ACT Government




CONSERVATION RESEARCH AND CONSERVATION PLANNING PROGRAM REPORT 2013–15

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Front cover photos: Collared Eastern Grey Kangaroo (Richard Barnsley); *Stypandra glauca* (Mark Jekabsons); Lick Hole Creek (Mark Jekabsons) and *Euastacus crassus* spiny crayfish (Mark Jekabsons)

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CONTENTS

FIGURES

TABLES

PROGRAM OVERVIEW

The Conservation Research and Conservation Planning units have a long tradition of providing science and research evidence within government to inform environmental conservation, policy, planning and management. This includes legislative requirements under the *Nature Conservation Act 2014* and the *Planning and Development Act 2007*. This report presents the unit's projects from July 2013 to June 2015.

This program report summarises projects spanning all of the elements of the units; flora, fauna, aquatic ecology and conservation planning. These elements establish the basis of the unit's program that delivers on:

- **Threatened species and communities** – improving knowledge, research, survey, monitoring and management of rare and threatened terrestrial and aquatic species and communities to effectively manage current populations, threats, manage action plans and assist recovery.
- **Threatening processes** – improving knowledge, research, survey, monitoring and management of potential or current threatening processes. Assist with ensuring management programs are evidence-based and reduce threats to biodiversity and nature conservation.
- **Survey and baseline information** – maintain up-to-date information on the ACT's biological resources and habitat and make data accessible to stakeholders through ACTMAPi and the internet.
- **Ecological restoratio**n – implement and provide research support for on-ground recovery and rehabilitation actions; develop information on connectivity and environmental corridors and support on-going restoration projects.
- **Recreational angling** – provision of recreational angling opportunities and monitoring in the urban lakes of Canberra.
- **Conservation advice for policy, land management and planning** – provide information for planning, policy and management programs for the protection of the ACT's terrestrial and aquatic ecosystems and ensuring it is based on sound scientific information, research, regulation and licensing advice.
- **Conservation planning and plans of management** – provide scientific advice on planning and development proposals to the Conservator of Flora and Fauna and other government agencies; prepare plans of management for non-urban public land reserves in accordance with the requirements of the Planning and Development Act.

None of the work of the units could be achieved without the interest, investment and support of our stakeholders and collaborators who assist in many ways, from funding to input and volunteering.

This report provides a comprehensive summary of the projects undertaken and demonstrates the application of evidence to support land management, planning and ecosystem restoration. By providing this overview of the focus and results of the research and planning work, we hope to ensure knowledge of these programs continues to grow and information about this work is shared. More detailed information is also provided through our web delivery services ACTMAPi and www.environment.act.gov.au/cpr.

1. INTRODUCTION

Figure 1.1 Button Wrinklewort.

This report provides an overview of the nature conservation programs for the Conservation Research and Conservation Planning units of the Environment and Planning Directorate for the period of July 2013 to June 2015.

Conservation Research (CR) and Conservation Planning (CP) are part of the Environment Division of the Environment and Planning Directorate (EPD) of the ACT Government. CR is responsible for providing scientific advice on nature conservation to stakeholders including ACT Government agencies, land managers and the public.

In order to underpin this advice with data and sound science, CR undertakes or supports a range of monitoring and research programs including wildlife research, ecological survey, social research and biodiversity monitoring. It prepares and guides the implementation of threatened species action plans. CR also undertakes or supports key on-ground actions to assist the recovery of threatened species, such as captive breeding programs. CP provides ecological input into planning decision making and development of reserve management plans.

2. THREATENED SPECIES AND COMMUNITIES

Monitoring the distribution, and in some cases abundance, of threatened species and ecological communities is a core activity of the Conservation Research unit (CR). This information is essential for determining the conservation status of species and communities, for identifying trends and recovery actions aimed at halting or reversing declines (thus conserving biodiversity), and for providing conservation and management advice to the Conservator of Flora and Fauna, the ACT Scientific Committee, other ACT and Commonwealth Government agencies, non-government organisations and the public. Monitoring programs have led to CR implementing on-ground recovery actions such as threatened plant translocations and a breeding program for Corroboree Frogs.

2.1 ACT Flora and Fauna Committee – Scientific Committee

A significant role of CR is providing information and advice to the ACT Scientific Committee (formerly the Flora and Fauna Committee). The Committee oversees the listing and reporting of declared threatened species and communities.

