BushBlitz
SPECIES DISCOVERY PROGRAM

Olkola Country Queensland

12–24 July 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

ATH
Australian Tropical Herbarium

CSIRO
Commonwealth Scientific and Industrial Research Organisation

CYP
Cape York Peninsula

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

MAGNT
Museum and Art Gallery of the Northern Territory

NCA
Nature Conservation Act 1992 (Queensland)

QM
Queensland Museum

UNSW
University of New South Wales

WONS
Weed of National Significance

Summary

A Bush Blitz survey was conducted on Olkola country, Cape York Peninsula, between 12 and 24 July 2015. The vast survey area, comprising six former pastoral leases and Alwal National Park, is managed by the Olkola Aboriginal Corporation and the Traditional Owners of this land were an integral part of this Bush Blitz.

Previous work had identified an array of key natural values and landforms, each with its own unique set of cultural values, biodiversity and conservation potential. The remote parts of Olkola country have been identified as having large areas of high conservation and cultural values due to minimal disturbance from European settlement.

The Bush Blitz provided an opportunity for biologists to undertake surveys across one of the most poorly surveyed areas of Australia. There were no records from Olkola country for many of the target taxa—even butterflies, which are one of the best collected groups of Australian insects. Likewise, there were few museum specimens from the area and those that existed often lacked tissue samples that would allow them to be investigated genetically.

The survey took place in the dry season, to minimise chances of weather-related disruptions; while this was not an optimal time for most of the survey targets, 897 species were recorded. At least 368 species had not been recorded previously on Olkola country (27 vertebrates and 341 invertebrates) and 55 of those may be new to science (five flies, two true bugs, 47 spiders and one land snail). In addition, one vascular plant and one non-vascular plant may be new to science. Two threatened plant taxa were collected: Brown Antelope Orchid (*Dendrobium johannis*) is listed as Vulnerable under the EPBC Act and NCA, and *Stemona angusta* is listed as Vulnerable under the NCA. One threatened vertebrate taxa was identified: Golden-shouldered Parrot (*Psephotus chrysopterygius*) is listed as Endangered (EPBC and NCA).

Some highlights of the survey included:

- a potentially significant population of Chevert's Gecko (*Nactus cheverti*)
- significant range extensions for a number of target taxa including Chevert's Gecko, an ant, several freshwater fishes, a snail and a vascular plant
- a larger than expected diversity of spiders, including 47 putative new species
- a new species of Camaenidae (land snails) which will lead to the rexamination of museum collections of 'hairy camaenids' from the base of the Cape previously considered to be one species
- the collection of freshwater sponges that are important first records for far north Queensland
- the largely weed-free status of some waterways
- the high diversity of fishes, with collection of significant spatial information on species distribution and material that will assist with taxonomic studies.

Five vertebrate and three invertebrate exotic or pest species were recorded. Of the 18 introduced plant species recorded, two are declared pest plants in Queensland and one of those is a Weed of National Significance (WONS).

Management recommendations include the protection of groundwater-dependent ecosystems, weed and pest control, and fire management. In addition, a consistent message is that, while many species were recorded during the survey period, much remains to be discovered on Olkola country and future surveys are likely to be very worthwhile.

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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 Olkola Country Bush Blitz

This survey took place between 12 and 24 July 2015. The climate of Olkola country is highly seasonal, with most rain falling during the wet season months of December to March. Olkola country is located in a remote part of Cape York Peninsula (CYP) where roads are unsealed and subject to closure after rain. The Bush Blitz was timed for the middle of the dry season to minimise chances of weather-related disruptions; however, this was not an optimal time to survey for many of the target groups, particularly as the previous wet season had been poor, essentially limited to modest rainfall events in February and March.

The Olkola people and Olkola Aboriginal Corporation were an integral part of this Bush Blitz. The Olkola Aboriginal Corporation works to look after country and culture on Olkola traditional lands. Their main goal is to return Olkola people to country following their forced removal and to establish sustainable livelihoods. To manage and protect their lands, the Olkola Aboriginal Corporation seeks out opportunities to link their traditional knowledge and cultural knowledge with the scientific way. They assisted the team in countless practical ways and there was a two-way sharing of information with scientists throughout the Blitz.

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

The expedition base was located at Killarney Station Homestead, near the eastern boundary of the survey area. From here, sites were accessed by four-wheel drive, helicopter and on foot.

The ABRS provided the logistical coordination and overall leadership of the survey. The Australian Tropical Herbarium (ATH) and the Queensland Museum (QM) were the host institutions for this Bush Blitz, providing the core group of personnel and accessioning the specimens into their collections. Experts from the following organisations also conducted the field and laboratory work:

- Museum and Art Gallery of the Northern Territory (MAGNT)
- National Herbarium of NSW
- University of New South Wales (UNSW)

Acknowledgements

The Bush Blitz team consisted of Kate Gillespie, Mim Jambrecina, Brian Hawkins and Sally Ingham. They would like to acknowledge the Olkola people as the Traditional Owners of country, and thank them for their support and participation in the field. In particular, they would like to thank Olkola Aboriginal Corporation CEO Amanda Hogbin, Chairman Mike Ross, and Committee member and camp manager Andrew Malcolm. Special thanks also go to the rangers, who assisted with base camp setup and provided guidance on culturally sensitive areas and features of Olkola, and Jeff Shellberg whose extensive on-ground knowledge and experience assisted the Bush Blitz team and scientists in planning the expedition.

The team would also like to thank all participants, the caterers and the helicopter pilot, Kelly Forster, who accommodated requests with courtesy, humour and professionalism.

Reserve overview[1]

Reserve name: Olkola country

Area: 8,800 km^2

Land manager/owner: Olkola Aboriginal Corporation

Description

The Olkola people are the Aboriginal Traditional Owners from land in southern central Cape York Peninsula in northern Queensland. Olkola country spans the Great Dividing Range from the Coleman River in the north to the King River in the south, and overlaps onto the western Mitchell Plains and the eastern Laura Plains. The country contains the headwaters of numerous major rivers. The Great Dividing Range forms the eastern section with drainage to the east while the western section is made up of westerly flowing floodplain.

In recent years, the Olkola people have taken back ownership of several former cattle grazing leases. The Bush Blitz survey area encompassed six former pastoral leases (Glen Garland, Dixie, Strathmay, Crosbie, Killarney and Wulpan) and Alwal National Park. The Olkola Aboriginal Corporation manages the pastoral leases and jointly manages Alwal National Park with the Queensland Government. The survey area was therefore an irregularly shaped block that extended approximately 130 km north to south, and 130 km east to west.

Olkola country covers 7.2% of the Cape York Peninsula (CYP) bioregion, and is located near the bioregion's southern boundary, 300 km northwest of Cairns and straddling the Great Dividing Range. At this point, the Great Divide is a low and at times barely perceptible ridgeline that extends north-south through Killarney and Dixie. Physical relief across the survey area is poorly developed, with the highest point in the survey area located on the Kimba Plateau reaching 313 m. Surface rock exposures within the survey area reflect a variety of geologies. To the east of Killarney Station, the Kimba Plateau is a prominent landscape feature, surrounded by low cliffs exposing coarse sediments and covered with Tertiary residual sands. Low-yield permanent springs are frequent in the shallow gorges surrounding the plateau, and support swamp communities and narrow gallery forests. North and west of the Kimba Plateau, rocks of the Coen Inlier form low ranges across Dixie and Glen Garland. These ranges comprise ancient metamorphics with more recent granitic intrusions. Sediments eroded from these low ranges have built up extensive floodplains to the west and south, notably those associated with the seasonal watercourses of the Alice River, Crosbie Creek, and Coleman River.

[1] Shellberg, J. 2014. *Physical and Biological Values of Olkola Country, Cape York Peninsula*. Published by Olkola Aboriginal Corporation with funding from Bush Heritage Australia, 141.

Conservation values

Olkola country contains an array of key natural values and landforms each with its own unique set of cultural values, biodiversity and conservation potential. Some of these include:

- Great Dividing Range, Coen Inlier and Southern Coleman Plateau
- Golden-shouldered Parrot habitat
- Kimba Plateau
- Holroyd Plain
- Crosbie Creek Mound Springs and Floodplain
- Alice River Anabranches
- Coleman River Floodplain and Megafan
- Pleistocene Megafauna Fossil

The remote parts of Olkola country have been identified as having large areas of high conservation and cultural values due to minimal disturbance from European settlement.

Olkola country encompasses a considerable diversity of habitats, from the sandstone escarpments of Kimba Plateau to the open floodplains of Wulpan. Vegetation types range from eucalypt woodlands on granite and sandstone to vine thickets on granite outcrops and moister rainforest in fire-sheltered sandstone gorges. The cessation of intensive grazing can potentially allow these habitats to approach their former condition, when Traditional Owners actively managed them. As such, Olkola country has great conservation value.

