BushBlitz
SPECIES DISCOVERY PROGRAM

Namadgi National Park, ACT

and

Kosciuszko National Park, NSW

8–14 December 2013

Bush Blitz Species Discovery Program

Australian Government
Department of the Environment

bhpbilliton
resourcing the future
Sustainable Communities

EARTHWATCH INSTITUTE

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

ANIC
Australian National Insect Collection

CSIRO
Commonwealth Scientific and Industrial Research Organisation

EPBC Act
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Summary

In December 2013, a Bush Blitz survey was conducted in parts of Namadgi National Park in the Australian Capital Territory (ACT) and Kosciuszko National Park in New South Wales (NSW). While the areas had been surveyed previously, the remoteness and roughness of the terrain meant that many of the collections were restricted to the more accessible sites. In addition, the parks had not been surveyed for some taxa, for example Namadgi had never been surveyed for spiders.

This survey gave researchers an opportunity to explore little-known areas and to benchmark the biodiversity of the Australian alpine regions. The survey focused on flora and invertebrate groups. The survey took place in early summer and provided ideal conditions for collecting.

Namadgi and Kosciuszko National Parks are situated in Australia's alpine region and provide habitat for a wealth of alpine and sub-alpine species. These parks are part of a 1.6-million hectare chain of national parks and reserves across the Australian Alps that are managed jointly by the Australian, ACT, NSW and Victorian governments in recognition of the significance of the area as a single biogeographical region. More than half of the Kosciuszko National Park is formally declared wilderness. The Australian Alps national parks and reserves are on the National Heritage List for their unique natural environment, longstanding human interaction and scientific significance.

The area was damaged severely by bushfires that burnt over 13,000 square kilometres in January 2003. The survey provided researchers with an opportunity to assess the recovery of the area since that time.

The Bush Blitz survey found 1254 species, 807 of which had not been recorded previously for the parks. Seventy-one species that may be new to science were identified, including 62 invertebrate species (two moths, seven ground beetles, seven weevils, 29 true bugs, 15 spiders and two snails), two vascular plants and seven lichenised fungi.

This was the most comprehensive invertebrate survey ever conducted in the area. Among the species collected were 1 wasp, 15 butterflies, 449 moths, 1 scorpion-fly, 131 flies, 41 beetles, 105 true bugs, 1 cockroach, 9 damselflies and dragonflies, 33 spiders and 20 snails and slugs.

Two hundred and seventy vascular plant species were collected, including five unnamed species and two species collected for the first time during this Bush Blitz.

The survey also found 177 lichen species, representing around one-third of all mainland Australian alpine and subalpine taxa. Eight are additions to the lichen flora of Australia, 10 are new records for NSW, and 27 are new records for the ACT. More than 500 lichen species and infraspecific taxa are known above 1000 metres in mainland south-eastern Australia.

Alpine Sunray (*Leucochrysum alpinum*), pictured here on Mount Scabby, Namadgi National Park, overlooking Yaouk Valley, Emma Clifton

The richness of the fauna and flora recorded during the survey indicates that there has been recovery since the 2003 fires. While there has been little or no recovery of the alpine eucalypt canopy in many of the more severely burnt areas, many populations of invertebrates and flora have persisted in other areas. In particular, a number of species and groups likely to have been severely affected by the 2003 fire event were collected, indicating that the invertebrate fauna has responded with resilience.

Two insect pest species were collected during the survey: the exotic European Wasp (*Vespula germanica*) and the native Rutherglen Bug (*Nysius vinitor*). These appear to be having a limited impact on native species. Two gastropod pests were collected: Garlic Snail (*Oxychilus alliarius*), which has the potential to severely affect local snail populations, was recorded in Namadgi National Park; and the Grey Field Slug (*Deroceras reticulatum*), which is an important agricultural pest, was recorded in Kosciuszko National Park. Twenty-three weedy plant species were collected, particularly at the heavily disturbed and grazed Blue Waterholes site in Kosciuszko National Park. Of these, only the Scotch Thistle (*Onopordum acanthium*) is listed as a declared weed in NSW.

The Bush Blitz team, Chris Manchester © Copyright, ANIC

Contents

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 Namadgi and Kosciuszko Bush Blitz

The Namadgi and Kosciuszko Bush Blitz was conducted in December 2013. Before this survey, there had been few collections in the area away from easily accessible roads and tracks, due in part to the rugged nature of these mountainous areas. The aim of the survey was to fill in gaps in distribution records and provide more up-to-date and complete records from previously collected sites. Survey scientists were provided access to otherwise off limits areas, while a helicopter allowed them to investigate some of the more remote peaks, including the Bogong Peaks Wilderness area of Kosciuszko National Park.

The weather and season were ideal for collecting both invertebrate and flora specimens, which were the focus of the survey.

Severe fires ravaged both parks in 2003 and significantly altered vegetation, and the expectations were that this would have affected many invertebrate groups, especially those which are dependent on plant diversity.

This Bush Blitz involved about 30 people, 20 of them leading Australian scientists. The ABRS provided the logistical coordination and overall leadership of the survey.

Jacqueline Karras beating for bugs in Namadgi National Park, Michael Preece

Experts from the following organisations conducted the field and laboratory work:

- Australian Museum
- Centre for Australian National Biodiversity Research
- CSIRO — Australian National Insect Collection (ANIC)
- Environmental & Biodiversity Consultancy
- Royal Botanic Gardens Victoria, Melbourne
- University of New South Wales
- ABRS.

Acknowledgements

The Bush Blitz team were Kate Gillespie, Jo Harding, Mim Jambrecina. They would like to thank ACT Parks and Conservation (particularly Richard Koch and Simon Tozer) and the NSW National Parks and Wildlife Service (particularly Glenn Stroud, Angela Lonergan and Dave Pearce) for facilitating access to the reserves and providing advice and assistance. They would also like to thank the helicopter pilot Colin de Pagter (Helisurveys) for getting people where they needed to go, Robbie Bayliss (RJs Catering) for keeping everyone fed, and all other Bush Blitz participants.

