fifth of these species belonged to the *Barea* group. *Barea* is known to occur in dry sclerophyll and rainforest; the larvae feed on the damp sapwood of dead logs and trees.

Highlights of the survey included the collection of more uncommon species. Two of these were geometrid moths. *Hypsitropha euschema* is a Tasmanian endemic geometrid, which is rarely encountered; one specimen was taken in *Eucalyptus pulchella* woodland at South Bruny National Park (SSS2). Little is known of the biology of this species. The second of these, was two specimens of the large boarmiine geometrid, *Thallogama corticola*, taken from one site only, near Mt Mangana in wet eucalypt forest; larvae of this species feed on sassafras, a rainforest species.

Even rarer moths belonging to minor lepidopteran families were collected. The endemic species *Lecithocera terrigena* is one of the few southern Australian members of the small family Lecithoceridae. Only 11 specimens of this species from one collecting event in Tasmania in 1963 are held in ANIC. In this survey, one specimen was collected from dry sclerophyll forest at the Lutregala Creek Forest Reserve. The endemic oecophorid *Ioptera aristogona* is also uncommon and, again, only one specimen was taken, in wet eucalypt forest at Mt Mangana.

One species collected represented a new record for Tasmania: the nolid, *Nola porrigens*, previously was recorded only from NSW and Victoria. In this survey, one specimen was collected in *Eucalyptus pulchella* woodland at the SSS2 site in the South Bruny National Park.

Two undescribed species from the large family Oecophoridae were also collected that are new to science, *Lichenaula* sp. BB Bruny CB11 and *Garrha* sp. BB Bruny CB15.

Bush Blitz surveys continue to be valuable avenues for discovery of many rare and new species, and additional records of Lepidoptera in Tasmania, greatly increasing our knowledge of this very large group of Tasmanian animals. The diversity of Lepidoptera on Bruny Island, at 20% of the fauna, was high, considering that moths are seasonal and need to be sampled at different times of the year to accurately reflect the species profile. To be replicable, any subsequent surveying would need to be conducted in summer.

Butterflies and Odonata

Butterflies and odonates (dragonflies and damselflies) are relatively well-studied, conspicuous insects, so discovery of new species or large range extensions is unusual. While both groups are day-flying, they have different habitat requirements. Butterflies tend to be found in relatively open areas, particularly grasslands and heathlands, while odonates require water for their immature stages and are usually found in or around rivers, lakes, swamps, and other areas of standing or flowing water. Dragonflies, damselflies and butterflies were surveyed at various sites within Bruny Island reserves.

Previous records were taken from the Natural Values Atlas, Tasmania, and the ALA. While some previous butterfly and odonate records were available for Bruny Island, only two butterflies and one damselfly were clearly inside a reserve. All six odonate species collected on this Bush Blitz appear to be new records for Bruny Island reserves as a whole, and three of the four species of butterfly were new records for the reserves. The number of species recorded in different reserves often reflects the amount

of sampling—in some reserves, only one site was visited, and only briefly, while in others, multiple sites of varied habitat were surveyed.

No butterflies or odonates were recorded at SSS1, possibly partly due to cold and cloudy weather. SSS2 was surveyed in warmer weather, but the uneven ground at that site made it difficult to chase and catch flying insects, which reduced the number of specimens collected.

Beetles

Prior to this Bush Blitz, only 19 species of Coleoptera were listed on the ALA for Bruny Island. The earliest records dated from 1935, and nearly half of those were of large, colourful, jewel beetles (Buprestidae) which would have attracted the attention of an opportunistic collector or photographer. Formal surveys for Coleoptera on Bruny Island have been limited to wet sclerophyll forest to determine the extent of populations of the Mt Mangana stag beetle, *Lissotes menalcas*, within the island's forest reserves.

It was anticipated that the proximity of xeric saline and sandy coastal habitats to mesic inland forests on the narrow island would support a high number of species exhibiting a wide range of evolutionary adaptations to their habitat.

This Bush Blitz added records of 186 Coleoptera species to the previously known 19 species listed for the island. Of these, 123 are formally named, 49 are informally recognised species awaiting further study, and 14 are putative new species.

