Oxley Wild Rivers New South Wales

3–15 November 2015

Bush Blitz Species Discovery Program

Australian Government
Department of the Environment and Energy

bhpbilliton
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

ALA
Atlas of Living Australia

AM
Australian Museum

ANBG
Australian National Botanic Gardens

BC Act
Biodiversity Conservation Act 2016 (New South Wales)

CSIRO
Commonwealth Scientific and Industrial Research Organisation

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

OWRNP
Oxley Wild Rivers National Park

NPWS
NSW National Parks and Wildlife Service

RBG
Royal Botanic Gardens (Sydney)

UNE
University of New England

UNSW
University of New South Wales

Summary

Oxley Wild Rivers National Park (OWRNP) in New South Wales was the focus of a Bush Blitz expedition from 3 to 15 November 2015. The park is managed by NSW National Parks and Wildlife Service (NPWS) and is part of the Gondwana Rainforests of Australia World Heritage Area. It features rare dry rainforest, dramatic gorges and waterfalls, extensive wilderness areas and a diverse array of wildlife. Its rich biodiversity includes a large number of rare and threatened species making it an area of national and international significance for science and conservation.

The Bush Blitz recorded 1312 species, 550 of which had not been recorded previously in the park (13 vertebrates, 532 invertebrates and 5 flowering plants). Five of the species collected are thought to be new to science (4 true bugs and 1 snail). Many unnamed or not formalised taxa were recorded; these may assist scientists to revise, compare and describe species in the future. Newly recorded taxa were within their recorded range distributions, however, for species in some groups insufficient baseline information is available to assess ranges, e.g. spiders and true bugs.

Among the hundreds of plant and animal records obtained, highlights include:

• 12 new records of fish for the park, including Mountain Galaxias (*Galaxias olidus*) found in a tiny stream near Birds Nest Hut

• first record for the park of a Mountain Stream Tree Frog (*Litoria barringtonensis*)

• discovery of four new species of true bugs all belonging to family Miridae

• 532 invertebrates newly recorded for the park (135 ants, 32 butterflies, 107 moths, 87 true bugs, 10 dragonflies, 14 damselflies, 97 spiders, and 50 molluscs)

• discovery of a new species of carnivorous, air-breathing land snail

• five new records of flowering plants for the park and many collections of significant and rare undescribed taxa

• records of nine threatened bird species, including Wompoo Fruit-doves (*Ptilinopus magnificus*) feeding on figs in dry rainforest, and good numbers of Little Lorikeets (*Parvipsitta pusilla*), attracted by the mass flowering of eucalypts.

OWRNP contains important breeding habitat for many threatened species, including over 60 EPBC-listed and/or State-listed animals and plants. The EPBC-listed Stuttering Frog (*Mixophyes balbus*) was observed in large numbers at two locations in the park. This frog is considered Vulnerable under the EPBC Act and Endangered under the *Biodiversity Conservation Act 2016* (BC Act) in NSW. A new population of the tree *Eucalyptus magnificata*, which is listed as Endangered under the BC Act, was discovered in the park. In addition, five plant species listed under both the EPBC Act and the BC Act (*Haloragis exalata* subsp. *velutina, Eucalyptus nicholii, Grevillea beadleana, Grevillea guthrieana* and *Hakea fraseri*) were found near previously known sites within OWRNP.

Introduced mammal species recorded included European Cattle (*Bos taurus*), Common Dog (*Canis familiaris*), Horse (*Equus caballus*) and Pig (*Sus scrofa*). The Bush Blitz teams noted that several river banks were damaged at a number of sites, presumably from the activity of feral animals. Exotic fish species including Goldfish (*Carassius auratus*) and Eastern Gambusia (*Gambusia holbrooki*) were found

only in the Macleay River. The upper reaches of the Apsley and Yarrowitch rivers were free of introduced fish as were the other streams surveyed.

Several exotic and pest invertebrate species were widespread in the park. Butterflies which feed on introduced crops or weeds including Cabbage White (*Pieris rapae*), Monarch (*Danaus plexippus*) and Orchard Swallowtail (*Papilio aegeus*) were locally common. Twelve exotic moths from the family Noctuidae were collected; however, all of these species were within their known ranges. Seven exotic species of true bugs were recorded mainly living on exotic plants along the rivers. Five exotic species of mollusc were found in areas where native species were significantly less common and in habitats that had been disturbed by feral animals such as cattle and horses.

Nineteen species of weeds were recorded, one (*Lysimachia nummularia*) being a new record for NSW; however, weeds were under-collected on this Bush Blitz due to botanists focusing on native vegetation. Many areas of OWRNP were remarkably weed free, despite the prevalence of weeds in some parts of the park, and often in large populations (near to and on roads, and around homesteads and creeks, etc). Areas along ridges appear to be relatively weed free, except at lower altitudes. One serious infestation of Crofton Weed (*Ageratina adenophora*) along the upper reaches of Reedy Creek was reported to the relevant NWPS staff.

In addition to the above collecting and recording, as part of an *ex-situ* conservation focus, specialists from the Australian National Botanic Gardens (ANBG) worked in partnership with the land managers to collect cuttings and seeds from threatened plants that only exist in small, isolated areas of the park. Over 800 of these plants have been successfully propagated at the ANBG, providing an insurance policy for the wild population. Plantings of *Grevillea guthrieana* and *G. beadleana* plus *Prostanthera* sp. aff. *howelliae* are doing well, with very few losses and very good growth. One of these species, the Endangered *Grevillea guthrieana,* was re-planted at OWRNP by a joint team of NPWS and ANBG staff, helping to secure the future of this plant in its natural habitat—a great outcome following on from the Bush Blitz.