Methods

Taxonomic groups studied and personnel

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

Table 1 Taxonomic groups surveyed and personnel

Group	Common name	Expert	Affiliation
Aves	Birds	Chris Burwell	QM
		Andrew Amey	
		Rod Hobson	
Amphibia and Reptilia	Amphibians and reptiles	Andrew Amey	QM
		Rod Hobson	
Pisces	Fish	Jeff Johnson	QM
		Michael Hammer	MAGNT
Hymenoptera	Ants	Chris Burwell	QM
Lepidoptera	Butterflies and moths	Chris Burwell	QM
		Greg Daniels	
Diptera	Flies	Greg Daniels	QM
Heteroptera	True bugs	Ryan Shofner	UNSW
Odonata	Dragonflies and damselflies	Chris Burwell	QM
		Greg Daniels	
Arachnida	Spiders	Robert Raven	QM
		Renan Castro Santana	
Mollusca	Molluscs	John Stanisic	QM
Porifera	Sponges	John Stanisic	QM
Vascular plants		Darren Crayn	ATH
		Stuart Worboys	
		Garry and Nada Sankowsky	
		Richard Jobson	National Herbarium of NSW

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

- Gary Cranitch, from Queensland Museum, was the photographer.
- Jeff Shellberg is an environmental consultant at Griffith University with expertise in hydrology and natural history. He has an understanding of Olkola country's physical and biological attributes and has undertaken numerous scientific surveys there.
- Patrick Couper from Queensland Museum identified amphibians and reptiles.
- Heather Janetzki from Queensland Museum identified mammals.
- Gavin Dally from MAGNT reviewed the freshwater fish report.
- Christine Lambkin identified flies (Bombyliidae, Therevidae) and Bjorn Fjellstad identified moths, both from Queensland Museum.
- Gerry Cassis, Celia Symonds and Serena Lam from UNSW assisted with identification, data management and reporting for Heteroptera.
- Karin Koch and Susan Wright assisted with curating and databasing the insect collections and Geoff Thompson photographed the specimen of *Epopostruma monstrosa*. All are from Queensland Museum Entomology.
- Robert Whyte photographed spiders.
- Allana Brown, the Healthy Landscape Manager and Ecologist (North Region) with Bush Heritage Australia.
- Louise Hucks from Queensland Department of Agriculture and Fisheries, Raelee Kerrigan from CSIRO and Fanie Venter from Australian Tropical Herbarium assisted with the identification of vascular plants collected during the survey.

As part of the TeachLive program developed by Earthwatch Australia, five science teachers were paired up with scientists as field assistants from 17–24 July. Brett McKay (NSW), Leslie Carr (ACT), Chris Greene (Vic), Susannah Webber (WA) and Tony Egan (SA) were accompanied by Bruce Paton and Cassandra Nichols from Earthwatch Australia.

Site selection

All scientists surveyed two standard survey sites selected by Bush Blitz using modelling prepared by CSIRO. Each standard survey site was centred on a point (permanently marked), but the area surveyed varied between taxa. Standard methodologies were used to sample these sites. Bush Blitz staff also collected soil for detailed analyses of soil and soil biota (as part of the Biomes of Australian Soil Environments program) at these two sites.

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

Aside from standard survey sites, site selection and collection methods were at the discretion of the individual scientist. CSIRO modelling was provided to suggest survey locations that thoroughly sample the full range of biophysical characteristics (soil characteristics, elevation, temperature, moisture etc.) on the property. Because different biophysical characteristics are important to different taxa, four sets of sites were selected—each appropriate to a particular taxon or group of taxa.

Site selection also depended on access, suitability for trapping and time restrictions. Further considerations included:

- Bird, reptile and amphibian sites were selected to sample the widest possible range of habitat types and geography given the time available.
- Freshwater fish sites were selected to target parts of the study area where previous minimal survey effort overlapped with unique or interesting habitat that could be included in a rapid survey design. Sites were primarily located in (a) upland areas targeting springs and permanent pools and (b) lowland wetlands and billabongs. Sites were selected with the assistance of aerial imagery from the dry season, information in previous reports and personal communication with Olkola rangers, Traditional Owners and other scientists. Sampling large lowland rivers was beyond the scope of the current survey, and has had reasonable effort in the past.
- Snail sites were selected to cover most major vegetation types with emphasis on vine thicket habitats. Vine thickets form an important habitat for land snails in the semi-arid CYP bioregion. In Olkola country, vine thickets occur mainly on granitic geologies (lithorefugia) where rocks form deep talus piles. Within these, sampling was focused on looking under rocks. These microhabitats tend to conserve moisture even in fairly dry times. Scattered woody debris with associated fungal growth is a preferred microhabitat of eastern Australian land snails but, in the absence of decomposing woody vegetation, the land snails will graze on the biofilm (fungi, algae, lichens) that forms on the rocks during periods of moisture.
- Insect sites were selected to sample the widest possible range of habitat types and geography, given the time available. As dragonflies and damselflies were one of the main insect groups targeted, some sites were selected to encompass a range of freshwater habitats including flowing streams, riverine lagoons and billabongs, and farm dams. Insect specimens were also extracted and identified from pitfall traps at spider survey sites.
- Spider sites were initially chosen using Google Earth, based upon accessibility, proximity to water and safe night access. Some of these sites were subsequently avoided because they were culturally sensitive.
- Vascular plant site selection was both planned and opportunistic. Scientists visited places that were most likely to remain moist enough during the dry season to find living specimens of seasonal herbaceous plants e.g. billabongs, depressions apparent on Google Earth, Jungle Creek and its feeder springs, and the banks of larger seasonal streams in Glen Garland, Crosbie and Wulpan. To target these wetter sites, R. Jobson accompanied the fish survey team on their expeditions. The other botany team (led by D. Crayn) visited a variety of sites. Another group of sites targeted for exploration were vine thickets. These are generally located in sites protected from fire such as rocky hilltops, river flats and moist gullies. They support flora with rainforest affinities, for example *Ficus* (figs), *Larsenaikia* (gardenia), and *Strychnos* (strychnine). Finally, once in the field, sites were selected and explored opportunistically. For example, once it was discovered that a small spring was present in a shallow gorge on the western side of the Kimba Plateau, other nearby gorges could be searched for water. At another site on Ethel Creek, the team undertook an unplanned exploration of *Acacia shirleyi* (lancewood) woodland. Selected sites were assessed using systematic site-based methods, or simply by exploration on foot (meanders).

The locations of sites were recorded using global positioning systems.

Survey techniques

A standard suite of survey techniques was used:

- **Bird** observations were made at reptile collection sites. At the standard survey sites, bird observations were made for one hour by two observers within 100 m of the study site marker by day and at night. In addition, individual records of significant species were gathered opportunistically and vegetation types that were thought likely to yield species not found elsewhere in the survey area were targeted.
- **Amphibians and reptiles** were collected by hand to include the widest range of habitat types in the time available. Pitfall traps need to be in place for at least a few days to be effective and need to be checked twice each day. This would have greatly reduced the number of sites surveyed. Hand collecting was therefore favoured to more effectively survey the large area of interest. Hand collecting involved: observing the ground and tree trunks for activity; turning rocks and logs; raking through soil under leaf litter, rocks or logs; and looking under bark. Capture was attempted whenever an amphibian or reptile was spotted. Spotlighting was used at night to reveal eye shine. Searches were not timed (except at standard survey sites) but continued for approximately one hour at each site. Incidental specimens were contributed by other members of the survey team. Captures were limited to three per species per site. At each standard survey site two people hand collected within 100 m of the study site marker for one hour. Collection times were mid-morning, around 9 am. Both sites were also surveyed at night (starting within one hour of sunset) using head torches in the same way (one-hour search by two people within 100 m of the study site marker).
- **Freshwater fish** sampling employed a rapid assessment design in order to cover as wide a spatial distribution, variety of habitats and environmental conditions as possible, and maximise efficiency with regard to the time window for helicopter access into remote and inaccessible areas. Backpack electrofishing is an ideal sampling technique in this regard and was employed at wadeable habitats using a Smith-Root model LR-20B with voltage and frequency adjusted according to water conductivity. Electrofishing temporarily shocks fish, and allows capture of target fish species; remaining fish quickly recover once electrofishing is ceased. For one site on Crosbie Creek a small boat was employed to set multi-panel monofilament gill nets during daylight hours (20 to 100 mm mesh). Nets were set perpendicular to the bank near structures such as snags or trees, and monitored. In some shallow wetlands, electrofishing was replaced or supplemented with seine netting using a 10 m x 1.5 m net, 4 mm mesh. Line fishing (angling) was used as a supplemental method at several sites. As with many northern Australian waterways, danger from Saltwater Crocodiles (*Crocodylus porosus*) was carefully considered in survey design and implementation (e.g. active sampling techniques such as seine netting and backpack electrofishing were restricted to sites above waterfalls; distance from water maintained and observers used in larger pools). Environmental data including physical characteristics, habitat components and water quality were recorded for each site. Captured fishes were sorted to species on site with the majority returned to the point of capture. Subsamples retained as vouchers were held in a bucket with aeration and transported back to the field laboratory (Killarney) where many were photographed in an aquarium. Retained fish were ultimately euthanased using AQUI-S, and vouchers were fixed in 10% formalin solution with a matching genetic tissue sample preserved in both 80% analytical grade ethanol and liquid nitrogen. On return to the Queensland Museum, all material was sorted and re-examined to

provide final confirmation of identifications after Allen et al. (2002)[2] and primary literature keys where applicable.