The following reports on implementation of actions in the action plans, reviews of action plans and other scientific information were provided during 2013–15 (full list of Action Plans at Appendix 1):

- Ribbons of Life ACT Aquatic Species and Riparian Zone Conservation Strategy – Implementation report (June 2013)
- Woodlands for Wildlife ACT Lowland Woodland Conservation Strategy – Implementation report (September 2013)
- Spotted-tailed Quoll – Implementation report (December 2013)
- Brush-tailed Rock-wallaby – Action plan review commenced (December 2013)
- Scarlet Robin – listing and conservation advice (March 2014)
- Vision Splendid of Grassy Plains Extended ACT Lowland Native Grassland Conservation Strategy (Action Plan 28) – Action plan/Strategy review commenced (June 2014)
- Canberra Spider Orchid, Brindabella Midge Orchid and Tarengo Leek Orchid – Implementation report (March 2015)
- Ginninderra Peppercress and Button Wrinklewort for inclusion in the revised Native Grasslands Conservation Strategy – Revised Action Plans (June 2015)

2.2 ACT Native Grassland Strategy

The ACT Lowland Native Grassland Conservation Strategy (Action Plan 28) was due for its 10 year review in 2015. CR developed a draft document incorporating the following key changes from the 2005 version:

- The new document is separated into an initial strategy (Part 1 – identifying actions for the conservation of grasslands in general) and action plans (Part 2). The action plans outline recovery action for individual species and can be used as standalone documents.
- The strategy component seeks to focus on management of all grassland associations in the ACT including those in the montane and sub-alpine tracts that were not covered by the previous strategy.
- The revised action plan for Lowland Natural Temperate Grassland will revise the definition of the Natural Temperate Grassland (NTG) community. This will change the altitudinal limit defining this community from the current maximum of 625 metres above sea level to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) maximum of 1200 metres above sea level. The term 'lowland' will thus be removed from the title of the strategy.

Before the draft revision is adopted it will be reviewed by the ACT Scientific Committee and a draft released for public comment.

2.3 Brindabella Midge Orchid

The Brindabella Midge Orchid (*Corunastylis ectopa*) was first discovered in 1992 as a small population of approximately 130 plants (Figure 2.1). It is known from only one location in the ACT, and is currently listed as endangered under the *ACT Nature Conservation Act 2014*, and critically endangered under the EPBC Act. The Brindabella Orchid site was burnt in the 2003 wildfires and the population appears to have fluctuated over the following years. In 2004 CR initiated an annual population monitoring program at the species' known location.

The aims of annual monitoring of the Brindabella Midge Orchid population between 2013 and 2015 were to:

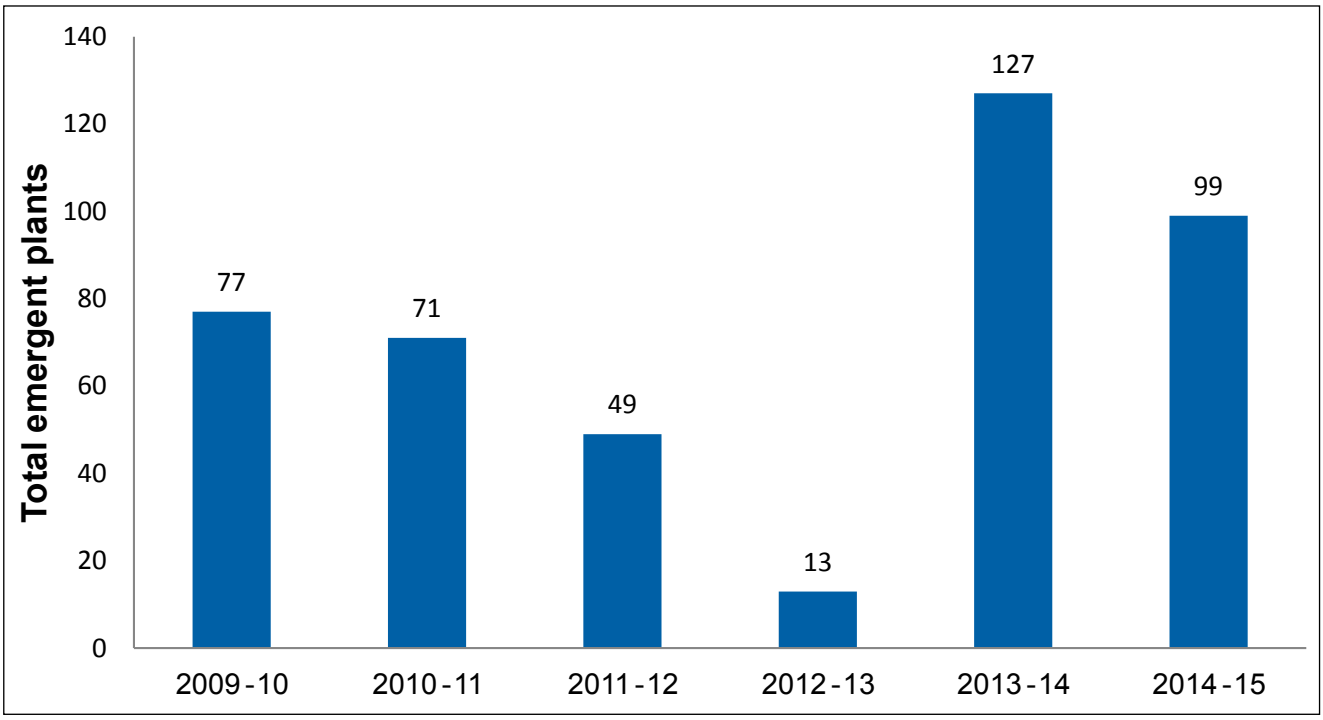
- re-establish a repeatable method for aligning the survey transect
- locate and count any orchids that had emerged as a formal population survey for 2013–14 and 2014–15 reporting years
- initiate a trial manipulation of litter and woody vegetation within the table drain adjacent to the known population to investigate if seed washed or blown into the table drain could be encouraged to establish. Site works were carried out by staff from the Parks and Conservation Service (PCS).