The 49 informal species recorded were all new records for Bruny Island. Of these, 34 informal species are considered to be new records for the state and require further work to determine whether they are new species or whether they can be referred to described species. This work is time consuming, particularly for speciose genera such as *Clivina* (Carabidae) and *Rhyzobius* (Coccinellidae) and will require viewing of type specimens held in various Australian entomological collections. Less than a third of informal species collected in this survey are known to have been previously collected in Tasmania and can be considered to be morphologically distinct species awaiting description or requiring further investigation to assign existing names. The remaining two thirds are potentially new species records for Tasmania or new to science.

Several species found during the Bush Blitz have not been recorded in Tasmania since their first collection over 50 years ago. One example is *Eurispa albipennis*, not seen since Oke's record near Hobart in 1948, in contrast to a related common species, *Eurispa vittata*, larvae of which feed upon species of cutting grass (including *Ghania grandis*). *Ercycodes tasmanicus*, a tiny, 2.5 mm, Hydrophilidae found feeding under rotting seaweed on sandy beaches, has not been recorded since early 1900 at George Town and Nubeena. *Csiro variegata* (Tenebrionidae), for which there are no ALA records for Tasmania, was collected from drier sandy islands of sedges and rushes where its fossorial legs would be advantageous. This same habitat was shared by two species of small (4–5 mm), saprophagous scarabs, *Ataenius brouni* and *Ataenius basiceps*.

Of particular interest are new Tasmanian records for some of Bruny Island's diverse halophilic Carabidae encountered in expanses of wet, barren sand adjacent to lagoons. The genus of one putative new species, *Setodyschirius* sp. 'BBBrunyLF06', is virtually unknown in Tasmania, with only one 1981 record for a close species, *S. stephensii*, from near Tunbridge.

Bembidion proprium (Carabidae) had not been recorded in Tasmania since its collection north of Hobart by Darlington 55 years earlier. The Bruny specimens were a mix of apterous, meso- and macro-winged morphs, regardless of sex, with meso-wings forming narrow strips less than the length of the elytra.

These wings were shorter than those recorded by Darlington, which might provide insight into the evolutionary history of *Bembidion* species in light of Darlington's proposal that a tropically adapted species might undergo wing atrophy following incursion into cold climates.

Wet sclerophyll forest species were similar to those collected in similar habitat elsewhere in the state, including the large ground beetle species *Rhabdotus reflexus* and *Notonomus politulus* and smaller *Sloaneana tasmaniae* (Carabidae). Moss beetle species in the recently revised family Byrrhidae were also collected: *Microchaetes hystricosus* occurred with metallic green *Notolioon griffithi* in moss beds. In contrast, *Microchaetes scoparius* was found in patches of damp sand under wood in the barren, drying bed of Little Lagoon.

Co-existing, predatory, small ground beetles were abundant in surface layers of wet sand within 5 m of the water at Big Lagoon, among them fossorial *Clivina* species and *Bembidion brullei*, an adventive species from South America. *Clivina deplanata* was common at Big Lagoon but absent from Little Lagoon where it was replaced by *C. suturalis* and two species from the *C. brevicornis* group, living sympatrically. One explanation for the difference in the two lagoons is that Little Lagoon appeared to have been dry for some time and supported species able to withstand drier conditions by digging deeper to moist conditions. Islands of sedges, rushes and *Poa* grass in lagoon sand provided habitat for weevil larvae (Curculionidae), which feed on roots, and leaf beetles (Chrysomelidae), which feed on plant surfaces.

The Bush Blitz provided a proximity of habitats which are less commonly surveyed, in particular dry sclerophyll forest and saline lagoons. The high rate of discovery of species in the mosaic of habitats provided by the island suggests that many more species may be found. Further survey work is encouraged as, based on the rate of discovery of species among the 504 specimens collected, many more species would almost certainly be detected. The number of un-named and poorly known named species found highlight the many gaps in our knowledge of Tasmanian Coleoptera.

Leaf beetles

The leaf beetle subfamily Chrysomelinae includes the predominantly Australian paropsine tribe/subtribe, members of which are prominent defoliators of *Eucalyptus* and *Acacia*. Other known hosts include *Leptospermum* and *Melaleuca*. The hosts are unknown for some non-paropsine genera. Sixty species of leaf beetle are known to occur in Tasmania, as well as several undescribed species.

The aim for this target group was to collect specimens for lodgement in the TMAG collection and to document the leaf beetle fauna of the region, with particular emphasis on occurrences within national parks and reserve areas. Prior to this Bush Blitz, Bruny Island was not well surveyed for this sub-family, although some specimens from there are in collections of the TMAG and Department of Primary Industries, Parks, Water and Environment (Tasmania) (DPIPWE). Notably, one of the earliest described species of Australian Chrysomelinae, *Paropsisterna morio*, was collected at Adventure Bay on Cook's third expedition, in 1777.