- **Insects** were surveyed using a variety of techniques aimed at targeting ants (Hymenoptera: Formicidae), dragonflies and damselflies (Odonata), butterflies (Lepidoptera: Papilionoidea) and particular groups of true flies (Diptera: lower Brachycera and Syrphidae). Collecting methods included the following:
    - **Day hand collecting**. Insects were actively searched for during the day. Flying insects were collected using insect nets (hand netting). Foraging worker ants were searched for on the ground and on tree trunks and foliage. Ant nests were searched for under rocks, in and under fallen logs and in dead branches and twigs on trees.
    - **Night hand collecting**. Insects, mainly foraging ants, were searched for during the night.
    - **Malaise traps**. Sharkey (Sante Traps) type Malaise traps (designed to capture flying insects) were erected and operated at some sites for 5–9 days depending on when the sites could be revisited to retrieve the traps.
    - **Light trapping.** Light trapping was conducted only once, at Jungle Creek. Two mercury vapour lamps, powered by a portable generator, were suspended from an aluminium framework in front of either side of a vertical white sheet. Selected insects attracted to the sheet were collected by hand and transferred to ethanol-filled vials.
    - **Insect pitfall traps**. Insect pitfall traps were employed only at the two standard sites. Ten 120 ml cylindrical plastic vials with an opening of 43 mm in diameter were installed at sites. The ten traps were located along a more or less straight line transect, with traps separated by around five metres. Each trap was supplied with a square, black plastic cover, suspended above the opening by nails. Traps were half-filled with 70% ethanol and operated for four to five days.
    - **Leaf litter extracts**. Leaf litter extracts were collected at the two standard survey sites. Leaf litter was gathered by hand and sieved with a litter sifter (mesh of approximately 15 mm). Deeper accumulations of leaf litter in hollows and at the bases of trees were targeted. Litter was collected until approximately 3 litres of the sieved portion was accumulated which was then transferred to a cloth bag. The sieved litter was processed in a Tullgren funnel within 24 hours of collection. Funnels were operated overnight using a single 60 W incandescent bulb.
    - **Bark sprays**. Bark spray samples were collected at the two standard survey sites. The trunks of 10 large living trees (at least 20 cm diameter at breast height) were sprayed using cans of Mortein fast knockdown (synthetic pyrethroid) insecticide and the jet directed from the base to as far as possible up the trunk. Invertebrates falling from the trunks were collected on sheets of ripstop nylon placed at the bases of the trunks. After 15 minutes, the sheets were collected and their catches transferred to an ethanol-filled vial using a suspended fabric funnel.
    - **Coloured pan traps**. Coloured pan traps were employed only at the two standard survey sites. At each site, 16 coloured pan traps (four blue, red, yellow and white), with an

[2] Allen, G.R., Midgley, S.H., Allen, M., 2002. Field Guide to the Freshwater Fishes of Australia. Western Australian Museum, Perth.

approximate internal upper diameter of 14 cm, were deployed. They were arranged in a more or less straight line transect with traps separated by approximately one metre. Each bowl was filled with around 250 ml of a weak detergent solution (four litres of water with a couple of drops of detergent). Traps were operated for 24 hours and the catches from the four traps of each colour were sieved and combined and transferred to 70% ethanol, resulting in four samples (from the blue, red, yellow and white bowls) per site.

- **Heteroptera** were collected from 30 localities and 18 host plant species. The survey focused on plant-associated heteropterans, using methods previously employed in Bush Blitz surveys. Specimens were collected by beating or sweeping vegetation, focusing particularly on flowers, fruits and seeds. Specimens were also collected at light.
- **Spiders** were surveyed using pitfall traps. Ten 1 litre, square, plastic, ice cream containers were installed at each site. Traps were half-filled with propylene glycol as the preservative and the pitfall traps' catches were later transferred to 70% ethanol. Traps were operated for 11 days. Spiders were also collected from eucalypt, creekside and rainforest using the following methods: log rolling, bark brushing, litter (day and night), creek bank, bark stripping, soil brushing, curled bark and Lycosids at night.
- **Land snails** were collected by hand. On the plains and in the woodlands they were collected from under woody debris, on the ground and buried in the sandy soil. In the rocky hills they were collected from the underside of rocks, the sparse litter between rocks and on the ground. Both live snails and dead shells were taken. The great majority of land snails can be identified from the shells alone and their presence usually indicates the presence of living individuals. Hence, post mortem collection forms an important part of land snail surveys, especially in drier areas where snail activity is limited by climatic conditions. Leaf litter was taken from selected sites for sorting under the microscope in the laboratory; however, these yielded comparatively few snails and, most significantly, no species additional to those collected by hand. Eleven sites were sampled, some on multiple occasions.
- **Vascular plant** specimens were collected in the field, photographed whilst fresh, stored and transported in thick plastic bags, and processed at the end of each workday. Only specimens bearing buds, flowers or fruits were collected, as infertile material is difficult to identify and less useful for research purposes. Samples were documented, pressed and dried following standard herbarium methodology. Subsamples of some specimens were dried in silica gel for later DNA extraction.

  At the two standard survey sites an attempt was made to provide a formal structural description of the vegetation community in line with recognised vegetation description standards so the vegetation assessment at these sites followed the Queensland Herbarium's secondary site assessment methodology. Data gathered using this methodology feeds directly into the Queensland State Government's CORVEG database. This provides a foundation for vegetation classification and mapping across the state. It is estimated that 50–100 secondary site assessments per 3,000 km^2 are needed to maximise mapping accuracy. This equates to roughly 185–370 secondary sites for mapping of the survey area; however, prior to the survey there were just 25. The vegetation description obtained using the secondary site assessment methodology informed the work of other scientists participating in the Olkola Bush Blitz, and data collected has been incorporated into the CORVEG database. The assessment was undertaken in a 10 x 50 m plot centred on the site marker peg. Data collected included: location information; detailed site physical description, including landform, slope, soils and local geology; summary of observations of apparent disturbance, including storm damage, fire, grazing, weed

invasion and erosion; structural summary, including determination of species that are prominent in each of the vegetation strata (i.e. emergent stratum, canopy and subcanopy strata, shrub strata and ground layer) and their heights; crown cover of woody strata as measured along a 50 m transect line; basal area (a surrogate measure of biomass) and woody stem counts; assessments and identification of ground cover within 5 x 1 m^2 quadrats along the 50 m transect; compilation of a full species list; and collection of specimens of fertile plants. The ground stratum had largely dried off at the time of assessment, and accurate identification of all species within the ground layer was not possible.

Plot-based vegetation assessments were undertaken at five other locations on Olkola country. The assessment methodology used was largely the same as that followed at the standard survey sites, except ground cover measurements were omitted. Most vascular plant collections were made during meanders—lengthy exploratory walks that targeted the various accessible habitats in the selected survey area. During these meanders, species lists were compiled and notes taken on vegetation structure and species composition, consistent with the Quaternary level assessments of Neldner et al. 2012[3]. These notes informed habitat descriptions for collected specimens.

Data were also obtained for non-target taxa. For example, mammals were recorded opportunistically through visual observation.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria. Fauna specimens were deposited with QM, except the true bugs which were deposited with UNSW. Vascular plants were deposited with the ATH. Data for all specimens can be accessed through the Atlas of Living Australia (ALA).

[3] Neldner, V.J., Wilson, B.A., Thompson, E.J. and Dillewaard, H.A. 2012. *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. Version 3.2.* Updated August 2012. Queensland Herbarium, Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane. 124 pp.

Results

Locational data for all collection and observation records are available to reserve managers. More than 368 species were new records for Olkola country (some results are yet to be finalised; new records for flora species are provided by reserve in Appendix A) including 57 putative new species—some of these await formal identification. One threatened animal species was observed and two threatened plants. Eight exotic or pest animal species and 18 weed species were also recorded. 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	Total species recorded	Species newly recorded for reserve	Putative new species	Threatened species*	Exotic and pest species**
Mammalia	Mammals	3	1	0	0	3
Aves	Birds	116	9	0	1	0
Reptilia	Reptiles	30	14	0	0	1
Amphibia	Frogs and toads	11	0	0	0	1
Pisces	Freshwater fishes	33	3	0	0	0
Hymenoptera	Ants	112	110	0	0	0
Lepidoptera	Butterflies and moths	21	21	0	0	0
Diptera	Flies	31	31	5	0	0
Heteroptera	True bugs	54	54	2	0	0
Odonata	Damselflies and dragonflies	25	21	0	0	0
Arachnida	Spiders	81	81	47	0	2
Arachnida	Scorpions	3	3	0	0	0
Arachnida	Pseudoscorpions	1	1	0	0	0
Mollusca	Land snails	13	13	1	0	1
Mollusca	Freshwater molluscs	4	4	0	0	0
Porifera	Freshwater sponges	2	2	0	0	0
Vascular plants	Vascular plants	354	See Appendix A	1	2	18
Non-vascular plants	Non-vascular plants	3	See Appendix A	1	0	0
Total		897	368+	57	3	26

* Species listed under the Commonwealth EPBC Act or NCA.
** Includes native species that are at times pests or are exotic to this region.

Species lists

Lists of all species recorded during the survey are provided in Appendix A. Species lists were compiled using data from participating institutions.

Names in **red bold text** are putative new species. Species marked with an asterisk (*) have not been previously recorded. Those without an asterisk have been recorded previously and were confirmed by this survey.

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 of date. Species-level identification is not possible for these groups. 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, AusMoss, and the Catalogue of Australian Liverworts and Hornworts.

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 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

Vertebrates

While none of the vertebrate specimens collected are thought to represent putative new species, this may change with future taxonomic work.

Freshwater fish

Subtle variation in the form of cryptic species cannot be ruled out, especially with the Northern Purple-spotted Gudgeon (*Mogurnda mogurnda*), a known species complex across northern Australia, which showed variation in appearance in the study area (three distinct forms were observed). Interestingly, the form of Threadfin Rainbowfish (*Iriatherina werneri*) observed in both the Crosbie Creek and Edward River floodplain had a distinctive black mark on the rear edge of the first dorsal fin not seen in other populations to the north on Cape York, in New Guinea, or Arnhem Land. This species and quite a number of obligate freshwater fishes fall into the category of 'needing review' based on the presence of likely cryptic taxa (e.g. One-gilled Eel *Ophisternon bengalense*). The survey successfully collected paired tissue and voucher material to advance such future research.

Invertebrates

Ants

There are likely to be several new species of ants among collections made during the survey, but recognising them as such is difficult due to a lack of recent revisions for many ant genera.