Snow Gums (*Eucalyptus pauciflora*) at the summit of Mount Bimberi, ACT, Patrick McCarthy © Copyright, ABRS

Reserve overviews[1]

Reserve names:

Namadgi National Park, ACT
Kosciuszko National Park, NSW

Established:

Namadgi National Park — 1984
Kosciuszko National Park — 1967

Area:

Namadgi National Park — 106,095 hectares
Kosciuszko National Park — 673,492 hectares

Description

Namadgi National Park in the ACT, Kosciuszko National Park in NSW and the Alpine National Park in Victoria are parts of the 1.6-million hectare chain of national parks and reserves across the Australian Alps.

Namadgi National Park, at over 100,000 hectares in size, makes up 46% of the area of the ACT. The park encompasses a significant portion of the Brindabella Range, a prominent northern rampart to the Australian Alps with its highest peaks 1200–1900 metres above sea level. The highest mountain is Bimberi Peak at 1911 metres, which is the highest peak in the Australian Capital Territory. Namadgi is the Aboriginal name for the mountains south-west of Canberra.

Kosciuszko National Park takes its name from Mount Kosciuszko, which at 2228 metres above sea level is mainland Australia's highest peak. With an area of almost 700,000 hectares, Kosciuszko National Park is the largest national park in NSW. Several rivers, including the Snowy, Murray and Gungarlin rivers arise in the park. The Kosciuszko National Park came into existence as the National Chase Snowy Mountains on 5 December 1906. In April 1944, following the passage of the *Kosciusko State Park Act 1944*, the Kosciusko State Park was proclaimed. It became the Kosciuszko National Park in 1967.

[1] Information sourced from the NSW National Parks and Wildlife Service website (www.nationalparks.nsw.gov.au/visit-a-park/parks/Kosciuszko-National-Park) and the ACT Territory and Municipal Services website (http://http://www.tams.act.gov.au/parks-conservation/parks-and-reserves/find-a-park/namadgi-national-park/namadgi-national-parkwww.tams.act.gov.au/parks-conservation/parks-and-reserves/find-a-park/namadgi-national-park/namadgi-national-park).

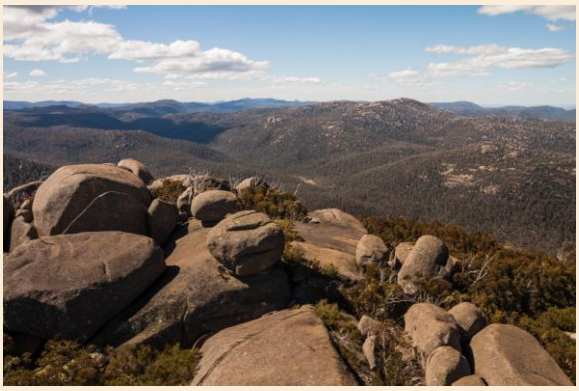
Conservation values

Alpine environments are rare in Australia, covering only 0.15% of the continent. Park agencies in the ACT, NSW, Victoria, and the Commonwealth Government work together to manage the alpine region in recognition of its significance as a single biogeographical region.

Namadgi National Park is part of the northern end of the Australian Alps and has spectacular granite mountains. Habitat in the park ranges from grassy plains above snow gum forests to alpine meadows. The park protects the Cotter River Catchment, which is a major source of water for Canberra.

Kosciuszko National Park covers a variety of climatic regions. In turn, these support several distinct ecosystems including alpine woodlands, montane forests and wet and dry sclerophyll forests. The alpine area above the tree line is one of the most fragile and covers the smallest area. This area is a patchwork of alpine heaths, herbfields, bogs and fens. Much of the tree cover in the lower sections of the park was burned severely in bushfires in 2003. Fires are a natural feature of the park ecosystem, but it will take some time for the region to return to its pre-2003 condition.[2]

The park is home to rare plant species found nowhere else in the world, and provides habitat for the endangered Mountain Pygmy-possum (*Burramys parvus*) and one of Australia's most threatened species, the Southern Corroboree Frog (*Pseudophryne corroboree*). In recognition of Kosciuszko's unique value as a conservation area, it is a named UNESCO Biosphere Reserve.[3] More than half the area of the park, over 350,000 hectares, is declared wilderness.[4]



Rocky tors, Namadgi Kosciusko National Park, Chris Manchester © Copyright, ANIC

Karen Meusemann collecting insects on Mount Murray, Chris Manchester © Copyright, ANIC

[2] McDougall, K. L., Walsh, N. G. & Wright, G. T. 2015, 'Recovery of treeless subalpine vegetation in Kosciuszko National Park after the landscape-scale fire of 2003', *Australian Journal of Botany*, 63(7): 597–607.
[3] www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/
[4] www.environment.nsw.gov.au/parktypes/Wilderness.htm

Methods

Taxonomic groups surveyed 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
Diptera	Flies	David Yeates Chris Manchester Karen Meusemann Michaela Purcell	CSIRO — ANIC
Lepidoptera	Butterflies and moths	David Britton	Australian Museum
	Moths	Glenn Cocking	CSIRO — ANIC
Coleoptera—Curculionidae	Weevils	Sara Pinzon-Navarro	CSIRO — ANIC
Heteroptera	True bugs	Gerry Cassis Jacqueline Karras	University of New South Wales
Odonata	Damselflies and dragonflies	David Britton	Australian Museum
Arachnida	Spiders	Barbara Baehr	Environmental & Biodiversity Consultancy
Gastropoda	Snails and slugs	Michael Shea	Australian Museum
Vascular plants	Vascular plants	Emma Clifton Bronwyn Collins	Centre for Australian National Biodiversity Research
		Neville Walsh	Royal Botanic Gardens Victoria, Melbourne
Lichens	Lichens	Patrick McCarthy	ABRS

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

- Nicole Fisher, David Ferguson, Rolf Oberprieler and Robyn Meier from ANIC
- Gunther Theischinger, Mandy Reid, Janet Waterhouse, Alison Miller, Rosemary Prior, Jim Teys and Peter Maresch from the Australian Museum
- Rossana Silveira from the University of New South Wales
- Martin Baehr from Zoologische Staatssammlung Munich (Germany)
- Volker Framenau from the Western Australian Museum
- Robert Raven from the Queensland Museum
- David Mallinson, Brendan Lepschi, Alexander Schmidt-Lebuhn, Laurie Adams, Andrew Slee and Maggie Nightingale from the Centre for Australian National Biodiversity Research
- Karen Wilson, National Herbarium of New South Wales.