It was hoped that this Bush Blitz would improve the knowledge of the Chrysomelinae subfamily on Bruny Island; unfortunately however, the midsummer timing of this survey coincided with a significant El Niño drought event in Tasmania and the island was much drier than normal. Under such conditions, and at the timing of the collection late in the season, it was expected that Chrysomelinae populations would be sparse.

The seven species that were collected represent approximately 10% of the known species diversity of the Chrysomelinae fauna of Tasmania. The diversity of species encountered and numbers of specimens collected were disappointingly low, especially considering the diversity of habitat on Bruny Island. The

paucity was attributed to the prevailing drought conditions triggered by the El Niño event, and unlikely to reflect the true Chrysomelinae biodiversity of Bruny Island.

Heteroptera

The Heteroptera of Australia comprise about 2500 species and recent surveys during Bush Blitz Phase 1 revealed 1391 species of Heteroptera, of which 391 are recognised as being new to science. In a report to the ABRS on Bush Blitz Phase 1, Prof. Cassis and Prof. Laffan indicated that the species' taxonomic accumulation curve was not levelling, and they predicted that the total heteropteran fauna of Australia would amount to around 6,500 species.

The Cassis Laboratory had not sampled Heteroptera from the South Bruny Island area previously. This Bush Blitz provided a unique opportunity to sample for Heteroptera in a region where there is no background information for Heteroptera. In line with this, there was an expectation that new species would be discovered, particularly for the family Miridae.

The Bush Blitz resulted in the discovery of 56 species from 15 families of Heteroptera, with the greatest species richness in the Pentatomidae (16 species) and Miridae (13 species).

Spiders

Spiders are generally very poorly known for Bruny Island. The diversity recorded was 85 species across 33 families, which is one the highest Tasmanian Bush Blitz spider diversities recorded. Of those 85 species, only 39 could be placed with confidence as named species, whereas 11 (13%) are unequivocally new species and the balance are mostly putatively new or possibly named (35, 41%).

An exciting find was a putative new species of intertidal or marine spider (*Amaurobioides* spnov2). Although this species was taken only at the rocky headland near Murray Field, if the steep rocky coastline were surveyable it is likely that more would have been found. Equally interesting was the remarkable burrow of a spiny trapdoor, found on the shoreline about 2 m above the high tide mark—the spider proved to be a member of the genus *Arbanitis*. The new racing stripe spider species, which is to be named for Robert Beaton, was also taken on the sandy shores of the freshwater lagoon, making it the southernmost species of the genus in Australia.

The best collections were made in the open forests. A single site would be expected to have around 90–120 species, with totals across combined sites on the island expected to be 200–300 species. However, this number would only be approached by widespread pitfall trapping and on-site surveys e.g. necessitating camping.

Land snails

Prior to this Bush Blitz, the land snail fauna of Bruny Island was considered to be fairly well surveyed. Previously, Kevin Bonham had sampled 19 sites on the island (14 on South Bruny, four on North Bruny and one on the connecting Neck) and there had been some collecting by others. Despite this generally good coverage, several reserves on the island had not been surveyed and there was a significant data gap in the far south-east of the island. Previous records were available for 36 species from Bruny Island (17 north, 32 south). It was not expected that any new species would be found on Bruny Island, as no new species had been taken in the past. It was expected, however, that there would be some new records for the island, but not necessarily many. An overall species total at least in the low twenties was expected.

During the Bush Blitz, eight reserves were sampled (South Bruny National Park, Mt Bruny Conservation Area (CA), Mt Midway CA, Mt Mangana CA, Coal Point CA, Lutregala Marsh Reserve, Dennes Hill Nature

Reserve, Bruny Island Neck Game Reserve) and 31 species of native land snail were recorded. Surprisingly, at least six of these had not been recorded from Bruny Island before. A previously unrecognised species of *Scelidoropa* that had been collected once before on the adjacent mainland was confirmed as distinct. No clearly new species were discovered, but one possibly new and as yet unidentified species was collected from the Bruny Island Neck Game Reserve. The total recorded native snail fauna of the island now includes at least 43 species.