Flies

Putative new species of flies identified include one species of robberfly (Asilidae), two species of beeflies (Bombyliidae) and two species of stiletto flies (Therevidae). An undescribed species of robberfly similar to *Zosteria* OKBB sp. 1 (rosevillensis group) is known from Mt White, Coen.

True bugs

Two species of true bug collected are putative new species. These belong to the families Miridae (*Pseudoloxops* sp_BBOLK15_Msp.034) and Tingidae (*Engynoma* sp_BBOLK15_Msp.051). In addition, 41 species require further taxonomic work to either identify them as described species or establish them as new species.

Spiders

Of the 48 unnamed spider species recorded, 47 are putative new species however years of work would be required to confirm new species and descriptions of some of the new species will not be possible due to the lack of male specimens.

Snails

One new land snail species was recorded during the survey, currently known only from a single granite outcrop in Alwal National Park. However, it is important to note that future collecting in the surrounding areas may extend the range of this endemic species beyond Olkola country. This species is distinguished by the combination of small size, curved radial ridges and periostracal setae (hairs) on the teleoconch. The discovery of a new species of land snail on Olkola country is not remarkable given that this part of Cape York Peninsula has been poorly surveyed for land snails in the past. This species will be described from material collected on the Bush Blitz depending on time, funding and the possible completion of additional field work. The lack of live adult material is the main impediment to description although the shell morphology is very distinctive.

Table 3 Putative new invertebrate species

Family	Species
Flies	
Asilidae	*Zosteria* OKBB sp. 1
Bombyliidae	*Comptosia* OKBB sp.1
Bombyliidae	*Ligyra* OKBB sp.1
Therevidae	*Agapophytus* OKBB sp.1
Therevidae	*Bonjeania* OKBB sp.1
True bugs	
Miridae	*Pseudoloxops* sp_BBOLK15_Msp.034
Tingidae	*Engynoma* sp_BBOLK15_Msp.051
Spiders	
Actinopodidae	*Missulena* sp.
Barychelidae	*Idiommata* sp. nov.27
Barychelidae	*Mandjelia* sp. nov.2
Barychelidae	*Ozicrypta* sp. nov.26
Barychelidae	*Zophorame* sp. nov.4
Ctenizidae	*Conothele* sp. nov.7
Dipluridae	*Cethegus* sp. nov.1
Dipluridae	*Cethegus* sp. nov.5

Gnaphosidae	*Eilica* sp.nov.15
Gnaphosidae	*Encoptarthria* sp.
Gnaphosidae	*Gnaphosidae* sp. nov. 11
Gnaphosidae	*Gnaphosidae* sp. nov. 9
Hersiliidae	*Tamopsis* sp.
Lamponidae	*Pseudolampona* sp.nov.12
Miturgidae	*Argoctenus* sp. nov.6
Miturgidae	Mit_newGen sp.
Miturgidae	*Miturga* sp.
Miturgidae	*Miturga* sp.nov.8
Miturgidae	*Miturga* sp.nov. 25
Mysmenidae	*Mysmena* sp.
Nemesiidae	*Aname* sp nov.17
Nemesiidae	*Aname* sp nov5
Oonopidae	*Grymeus* sp.nov.16
Oonopidae	*Ischnothyreus* sp.nov.21
Oonopidae	Oonopidae
Oonopidae	Oonopidae sp.nov. 22
Oonopidae	Oonopidae sp.nov. 23
Oonopidae	Oonopidae sp.nov.10
Oonopidae	*Opopaea* sp.
Oonopidae	*Opopaea* sp. nov. 20
Oonopidae	*Pelicinus?* sp.
Oxyopidae	*Oxyopes* sp.
Pholcidae	*Wugigarra* sp.
Pisauridae	*Dolomedes* sp.nov.14
Prodidomidae	*Molycria* sp.
Prodidomidae	*Molycria* sp. nov. 19
Prodidomidae	Prodidomididae
Prodidomidae	*Prodidomus* sp. nov.3

Salticidae	*Salticidae* sp.nov.24
Segestriidae	*Ariadna* sp.nov. 18
Theraphosidae	*Phlogiellus* sp. nov. 28
Theridiidae	*Gmogala* sp.
Uloboridae	*Miagrammopes* sp.
Zodariidae	*Habronestes* sp.30
Zodariidae	*Nostera* sp.nov.29
Zodariidae	Zodariidae
Zodariidae	Zodariidae sp.13
Land snail	
Camaenidae	Camaenid CY 13

Flora

Vascular plants

Two new wetland plant species may have been discovered during the Bush Blitz. One, a non-vascular plant, a small moss in the family Hookeriaceae, was found at Alwal, around a pool on the creek line. The second was a carnivorous plant *Utricularia* sp. aff. *lasiocaulis* (a bladderwort) found at Killarney in Jungle Creek swamp. The status of both species is uncertain, and further investigation is needed to determine their relationships.

Table 4 Putative new flora species

Family	Species
Lentibulariaceae	*Utricularia* sp. aff. *lasiocaulis*
Hookeriaceae	Moss

Threatened species

Australia is home to an estimated 580,000–680,000 species, most of which are yet to be described. Approximately 92% of Australian plants, 87% of mammals, 93% of reptiles and 45% of birds are endemic. Changes to the landscape resulting from human activity have put many of these unique species at risk. Over the last 200 years, many species have become extinct; many others are considered to be threatened, i.e. at risk of extinction.[4]

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

Fauna

Vertebrates

The only threatened vertebrate recorded during the survey was the Golden-shouldered Parrot (*Psephotus chrysopterygius*), with sightings at both Dixie and Killarney.

Olkola country is considered to harbour three other threatened vertebrate species that were not recorded during the survey: the Gouldian Finch (*Erythrura gouldiae*), the Coen Rock Wallaby (*Petrogale coenensis*) and the Ghost Bat (*Macroderma gigas*). The rivers in the area were relatively small and are unlikely to be suitable for the nationally Vulnerable Freshwater Sawfish (*Pristis pristis*), however occasional upstream visits cannot be ruled out.

Table 5 Threatened vertebrate fauna species

Family	Species	Common name	Status
Birds			
Psittacidae	*Psephotus chrysopterygius*	Golden-shouldered Parrot	Endangered (EPBC Act and NCA)

Invertebrates

None of the invertebrate species collected during the Bush Blitz are listed under the EPBC Act or the NCA.

Flora

Two threatened flora species were recorded during the Bush Blitz. Previous surveys in Olkola country found other threatened species: *Astonia australiensis* (Endangered, NCA), *Cajanus mareebensis* (Endangered, NCA and EPBC Act) and *Jedda multicaulis* (Vulnerable, NCA).

Table 6 Threatened flora species

Family	Species	Common name	Status
Vascular plants			
Orchidaceae	*Dendrobium johannis*	Brown Antelope Orchid	Vulnerable (NCA and EPBC Act)
Stemonaceae	*Stemona angusta*		Vulnerable (NCA)

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

Vertebrates

Most of the pest vertebrate species detected are well established and well known in the Cape. In addition, the fish team reported that damage to stream verges and riparian vegetation from pigs was evident at most sites. Standard management techniques for these pest species should be employed.

The presence of the Asian House Gecko (*Hemidactylus frenatus*) is disappointing but not unexpected. Its impacts are not well understood; however, it is very likely a threat to native geckos inhabiting a similar niche, e.g. Dubious Dtella (*Gehyra dubia*), through competition for resources and as potential vectors of new parasites and diseases. Its current distribution on Olkola country should be assessed and monitoring of bush near buildings should be carried out to see if it will spread into more natural areas.

No introduced fishes were recorded during the survey and there are no historical records of such species from the immediate area.

Table 7 Exotic and pest vertebrate species

Family	Species	Common name	Status
Mammals			
Bovidae	*Bos taurus*	Cattle	Sighted.
Felidae	*Felis catus*	Cat	Sighted.
Muridae	*Mus musculus*	House Mouse	Recorded at Killarney Homestead. Likely to be widespread in buildings and elsewhere, particularly grassy habitats.
Reptiles			
Gekkonidae	*Hemidactylus frenatus*	Asian House Gecko	Recorded at Glen Garland Homestead. Abundant but localised. May be able to establish away from human settlement.
Amphibians			
Bufonidae	*Rhinella marina*	Cane Toad	Reported at freshwater fish sites. Moderate to high abundance.

Invertebrates

An introduced subulinid snail, *Allopeas gracile*, was found under timber near Killarney Homestead. This species is a tropical tramp, emanating from India but widely distributed through human activity. It has previously been recorded from northern Australia (Torres Strait islands, Top End) and its presence is not considered remarkable. This species was not recorded in any native vegetation.

Two introduced spider species were also taken however no exotic or pest insect species were recorded.

Table 8 Exotic and pest invertebrate species

Family	Species	Common name	Status
Spiders			
Pholcidae	*Phlocidae sp.*	Daddy long-legs	
Theridiidae	*Latrodectus hasseltii*	Redback Spider	Taken on the plateau of Alwal National Park, remote from habitation
Mollusca			
Subulinidae	*Allopeas gracile*	Graceful Awlsnail	Found under timber at Old Killarney Homestead. Widespread in tropical Australia, found in disturbed environments.

Flora

Of the 354 vascular plant species collected or observed during the Bush Blitz, 18 species are exotic. These include cultivated species around homesteads, such as mangoes and coconuts, as well as recognised weedy species.

The number of weed species encountered during field surveys was very low. This was a pleasant surprise—prior to survey there was some expectation that weediness would be high, particularly on fertile alluvium along rivers, and around homesteads and other infrastructure.

Of particular note was Crosbie Creek, where no weeds were recorded during a one kilometre long meander along its banks.