Site selection

Site selection depended on access, suitability for trapping and time restrictions. Locations were recorded using global positioning systems.

Survey techniques

A standard suite of survey techniques was used:

- **Flies, beetles, weevils and spiders** were collected using light, Malaise and pitfall traps; by hand collecting using a sweep net; and by beating or searching vegetation.
- **Butterflies, moths and dragonflies** were collected using mercury vapour lights hung at sheets and black-light bucket traps for nocturnal Lepidoptera and sweep netting for diurnal Lepidoptera and Odonata.
- **True bugs** were collected by beating or sweeping vegetation.
- **Snails and slugs** were collected by searching under logs, rocks and in litter around the bases of trees. Two-litre bags of leaf litter were also collected from each site and taken back to the Australian Museum where they were sieved to sort out coarse, medium and fine fractions. Each of these fractions was searched with the naked eye and under a microscope.
- **Vascular plants** were collected with opportunistic and targeted sampling; collections were pressed and dried in the field and at the base camp.
- **Lichens** on granite and limestone were collected, usually along with their substratum, using a hammer and cold chisel. Slivers of bark and wood supporting lichens, as well as soil samples, were collected with the aid of a sharp knife. Specimens were air-dried, wrapped in tissue paper, stored in stiff paper bags or small cardboard boxes and returned to the laboratory for identification.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria. The animals collected were deposited with the Australian Museum and the Australian National Insect Collection (ANIC), and vascular plants with the Australian National Herbarium, Canberra, and National Herbarium of Victoria. Lichen specimens will be deposited in the Australian National Herbarium.

Emma Clifton and Bronwyn Collins pressing the morning's plant collections, Mim Jambrecina © Copyright, ABRS

Jacqueline Karras with some of the invertebrate collection, Mim Jambrecina © Copyright, ABRS

Results

All locational data for survey sites and for collected and observed specimens are available to reserve managers. In total 807 species were added to those previously recorded from the reserve, including 71 putative species new to science that were discovered during this Bush Blitz — these await formal identification. Two threatened plant species were recorded, as well as four exotic or pest animal species and 23 weed species. Table 2 provides a summary of the flora and fauna records for the reserve.

Table 2 Summary of flora and fauna records

Group	Common name	Number of species collected	Species new to the reserve		Putative new species	Threatened species*	Exotic and pest species**
			Namadgi	Kosciuszko			
Hymenoptera	Wasps	1	1	0	0	0	1
Lepidoptera	Butterflies	15	6	1	0	0	0
Lepidoptera	Moths	449	421	50	2	0	0
Mecoptera	Scorpion-flies	1	1	0	0	0	0
Diptera	Flies	131	128	0	0	0	0
Coleoptera	Beetles	41	41	0	14	0	0
Heteroptera	True bugs	105	98	23	29	0	1
Blattodea	Cockroaches	1	1	0	0	0	0
Odonata	Damselflies and dragonflies	9	0	0	0	0	0
Arachnida	Spiders	33	33	0	15	0	0
Gastropoda	Snails and slugs	20	14	1	2	0	2
Vascular plants	Vascular plants	268	3	22	2	2	23
Lichens	Lichens	177	37	11	7	0	0
Total		**1252**	**783**	**108**	**71**	**2**	**27**

* Species listed under the Commonwealth EPBC Act and NSW *Threatened Species Conservation Act 1995*. Threatened species known from the reserve are listed in Table 3.

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

Species lists

An updated species list for the reserve is provided in Appendix A. Species lists were compiled by combining the results of this Bush Blitz with data provided by participating institutions.

Names in **brown bold text** are putative new species. Species marked with an asterisk (*) had not been recorded previously. Those without an asterisk had been recorded previously and were confirmed by this survey. Species shown with blue squares were not recorded during this survey, but are known from previous studies.

Some specimens have been identified only to family or genus level. This is partly because identifying specimens is very time-consuming, with detailed microscopic examination needed in many cases. Also, some groups are 'orphans': there are no experts currently working on them, and the taxonomic literature is out-dated. Thus for orphan groups, species-level identification is not possible. Unidentified Bush Blitz specimens are held in institutional collections where they can be subject to future study.

Nomenclature and taxonomic concepts used in this report are consistent with the Australian Faunal Directory, Australian Plant Name Index, Australian Plant Census and the Checklist of the Lichens of Australia and its Island Territories.

A male 'living fossil' scorpion-fly (*Nannochorista eboraca*), Chris Manchester © Copyright, ANIC

Discussion

Putative new species

A putative species new to science is an unnamed species that, as far as can be ascertained, was collected for the first time during the survey. It is confirmed as a new species once it is named and its description published. Specimens collected during the Bush Blitz also include unnamed taxa that are already known from museum and herbarium collections: these are not counted as putative new species.

Fauna

Moths

Two moth species that may be new to science were collected. Two specimens of an attractive black and white Oecophoridae species (listed as *Eulechria* n. sp. 01) were not matched to the ANIC collection. They come closest to *Eulechria platyrrhabda*, a smaller species recorded mostly from Yeppoon to Carnarvon National Park, and not from south of Queensland. A female specimen of a medium-sized species (listed as Lithinini n. sp. 01) was collected in Namadgi National Park. Three males of the same species were among a recently donated collection.

Ground beetles

Seven new species of ground beetles from the following genera were found: *Philophloeus* (2 species), *Promecoderus* (3 species), *Prosopogmus* (1 species) and *Sarothrocrepis* (1 species). All of these are night active, the *Philophloeus and Sarothrocrepis* species hiding under bark and the *Promecoderus* and *Prosopogmus* species under stones or in leaf litter during the day.