Overall, the survey results confirmed that the South Bruny fauna is similar to that of the wet southern forests of the adjacent mainland, while the fauna of North Bruny resembles that of the dry Hobart foothills, with very few wet forest species. The fauna of forested parts of the Neck requires further study. For at least two taxa (*Elsothera* and *Prolesophanta*), parapatric boundaries between species that are known on the Tasmanian mainland appear to extend onto the island.

By the time of the survey there had been substantial rain, so effects of the El Niño summer on results were not apparent. Given the brief time available for surveying, and the fact that surveying was restricted on some days by lack of transport, the results of this survey were impressive both in terms of the overall species tally and the number of new records for the island. Almost every species widespread enough to be recorded both on the far southern mainland and the Tasman Peninsula has now also been recorded from Bruny Island, the sole exception being *Roblinella curacaoe*. Thus, there is no evidence that Bruny Island is lacking in numbers or diversity compared to the adjacent mainland. However, it appears not to support any locally endemic species, with the possible exception of those in the diverse "*Allocharopa*" group.

South Bruny appears to be much more species rich than North Bruny, although there has been less surveying on the latter. Of interest is the distribution of some genera (e.g. *Prolesophanta*, *Elsothera*, possibly *Tasmaphena* and *Allocharopa*) such that one species of each occurs on North Bruny and another occurs on South Bruny, mirroring the dry forest/wet forest or other biogeographic splits that occur for the same genera on the adjacent Tasmanian mainland.

A noteworthy site is the area of swamp forest at Bruny Island Neck Game Reserve where the sole specimen of a possible new species was collected. Land managers are requested not to burn swamp forest in that area and to consult with Kevin Bonham if any road works or similar activities are intended through the swamp that may have the potential to introduce predatory snails.

Species have been treated as "un-named" where they are not correctly referable to any species name listed as a valid species in the AFD. This includes specimens considered to resemble names incorrectly listed as synonyms, some of which will be removed from synonymy in upcoming publications. In these cases the species is referred to by a cf followed by the senior name according to the AFD in brackets.

Marine taxa

This was the first attempt to sample experimentally the marine biota of an area during a Bush Blitz. This necessitated an experimental or exploratory approach to try to determine the most effective sampling techniques for targeting poorly known marine species in the area, or what techniques were possible given the practical limitations of sampling in marine waters. The collecting permits obtained from DPIWWE did not allow sampling in the marine reserves; however, sampling sites were chosen to cover a range of environments and locations, some adjacent to marine reserves. Pre-survey expectations were intentionally minimal due to the exploratory approach but it was hoped that concentrating in the under-sampled areas would maximise the opportunities for new species records and extended distributions.

The purpose was to trial different collecting methods over a large depth profile (+2 m to -50 m) by means of intertidal collecting, dredging and snorkelling, and to collect marine taxa to be lodged as voucher specimens in the TMAG.

Marine invertebrates

Marine molluscs and ascidians were the two taxa groups identified to species level and used as example groups. No undescribed taxa were collected among either group and most of the taxa taken had been recorded in the area previously. A few taxa collected were outside the documented range on ALA but these were more likely to reflect paucity of data rather than range extensions.

A total of 399 specimens of mollusc were collected and registered into the TMAG collections, representing 87 species. The list comprised 31 bivalve species, 52 gastropod species, and four chiton species. None of the species was unexpected, but many were useful additions to the collections—particularly those species that live in deeper waters rather than the shallow subtidal zone and which are therefore rarely, if ever, found washed up on beaches. These include the bivalves *Plectodon brazieri*, *Chlamydezza favus*, *Pseudolucinisca lacteola*, *Talochlamys pulleineana* and *Channelaxinus adelaideanus*, and the gastropods *Gemixystus polyphyllus*, *Siphonochelus syringianus*, *Nassarius mobilis*, *Crosseola cancellata*, *Colpospira atkinsoni* and *Colpospira quadrata*. In addition, two introduced mollusc species were observed but not collected.

Three chiton specimens belonging to the genus *Ischnochiton* were collected and have yet to be identified to species. All other mollusc taxa were identified as belonging to recognised species.

A total of 32 specimens of Ascidiacea, representing nine species, were collected. With the exception of *Agnezia glaciata*, which was a new record for Tasmania, all species listed have already been recorded in the D'Entrecasteaux Channel or nearby (ALA website accessed Feb 2017). Another species which has not been recorded officially from Tasmania before is *Diplosoma listerianum*. This species is included as a possible identification only, due to taxonomic uncertainty. This species was first described from the northern hemisphere and has been recorded in many vastly different locations. It is considered as truly cosmopolitan, being recorded from tropical to temperate waters of the Pacific, Atlantic and Indian Oceans and the Mediterranean and North Seas. However, there is some reservation regarding the taxonomy of the species and the lack of conclusive features to characterise it, hence here it is listed as a possible identification only.