Weed density and diversity was highest around the homesteads. For instance, eight weed species were recorded at Crosbie Creek Homestead, and five were recorded at Killarney Homestead. These included woody weeds—Coconut (*Cocos nucifera*), Poinciana (*Delonix regia*) and Mango (*Mangifera indica*)—as well as the more familiar herbaceous weeds Shrubby Stylo (*Stylosanthes scabra*), Hyptis or Stinkweed (*Mesosphaerum suaveolens*) and Wynn Cassia (*Chamaecrista rotundifolia*).

More significant weed infestations were observed at Glen Garland, where Hyptis was locally dominant in the ground stratum, and on an isolated section of the Alice River in Wulpan, where Rubber Vine (*Cryptostegia grandiflora*) was present in low densities. The presence of Rubber Vine on a remote reach of the Alice River is a concern. This species causes significant structural damage to trees in riverside communities. It is a WONS for this reason. Systematic survey and control of this weed species is considered a priority.

Without a thorough and systematic survey of Olkola country, it is difficult to assign geographical priorities for weed control. Of the places visited by the botany team, waterways such as Crosbie Creek and Coleman River are high priorities for weed monitoring and control. These streams were outstanding as rare examples of almost weed-free waterways. Maintenance of their weed-free status will ensure their place as rare examples of the way Cape York used to be.

Tables 9 and 10 list the exotic species recorded during the survey and include some recommendations for weed control; however, the primary guide for weed control priorities should be the Cook Shire Council Pest Management Plan[5].

Table 9 Gazetted weed species

Family	Species	Common name	Status
Apocynaceae	*Cryptostegia grandiflora*	Rubber Vine	Sparsely distributed along Alice River, Wulpan. Historical collection records from Crosbie, Dixie and Strathmay. High priority for control. State Class 2 pest plant and WONS. Significant threat to vegetation along rivers and streams.
Fabaceae	*Senna obtusifolia*	Sicklepod	Locally common around Crosbie Creek Homestead and historical record from Strathmay. High priority for control. State Class 2 pest plant. Significant threat along creeklines.

[5] Cook Shire Council 2013. Cook Shire Council Pest Management Plan 2012-2016. http://www.capeyorknrm.com.au/sites/default/files/downloads/cynrm066_pest-cook-shire-mgt-plan.pdf

Table 10 Non-gazetted weed species

Family	Species	Common name	Status
Anacardiaceae	*Mangifera indica*	Mango	Planted around Crosbie Creek and Killarney homesteads. High priority. Remove trees that are not used as food or shade trees.
Arecaceae	*Cocos nucifera*	Coconut	Planted around Killarney Homestead. Low priority.
Fabaceae	*Chamaecrista rotundifolia*	Wynn Cassia	Dominant ground cover plant around Crosbie Creek Homestead and cattle yards. Locally dominant in ground stratum at Killarney Homestead. Historical collection record from Strathmay. Low priority. Introduced cattle fodder plant.
Fabaceae	*Delonix regia*	Poinciana	Planted around Killarney Homestead. Low priority.
Fabaceae	*Macroptilium lathyroides*	Phasey Bean	Killarney Homestead. Rare. Low priority.
Fabaceae	*Senna occidentalis*	Coffee Senna	Locally common around Crosbie Creek Homestead. Medium priority.
Fabaceae	*Stylosanthes hamata*	Caribbean Stylo	Recorded on eastern fall of Kimba Plateau, Killarney. Low priority. Introduced cattle fodder plant.
Fabaceae	*Stylosanthes scabra*	Shrubby Stylo	Scattered at Crosbie Creek. Also recorded at Glen Garland. Low priority. Introduced cattle fodder plant.
Lamiaceae	*Mesosphaerum suaveolens*	Hyptis or Stinkweed	Recorded at Crosbie Creek, Killarney and Glen Garland. Historical collection record from Alwal. Low priority. Locally significant environmental weed.

Family	Species	Common name	Status
Malvaceae	*Sida acuta*	Spiny Sida	Glen Garland. Abundance not recorded. Low priority.
Malvaceae	*Sida cordifolia*	Flannel Weed	Locally common around Crosbie Creek Homestead. Low priority.
Malvaceae	*Urena lobata*	Urena Burr	Locally common around Crosbie Creek Homestead. Also recorded in woodland near Coleman River at Glen Garland. Low priority. Burr easily dispersed by animals and on people's clothing.
Nyctaginaceae	*Bougainvillea sp.*		Recorded as a host plant for Heteroptera.
Passifloraceae	*Passiflora foetida*	Stinking Passionfruit	Widespread along Alice River in Wulpan but never abundant. Scattered at Glen Garland. Low priority.
Rubiaceae	*Mitracarpus hirtus*		Coleman River. Abundance not recorded. Low priority.
Verbenaceae	*Stachytarpheta jamaicensis*	Snakeweed	Recorded in Coleman River tributary, Glen Garland. Low priority but should be removed where possible. Locally significant environmental weed.

Two additional exotic species not found during this survey but with recent historic records are:

- Gamba Grass (*Andropogon gayanus*) which has been recorded at Strathmay. This is a high priority for control (Class 2 pest plant). This WONS significantly enhances fire risk in infested communities.
- Chinese Apple (*Ziziphus mauritiana*) has been recorded at Dixie. While this weed is not currently recognised as established in Cook Shire, it is a very high priority for control as it poses a significant threat to woodlands.

Range extensions

Fauna

Vertebrates

Reptiles

Chevert's Gecko (*Nactus cheverti*) was recorded at Kimba Plateau, Alwal National Park. It is mostly known from the eastern coast of north Queensland, from Princess Charlotte Bay south to Cairns. The Kimba Plateau population is the furthest west the species has been recorded. Although the nearest population to the Kimba Plateau is only 34 km away at Kings Plains, this population was itself only discovered in 2014 during a Queensland Museum survey and both the Kimba and Kings Plains populations are confined to rock outcrops. The significance of this habitat preference has not been assessed.

Freshwater fish

Several species recorded in the Crosbie Creek sub-catchment represent new records for the Mitchell River catchment. The Alice River and Crosbie Creek sub-catchments represent a distinctive area of the Mitchell, only really sharing the river mouth where they join. They are more aligned in terms of habitat and fauna with the Coleman/Edward system, with the main branch of the Coleman also having its terminus close to the mouth of the Mitchell (and indeed the Mitchell, Coleman and Edward are grouped into a single larger River Basin).

Important finds included the first record of the Threadfin Rainbowfish (*Iriatherina werneri*) from the Mitchell River catchment as a southern range extension, the first record of Delicate Blue-eye (*Pseudomugil tenellus*) from the Mitchell River catchment (filling a major gap in distribution), and widespread records of the normally estuarine Tadpole Goby (*Chlamydogobius ranunculus*) in mound spring and wetland habitats. The Tadpole Goby had been previously recorded from the Crosbie Creek mound springs and thought to be limited to this specific habitat; however, it was recorded widely in the lower Alice River, along Crosbie Creek and in wetlands of the Edward River representing an extended distribution and habitat type (inland freshwater wetlands).

Insects

The collection of the ant *Epopostruma monstrosa* represented a significant range extension. It is known from relatively few specimens from south-eastern Queensland, eastern New South Wales and Victoria. Two specimens from north Queensland's Wet Tropics region (Cairns and Port Douglas) have also been assigned to this species. A single specimen collected from Killarney Station extends the known distribution of *E. monstrosa* around 240 km to the north-west.

None of the other collections of described insect species were significant range extensions.

Snails

Apart from the new species of land snail, all but one are known from the general area so represent minimal range extensions. The only significant range extension is the camaenid Greenvale Radial-lined Snail (*Tolgachloritis jacksoni*) which has previously only been recorded from Lakeland in the east and Ngarrabullgan (Mt Mulligan) in the south. Finding this species on Olkola country has extended its range by more than 120 km to the east and north. In most of its distribution, this species prefers drier

woodland. The records on Olkola country are from a vine thicket habitat, which may indicate that this could be a different species. Live adult material will be needed to investigate this further.

True bugs

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

Flora

Several of the plant collections represent range extensions or significant infills in known distributions. For example, collections of Swamp Satinash (*Syzygium angophoroides*), Kangaroo Grass (*Themeda triandra*) and Red-leaf Fig (*Ficus congesta*) filled large gaps in the known distribution of species. Other collections represented substantial range extensions; in the case of *Cryptandra pogonoloba* subsp. *pogonoloba*, a north-westerly extension of 200 km.

Table 11 Range extensions

Family	Species	Common name	Nearest previous record
Reptiles			
Gekkonidae	*Nactus cheverti*	Chevert's Gecko	34 km, Kings Plains
Fish			
Ambassidae	*Denariusa australis*	Pennyfish	50 km direct line, 300 km by river distance. First scientific record from Crosbie Creek, significant infill between Coleman and Mitchell River.
Gobiidae	*Chlamydogobius ranunculus*	Tadpole Goby	50 km. Normally known as an estuarine species with a single recording at Crosbie Mound Springs, was recorded widely inland during this study.
Melanotaeniidae	*Iriatherina werneri*	Threadfin Rainbowfish	50 km direct line, 300 km by river distance. First scientific record from Crosbie Creek, most southerly known record.
Pseudomugilidae	*Pseudomugil tenellus*	Delicate Blue-eye	50 km direct line, 300 km by river distance. First scientific record from Crosbie Creek, significant infill between Edward River and Normanton.