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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 Oxley Wild Rivers Bush Blitz

The Bush Blitz took place between 3 and 15 November 2015 and therefore the results are representative of those taxa present/active in the mid dry season. Wet weather at the beginning and end of the survey affected some collecting and site accessibility, and probably increased the mobility of ground-dwelling fauna over the main collecting period.

An important feature of this Bush Blitz was the participation of NPWS rangers from Walcha and Armidale; the rangers provided invaluable assistance by sharing their knowledge of the local environment, guiding survey teams, and finding rare and threatened plants.

Staff from ANBG worked with rangers to collect propagation material from more than 15 rare and significant plant species found only in isolated pockets of the park. These species were cultivated at the Gardens to provide an insurance policy for wild populations. Seedlings of the endangered *Grevillea guthrieana* collected on the Bush Blitz and propagated at ANBG, were returned to OWRNP in 2016 by ANBG staff and NPWS rangers, boosting the numbers of this species in the wild.

Bush Blitz provided the logistical coordination and overall leadership for the survey. Seven BHP Billiton employees, coordinated by Earthwatch Australia, participated as field assistants to the scientists. The Australian Museum and the Royal Botanic Gardens Sydney were the host institutions for this Bush Blitz, providing the core group of personnel, and accessioning specimens into their collections. Experts from the following organisations conducted the field and laboratory work:

- Australian Biological Resources Study
- Australian National Botanic Gardens
- Australian National University
- Australian Museum
- Royal Botanic Gardens Sydney

- University of New South Wales
- University of New England.

Acknowledgements

Oxley Wild Rivers National Park and surrounding areas are the traditional lands of the Dunghutti, Gumbaynggirr and Anaiwain peoples. 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 Brian Hawkins, Kate Gillespie and Beth Tully. They would like to thank NPWS, including Walcha Area Manager, Roger Mills and Piers Thomas, Patrick Lupica, Sam Doak, Neil Reckord, Matt Ryan and Alan Hill for their generous assistance and knowledge of the park.

The team would also like to acknowledge the contributions of David Taylor and Toby Golson from ANBG who collected plant propagation material during the Bush Blitz, ensuring the *ex-situ* conservation of several rare and threatened species.

The enthusiastic and good humoured field assistants from BHP Billiton and their coordinators, Cassandra Nichols and Bruce Paton (Earthwatch Australia), are gratefully acknowledged. BHP Billiton employees on the trip were Jamie King, Kylie McKay, Charles Nzama, Ben Dwyer, Sally Lamb, Matthew Wojas and Jess Birmingham.

Finally, the team would like to thank Robert, Olive and Stan Bayliss for their excellent catering; Barry Blacker from Fleet Helicopters; and all other participants, including students from Walcha Central School and St Patrick's Primary who hosted the scientists for a day of discovery.

This report is dedicated to the memory of Olive Bayliss, a beloved member of the Bush Blitz family.

Reserve overview[1]

Reserve name: Oxley Wild Rivers National Park

Area: 1650 km^2

Description

OWRNP is located approximately 350 km north of Sydney between Kempsey and Armidale in New South Wales. The western fringe of the park is in the New England Tablelands within the Armidale-Dumaresq and Walcha local government areas. The park is part of a large tract of relatively undisturbed, forested land along the Great Escarpment, and connects with Cunnawarra National Park to the north-east, Werrikimbe National Park to the south, and Willi Willi and Carrai National Parks to the east.

The park lies within the catchment of the Macleay River and consists largely of gorges and deep river valleys on the upper reaches of the river and its tributaries. The majority of the park is in a rain shadow at a lower elevation than surrounding areas. In the central section of the park at East Kunderang the annual rainfall is approximately 600 mm, while annual rainfall typically is above 750 mm at Armidale and Walcha to the west and above 1000 mm in adjacent forests to the north, south and east.

Altitude ranges from 200 m above sea level at Georges Creek to 1294 m at Baynes Mountain. Elevation exerts a major influence on climate and therefore on plant and animal communities. In general, the plateaux and upper slopes, especially those with a northerly aspect, are dry and fairly open. Within gorges, the vegetation is often starkly different on each side, with rainforest or denser eucalypt forest facing much drier rocky slopes.

A large part of the park has been disturbed by mining, cattle grazing, timber extraction, frequent fires and increasing numbers of feral animals.

Conservation values

The majority of the park has been inscribed on the World Heritage List[2] as it satisfies the following criteria for natural values of outstanding universal significance:

- major stages of the Earth's evolutionary history, including rainforest ecosystems and relict plant and animal species dating from Gondwana

[1] Department of Environment and Conservation (NSW), 2005. Oxley Wild Rivers National Park, Oxley Wild Rivers State Conservation Area, Cunnawarra National Park and Georges Creek Nature Reserve. Plan of Management. NPWS, http://www.environment.nsw.gov.au/resources/parks/OxleyPom.pdf.

[2] First inscribed on the World Heritage List in 1986 (extended in 1994), the Gondwana Rainforests of Australia were one of 15 World Heritage places included in the National Heritage List on 21 May 2007, http://www.environment.gov.au/heritage/places/world/gondwana.

- significant ongoing geological processes and biological evolution, including centres of endemism where ongoing evolution is taking place and taxa showing evidence of relatively recent evolution
- significant habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive, including rainforest, wet sclerophyll and rocky outcrop habitats containing threatened and rare plant and animal species.