***Asterolasia* sp. Namadgi, an undescribed taxon confined to the Southern Tablelands of NSW and ACT, Neville Walsh © Copyright, Royal Botanic Gardens**

A new ground beetle species (*Prosopogmus* n. sp. 04). All seven new species of ground beetles (family Carabidae) are night active © Copyright, Barbara Baehr

Weevils

Joint efforts with Barbara Baehr and the Diptera team added two specimens of an undescribed species of *Acantholophus* (nr. *A. parvulus* Ferguson), collected in pitfall traps. Six other undescribed weevil species were also collected: two of the tribe Cryptorhynchini (one in a pitfall trap in heath with snowgums and the other under bark at Mount Bimberi), two of Leptopiini (by beating *Acacia mearnsii* with flowers and pods and *Acacia dealbata*, in Corin Forest and Mount Franklin Rd., respectively) and two of Storeini (by beating branches of *Acacia mearnsii*, *Acacia dealbata* and *Eucalyptus* species).

True bugs

There were 29 new species of true bugs found during the survey. These included 25 species of Miridae, three Acanthosomatidae and one Pentatomidae.

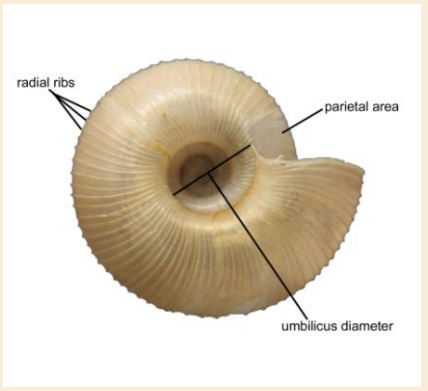
Spiders

Fifteen new species of spider were identified during the survey. Almost all of these species are medium-sized hunting spiders: Corinnidae (3 species), Cycloctenidae (1 species), Desidae (1 species), Lycosidae (3 species), Orsolobidae (1 species) and Zoridae (5 species). Only 1 species of night-active hunters that hide in burrows was identified (Idiopidae). No recent comprehensive revisions exist for the Australian Cycloctenidae, Desidae, Idiopidae, Lycosidae or Zoridae, therefore it is not surprising that most of the new species are from these families. A recent revision resulted in the naming of the three new species of Corinnidae: *Battalus diadens* (n. sp. 04), *Poecilipta contorqua* (n. sp. 01) and *Poecilipta kgari* (n. sp. 06).[5]

Snails

Two snails putatively new to science were collected. The species are very small charopid snails that were harvested from leaf litter sieving. Charopidae n. sp. ST 44 was found at Mount Ginini in scree about 200 metres from the summit and is characterised by having fine sharp radial ribs and a narrow umbilicus. Charopidae n. sp. ST 45 was found at three sites at Cooleman Caves in Kosciuszko National Park. It has fine sharp radial ribs, a discoidal shape and a wide umbilicus. This was the first recording of the species despite a snail survey done in the area by the Queensland Museum in the 1990s.

Charopidae n. sp. ST 44, Des Beechey © Copyright, Australian Museum



Snail diagram showing the radial ribs and umbilicus, Vince Railton © Copyright, Queensland Museum

[5] Raven, R. (2015), 'A revision of ant-mimicking spiders of the family Corinnidae (Araneae) in the Western Pacific', *Zootaxa*, 3958(1):1–258.

Flora

Vascular plants

One new vascular plant species was identified in Namadgi National Park and one in Kosciuszko National Park. *Pelargonium* n. sp. Booroomba Rocks (N.G.Walsh 8114) was only found in the Booroomba Rocks area of Namadgi National Park. *Geranium* n. sp. Blue Waterholes (N.G.Walsh 8051) was found on a bluff overlooking Nichols Gorge and is apparently undescribed, though it has affinities to an endangered, unnamed species of the Victorian Volcanic Plain.

Lichen

Seven lichen species were collected during this Bush Blitz which are likely to be new to science. Others are potential new species or new records from comparatively poorly known groups; identification is unlikely in the short term, although this could be resolved sooner with the availability of additional, high quality collections.

***Pelargonium* n. sp. Booroomba Rocks is a new species known only from the Booroomba Rocks area, Neville Walsh © Copyright, Royal Botanic Gardens**

Sub-alpine woodland and bog in Namadgi National Park, Michael Preece © Copyright, ABRS

Threatened species

Australia is home to an estimated 570,000 species, most of which are yet to be described formally. Approximately 92% of Australian plants, 87% of mammals, 93% of reptiles and 45% of birds are endemic. Changes to the landscape and native habitat 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 threatened.[6]

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

Fauna

No threatened invertebrate fauna species were found during the survey. Alpine Redspot Dragonfly (*Austropetalia tonyana*), which has been previously identified in Kosciuszko National Park, is listed as vulnerable under the *Fisheries Management Act 1994*. Vertebrate fauna were not surveyed.

Flora

Table 3 lists the two threatened flora species that were found during the survey. Between 50 and 100 Hoary Sunray (*Leucochrysum albicans* subsp. *tricolor*) plants were found in a one-hectare area in Woodvale-Brandy Flat, Namadgi National Park. The Hoary Sunray occurs in a wide variety of grassland, woodland, forest and modified habitats, and is still relatively widely distributed, but has suffered a substantial decline in range and abundance since European settlement. It is listed as endangered under the EPBC Act. Threats include habitat destruction and clearing, grazing, weeds, lack of representation in reserves and inappropriate fire regimes.[7]

The Leafy Anchor Plant (*Discaria nitida*), listed as vulnerable under the *Threatened Species Conservation Act 1995*, was found at Blue Waterholes, Kosciuszko National Park, with around 30 plants found along a 100-metre length of creek. The species is confined to the far south of the Southern Tablelands of NSW and the north-east highlands of Victoria. Most populations are in rarely burnt sites — the species is highly fire sensitive and most plants that have been burnt, even lightly, have died. All NSW populations contain individuals of varying size-classes, but seedlings have only been seen at a few sites — none was seen during this survey. This suggests that recruitment is infrequent, even though abundant fruit is set.[8]

Table 3 Threatened flora documented on Namadgi and Kosciuszko

Park	Family	Species	Common name	Status
Flowering plants				
Namadgi	Asteraceae	*Leucochrysum albicans* subsp. *tricolor*	Hoary Sunray	Endangered, EPBC Act
Kosciuszko	Rhamnaceae	*Discaria nitida*	Leafy Anchor Plant	Vulnerable, NSW

[7] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=56204
[8] http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10233