Family	Species	Common name	Nearest previous record
Ants			
Formicidae	*Epopostruma monstrosa*	An ant	240 km north-west of the nearest previous record, 4 miles west of Port Douglas
Snails			
Camaenidae	*Tolgachloritis jacksoni*	Greenvale Radial-lined Snail	More than 120 km to the east and north
Flora			
Rhamnaceae	*Cryptandra pogonoloba* subsp. *pogonoloba*		North-westerly extension of 200 km

Other points of interest

Fauna

Vertebrates

Birds, reptiles and amphibians

Prior to this Bush Blitz, Queensland Museum records from Olkola country were sparse, consisting of five amphibian, 25 reptile, one mammal and no bird records. Crucially, none of these specimens had tissue samples associated with them, meaning they could not be investigated genetically, limiting their taxonomic usefulness. Olkola country thus represented a significant 'knowledge gap' for many taxa.

The dry conditions, limited time and large survey area meant that sampling of reptiles and amphibians was very limited and unlikely to reflect the true extent of their diversity; however, new records were obtained. Further survey work, planned to encompass the range of habitats and using a greater variety of sampling techniques, such as pitfall traps, is likely to be well rewarded. This is an essential part of successfully managing the natural environment of Olkola country.

Noteworthy habitat and management priorities include:

- Kimba Plateau, Alwal National Park. This weathered sandstone escarpment is a significant habitat for many species, including the most westerly locality for Chevert's Gecko.
- Crosbie wetlands form a corridor to western coastal wetland habitats for many bird species such as the White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Radjah Shelduck (*Tadorna radjah*) and Striated Heron (*Butorides striatus*). These wetlands should be managed for pigs and cattle.
- Jungle Creek (Killarney) heathland habitat needs a fire management plan devised in collaboration with a fire ecologist. Heathland species are sensitive to fire and can be taken over by woody species if the fire regime is not favourable. The swampy areas are also easily damaged by pigs and pig activity was evident.

- Grasslands, which comprise the majority of Olkola country, need to have a carefully conceived fire management plan implemented. This is particularly important for the long-term viability of grass-seed specialists, such as the Golden-shouldered Parrot, the Black-throated Finch (*Poephila cincta)*, the Gouldian Finch (*Erythrura gouldiae*) and the Masked Finch (*Poephila personata)*.

Proposed eco-tourism activities, such as bird watching, recreational hunting and fishing, while potentially having minimal impact, need to be carefully considered for their potential effects on sensitive species.

Freshwater fish

Previous survey effort in this region had been patchy. Between 1973 and 2003, 178 museum collection lots of fishes are recorded for the survey area (with a 20 km buffer), with the vast majority of records centred on the Edward and Coleman river area in the north-west part of the region (ALA 2015). A large number of records are linked to the pioneering efforts of the freshwater fish survey work associated with the Cape York Peninsula Land Use Strategy, which used a comprehensive suite of gear (e.g. seine net, gill net and backpack electrofishing) and deposited important voucher material to validate records and for future reference. The Northern Australian Freshwater Fish Atlas sampled widely across northern Australia including the southern Cape York region in 2006 and 2007, and had a strong focus on the Mitchell system including off-channel habitats, Edward and Coleman rivers and the Normanby River. Despite these two surveys, large areas of Olkola country, including the Crosbie Creek and Alice River sub-catchments lacked any formal survey data. This gap was partially addressed in 2012 with fish surveys conducted by Olkola Land Managers and Traditional Owners with the scientific assistance of Jason Carroll. Surveys used yabby pots, line fishing, visual observations and dip nets. Eight sites were sampled on Crosbie Creek recording 16 fish species, and on the Kimba Plateau, seven sites were sampled in the upper Morehead catchment recording nine species for this drainage area.

The Bush Blitz survey area spanned three major river catchments—two western-flowing systems in the Edward/Coleman (rivers and floodplains) and the Mitchell (represented by Crosbie Creek and Alice River sub-catchments); and the eastern-flowing Normanby system (represented by the headwaters of the Morehead and Hann rivers). The expansive area and geography meant the survey area comprised a variety of habitat types stretching from headwater streams to moderate-sized rivers and larger areas of floodplain wetland.

Seventeen sites were sampled, using a combination of helicopter and vehicle access and appropriate gear types (i.e. mainly compact gear including backpack electrofisher and seine net, with some gill netting). The survey focus was on remote wetland and upland stream habitats that had limited to no representation in museum collections or the previous large-scale fish research programs.

A total of 33 species (34 taxa, including the two subspecies of Eastern Rainbowfish) of native fish were recorded. These ranged from more common small species such as Eastern Rainbowfish (*Melanotaenia splendida*), which were recorded at all but one site (with different sub-species represented on eastern and western drainages), and Mouth Almighty (*Glossamia aprion*) at 11 of 17 sites, to those apparently much rarer with specific habitat requirements, such as Northern Saratoga (*Scleropages jardinii*) at three sites and Delicate Blue-eye (*Pseudomugil tenellus*) at two sites. Several species of recreational or cultural significance were recorded including Barramundi (*Lates calcarifer*), Sooty Grunter or Black Bream (*Hephaestus fuliginosus*), Gulf Grunter (*Scortum ogilbyi*), eels and three species of fork-tailed catfish. Important voucher and genetic material was obtained for inclusion of Olkola fishes within broader taxonomic research.

Three taxa were newly recorded for Olkola country and a major increase was reported in the fish fauna in two of the drainage areas represented within the study area. There were 13 additional species for the Alice River and Crosbie Creek sub-catchments, bringing the number of species known here to 29, and five additional species for the Morehead and Hann river tributaries, taking total known species to 14.

The survey confirmed the Edward/Coleman system as a significant area for wetland fish biodiversity, and identified the Crosbie Creek sub-catchment as another similar refuge area. Upland spring habitats on both sides of the drainage divide were also key aquatic refuges, especially during dry periods. Sampling occurred after a poor wet season so most locations were concentrated or maintained by springs and many are likely to represent key refuges, even though the condition of some sites with limited spring flow may have considerably deteriorated by the end of the 2015 dry season and build up.

Freshwater fish diversity in Australia increases dramatically in the tropical north, and there is still much to be documented in terms of the species baseline, especially in areas yet to be fully surveyed such as Cape York Peninsula. New, novel forms continue to be recorded from remote regions of Australia, and recent interrogation with genetic techniques suggest there are likely to be two to three times the number of species actually present than is currently recognised. Hence, detailed surveying and taxonomic review of local fish faunas are likely to provide important and exciting biodiversity updates as the foundation for management and conservation.

Seven additional freshwater fish species have been recorded in previous sampling in or very near Olkola country, bringing the total number of species known from Olkola country to 40. These included five species recorded for the Coleman River from large river habitat not targeted during this survey: Oxyeye Herring (*Megalops cyprinoides*), Blue Catfish (*Neoarius graeffei*), Toothless Catfish (*Anodontiglanis dahli*), Freshwater Longtom (*Strongylura krefftii*) and Gilbert's Grunter (*Pingalla gilberti*). The Silver Catfish (*Porochilus argenteus*) has previously been recorded on the Edward-Coleman overflow. Surprisingly few eel-tailed catfish were recorded, despite the employment of methods that otherwise prove suitable—perhaps a reflection of the poor preceding wet season. The final additional record concerns a freshwater garfish, recorded from both Crosbie Creek and the Edward River tentatively identified as *Zenarchopterus novaeguineae* but requiring voucher material for further investigation.

Olkola country boasts a great variety of unregulated aquatic habitat types with a mosaic of stream and floodplain habitats, an important landscape feature when considering development elsewhere in Australia. The areas of Crosbie Creek, Coleman River, Edward River floodplain and Jungle Creek are particularly important, having high species richness and acting as refuges during dry times. The Alice River system appears fairly ephemeral, at least in its lower section during very dry periods, but has some important refuge habitats.

Another significant positive attribute of Olkola country is the lack of introduced fishes, a feature common to much of the Cape York Peninsula at present. Further south, many catchments are rife with introduced species, including the highly invasive Tilapia (*Oreochromis mossambicus*), which spread rapidly throughout the Burdekin River. Control of such species is very difficult once established, so proactive approaches involving education and procedures (e.g. controls on bait bucket fish movement) are paramount.

Further sampling in larger waterholes of Crosbie Creek would likely reveal additional species and provide further information for the management of this important area. A combined approach using boat electrofishing, gill netting, angling and cast netting could target larger or rarer species including Gilbert's Grunter, and provide specimens of freshwater garfish for research to confirm the identity. Better mapping of the distribution of Threadfin Rainbowfish, as a key ecological asset for the sub-

catchment, will improve the ability of land managers to consider the needs of the species; it appears to prefer larger well vegetated, clear-water billabong habitat. These projects represent ideal opportunities to combine traditional knowledge and involvement in a scientific data collection process. Ongoing efforts to control feral animal damage to riparian areas, especially key refuge waterholes and billabongs, would be beneficial.

Many of the small to medium sized fishes recorded on the survey are suitable as aquarium fishes. Fitting with the Killarney ecotourism facilities, there may be ecotourism opportunities that could be developed for native fish and wetland tours or events, and opportunities for sustainable use of natural resources through aquaculture (e.g. Threadfin Rainbowfish).

Noteworthy fish habitat on Olkola country includes:

- Crosbie Creek—a series of lagoons, wetlands and large refuge pools—has high species richness and is a refuge for wetland species including the southernmost population of Threadfin Rainbowfish.
- Edward River—floodplain—provides diverse wetland habitat with high species richness.
- Coleman River—large, deep pools with good connectivity to the floodplain—has high species richness and riverine species including Gilbert's Grunter.
- Jungle Creek—eastern-flowing spring-fed stream—provides unique habitat and high species richness for an upland site.

Olkola country supports a high diversity of fishes in an impressive landscape. The targeted survey for fishes during the 2015 Bush Blitz added significant spatial information on species distributions in the area and collected material for future studies that promises to uncover new information on the taxonomy of local and regional fishes. There is scope for further research to better understand the distribution of species and to review the conservation needs of fishes within a proactive context to maintain healthy and diverse aquatic communities.