OWRNP is best known for its diversity of rainforest types and its populations of the endangered Brush-tailed Rock-wallaby (*Petrogale penicillata*), a species that is now extinct over much of its former range. The area supports a diverse assemblage of plant communities including rare and threatened flora; several short-range endemic plants have been discovered in the park in recent years.

Two areas within OWRNP, largely unchanged by human activity, have been declared wilderness under the *Wilderness Act 1987*: the Macleay Gorges Wilderness covers the majority of the core area of the park; and the Kunderang Wilderness covers much of the eastern and south-eastern sections of the Kunderang Brook catchment.

Features of geological and geomorphic interest are protected, including the Great Escarpment and its associated waterfalls and gorges. The Apsley Macleay Gorge is one of Australia's largest gorge systems and Wollombi Waterfall is the highest waterfall in NSW. There are significant granite outcrops and a small area of limestone (karst) in the upper reaches of the Kunderang Brook, which includes several caves.

OWRNP contains a range of cultural heritage sites including Aboriginal archaeological and burial sites, an historic homestead at Kunderang East and the remains of Australia's first commercial hydro-electric scheme. It also features many recreational and educational areas of interest for visitors.

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
Amphibia and Reptilia	Frogs and reptiles	Jodi Rowley	AM
		Timothy Cutajar	AM
Pisces	Fishes	Mark McGrouther	AM
Hymenoptera	Ants	David Bray	AM
Diptera and other insects	Flies and other insects	John Tann	AM
Lepidoptera	Butterflies	Jean Weiner	AM
Lepidoptera	Moths	Andrew Mitchell	AM
Heteroptera	True bugs	Anna Namyatova	UNSW
Odonata	Damselflies and dragonflies	John Tann	AM
Arachnida	Spiders	Helen Smith	AM
Mollusca	Molluscs	Frank Koehler	AM
Flora	Flowering plants, ferns and mosses	Andrew Orme	RBG
		Richard Jobson	RBG
		Marco Duretto	RBG
		Brett Summerell	RBG
		Jeremy Bruhl	UNE
		Tim Collins	UNE
		Boyd Wright	UNE
		Ben Vincent	UNE

Site selection

All terrestrial scientists surveyed two standard survey sites selected by Bush Blitz by using modelling prepared by 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 that underpin many conservation decisions (e.g. assumptions about relationships between the diversity of different taxa). It will also allow comparisons between sites, and establish a basis for future monitoring by reserve managers.

Apart from standard survey sites, site selection and collection methods were left to the discretion of the individual scientist. Site selection depended on access, suitability for trapping and time restrictions. Site locations were recorded using global positioning systems.

Survey techniques

A suite of survey techniques was used:

- **Birds** were surveyed opportunistically, using binoculars, mainly around East Kunderang.
- **Frogs** were surveyed at night with the aid of head-torches and by locating calling males. Frog calls were also recorded to aid in identification.
- **Freshwater fish** were collected using different techniques depending on water levels and habitat types. This included backpack electrofishing, single operator seines (Japanese seine and Bleher's folding hand-net), a beach seine, gill nets, baited traps, and hook and line.
- **Invertebrate** collecting depended on group, and involved hand collection, sampling of leaf litter and use of Pyrethrum spray, malaise traps, pitfall traps, and coloured pan traps.
- **Butterflies, dragonflies and damselflies** were sighted or collected mainly by opportunistic sweep-netting of active adults, observed or captured by wandering through differing terrains and sweeping across vegetation.
- **Moths** were collected at five sites using portable bucket traps with a 160W MV lamp, white sheet and portable generator. Light traps were deployed at night, the bucket traps distributed over as many different plant communities as possible.
- **True bugs** were collected by beating and sweeping of vegetation and hand collection, focusing on flowers, fruits and seeds. Specimens were also surveyed by light trapping and aquatic netting, and were collected from across 24 localities selected on the basis of the local vegetation and accessibility.
- **Spiders** were collected using pitfall traps, a range of hand-collecting techniques, including log rolling, bark brushing, sorting through leaf litter, inspecting curls of bark, spotlighting and spraying of pyrethrin.
- **Molluscs** were collected by hand, typically over a small area (50–100 m) by searching litter, logs, bark and rocks, with the emphasis on dry rainforest patches and dry sclerophyll forests. Micro snails were sorted from leaf litter samples, with aid of a microscope.

- **Plants** to be dried were pressed in newspaper, others preserved in spirits and/or silica as appropriate.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria. Fauna specimens were deposited in the Australian Museum (AM) with the exception of true bugs which were deposited in the collections of the University of New South Wales (UNSW). Some identifications require further work and will be referred to other experts in the field, possibly at other institutions. Plants were deposited with the Royal Botanic Gardens (RBG). 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 550 species were new records for the park (some results are yet to be finalised), including five putative new species—these await formal identification. Ten threatened animal species were observed and six threatened plants. Thirty-four exotic or pest animal species and 19 weed species were also recorded.

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

Table 2 Summary of flora and fauna records

Group	Common name	Total species recorded	Species newly recorded for reserve	Putative new species	Threatened species*	Exotic and pest species**
Mammalia	Mammals	4	0	0	0	4
Aves	Birds	117	0	0	9	1
Amphibia	Frogs	19	1	0	1	0
Reptilia	Reptiles	1	0	0	0	0
Pisces	Fishes	16	12	0	0	2
Hymenoptera	Ants and bees	147	135	0	0	0
Lepidoptera	Butterflies	32	32	0	0	3
Lepidoptera	Moths	107	107	0	0	12
Diptera	Flies	13	0	0	0	0
Other insects	Other insects	3	0	0	0	0
Heteroptera	True bugs	87	87	4	0	7
Odonata	Damselflies and dragonflies	24	24	0	0	0
Arachnida	Spiders	315	97	0	0	0
Mollusca	Molluscs	52	50	1	0	5
Vascular plants	Flowering plants and ferns	374	5	0	6	19
Bryophytes	Mosses	1	0	0	0	0
Total		1312	550	5	16	53

* Species listed as threatened under the Commonwealth EPBC Act or an equivalent listing under the BC Act.
** Includes native species that at times are pests or are exotic to this region.