Dull Copper Butterfly (*Paralucia pyrodiscus*), Chris Manchester

A leaf beetle from the Chrysomelidae family, Chris Manchester

Exotic and pest species

Conservation reserves help 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

Table 4 lists the pest invertebrate fauna identified during the survey. The two pest insects documented were European Wasp (*Vespula germanica*) and Rutherglen Bug (*Nysius vinitor*). European Wasps are now in many parts of southern Australia. In large numbers they can be a serious environmental pest and are a threat to native insects and spiders. The Rutherglen Bug is a native species that is a pest of many crops across Australia. Insects can migrate into crops in very large numbers in favourable seasons. Cabbage White Butterfly (*Pieris rapae*) is an international pest on brassica crops. Although not found during this survey, the species has been recorded in Namadgi National Park and is likely to be widespread throughout both parks where weedy brassicas are growing alongside roads. Its omission from the Kosciuszko National Park records is most likely due to collector bias and incomplete databasing of collections.

Two exotic species of molluscs were also found, one of which could have a future impact on native snail populations. Garlic Snail (*Oxychilus alliarius*) is a predatory species and has had an adverse impact on native snails in isolated bushland fragments in Western Australia (Adnan Moussalli pers. comm.). Its presence in bushland at Yankee Hat and Boboyan forest walking tracks in Namadgi National Park is of some concern. The reporting scientist, Michael Shea, is unaware of any method of eradicating the snail. Grey Field Slug (*Deroceras reticulatum*) is a European slug found in cool climates usually near water. Its effect on native snail populations is unknown.

While mammals were not a target of the survey, it should be noted that there are significant populations of feral animals in the parks, including wild horses.

Table 4 Pest invertebrate fauna documented on Namadgi and Kosciuszko

Park	Family	Species	Common name	Status
Wasps				
Namadgi	Vespidae	*Vespula germanica* *	European Wasp	Uncommon
Butterflies				
Namadgi	Pieridae	*Pieris rapae*	Cabbage White Butterfly	Likely to be common in areas
True bugs				
Both	Lygaeidae	*Nysius vinitor* *	Rutherglen Bug	Common
Snails and slugs				
Namadgi	Zonitidae	*Oxychilus alliarius* *	Garlic Snail	Uncommon
Kosciuszko	Agriolimacidae	*Deroceras reticulatum*	Grey Field Slug	Uncommon

* = New record for this reserve.
Blue text = Previously recorded on the reserve but not found during this survey.

Flora

Tables 5 and 6 list the 23 introduced weeds that were identified. Weeds were collected particularly at the heavily disturbed and grazed Blue Waterholes site in Kosciuszko National Park. Many of these species are known to be widespread throughout the area, but herbarium records are not representative of this. For example, Scotch Thistle (*Onopordum acanthium*) is a widespread weed throughout south-east Australia, including Kosciuszko National Park, however our collection of this species was only the fourth for the park and the first in over 30 years. Scotch Thistle is the only weed listed at the national or state level — as a declared weed in NSW.

Brown Sedge (*Carex disticha*) has been collected previously in Victoria and the ACT on only a few occasions. This collection is the third record for the ACT. Drooping Brome (*Bromus tectorum*) is also an uncommon weed, but is a species of concern as it has spread widely after introduction in other cool-climate areas. It was collected for the eighth time in Kosciuszko National Park. Sheep Sorrel (*Acetosella vulgaris*) is widely naturalised in many states and is a common invader of montane and subalpine communities. Flatweed (*Hypochaeris radicata*) and White Clover (*Trifolium repens*) are also known to be widespread invaders of these communities. The remaining collected introduced species in the parks are considered unremarkable and none are currently of concern.

It is worth noting that while many of the introduced and naturalised species collected are known to occur in the reserves, in many cases there are relatively few herbarium records to validate these anecdotal observations. For example, there are only nine White Clover records for Namadgi National Park, with most being from the far south of the park and the most recent record from nearly 25 years ago. Similarly, Sheep Sorrel has previously been recorded in Namadgi National Park only nine times despite being widely-spread throughout the park. Apart from two collections in 1988, most were collected in the early 1970s. The collection from the Big Plain Swamp was the first for the Bogong Peaks Wilderness area. Soft Brome (*Bromus hordeaceus*) was only recorded on three previous occasions from Namadgi National Park. Despite being considered widespread in the area, the collection made during this survey is only the second record of Ribwort Plantain (*Plantago lanceolata*) in Kosciuszko National Park since 1966.

Table 5 Gazetted weeds documented on Namadgi

Park	Family	Species	Common name	Status
Flowering plants				
Namadgi	Asteraceae	*Onopordum acanthium*	Scotch Thistle	Rare

Table 6 Non-gazetted weeds documented on Namadgi and Kosciuszko

Park	Family	Species	Common name	Status
Flowering plants				
Namadgi	Asteraceae	*Hypochaeris radicata*	Flatweed	Frequent
		Tragopogon dubius	Goatsbeard	Rare
	Boraginaceae	*Myosotis laxa*	Tufted Forget-me-not	Common but localised
	Caryophyllaceae	*Cerastium vulgare*	Commmon Mouse-ear Chickweed	Frequent
	Cyperaceae	*Carex disticha*	Brown Sedge	Common but localised
	Fabaceae	*Trifolium dubium*	Hop Clover	Frequent
		Trifolium repens	White Clover	Common
	Plantaginaceae	*Veronica anagallis-aquatica*	Blue Water Speedwell	Common but localised
	Poaceae	*Anthoxanthum odoratum*	Sweet Vernal Grass	Common
		Bromus hordeaceus	Soft Brome	Common but localised
	Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	Common
Kosciuszko	Apiaceae	*Conium maculatum*	Hemlock	Rare
	Asteraceae	*Crepis capillaris*	Smooth Hawksbeard	Common at site
		Taraxacum sect. *Taraxacum*	Dandelion	Common at site
	Brassicaceae	*Rorippa palustris*	Marsh Cress	Rare
	Crassulaceae	*Sedum acre*	Wall Pepper	Common at site
	Fabaceae	*Medicago lupulina*	Black Medic	Occasional
	Plantaginaceae	*Plantago lanceolata*	Ribwort Plantain	Common
		Veronica serpyllifolia	Thyme Speedwell	Common at site
	Poaceae	*Anthoxanthum odoratum*	Sweet Vernal Grass	Common
		Bromus diandrus	Great Brome	Common

Park	Family	Species	Common name	Status
		Bromus tectorum	Drooping Brome	Common but localised
	Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	Common
	Violaceae	*Viola arvensis*	Field Pansy	Common at site

Other points of interest

Fauna

Invertebrates

Research on Australian invertebrates has increased significantly over the last 20 years, but it is estimated that less than 15% of species have been formally described. In general, about one-third of the species collected in any area are found to be new to science.