Key findings

- The number of plants known to have emerged was 127 in 2013–14 and 99 in 2014–15 (Figure 2.2). This number is the largest number of observed emergent individuals for each year in each transect across multiple surveys. Numbers in both the past two years were the highest since detailed annual records have been kept (Figure 2.2).
- In 2015 each of the three surveys documented a representative spread of individuals from all vegetative and reproductive life stages. This is in contrast to previous patterns where there has been a clear linear progression from a majority of individuals in a vegetative state to majority reproductive (and post-reproductive) states over successive surveys in the same year.
- Brindabella Midge Orchid individuals were observed along the length of the transect (including the 5–10 metre zone which was unoccupied in 2014).
- Individuals were also recorded beyond the range of the 40 metre survey transect along the road cutting, although not beyond the section of road cutting previously documented in ACT Government spatial data.
- Recorded individuals were evenly spread between the bare earth on the cutting face and above the lip of the cutting face.
- No individuals were detected above the transect tape in 2015 (whereas one had been detected emerging from dense leaf litter for the first time in the May 2014).
- No plants were observed in the table drain, indicating the experimental removal of vegetation cover and litter in the table drain did not stimulate establishment or germination in the first or second years of this trial.

Figure 2.1 Brindabella Midge Orchid.

Figure 2.2 Brindabella Midge Orchid abundance from 2009 to 2015.



Increased variability in life stage compared to previous survey years suggests a shift in reproductive strategy for the species in 2015. It was anticipated that due to the continuing high numbers of new shooting vegetative individuals in May 2015 that there may be high numbers of individuals for some time to come through even the winter period. Informal observations will be maintained throughout the year to assist in understanding the complex natural history of this species.

2.4 Brush-tailed Rock-wallaby – revised action plan

CR reviewed the Brush-tailed Rock-wallaby Action Plan in 2014–15. The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a member of the kangaroo family Macropodidae and one of 16 known rock-wallaby species. The species possesses a long tail (regularly exceeding the body length) with a prominent brush at its end.

While formerly more widespread in south-eastern Australia and nearby inland areas, the range of the species is thought to have been reduced by 50–90% since the European settlement of Australia. The Brush-tailed Rock-wallaby is thought to be extinct in the ACT with the last wild animal seen in 1959 at Wallaby Rocks in Tidbinbilla Nature Reserve. However, the discovery of skeletal material in Namadgi National Park in 1996 suggests a more recent occurrence.

There are two small populations of this species persisting in Victoria. In NSW, apart from a population in the Warrumbungles in northern NSW, the two closest colonies to the ACT are at Nattai National Park (156 km north north-east of Canberra) and in the Kangaroo Valley (187 km east north-east of Canberra).

The Brush-tailed Rock-wallaby was first declared 'Endangered' in the ACT on 27 December 1996, with the first action plan for this species in the ACT completed in October 1999. This second action plan builds on the considerable research achievements flowing from the first plan and aims to build on this research knowledge of the ecology and management of the species looking forward to the recovery of the species in the future.

Tidbinbilla Nature Reserve, which maintains a captive population of the species, has contributed significantly by providing an important venue for research that includes physiological, behavioural and reproductive biology studies. Tidbinbilla has successfully bred animals for reintroduction in Victoria. It is envisaged the ACT will continue to contribute to state and national recovery teams, continue to provide breeding facilities, and staff will continue to develop expertise in the ecology and management of the species.