The sampling regime, a combination of intertidal searches, snorkelling and dredging, allowed a broad sampling of some taxa (e.g. large molluscs) but was not greatly successful for sampling of a broad range of other taxa (e.g. ascidians, small taxa).

The intertidal searches were a useful exercise, allowing participation for the TeachLive teachers and other personnel, but tended to allow only the collection of large, well-known taxa. These searches resulted in the collection of 115 specimens, of which 45 species have to date been identified. Intertidal collections tended to present common, known species; however, only if identifications could not be confirmed immediately, or if the specimen would be useful in the TMAG collection, were the specimens retained.

Snorkelling was slightly more successful at giving access to more unusual or less well-sampled taxa but was hugely restricted by unfavourable weather and the time that could be spent in the water.

The dredging collaboration with the Woodbridge Marine Study Centre was an effective and useful exercise, with a variety of taxa collected over the 13 tows completed. The restrictions in distance that could be covered in the time allocated and the dredge size and mesh meant that the dredging was

restricted to certain substrates; however, it allowed collection in depths and areas that otherwise would have been totally inaccessible.

Many of the specimens collected were from groups outside the agreed specialist areas (e.g. crustaceans, bryozoans, hydrozoans). For a full survey of the marine biota collected in a Bush Blitz survey, target taxa or additional specialists similar to the arrangement for the established terrestrial Bush Blitzes would be required.

Some of the identified taxa are not listed as occurring in Tasmania on the ALA. This is much more likely to be due to a deficiency of data on these taxa and this area rather than a recent range extension.

Flora

Marine macroalgae

Marine macroalgal surveys have previously been undertaken at specific sites around the D'Entrecasteaux Channel and Bruny Island. Some of these sites (Tinderbox, Ninepin Point, Butts Reef) are well known for having high levels of macroalgal endemism and species richness. Yet there are many areas of the Bruny Bioregion, particularly the east coast of Bruny Island, that have not been well surveyed for macroalgae.

Pre-survey expectations included making of a general collection of macroalgae, but excluding well known, commonly found taxa unless such specimens were thought to contribute significantly to the Tasmanian Herbarium collections. The collection of a small percentage of putatively 'rare' species was a reasonable expectation.

Intertidal collecting, dredging and snorkelling all proved to be suitable methods for the collection of marine macroalgae and the combination of the three resulted in a good depth collecting profile. Using the dredge method is acceptable in lieu of undertaking SCUBA diving, which allows specimens to be hand-picked. A small percentage of rare species could be expected in the samples. Targeting rare species when collecting is inherently challenging since a positive identification is only likely after detailed examination of material using a microscope—it would be extremely unusual to be able to identify a species as 'rare' *in situ* underwater.

Eighty-five voucher specimens representing 67 taxa were collected. Of these, 63 macroalgae and one seagrass were named and three macroalgae were un-named (or partly named). Voucher specimens of the three un-named taxa were collected and have been accessed and databased into the Tasmanian Herbarium (TMAG) collections. Further collections of both vegetative and reproductive material would enable identification of these taxa to a higher level.

The algal collection made in Bruny Island waters represents a valuable addition to existing knowledge of algae of Tasmania. Historical herbarium records show that 635 marine algae have been recorded for Tasmanian waters, but recent molecular taxonomic research indicates that the number is likely to be much higher. During a five day period, approximately 10% of the known marine flora of Tasmania was collected.

Two 'little-known' algal species were collected; *Antithamnion pinnaefolium* and *Crouania brunyana*. There is no doubt that both species have been collected only rarely; however, the scarcity of experienced botanists focussing on such small filamentous species means that there is still a general absence of accurate information about the populations and occurrences of either species. This overall paucity of data means that, as yet, there can be no true assessment of rarity or risk. At present, it would be misleading to categorise either species as 'Rare' as defined by the TSP Act, since this category implies

that the species is at risk, and no risk has been demonstrated. Using the specific definition of having been recorded previously at only five or fewer localities (Australian Virtual Herbarium data searched June 2016), both *C. brunyana* and *A. pinnafolium* were categorised as 'Rare'. In terms of geographic location *C. brunyana* has a restricted geographic range (<50 km²), whereas *A. pinnafolium* is more widespread (geographic range >500 km²). The IUCN (International Union for the Conservation of Nature) conservation category into which these two 'little-known' macroalgae would fall is either 'Data Deficient' or "Not Evaluated".