The insect records from the survey in these higher altitude regions represent valuable long-term information for any future researchers who may track the impact of climatic and other environmental change on these sensitive habitats.

Butterflies

Butterflies are one of the best known and well-collected insect groups in Australia. Approximately 398 species are known from mainland Australia. A few species are adapted to higher altitude habitat areas, such as the mainland alps and montane regions. These are mostly browns in the subfamily Satyrinae with larvae that feed on alpine grasses and other monocots. Adults of alpine butterflies are normally highly abundant in suitable habitats, but often are localised.

The butterflies recorded represent a reasonably accurate overview of the species expected in these habitats at the time of year when the survey took place. Fifteen butterfly species were identified. Alpine and subalpine species collected include Spotted Alpine Xenica (*Oreixenica orichora orichora*) and Alpine Rayed Blue (*Candalides heathi alpinus*).

An Acacia seed weevil, *Melanterius* sp., Chris Manchester © Copyright, ANIC

This ground beetle (*Agonocheila* cf. *anomala*) is a new record for Namadgi National Park © Copyright, Barbara Baehr

Collections included other butterfly species associated with higher montane habitats in south-eastern Australia, such as Bright-eyed Brown (*Heteronympha cordace cordace*) and Macleay's Swallowtail (*Graphium macleayanum moggana)*. Spotted Alpine Xenica is typically associated with tussock grasses growing adjacent to sphagnum bogs, and was found only in this habitat during the survey. Species collected in the survey that often characteristically form localised and disjunct populations included the Silky Hairstreak (*Pseudalmenus chlorinda zephyrus)* and the Dull Copper (*Paralucia pyrodiscus*).

For Namadgi National Park six species of butterfly were newly recorded, and one for Kosciuszko National Park.

Moths

Moth specimens representing 39 of the 87 families in the 1996 Australian Checklist were collected. The family with the highest representation was Oecophoridae, with 113 species, followed by Geometridae, with 83, and Cosmopterigidae with 42. As is the bias for Australian moths generally, the majority of the collected species were micromoths.

More than half of the moths were collected at four sites on one warm cloudy night — the weather on the other nights was generally cold and windy and strongly moonlit. While many species were present at more than one site, and some at all sites, many other species were observed only at one site. This suggests that many more species are yet to be found in Namadgi National Park.

Among taxa seen but not collected was this female Southern Pyrgomorph (*Monistria concinna*), Chris Manchester © Copyright, ANIC

Scorpion-flies

Two male specimens of the living fossil scorpion-fly (Mecoptera) family Nannochoristidae were found during the survey, both identified as *Nannochorista eboraca*. This species is found in upland regions of south-eastern Australia, usually adjacent to clean, fast-flowing streams. While most scorpion-fly larvae are terrestrial, Nannochoristidae are unusual in being aquatic. The family is known from Australia, New Zealand and South America, and has a fossil record dating back to the Jurassic, 200 million years ago. They are survivors of the ancient Mesozoic forests that thrived on Pangaea and Gondwanaland.

David Yeates collecting invertebrates with a sweep net, Michael Preece © Copyright, ABRS

Flies

Diptera are one of the megadiverse orders of insects, with over 150,000 described species globally. Australia is home to over 100 distinct families and tens of thousands of species. For this Bush Blitz survey, the focus was mainly on the lower Brachycera, a subgroup of the Diptera, including families such as the Tabanidae (horse flies), Therevidae (stiletto flies), and Asilidae (robber flies).

Species from 27 families out of the total of 109 families of Australian Diptera were curated and identified, represented by 131 different species. Many of these species are yet to be described. From one particular family of research interest, the Therevidae, 17 species from 11 genera were collected and identified.

Fergusonina (Diptera: Fergusoninidae) is a genus of gall-forming flies that have a unique obligate mutualism with nematodes of the genus *Fergusobia* (Tylenchina: Neotylenchidae); the two organisms co-occur in galls on Myrtaceae. The nematodes are deposited into the plant by the female fly when she lays her eggs, and are believed to initiate the gall formation. The flies develop within the gall along with the nematodes, and when the female fly larvae are ready to pupate they are entered by a small number of fertilised nematodes that lay their eggs inside the larva, apparently without causing significant harm. The female flies then carry the next generation of nematodes to a new plant host. Generally, each fly-nematode species pair is only associated with one host plant species.

The galls appear not to cause much damage to their hosts; though they often occur on plants that are under attack by a number of other herbivores and gallers, suggesting that the plant has weakened defences.

Spent fergusoninid galls were found on Snow Gum *(E. pauciflora*) and Black Sallee *(E. stellulata*). *E. stellulata* is host to *Fergusonina herbaservus*, previously collected only from Captains Flat, NSW. Three *Fergusonina* species are known to attack Snow Gums in this region: *F. omlandi*, *F. daviesae* and *F. taylori*; the latter two are found at higher elevations than *F. omlandi*. Distinguishing these species would require molecular data from analyses of intact DNA, and no live specimens were collected for DNA extraction.

Beetles

Forty-one beetle species were collected in the Namadgi National Park, including 18 ground beetles (Carabidae). Eleven of those were new records for the park. Most of these hide under bark during the day and hunt at night; only *Scopodes boops* hunts in leaf litter. Two alpine species were collected: *Amblytelus matthewsi* is known only from Mount Macedon, Victoria, Northern NSW and the ACT, and *Anomotarus kosciuskoanus* only from Mount Kosciuszko. Five species are restricted in distribution to Victoria and NSW and four are widely distributed in the south-eastern corner of Australia.