Invertebrates

Insects

There appear to have been no substantial surveys for insects on Olkola country prior to the Bush Blitz. Interrogation of the ALA for the targeted insect groups, revealed only a handful of records from Olkola country. The majority of data points within Olkola country relate to non-localised collections from "Cape York" or "Cape York Peninsula" and the presence of those species on Olkola country is unconfirmed. Despite the butterflies being one of the best collected and most taxonomically known groups of Australian insects, a search revealed no unequivocal records of any species of butterfly from Olkola country. As such, Olkola country represents a significant 'knowledge gap' for the majority of insect groups. Therefore, despite the suboptimal time of year of the survey (insect activity is lowest in the dry season) it was anticipated that numerous new insect records would be generated.

The very dry conditions combined with the suboptimal time of year, limited time and enormous survey area means that the survey results are likely to be a substantial underestimate of the full extent of the area's biodiversity. Despite these limitations, 31 species of flies (11 Bombyliidae, 10 Asilidae, 8 Therevidae, 1 Tabanidae, 1 Syrphidae); 112 species of ants; 21 species of butterflies and moths, and 25 species of dragon- and damselflies were recorded by the entomologists from Queensland Museum.

The vast majority of species collected on the survey represent new records for each reserve and for Olkola country in general. This reflects the paucity of prior survey effort. Further survey effort, particularly in spring and summer would greatly increase the known diversity of this area.

As a result of this Bush Blitz, 1334 registered insect specimens have been added to Queensland Museum collections and database comprising; 1055 ants (112 species, at least 17 described, and 2 species-groups), 122 flies (31 species, 11 described), 96 dragon- and damselflies (25 species, all described) and 62 butterflies and moths (21 species, all described).

Killarney had the most diverse insect fauna recorded during the survey, with more than three times the number of species recorded from any other area. This, however, is most likely only a product of the greater sampling effort within Killarney where sites were more easily accessible by road. In addition, a wider variety of collecting techniques were employed at the Bush Blitz standard sites, both located within the Killarney reserve.

The insect fauna of Olkola country is likely to be far more diverse than indicated by the results of our limited collections and further surveys of the area will certainly reveal additional species.

Ants

A total of 112 species (at least 17 described) and two species-groups of ants (Formicidae) from 31 genera were collected. For many ant genera, recent reliable species revisions are not available. Consequently, the many ant genera were sorted to morphospecies and each assigned a species-code that is specific only to this survey. In two cases, ants were assigned only to a species group where a complex of morphologically similar species is known to exist (*Monomorium rothsteini* group and *Camponotus maculatus* group).

There were previous records for four species of ants of the genus *Iridomyrmex* (*I. hartmeyeri, I. mjobergi, I. reburrus and I. sanguineus*). Only the two latter species were collected during the Bush Blitz.

Flies

Unidentified species of robberflies of the genera *Stichopogon* and *Bathypogon* had previously been collected from Olkola country but *Bathypogon* was not recorded during the Bush Blitz.

Ommatius OKBB sp.1 is known from several localities in Cape York, from Coen south to the Mareeba area. Worldwide, most species in the genus rest on the end of twigs, whereas this species rests on exposed rock. This behavioural difference combined with morphology, are indicative of an undescribed genus. *Ommatius* OKBB sp. 2 is also known from several sites in the Laura area.

Dragonflies and damselflies

The 25 species of Odonata collected are all described and include 13 species of damselflies, from three families, and 12 species of dragonflies from two families. All of the species are within their expected distributional ranges although there are relatively few previous collections of *Agriocnemis pygmaea*, *Agriocnemis rubricauda* and *Pseudagrion microcephalum* from Cape York Peninsula.

Jungle Creek, heath habitat with a permanent stream on Killarney Station, was recognised as an important site for dragonflies and damselflies, providing suitable habitat for a considerable diversity of species, even in the dry season. The stream has a mixture of narrow-flowing channels and broader, larger pools providing a variety of aquatic microhabitats. This was the most diverse area (13 species) surveyed with 5 species not found elsewhere, including several flowing water specialists, *Nososcticta*

solitaria, *Pseudagrion lucifer* and *Nannophlebia eludens*. There was some evidence of disturbance by feral pigs.

The ALA records included five species of dragonflies—*Diplacodes haematodes*, *Nannophlebia eludens*, *Nannodiplax rubra*, *Pantala flavescens* and *Agrionoptera insignis*—all of which, except the last species, were collected during the survey.

True bugs

Of the 54 species of Heteroptera found, two were new to science, belonging to the families Miridae (one species) and Tingidae (one species). The 54 species were collected from 23 families, with the greatest species richness occurring in the Reduviidae (seven species), Tingidae (seven species), and Pentatomidae (six species). A total of 190 specimens were collected and processed. The Heteroptera were collected from 30 locations, from 18 plant taxa belonging to 13 families of flowering plants. Five species were from the family Myrtaceae, and two from the family Proteaceae; the remaining families were each represented by one species. Most Heteroptera were collected on seeding plants. The number of species collected is within normal range for surveys of this type.

Spiders, scorpions and pseudoscorpions

While no previous spider collections had been conducted on Olkola country, a number of surveys had been conducted on the Cape, to the north, south and east, in the previous few years. As a result, the number of new or previously unencountered spider species was expected to be low and the diversity of spiders collected was most unexpected. The best collections were made at the main campsite where the number of mygalomorph spider species found far exceeded that of any previous Bush Blitz; most proved to be new.

At some sites, only juveniles were taken and, without a large context of molecular work, the identifications of juvenile spiders to species or even genus are generally not possible.

The diversity included three scorpion, one pseudoscorpion and 81 spider species across 32 families. Of the 81 spider species, only 33 could be considered named species. It is estimated that in the wet season the species diversity would approach 200.

To get a more comprehensive understanding of the spider fauna of this region, long-term sampling needs to be undertaken, especially with camping/overnight collections in summer at a number of the key habitats.

Land snails

Land snails form an estimated 6% of the terrestrial invertebrate fauna worldwide and are a key bio-indicator group linked to the decomposition process in the environment. Their presence is an indication of environmental integrity and health. Olkola country has not been the subject of previous detailed land snail collecting and this survey represents the first comprehensive investigation of the reserve's terrestrial gastropods and their environments. In addition to establishing baseline data for the land snails of Olkola country, this survey also provided an opportunity to uncover new species in a rarely visited part of the CYP bioregion of far north Queensland.

Twelve native land snail species were recorded, representing five families, and an introduced subulinid. Olkola country had not been previously surveyed for land snails so all are first records. In total, 319 native land snail specimens were collected. Most collections were dead shells, probably because most species were buried deep in the rock piles due to the dry conditions. Post mortem collection is critical in

providing a comprehensive inventory of the species that are present. The native land snails collected comprised a combination of minute (1–4 mm in shell diameter) [Pupillidae], small (5–15 mm) [Subulinidae, Rhytididae, some Camaenidae] and large species (15–25 mm) [some Camaenidae]. Most snails (and snail shells) were found in sites with vine thicket and rocky microhabitat, with dead shells lying in the litter. To a much lesser extent, snails were found in woodland, with dead shells usually strewn on the ground and live specimens (*Trachiopsis musgravensis*) buried in the soil.

The new species of Camaenidae recorded from a remnant vine thicket on a low granite outcrop at Alwal National Park is an exciting find. It opens the door to re-examination of museum collections of 'hairy camaenids' from the base of the Cape previously considered to be the one species, *Boriogenia hedleyi*.

Most of these species were vine thicket obligates with a few species widespread across the woodland habitats. The land snails highlight the vine thickets and wetter gorges as significant habitats for biodiversity conservation. Their management should be a priority. Interestingly, some of the lusher rainforested gorges yielded very few to no snails. The absence of snails or lack of land snail diversity in these areas is difficult to interpret and requires more study.

Camaenids dominate the fauna, as they do in much of arid and semi-arid Australia. The species list of land snails collected during the survey is considered to be reasonably comprehensive for the area as far as family representation is concerned. The named species include a suite of wide ranging species (*Gastrocopta pediculus*, *Gastrocopta macdonnelli*, *Pupoides pacificus*, *Eremopeas tuckeri*, *Stenopylis coarctata*) that are known to be dry adapted and are usually found in dry vine thickets. Their presence in the Olkola vine thickets is not unexpected. However, these records now represent the most western occurrences of these species on Cape York. The single record of a carnivorous snail (*Saladelos commixta*) in the wetter gorges of Alwal National Park is probably an indication that this species is more widespread in the north-eastern sector of Olkola country.

The Olkola country land snails represent a unique community of land snails identified by a small suite of endemic Cape York species. Most of this fauna lives in the reserve's vine thickets which are significant lithorefugia supporting a range of faunal diversity. Land snails are important biodiversity predictors flagging areas where other significant invertebrate diversity also resides and in these situations are key surrogates for this invertebrate biodiversity.

This study highlights the significance of the Olkola country vine thickets for land snail survival in an otherwise harsh environment. However, these vegetation communities are also significant refugia for a large number of other local invertebrate species apart from land snails and these findings emphasise their importance for biodiversity conservation at the local level. At a bioregional level they further reinforce the geographically diverse nature of the vine thicket archipelago in Queensland.

Freshwater molluscs

The freshwater mollusc fauna of the CYP bioregion is poorly known so, although not a primary focus of collecting, the specimens obtained during this Bush Blitz are an important addition to the existing inventory. A synoptic collection of freshwater molluscs (three gastropods and one hyriid bivalve) was obtained, mainly during fishing expeditions. All of these species are first records for Olkola country.