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, 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 is 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

Vertebrates

Frogs

Additional molecular, acoustic and morphological analysis of specimens across eastern NSW will be required to determine whether any new frog species were discovered during the Bush Blitz. Due to their similarities, several groups of frogs were suspected to be species complexes or closely related, including the Leaf-green Tree Frog (*Litoria phyllochroa*) group. The Mountain Stream Tree Frog (*Litoria barringtonensis*) was recorded for the first time in OWRNP. This was one of the species that was difficult to distinguish from related species, particularly the Leaf-green Tree Frog.

Invertebrates

Ants

Many ant species were identified to genus only and may be new species. Confirmation of any new species will require further examination by taxonomists with experience in the relevant genera.

True Bugs

The Bush Blitz recorded 87 new records of true bugs collected from 22 families. Four species were putatively new to science, all belonging to the family Miridae. A further 70 taxa require additional taxonomic work to determine if they are new or established species.

Spiders

It is unlikely that there were any putatively new spider species recorded during this survey. Several undescribed species were previously known and some have yet to be identified. Many collected specimens required full taxonomic revision and comparison with type species before their identity can be confirmed.

Molluscs

Based on its shell morphology, one species of carnivorous, air-breathing land snail (Rhytididae sp. "MV8") was identified as putatively new to science. Several other terrestrial snail species were potentially new to science, but a decision on their taxonomic status requires further comparative investigation.

Table 3 Putative new invertebrate species

Family	Species
True Bugs	
Miridae	Gn_Dicyphini_001 sp_BBOWR15_Msp.051
Miridae	Gn_Orthotylinae_004 sp_BBOWR15_Msp.050
Miridae	Gn_Orthotylini_001 sp_BBOWR15_Msp.054
Miridae	*Pseudoloxops* sp_BBOWR15_Msp.034
Molluscs	
Rhytididae	Rhytididae sp. "MV8"

Flora

Flowering plants

No flowering plants were determined to be definite new species. However, further work is required on collections that probably represent unresolved species complexes within four genera; *Dianella, Olearia, Ozothamnus* and *Lepidosperma*. It is highly likely that new taxa will be described after further research on these collections. For example, the *Dianella* collected at Kunderang Creek on limestone was distinct, but can be referred to the *D. caerulea* group.

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 gone extinct; many others are considered to be threatened, i.e. at risk of extinction.[3]

Fauna

Vertebrates

Birds

Wompoo Fruit-doves (*Ptilinopus magnificus*) were seen and heard on several occasions, feeding on figs in the rainforest gully near East Kunderang Homestead. Dusky Woodswallows (*Artamus cyanopterus*), Varied Sittellas (*Daphoenositta chrysoptera*) and Little Lorikeets (*Parvipsitta pusilla*) were all recorded widely in the park. Little Lorikeets were present in good numbers, probably responding to the mass flowering by the Forest Red Gum (*Eucalyptus tereticornis*); they were also observed taking nectar from mistletoe of the genus *Amyema*. Evidence of feeding by Glossy Black-cockatoos (*Calyptorhynchus lathami*), such as chewed *Allocasuarina* cones, was seen at the Kunderang gate, but no birds were

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

recorded. A Masked Owl (*Tyto novaehollandiae*) was seen and heard near East Kunderang Homestead, and appeared to be roosting in a tree hollow a short distance up the hill. A White-bellied Sea-eagle (*Haliaeetus leucogaster*) and an Osprey (*Pandion cristatus*) were seen, separately, flying over the Macleay River near East Kunderang and an Olive Whistler (*Pachycephala olivacea*) was heard calling near Dangar Falls.

Frogs

The Stuttering Frog (*Mixophyes balbus*), listed as Vulnerable under the EPBC Act and Endangered under the BC Act, was observed at two locations. Individuals, calls and tadpoles were observed in large numbers at Brumby Creek and at a 'rainforest stream' site which was difficult to access. Additionally, Davies's Tree Frog (*Litoria daviesae*), listed as Vulnerable under the BC Act, was observed in the adjacent Werrikimbe National Park.

Table 4 Threatened vertebrate species

Family	Species	Common name	Status
Birds			
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Vulnerable – BC Act
Accipitridae	*Pandion cristatus*	Osprey	Vulnerable – BC Act
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	Vulnerable – BC Act
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	Vulnerable – BC Act
Columbidae	*Ptilinopus magnificus*	Wompoo Fruit-dove	Vulnerable – BC Act
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	Vulnerable – BC Act
Pachycephalidae	*Pachycephala olivacea*	Olive Whistler	Vulnerable – BC Act
Psittacidae	*Parvipsitta pusilla*	Little Lorikeet	Vulnerable – BC Act
Tytonidae	*Tyto novaehollandiae*	Masked Owl	Vulnerable – BC Act
Frog			
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	Vulnerable – EPBC Act Endangered – BC Act

Flora

Flowering plants

Six species listed under the EPBC Act and BC Act were found at OWRNP. Most of these were found near known sites. The discovery of five mature trees of *Eucalyptus magnificata* was an important find as very few other stands remain.