Weevils (superfamily Curculionoidea) constitute one of the most diverse groups of beetles with more than 60,000 described species, feeding on almost all plant tissues and species. Seed-feeding weevils play a major role in ecosystem dynamics (impeding the recruitment of seeds) and are used as biocontrol agents. The survey focused on the native Australian genus *Melanterius,* which is used as a biocontrol agent for *Acacia* weeds. Determining the host specificity of the weevils and their relationships to the acacias is crucial for the control of weeds. More than 60 plants representing eight species of *Acacia (A. dealbata, A. buxifolia, A. mearnsii, A. obliquinervia, A.penninervis, A. pravissima, A. rubida, A. verniciflua*) were inspected. Seventy weevils from four different families were collected from five species of *Acacia*: *A. dealbata*, *A. mearnsii*, *A. pravissima*, *A. rubida* and *A. verniciflua*.

True bugs

The 105 species of Heteroptera collected during the Namadgi and Kosciuszko survey were from 68 plant species belonging to 17 families, with the great majority belonging to the speciose plant families Fabaceae and Myrtaceae.

The collections were typical for the temperate region, with the majority of species found belonging to the family Miridae. What was particularly unexpected and exciting was the discovery of 25 new species of Miridae so close to the national capital. The discovery of two species of the ant-mimetic genus *Myrmecoroides* (*M. grossi* and *M. rufescens*) from the same *Poa* species was unexpected; such sympatry has not been found elsewhere in Australia. These ant-mimics, commonly called hatchet-head bugs, are rarely encountered and their discovery has increased our knowledge of their habitat preferences. The capture of 11 species of Acanthosomatidae is noteworthy, as it represents a quarter of the Australian acanthosomatid fauna. This includes the discovery of a new species of *Amphaces* and two new species of *Eupolemus*. Two species of wasp-mimicking mirid bugs (*Zanessa pictulifer* and *Saturniomiris* sp.) were found in association with at least three species of braconid wasps which are possible models for the wasp-mimics. The bug mimics and wasp models were found together on the same individuals of *Eucalyptus stellulata*. This represents a new mimicry system for Australia.

Cockroaches

A species of particular interest found in the survey was the spectacular Mountain Cockroach (*Polyzosteria viridissima)*. This alpine cockroach is large and coloured bright metallic green; it is known only from a few localities in the Namadgi and Kosciuszko National Parks, along high alpine creek margins and in swamps. The use of a helicopter on this survey enabled access to some swamps that previously had not been surveyed. In the sphagnum bog near the top of Mount Murray, three specimens of this species were collected, extending its known range, and allowing more research into its genetic diversity and population structure.

The sphagnum bog was severely burnt during the 2003 bushfires. *P. viridissima* is a shy wingless ground-dwelling species that was probably severely affected by the 2003 fires. The existence of this population in 2013 provides strong evidence that the species has a mechanism for surviving fires, such as burrowing into the ground, or depositing egg cases into sheltered places in the soil.

Damselflies and dragonflies

Nine species of odonate — damselfly and dragonfly — were collected during the survey. Only one specifically alpine species was collected, the Alpine Flatwing (*Griseargiolestes intermedius)*. The other odonate species taken are common and widely distributed throughout eastern Australia. Odonata have aquatic larvae, and the presence or absence of particular species can act as an indicator of water quality.

Spiders

Most of the spiders collected are active hunting spiders. Corinnids, cycloctenids, prodidomids, zodariids and zorids are mainly diurnal hunters whereas idiopids, most lycosids and miturgids are nocturnal, being hidden in burrows or under stones during the day.

All of the eight named species of wolf spider were found in the area for the first time. *Artoria berenice*, *A. flavimana*, *A. lineata*, *A. quadrata*, *A. victoriensis*, and *Venatrix pictiventris* are restricted to south-eastern Australia, and *Tasmanicosa musgravei* occurs only in the alpine zone. Only *Venonia micarioides* is found Australia-wide. Three putative new species of wolf spider were discovered, all from the genus *Artoria*.

Only one described species each of the Miturgidae, Prodidomidae, Stiphidiidae and Zoridae families was collected. *Myandra cambridgei* (Prodidomidae) and *Hestimodema ambigua* (Zoridae) are widespread species, while *Miturga agelenina* (Miturgidae) has a southern distribution, mostly in Victoria and *Stiphidion facetum* (Stiphidiidae) can be found from Tasmania to south-eastern Queensland.

The zodariid collection yielded six described species in four genera. All of these mimic ant behaviour and live with ants while preying upon them. Their mimicry extends in some cases to their ability to produce ant pheromones as in the common and widespread species *Habronestes bradleyi*. *Habronestes grahami* and *Holasteron aciculare* have wide distributions, whereas *Asteron grayi* is restricted to the coastal region of NSW; previously *Habronestes piccolo* and *Pentasteron oscitans* had been collected only from Barrington Tops National Park in NSW.

Naas River, ACT, Chris Manchester © Copyright, ANIC

Snails and slugs

Land snails inhabit a wide range of vegetation communities from deserts to subalpine areas to rainforests. Relatively few species inhabit dry eucalypt woodlands or forests, but more species inhabit the cooler higher-altitude eucalypt woodlands and forests along the southern Great Dividing Range than anywhere else outside rainforests. In general, the southern Great Dividing Range of NSW in the Namadgi and Kosciuszko National Parks has been undersampled for land snails and it was thought initially that few species would be found on this survey. However, more species were found than expected, among them two new species. Most of the named species collected are quite widely distributed and are species that were predicted to be in the area.

Sites were generally selected at random, but within a range of varying altitudes and aspects. However, Cooleman Caves in Kosciuszko National Park and Mount Ginini in Namadgi National Park were specifically selected. Cooleman Caves was chosen because it is a limestone area — limestone areas are generally rich in snails and Cooleman Caves was no exception with large numbers extracted from the leaf litter samples taken from the five limestone area survey sites. Snails are generally more numerous on limestone as they use the calcium carbonate for the construction of their shells. Mount Ginini was sampled as it has scree areas that are also generally rich in snails. Deep rock scree provides protection from the desiccating effects of the sun and wind and also affords protection from fire. Snails generally tended to be in lower numbers away from limestone areas and scree slopes and those that were found away from limestone and scree were mainly wide-ranging species.