The freshwater mollusc collections are too sparse to make much critical comment but they include the usual mix of family representatives found in most freshwater systems in eastern Australia. They indicate a locally diverse freshwater mollusc fauna. Given the wide array of freshwater drainages and environments present on Olkola country, a survey targeting freshwater molluscs would add considerably

to knowledge, not only of these invertebrates on Olkola country but for the CYP bioregion as a whole. At a broader scale, such a survey would serve to enhance knowledge of the local freshwater biodiversity.

Freshwater sponges

Freshwater sponges are important indicators of healthy waterways; however, little is known about the freshwater sponge fauna of the CYP bioregion. Previous scant Queensland records all come from south of the Sunshine Coast. Hence, the specimens collected on this expedition are important first records for far north Queensland.

Two species of freshwater sponge (Family Spongillidae) were recorded. Both have previously been recorded from Australia: *Radiospongilla hispidula* from Darwin, Northern Territory and *R. philippinensis* from southern Queensland, New South Wales and Western Australia. *R. hispidula* has never been previously recorded as a live specimen. The Olkola country specimen was green due to the presence of symbiotic intracellular algae (zoochlorellae). This association is common to a number of freshwater sponges that acquire nutrition from the photosynthetic processes of the algae. Sponges are able to form gemmules (asexual reproductive bodies containing embryonic sponge cells) that are an adaptation to existence in ephemeral environments and allow freshwater sponges to withstand drying. These collagen-enveloped spheres are further protected by specialised spicules (gemmoscleres) which are diagnostic in identification.

Flora

Vascular plants

The collection of plant specimens had a focus on vascular plants, compiling species inventories and undertaking vegetation descriptions at sites across the survey area. Before the Bush Blitz, only 579 vascular plant collections, representing 345 species, were recorded from Olkola country. These were largely from the easily accessible locations along the few roads that traverse the survey area. In comparison, the flora of CYP bioregion consists of 3,317 plant species, which include 1,543 rainforest species. Additionally, only 25 detailed vegetation assessments had been conducted in the area. In large part because of its remoteness, relatively little is known about the plant biodiversity of the survey area.

Surveys undertaken as part of the Bush Blitz resulted in a substantial increase in the knowledge of the flora of the area. Despite the relatively dry conditions, 241 collections representing 199 species were made. Information concerning all specimens lodged at the Australian Tropical Herbarium is publicly available through Australia's Virtual Herbarium and the ALA. Additional species were observed but not collected. The increase in total number of specimen-backed species records for Olkola country ranged from 14% for Strathmay to 640% for the poorly collected Alwal National Park. No collections were obtained from Dixie.

Detailed vegetation descriptions were compiled at seven locations. At each location, data on vegetation structure and species composition were recorded to characterise the vegetation community. Combined with geological mapping, these data allow for ground-truthing of the Queensland Herbarium's regional ecosystem mapping at that point. The vegetation descriptions have been added to the Queensland Herbarium's CORVEG database and will be used to improve vegetation mapping within Olkola country. Notable observations were groundwater-dependent ecosystems on the Crosbie Creek floodplain, and around the edges of the Kimba Plateau.

Despite being poorly collected, the flora of Olkola country appears well described i.e. most vascular plants are known to science. Two known but unnamed species were collected—*Scleria* sp. Laura, known

from only four collections on Cape York, collected in Killarney; and *Lindernia* sp. 'Merepah' (now described as *Lindernia beasleyi*), collected from Wulpan, on the Crosbie floodplain. Another unnamed entity was collected in Killarney, a variety of *Planchonella pohlmaniana* called *Planchonella pohlmaniana* var. Gilbert River (Yellow Boxwood). This small tree is widespread, though never common, in the survey area.

The survey took place in the dry season, soils had largely dried out, and many species had ceased flowering and fruiting. Furthermore, much of the herbaceous flora is annual and not present during the dry season. Consequently, expectations for sampling the seasonal herbaceous flora of the survey area were not high. While the flora team expected to find plenty of woody plants (trees, shrubs and vines) and fill numerous gaps in the flora of this poorly explored region, hopes for finding shorter-lived taxa were pinned on being able to sample in areas close to waterholes and streams.

Springs, swamps and streams, fed by seepage around the edges of the Kimba Plateau, provide locally significant habitats for numerous flora species. They are also likely to provide important dry season habitat for native wildlife. Long-term survival of these highly restricted habitats is dependent on careful management, both to conserve the flora of these spring-fed environments, and to protect the ground water resources that feed them. Protection measures should include:

- Reduction in fire frequency, to reduce impacts on fire-sensitive trees and shrubs in these wet localities
- Exclusion of cattle and pigs, which trample the swampy ground and destroy the vegetation
- Measures to reduce weed spread, such as cleaning of vehicles and clothing prior to visit
- Control of weed infestations when and if they appear
- Prevention of groundwater extraction from the Kimba Plateau, to maintain the aquifers that supply the springs.

The mound spring vegetation on Crosbie is unusual; it is a community normally found on marine plains. The community provides habitat for several wetland species not previously recorded from the survey area, and protects a population of the vulnerable orchid species, *Dendrobium johannis*. Protection measures should include:

- Exclusion of cattle and pigs, which trample the swampy ground and destroy the vegetation
- Minimisation of groundwater extraction from the aquifer and identification and protection of recharge areas, to ensure maintenance of the mound springs.

Alwal National Park provides important habitat for the vulnerable shrub species, *Jedda multicaulis*, and contains the northernmost and westernmost records of the species. Potential threats to this species include changed fire and grazing regimes. Management of the park should ensure the fire regimes are suitable for the survival of populations of Jedda.

One of the most exciting observations made was the largely weed-free status of some waterways: Holroyd Plain, Coleman River and Crosbie Creek. In northern Australia, the fertile, well-watered floodplains and terraces along watercourses are usually the first to be infested by weeds, and the ground stratum of these localities is frequently dominated by exotic species to the exclusion of most native plants. It was therefore a rare pleasure to see large expanses of weed-free creek terraces, and preservation of this weed-free status should be a high priority management target. Measures should include:

- Identification and mapping of weed-free waterways, and implementation of measures to avoid weed introduction
- Weed control in the catchments of these streams (all it takes is one flood to spread seed from one small weed infestation throughout the entire downstream river system)
- Careful consideration of management needs and closure of all but essential management roads, as vehicles are one of the most effective dispersers of weed seeds. Road closure should incorporate robust physical blockages, such as fallen logs, bridge removal, or strategically placed piles of dirt and/or rocks
- Building a culture of weed hygiene. Rangers should be trained in weed hygiene and all tools and vehicles should be cleaned before entering mapped weed-free waterways
- Exclusion of cattle and reduction in pig numbers
- Surveying the lower reaches of the Alice River for Rubber Vine (*Cryptostegia grandiflora*) infestations and undertaking control.

The Olkola Bush Blitz provided an opportunity to visit and explore a remote and poorly surveyed part of Cape York Peninsula. While this contributed significantly to the knowledge of the area, land managers would benefit from further surveys. Two aspects of the area's flora require more detailed assessment:

- Wet season flora surveys, although logistically challenging, are needed. Apart from the wetland collections of Richard Jobson, almost nothing is known about the herbs and grasses of the area. Wet season collections in a variety of habitats across Olkola country would contribute knowledge of the area's floristics, and would probably identify range extensions in this poorly known corner of the Australian continent
- Additional CORVEG sites are needed to improve regional ecosystem mapping across Olkola country. Seven sites have been added to the existing 25 however large areas of Alwal, Crosbie Creek, and Wulpan lack ground-truthed mapping. Additional sites would substantially improve the quality and precision of mapping, and contribute to management of the lands.

This survey has significantly increased the number of botanical collections from the area, and the number of known species. As expected, dry conditions present during the survey period meant that collections of herbs and grasses were inadequate, and future wet season surveys are strongly recommended. Additional vegetation assessment sites are also needed to improve the precision of regional ecosystem mapping.

Looking to the future, weeds and water are of greatest concern. Olkola country preserves some of the least weed-impacted landscapes in Queensland, and only careful management, hygiene and quarantine can ensure this status is maintained in the long term. Groundwater-dependent ecosystems exist on the Crosbie Creek floodplain and around the edges of the Kimba Plateau. These rich ecological communities support a diversity of species dependent on year-round moisture, many of which were seen nowhere else in the survey area. Activities that tap into the aquifers that feed these communities will negatively

impact on the often meagre surface flows. Careful planning and management of water demand is essential if these ecosystems are to be conserved.

Glossary

Cryptic species (cryptospecies): Species that are physically similar but reproductively isolated from each other.

Ecological communities: Unique and naturally occurring groups of plants and animals. Their presence can be determined by factors such as soil type, position in the landscape, climate and water availability.

Morphospecies: A group of individuals considered to belong to the same species on the grounds of morphology (physical features) alone.

Periostracal: Relating to the periostracum, which is a thin organic coating or "skin" that is the outermost layer of the shell of many shelled animals, including molluscs.

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

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

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

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

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

Teleoconch: The whorls of the adult shell, which are formed after the larval shell.

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

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

PUBLISHER ABRS, Canberra
EDITOR ABRS
LAYOUT Biotext
DESIGN TEMPLATE Biotext

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

Research agencies involved in this Bush Blitz were the Queensland Museum, the Australian Tropical Herbarium, the National Herbarium of New South Wales Museum, the Art Gallery of the Northern Territory and the University of New South Wales.

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BushBlitz

Olkola Country

Queensland

12–24 July 2015

Australian Government
Department of the Environment and Energy

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Sustainable Communities

EARTHWATCH INSTITUTE

Australian Biological Resources Study