Two other extremely vulnerable plants found on the survey and nominated to be listed include *Prostanthera* sp. Rowleys Creek and *Leionema* sp. aff. *gracile*. These plants were found in isolated pockets of the park near the rim of Rowleys Gorge. While the park abounds with native vegetation, a disproportionately high number of endemic and threatened species are found in a narrow band around the rims and edges of gorges.

Prostanthera sp. Rowleys Creek and *Leionema* sp. aff. *gracile* have now been propagated successfully at the ANBG and will be grown on to be secured in the living collection. A genotype collecting method was employed for the collection of these species, together with *Grevillea beadleana* and *G. guthrieana,* to ensure that the *ex-situ* collection remains viable for future restoration, conservation and research opportunities. This method involved following a protocol for collecting seed and non-seed material with the aim of standardising collection methods, capturing key information and ensuring lineages are retained *ex-situ* and linked to origin and parentage.

Table 5 Threatened flora species

Family	Species	Status	Comments
Haloragaceae	*Haloragis exalata* subsp. *velutina*	Vulnerable—EPBC Act Vulnerable—BC Act	Very common locally along creeks at Kunderang Brook. Known site. Material was used in Bush Blitz taxonomy grant-funded project.
Myrtaceae	*Eucalyptus magnificata*	Endangered—BC Act	Of the two largest populations, one stand of 500 trees was on private land and the other grove of 220 individuals was near a haulage road for a mine expansion.
Myrtaceae	*Eucalyptus nicholii*	Vulnerable—EPBC Act Vulnerable—BC Act	Widespread species. Collected from OWRNP a few times, including from the same location in 2013.
Proteaceae	*Grevillea beadleana*	Endangered—EPBC Act Endangered—BC Act	Locally common though limited at Salisbury Waters Gorge. Known site.
Proteaceae	*Grevillea guthrieana*	Endangered—EPBC Act Endangered—BC Act	Cultivated at ANBG; living plants returned to OWRNP in 2016.
Proteaceae	*Hakea fraseri*	Vulnerable—EPBC Act Vulnerable—BC Act	Very rare, only two plants observed to east of Yarrowitch Falls.

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

Vertebrates

Mammals

A number of introduced species were recorded by several teams during the survey, including cattle, dogs, horses and pigs. Horses and associated habitat disturbances were observed at Hole Creek (local name; Oaky Creek) and in eucalypt forest on steep slopes at Halls Peak campground on the Chandler River. A significant track, probably due to pig activity, was observed to pass through the edge vegetation into dry rainforest at a site 4 km west of the homestead. The teams noted that several river banks were damaged at a number of sites, presumably due to the activity of feral animals.

Birds

Common Mynas (*Sturnus tristis*) were heard and seen on a number of occasions near East Kunderang Homestead; they appeared to be confined to cleared areas and their edges.

Fishes

Two introduced fish species were recorded: Goldfish (*Carassius auratus*) and Eastern Gambusia (*Gambusia holbrooki*). Both these species were found in the Macleay River only and not its tributaries. The hardy Goldfish was found at four of the 19 sites, always in shallow, slow-flowing waters by the river banks. Control of this species is difficult due to its omnivorous diet and its fast breeding and maturity rates. However, it was encouraging that Goldfish were not found in other streams.

Eastern Gambusia were recorded at six of the 19 sites. The species was collected in the slower-flowing or still waters, sometimes observed in large numbers. In many streams Eastern Gambusia can greatly outnumber the native species and may behave aggressively toward them, often nipping their fins. Huge numbers of Eastern Gambusia were present in the headwaters of the Macleay River where the river flowed into a large still pool.

Table 6 lists the pest vertebrate species that were collected or observed in OWRNP.

Table 6 Pest vertebrate species

Family	Species	Common name	Comments
Mammals			
Bovidae	*Bos taurus*	European Cattle	
Canidae	*Canis familiaris*	Common Dog	
Equidae	*Equus caballus*	Horse	
Suidae	*Sus scrofa*	Pig	
Birds			
Sturnidae	*Sturnus tristis*	Common Myna	Near East Kunderang Homestead

Family	Species	Common name	Comments
Fishes			
Cyprinidae	*Carassius auratus*	Goldfish	Not common. Only collected from the Macleay River but not its tributaries.
Poeciliidae	*Gambusia holbrooki*	Eastern Gambusia	Common to extremely common. Only collected from the Macleay River but not its tributaries.

Invertebrates

Butterflies

Several pest butterfly species, all of which feed on introduced cruciferous crops or weeds, were found in many parts of the park. The most abundant of the introduced butterflies were Cabbage White (*Pieris rapae*), Monarch (*Danaus plexippus*) and Orchard Swallowtail (*Papilio aegeus*). There are a few pest species the food plants of which need to be kept under control, if not eliminated. The Cabbage White is difficult to control as it breeds on many food plants, some of which are grown by farmers on the plateau near the park. It is the responsibility of farmers to minimise damage caused by larvae of this species.

Moths

Twelve pest species from the family Noctuidae were collected. However, all of these species were within their known ranges.

True Bugs

Seven heteropteran pest species were recorded, in four families: three in Lygaeidae (*Nysius caledoniae*, *Nysius* sp_BBOWR15_Msp.081, *Nysius vinitor*), two in Pyrrhocoridae (*Dindymus versicolor*, *Dysdercus sidae*), one in Oxycarenidae (*Oxycarenus arctatus*), and one in Pentatomidae (*Plautia affinis*).

Spiders

No introduced spiders were recorded. An introduced pholcid (daddy long-legs) is probably present at the homestead but only juveniles were seen.