Twenty land snail species were collected at Namadgi National Park and Kosciuszko National Park (18 native and two exotic species). Most were small to minute, litter-dwelling species that can only be collected successfully by taking samples of leaf litter for sieving and sorting in a laboratory.

Granite outcrop showing (dotted line) the extent of bushfire damage to a lichen community on Mount Bimberi, ACT, Patrick McCarthy © Copyright, ABRS

A new snail species (Charopidae n. sp. ST 45) found at three sites at Cooleman Caves in Kosciuszko National Park, Des Beechey © Copyright, Australian Museum

Flora

Vascular plants

This survey added considerably to botanical knowledge of Namadgi and Kosciuszko National Parks. The survey collected 270 plant species, including eight unnamed species, two of which were not previously collected.

Bogong Peaks Wilderness Area is very poorly collected, probably due to its remote, inaccessible nature and steep terrain. As a result, 24 of the 42 collections made are new records for the area; however, none of these are new records for the wider Kosciuszko National Park. Three new species occurrences were recorded for Namadgi National Park.

Alpine Heath (*Epacris paludosa*) in sphagnum bog on Mount Murray, Chris Manchester © Copyright, ANIC

Lichens

More than 500 lichen species and infraspecific taxa are known above 1000 metres in mainland south-eastern Australia. In this survey, highly diverse lichen communities were observed and sampled, and approximately one-third of all mainland Australian alpine and subalpine taxa were recorded.

The visual prominence of lichens in the alpine environment, their considerable diversity, and the numerous taxonomic and distributional novelties to be found emphasise their importance to biodiversity and the description of vegetation.

The lichens of alpine and subalpine habitats in the ACT, NSW and Victoria have been investigated with increasing diligence and intensity since the late 1960s. The December 2013 Bush Blitz survey focused on lichens on granite and its associated eucalypts at elevations of 1700–1900 metres in the southern ACT; species on granite and eucalypt bark at several less elevated sites (900–1300 metres) further north in Namadgi National Park; and subalpine lichens on limestone and adjacent substrata at Blue Holes, Cooleman Plain, Kosciuszko National Park (around 1200 metres).

***Geranium* n. sp. Blue Waterholes, Neville Walsh © Copyright, Royal Botanic Gardens**

At these elevations, a flat, palm-sized piece of rock can support 10–15 species, while a short snowgum twig can be home to 5–10 completely different lichens. The latter are inconspicuous but fascinating, and they will certainly repay a more systematic and prolonged research effort.

The availability of a helicopter during this Bush Blitz provided an opportunity to investigate some of the more remote peaks in the southern ACT less affected by recent bushfires. The rich and conspicuous lichen communities on granite outcrops and boulders near the summits of Bimberi Peak, Mount Murray, Mount Scabby and Sentry Box Mountain in the southern ACT are dominated by the families Parmeliaceae, Physciaceae and Lecanoraceae. As expected, *Rhizocarpon* (Rhizocarpaceae) is also prominent here. However, several new national records and potential new species collected during this Bush Blitz will be the subject of further investigation.

A very different lichen flora was sampled from limestone at Blue Holes, in Kosciuszko National Park. Indeed, chemical and physical differences between the two rock types are so marked that not a single species was common to both substrates.

The many new state and territory records found during the survey demonstrate that the continued investigation of diverse but under-investigated groups, such as lichens, will expand known distributional ranges across the full spectrum of suitable habitats. These additions bring to 3711 the number of species and infraspecific taxa known from Australia, with 3505 recorded from continental Australia (excluding our oceanic islands), among them 1611 from NSW and 466 from the ACT.

Lichen publications based on this survey are: McCarthy, P. M. 2014, 'Additional lichen records from Australia 77. Verrucariaceae', *Australas. Lichenol.* 75: 3–5; McCarthy, P. M. 2015, 'Additional lichen records from Australia 81,' *Australas. Lichenol.* 77: 3–11; and McCarthy, P. M. & Elix, J. A. 2014, 'The lichen genus *Rhizocarpon* in mainland Australia', *Telopea* 16: 195–211.

Rhizocarpon geographicum **on a granite boulder on Mount Murray, ACT, Patrick McCarthy © Copyright, ABRS**

Candelariella vitellina **(yellow) and** ***Xanthoparmelia*** **sp. (lobed) on a granite outcrop with a grey background of crustose lichen on Mount Bimberi, ACT, Patrick McCarthy © Copyright, ABRS**

Glossary

Diurnal: Active during the day.

Endemic: Native to or limited to a certain region.

Exotic species: A species occurring outside of its normal range.

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

Putative new species: A species that has been recognised by an expert as never having been named or described in the scientific literature.

Scree: Loose rock debris covering a slope.

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.

Undescribed taxon: A taxon (usually a species) that has been discovered but not yet formally described or named.

All publications are available online at:
www.bushblitz.org.au

Acknowledgement of Country

The Department 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.

Disclaimer

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government or the Minister for the Environment.

While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

PUBLISHER ABRS, Canberra
EDITOR ABRS
LAYOUT Biotext
DESIGN TEMPLATE Biotext

Contributors

Bush Blitz is coordinated by the Australian Biological Resources Study (ABRS), which is part of the Australian Government Department of the Environment. The program is a partnership between the Australian Government, BHP Billiton and Earthwatch Australia.

Research agencies involved in this Bush Blitz were the Australian Museum; Centre for Australian National Biodiversity Research; CSIRO — Australian National Insect Collection; Environmental & Biodiversity Consultancy; Royal Botanic Gardens, Melbourne; and University of New South Wales.

Photo credits

Photographs have been reproduced in this publication with permission. Effort has been made to credit the photographers correctly, however, please contact us if incorrectly credited.

FRONT COVER The Alpine Cockroach (*Polyzosteria viridissima*) is only known from a few localities in the Namadgi and Kosciusko National Parks, Chris Manchester © Copyright, ANIC

BACK COVER Alpine landscape, Chris Manchester © Copyright, ANIC

Namadgi National Park, ACT and Kosciuszko National Park, NSW

8–14 December 2013

BushBlitz