South-east Tasmania is known for its high level of local endemism in marine fauna (crabs, shrimps, echinoids, holothurians, and asteroids). Local endemism is also evident for marine macroalgae in this region. The confluence of the Huon and Derwent Estuaries (the upper D'Entrecasteaux Channel) is home to several restricted-range (<10 km²) macroalgae including the recently described *Entwisleia bella*, representing a new species, genus, family and order of red algae. Several specific areas of the D'Entrecasteaux Channel (Ninepin Point, Satellite Island, Simpsons Bay) have been identified as 'centres of macroalgal rarity' with high numbers of 'rare' species of either broad-, narrow- or restricted-range.

The finding of two 'little-known' macroalgal species during this Bush Blitz supports the concept of a D'Entrecasteaux Channel 'centre of macroalgal rarity'. The small number of 'rare or little-known' species found during the study is almost certainly due to the discrete sampling regime undertaken. The region is definitely worthy of further marine botanical exploration.

It is vital that stands of the protected kelp-forest community along Bruny Island shores are accurately identified and mapped regularly in order to maximise their protection in a region currently subject to the large commercial operations of both wild fisheries and aquaculture industries.

Marine biota surveys are worthy of inclusion in future Bush Blitz programs. If this happens, it is imperative to use consistent criteria and categories to describe the conservation status of any given marine species, e.g. the rigorous IUCN Red List Criteria and Categories. Marine Protected Areas (MPAs) are usually considered to have biodiversity conservation as the primary goal in management plans. MPAs contribute greatly to the concept of safeguarding species considered to be either threatened, vulnerable or endangered, even though measuring the success of such protection is difficult. Algal surveys with varying levels of detail have been undertaken for most Tasmanian MPAs. Within the Bruny Bioregion there are currently 16 MPAs (two marine nature reserves and 14 marine conservation areas) affording varying levels of protection for marine biota. Targeting MPAs during future Bush Blitz marine algal surveys would add greatly to the base-line knowledge of 'rare or little-known' species occurring in these areas.

Seed collection

The Royal Tasmanian Botanical Gardens (RTBG) conducted a seed-collecting program during the Bush Blitz. Two previous collecting trips on Bruny Island had resulted in four collections. Surveying of plants on Bruny Island has been fairly extensive over the past several decades but pre-trip surveying was carried out as a guide to selecting reserves to work in. A limited number of species were available for collection during the Bush Blitz—collecting was limited to those species bearing ripe seed. Ten collections were made of 10 taxa, totalling 816,700 viable seeds.

Conservation seed collecting requires that:

- 50 or more individuals be sampled to capture the genetic diversity of the population
- only 10–15% of seed available on that day be collected to prevent impacts to natural recruitment
- collecting target of 10–20,000 seeds is the aim for long-term conservation collections

- herbarium samples are also collected to ensure full verification of target taxa
- detailed field data record all relevant information so as to permit long-term usage.

Eight of the ten seed collections met the long-term conservation target quantity of more than 10,000 viable seeds. No Threatened flora were collected during the field trip due either to timing, fecundity, population size or combinations of all three. However, the collections made contribute significantly to improving provenance holdings of the seedbank, facilitate further work into seed germination/provenance interactions and thereby enhance the overall conservation goals for the Tasmanian seedbank program.

Glossary

Endemic: native to or limited to a certain region.

Exotic species: a species occurring outside its normal range.

Host plant: a species of plant that is used by larvae of insects as food and a place to develop.

Pest species: a species that has the potential to have a negative environmental, social or economic impact.

Putative new species: an unnamed species that, as far as can be ascertained, was collected for the first time during the Bush Blitz.

Range extension: increase in the known distribution or area of occurrence of a species.

Species range: the geographical area within which a particular species can be found.

Taxon (plural taxa): a member of any particular taxonomic group (e.g. a species, genus, family).

Taxonomy: the categorisation and naming of species. The science of identifying and naming species, as well as grouping them based on their relatedness.

Threatened: fauna or flora that are listed under Section 178 of the EPBC Act in any one of the following categories—extinct, extinct in the wild, critically endangered, endangered, vulnerable, conservation dependent.