Molluscs

Five exotic mollusc species were recorded. The diversity of native mollusc species was significantly lower in habitats that had been disturbed by feral animals, such as cattle and horses. These were also the only habitats where exotic species were found.

Table 7 lists the pest invertebrate species that were collected or observed in OWRNP.

Table 7 Pest invertebrate species

Family	Species	Common name	Comments
Butterflies			
Nymphalidae	*Danaus plexippus*	Monarch	Very common; found throughout eastern and southern Australia. Recorded mainly in river and creek valleys.
Papilionidae	*Papilio aegeus*	Orchard Swallowtail	Common; found throughout eastern Australia. Recorded across the park.
Pieridae	*Pieris rapae*	Cabbage White	Very common; found throughout eastern and southern Australia. Recorded across the park.
Moths			
Noctuidae	*Adisura marginalis*		A pest on peas.
Noctuidae	*Aedia leucomelas*		Sometimes a pest of sweet potatoes.
Noctuidae	*Agrotis infusa*	Bogong Moth	Native, but a pest of various agricultural crops.
Noctuidae	*Agrotis munda*		Native, but a pest of various agricultural crops.
Noctuidae	*Chrysodeixis argentifera*		A pest of some vegetable crops.
Noctuidae	*Chrysodeixis subsidens*		A pest of some vegetable crops.
Noctuidae	*Dasygaster padockina*		Major pest of cereals and grasses.
Noctuidae	*Helicoverpa punctigera*		Pest species.
Noctuidae	*Leucania stenographa*	Sugarcane Armyworm	A pest of sugarcane.
Noctuidae	*Mythimna convecta*	Common Armyworm	An agricultural pest on grasses, cereals, and some fruit and vegetable crops.
Noctuidae	*Neumichtis nigerrima*		A pest of some vegetable crops.
Noctuidae	*Tiracola plagiata*		A pest of bananas and other agricultural crops.

Family	Species	Common name	Comments
True Bugs			
Lygaeidae	*Nysius caledoniae*	Caledonia Seed Bug	
Lygaeidae	*Nysius* sp_BBOWR15_Msp.081		
Lygaeidae	*Nysius vinitor*	Rutherglen Bug	
Oxycarenidae	*Oxycarenus arctatus*	Coon Bug	
Pentatomidae	*Plautia affinis*	Green Stink Bug	
Pyrrhocoridae	*Dindymus versicolor*	Harlequin Bug	
Pyrrhocoridae	*Dysdercus sidae*	Pale Cotton Stainer	
Molluscs			
Agriolimacidae	*Deroceras invadens*		Exotic
Bradybaenidae	*Bradybaena similaris*		Exotic
Gastrodontidae	*Zonitoides arboreus*	Orchid Snail	Exotic
Lymnaeidae	*Pseudosuccinea columella*		Exotic
Physidae	*Physa acuta*		Exotic

Flora

Although weeds were under-collected on this trip due to botanists focusing on native vegetation, 19 weed species were recorded. Creeping Jenny (*Lysimachia nummularia*) was a new record for NSW and was published as a new record in 2016[4]. Many areas were remarkably weed free despite the prevalence of weeds in the park (near and on roads, homesteads, creeks, etc). Many sites were not weedy—even sites near agricultural land. However, areas along creeks, roads and in pasture were dominated by weeds and often in large populations. These weeds are widespread in northern NSW. Areas along ridges appear to be relatively weed free—places such as Paradise Rocks—though the more lowland areas are not. A serious infestation of Crofton Weed (*Ageratina adenophora*) along much of the traversed length (c. 3 km) of the upper reaches of Reedy Creek was reported to the relevant NPWS ranger.

Table 8 lists the exotic weed species that were collected or observed in OWRNP.

[4] Kodela, P.G., and Jobson, R.W., 2016. *Lysimachia nummularia* (Primulaceae) naturalised in New South Wales, Australia. *Telopea*, 19: 153-157.

Table 8 Weed species

Family	Species	Common name	Comments
Flowering plants			
Apocynaceae	*Asclepias curassavica*	Redhead Cottonbush	Scattered at site, growing along Macleay River bank, 1 km south of East Kunderang homestead.
Asteraceae	*Ageratina adenophora*	Crofton Weed	A serious infestation along the upper reaches of Reedy Creek. This was reported to the relevant Ranger.
Asteraceae	*Senecio madagascariensis*	Fireweed	Rare at Raspberry Road, 21 km south of Armidale-Kempsey Road. Scattered at Ring-o-rocks Firetrail, 200 m north of Dourallie Firetrail.
Caprifoliaceae	*Lonicera fragrantissima*	Winter Honeysuckle	Rare, only one plant found on the north side of Yarrowitch Falls.
Caryophyllaceae	*Cerastium vulgare*	Mouse Ear Chickweed	
Caryophyllaceae	*Petrorhagia dubia*		Occasional at Apsley Falls
Caryophyllaceae	*Silene* sp.		
Fabaceae	*Senna septemtrionalis*	Arsenic Bush	Locally very common though restricted to Rafferty's creek edge. New record for the park.
Fabaceae	*Swainsona brachycarpa*	Slender Swainson-pea	
Fabaceae	*Trifolium dubium*	Yellow Suckling Clover	Widespread (near pasture) at Apsley Falls area. New record for the park.
Gentianaceae	*Centaurium tenuiflorum*	Branched Centaury	Erect herb, common along Rafferty's Creek bank.
Oxalidaceae	*Oxalis corniculata*	Yellow Wood Sorrel	Common low herb found at Macleay River, 1 km south of East Kunderang homestead.