Type locality: the location where the primary type specimen(s) (holotype or syntype series) was found.

Type specimen(s) (holotype, syntypes): the specimen, or set of specimens, on which the description and name of a new species is based.

Undescribed taxon: a taxon (usually a species) that has not yet been formally described and named.

Vouchers (voucher specimens): any specimen, usually a dead animal or preserved plant sample, that serves as a basis of study and is retained as a reference.

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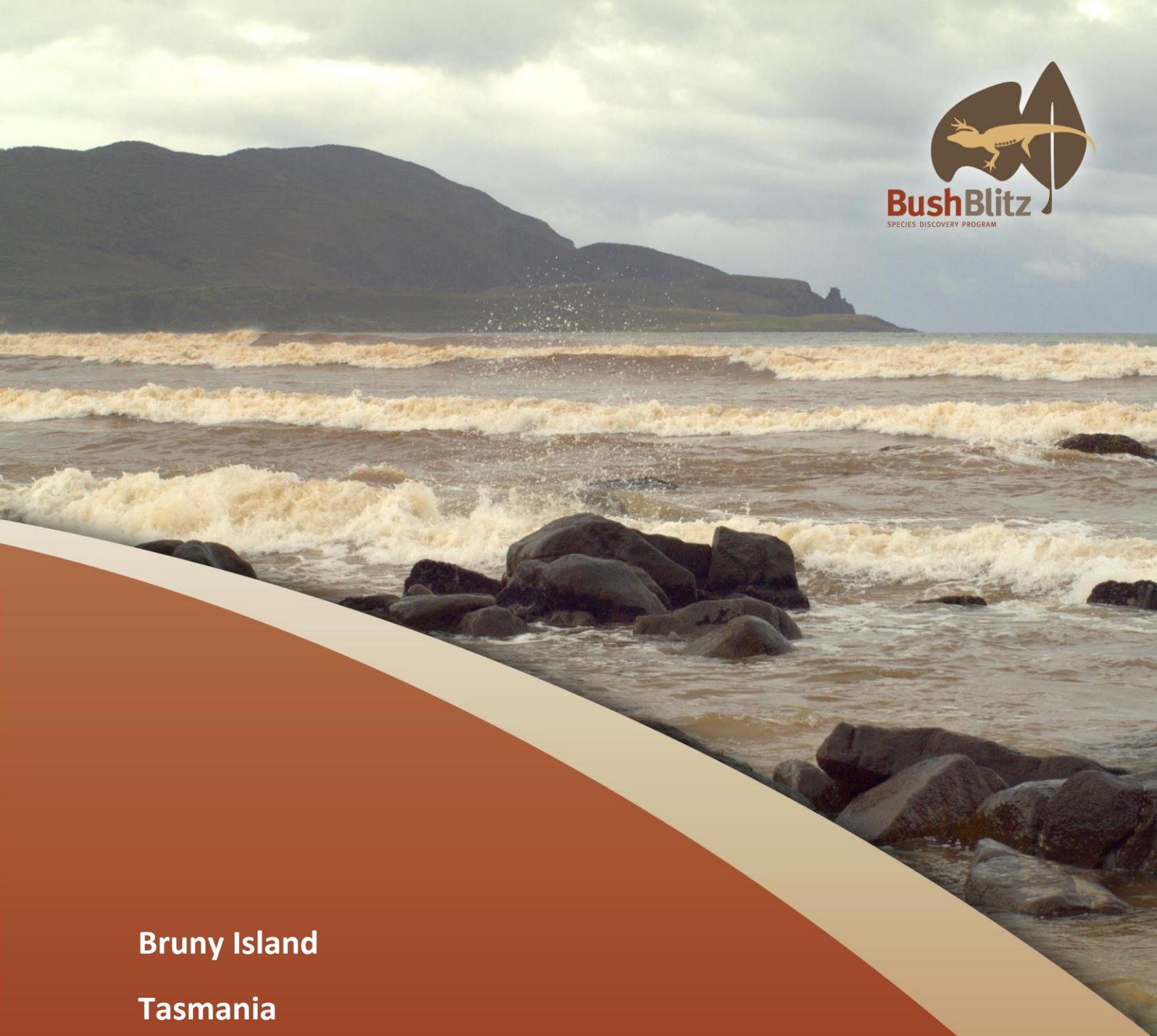
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