Family	Species	Common name	Comments
Passifloraceae	*Passiflora subpeltata*	White Passionflower	Several plants observed at Macleay River. Vigorous climber.
Plantaginaceae	*Callitriche stagnalis*	Common Starwort	
Polemoniaceae	*Collomia grandiflora*	Large-flowered Mountain Trumpet	
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	
Primulaceae	*Lysimachia arvensis*	Scarlet Pimpernel	Common low herb, growing along Rafferty's Creek bank.
Primulaceae	*Lysimachia nummularia*	Creeping Jenny	New weed record for NSW. Uncommon at Apsley Falls, potential wetland invasive.
Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein	Locally common at Rafferty's Creek.

Range extensions

Fauna

Invertebrates

Ants

Most of the ants identified during the Bush Blitz were within their recorded distributions. However, for two ant species, *Tetraponera* sp. and *Notostigma foreli*, the distributions recorded in the ALA include no records within 95 km. Most of the species detected at OWRNP were shared with nearby wetter forests to the east and south but some species also occur in dry inland forest to the west.

Moths

While the Lepidoptera species identified were all within their recorded distributions, limited data were available for comparisons with most Australian species. Of particular interest, however, was the discovery of a blood-feeding noctuid moth, *Calyptra minuticornis*, and other noctuids known mainly from the tropics.

Spiders

The Bush Blitz has more than doubled the number of named species recorded from the reserve and significantly increases the recorded range for several taxa. Except for the most common and widespread species, the majority of spider taxa are insufficiently well known, which limits any meaningful assessment of significance. Records of spiders previously reported from OWRNP were compiled from the ALA and from the AM's database. Almost 430 registered specimen lots are included, representing 40 spider families; 55 species-level taxa were identified among this material.

Molluscs

Several species of land snails have rather small ranges that extend into the neighbouring national parks. More species were found in OWRNP than anticipated, including a remarkable number of *Austrochloritis* species.

Flora

A major contribution of this survey was the addition of taxa not previously recorded for the park. However, since most of these are known from near the reserve and are widespread species, the extensions, while important, are not highly significant.

Table 9 Range extensions

Family	Species	Nearest previous record / Comments
Ants		
Formicidae	*Notostigma foreli*	95 km at Sea Acres, Port Macquarie.
Formicidae	*Tetraponera* sp. BB_OWR_FOR_147	230 km at Narrabri.
Flowering plants		
Boraginaceae	*Hackelia* sp. nov.	Extension of range (rarely collected).
Caprifoliaceae	*Lonicera fragrantissima*	Located on north side of Yarrowitch Falls. Nearest specimen was 100 km SW.
Euphorbiaceae	*Ricinocarpos speciosus*	Located at Steepdrop Lookout. Nearest specimen was 70 km NNE.
Geraniaceae	*Pelargonium inodorum*	Located at tributary of Port Macquarie Creek. Nearest specimens were 200 km north or 200 km south.
Moraceae	*Maclura cochinchinensis*	Located at Macleay River, 2 km south of East Kunderang homestead. Nearest specimen was 50 km away.
Myrsinaceae	*Myrsine variabilis*	Located at Macleay River, 2 km south of East Kunderang homestead. Nearest specimen was 70 km NE.
Rhamnaceae	*Pomaderris angustifolia*	Located on north side of Yarrowitch Falls. Nearest specimen was 70 km west.
Solanaceae	*Solanum amblymerum*	Located at Tabletop Trail, north of Link Mgt Trail. Nearest specimens were 100 km north and 100 km west.
Ulmaceae	*Trema tomentosa* var. *aspera*	Located west of Tabletop Hut. Nearest specimen was 50 km east.

Other points of interest

Fauna

Vertebrates

Frogs

Eastern Australia includes some of the most biologically diverse regions of the continent. Along the east coast, there are a number of barriers to animal dispersal, both habitat-related (i.e. areas of dry forest) and physical (i.e. mountain ranges). These barriers have led to genetic and morphological differences between populations, and in some cases, speciation[5]. A number of frog species in the region have broad distributions, and relatively recently many apparently widespread species, spanning eastern Australia from Victoria through NSW to Queensland, have been found to include several species.

Preliminary mitochondrial DNA data on Australian frogs has revealed that many current "species" distributed along Eastern Australia are likely composed of two or more evolutionarily distinct lineages, which are likely to represent separate species. However, more extensive sampling is needed in order to fill large distributional gaps in collections and to gather detailed information regarding colour in life and variation in advertisement calls.

Prior to this Bush Blitz, OWRNP represented a significant data gap for Amphibia of NSW, with AM holding only two frog specimens from the park, and no tissues available for molecular analysis. OWRNP was found to have high frog diversity due to geographic location and topographic variation. Further surveys, along with additional research on the molecular and acoustic data are likely to reveal additional information on species within OWRNP.

Fishes

Prior to the Bush Blitz, no fish from OWRNP were held in any museum collections, although six species of fishes and their life cycles had been recorded from the park[6]. The Bush Blitz confirmed the presence of four of the six species previously recorded. The two species not collected were the Freshwater Mullet (*Trachystoma petardi*) and the Sea Mullet (*Mugil cephalus*). Specimens of at least one species of mullet were observed jumping but were not captured.

Limited rainfall prior to the expedition meant that some streams were dry. A number of river banks were damaged, presumably by the activity of feral animals such as horses, cattle and pigs.

Invertebrates

Butterflies

The abundance of butterflies within the park depends entirely on the availability of food plants for the different species. Much of the native flora naturally maintains its presence but some can diminish or disappear due to drought or bushfires.

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[5] Moritz, C., Hoskin, C., Graham, C.H., Hugall, A. & Moussalli, A., 2005. Historical biogeography, diversity and conservation of Australia's tropical rainforest herpetofauna. *Phylogeny and conservation* (ed. by A. Purvis, J.L. Gittleman and T.M. Brooks), pp. 244–264. Cambridge University Press, London.
[6] Pidgeon, R., 1983. The possible management of discharge to facilitate migration of catadromous fish in the Apsley and Macleay Rivers after impoundment of the Apsley River. Prepared for: Electricity Commission of New South Wales. 1-51.

Damselflies and dragonflies

Some different species of damselfly and dragonfly were found on the tableland around Tia Falls and Apsley Falls compared to those in the gorges and river valleys. A serious problem for damselflies and dragonflies will be protecting their aquatic habitat from disturbance by feral animals.

Spiders

Spiders occur in every habitat within the park—from bare rock faces to deep, moist leaf litter. Species from several families are known to forage upon water, some under water, catching small fish and aquatic invertebrate prey. Aquatic margins provide an abundant source of insect food. Overgrazing and trampling by feral animals such as horses are more likely to affect spider diversity and abundance due to the large number of spiders reliant on diverse ground habitats.

Several spider habitat types were not surveyed during this expedition, such as the karst areas, the wetter forest types of the Carrai Plateau and many higher altitude valleys and uplands.

Molluscs

The land snail fauna of OWRNP has been very poorly documented with only a handful of records from a few sites. Prior to the Bush Blitz, this fauna was expected to be poorer than that of nearby national parks, such as Dorrigo National Park, with more favourable climatic conditions. Snails were expected to occur mainly in protected landscape pockets, such as gullies, the rainforests indicating a generally more favourable microclimate. Surprisingly, the snail population was more diverse than expected with gorges and rainforests providing valuable refuges for snails. Large populations of aquatic species also indicated good water quality.

Generally for land snails, the rainforest pockets are the most critical habitat supporting the highest number of species. Protecting such habitat from bushfires and damage by feral animals is the most obvious management recommendation. Even small pockets of suitable habitat (i.e. gullies, talus at base of cliffs) may harbour significant numbers of species and are therefore worthy of protection.

Flora

Flowering plants

A range of undescribed taxa and local endemics were targeted for collection, and are now secured as part of the *ex-situ* living collection at the ANBG. Many taxa were added to the species list for the park. The large number of taxa collected indicated that OWRNP is of outstanding conservation value with a highly diverse flora in which evolutionary processes appear to be active. An unusually large number of unresolved taxa await further investigation, and offer some potential for the description of new species or subspecies. These taxa include many species that are endemic to the area, several of which are likely to be candidates for listing as Threatened. The ANBG targeted this group of plants for collection, and now has secured in its living collection the following significant species:

Ajuga sp. aff. *australis*
Callistemon sp. aff. *salignus*
Coronidium elatum subsp. *minus*
Coronidium sp. aff. *lindsayanum*
Dodonaea serratifolia
Leionema sp. aff. *gracile* (OWRNP)
Phebalium squamulosum subsp. *verrucosum*
Pimelea sp. aff. *cremnophila*
Plumbago zeylanica

Prostanthera sp. aff. *howelliae* (OWRNP)
Prostanthera sp. Wollomombi Gorge (J.B. Williams NE73839)
Rhodanthe sp. aff. *anthemoides*
Teucrium sp. aff. *corymbosum*
Westringia sp. aff. *glabra* (OWRNP)

There are strong recommendations for further surveys in the park, particularly during other times of year in areas and habitats that were not surveyed during this Bush Blitz.

Information for land managers

Feral animals, especially horses and cattle, were visible and abundant in OWRNP, causing damage to waterways and to vegetation beside rivers. This is a concern for many invertebrates, especially those such as damselflies and dragonflies that have aquatic life stages. In particular, large numbers of feral horses were seen around Oaky River near Jeogla. These animals had caused widespread damage to vegetation and watercourses.

Table 10 Noteworthy sites provided by Odonata team

Site	Latitude	Longitude	Description	Comments
Apsley River, Apsley Gorge	-31.092	151.867	Stream	Quality habitat.
Apsley River, below Yarrowitch River	-30.88	152.02	Stream	Cattle present, poor habitat.
Apsley River, above Apsley Falls	-31.051	151.765	Stream	Weedy.
Blue Mountain Creek, near Oaky Creek	-30.769	151.899	Creek bed, no running water	Highly isolated, yet evidence of feral horses.
Brumby Creek at Birds Nest Hut	-31.006	152.159	Stream	Quality habitat.
Chandler River, below Oaky River	-30.692	152.03	Stream	Evidence of feral horses and cattle.
Chandler River, Halls Peak camping area	-30.742	152.016	Stream	Feral horses present.
Kunderang Brook at Youdales	-31.072	152.255	Stream	High quality habitat with some impact from feral animals.
Tia River, above Tia Falls	-31.159	151.852	Stream	High diversity of Odonata around Tia River above falls.
Yarrowitch River, Yarrowitch Gorge	-31.076	152.056	Stream	High quality habitat, low impact from feral animals.

Glossary

Endemic: native to or limited to a certain region.

Exotic species: a species occurring outside its normal range.

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 complex: a group of closely related species that are very similar in appearance to the point that the boundaries between them are often unclear.

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 (or equivalent State legislation) 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.

Vascular plants: A lineage of plants that possess well-developed veins (vascular tissue) in their stems, roots and leaves. Vascular plants include the majority of familiar land plants: flowering plants, ferns, conifers, cycads and fern allies, but not mosses, liverworts or algae.

Notes

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