2.4.1 Key objectives of the revised new action plan include the following:

An ongoing program of survey, monitoring and research to understand the ecology of the species and to identify and manage the causes of pollution decline.

- While survey of formerly occupied sites in the ACT has been completed, further habitat modelling using geographic information systems (GIS) can target potential reintroduction sites.

Identifying and protecting habitat critical for the Brush-tailed Rock-wallaby in the ACT.

- Plans for re-introduction should consider the key research questions in re-introduction biology and the International Union for Conservation of Nature (IUCN) re-introduction guidelines. Re-introduction should only be considered when a landscape level, multi-species recovery effort including predator control, becomes possible.

Cooperating with state and local authorities in formulating conservation measures.

- Breeding facilities at Tidbinbilla Nature Reserve and direct involvement by staff in the Commonwealth, Victorian and New South Wales Brush-tailed Rock wallaby Recovery Programs to be maintained.

Increasing community awareness of the need to protect the Brush-tailed Rock-wallaby and its habitat.

- The captive population of the Brush-tailed Rock-wallaby at Tidbinbilla Nature Reserve will continue to be used as a basis for developing interpretive material and a community education program.

2.5 Button Wrinklewort monitoring

In the Canberra–Queanbeyan region the slender perennial Button Wrinklewort (*Rutidosis Leptorrhynchoides*) primarily occurs between grasslands and the open grassy woodlands. ACT populations often extend well into the grasslands. Known sites occur at elevations between 570 and 780 metres above sea level on shallow, stony red-brown clay loam soils. ACT populations have been monitored since 1998, with counts being conducted on the discovery of new populations. Most populations have been tagged with metal tags at the extents of the population.

Due to the large size of some of the populations (e.g. Stirling Ridge has been estimated to support as many as 50,000 plants) it is not possible to generate accurate counts or estimates without a substantial input of resources. In recent years CR monitoring has focused on identifying threats to the various populations along with very rough estimates of numbers.

Estimates up to 2007 indicated that many of the populations were increasing, with the possible exception of St Marks. More recent estimates shown in Table 2.1 do not support a continued increase but count numbers are not fully accurate. Future monitoring should attempt to establish an index of abundance at the largest populations to try and identify trends.

PCS has undertaken a translocation of this species into Jerrabomberra East Nature Reserve (NR). Monitoring of this population has shown that tubestock out-performed direct seeding as a means of establishing a population. However, despite a good survival rate of the tubestock there has been no evidence of recruitment in the translocated population. Tubestock plants were also translocated into the southern-most Woods Lane population to help remediate disturbance caused by development. These plants are now well established.

In June 2015 PCS and CR undertook small prescribed burns to reduce the grass biomass in portions of each population on Woods Lane. Not all plants were burned. CR will monitor comparative survivorship of burnt and unburnt plants to determine if the treatment was beneficial for the populations.

Table 2.1 Survey for Button Wrinklewort.

Location	2011 population notes	2012 population notes	2015 population notes
Crace NR	Not monitored	Not monitored	Very healthy, seedlings and reproductive plants
Kintore St Yarralumla	Population healthy and flowering	No plants found, possible removal?	No plants found
Woods Lane	All populations flowering Some disturbance from road works	Northern population impacted by road works –1 plant found Central population in dense grass – 21 plants Southern site generally good condition – 60-80 plants	Northern population contains at least 38 plants on western side of road but all overgrown Central population has at least 20 plants but grass dense Southern population has at least 100 plants, excluding those that have been translocated, and some weeds.
Baptist Church Kingston	Whole site mown and rubbish dumped – 3 plants found	Site mown and car park encroaching on habitat and crushing plants – 6 plants found	Site mown and parking encroachment continues, at least 71 plants present with evidence of seedlings and flowering
St Marks Barton	Population healthy and flowering, not effected by 2009 burn	Population flowering but strong competition from grass – estimated 40-50 plants	Biomass high, site probably not burnt in 2014 fire, evidence of flowering – at least 31 plants
State Circle	All populations flowering, closest to State Circle dying back, weedy	Weeds noted, up to 100 plants scattered across site with most flowering	No plants found in northern population Southern population – at least 20 plants flowering but weeds a problem
Campbell Offices	All populations in flower and distribution expanding	Most populations flowering and in good condition – estimated 80-90 plants	Not monitored
Red Hill	All populations flowering and in good health	Not monitored by CR	Not monitored by CR
Majura Training Area	No longer monitored by CR	No longer monitored by CR	No longer monitored by CR
Tennant St Fyshwick	Not monitored	Very good condition – estimated 100 plants, minor weed encroachment	At least 400 plants counted, lots of seedlings, most plants flowering, site conditions good

2.6 Canberra Spider Orchid monitoring

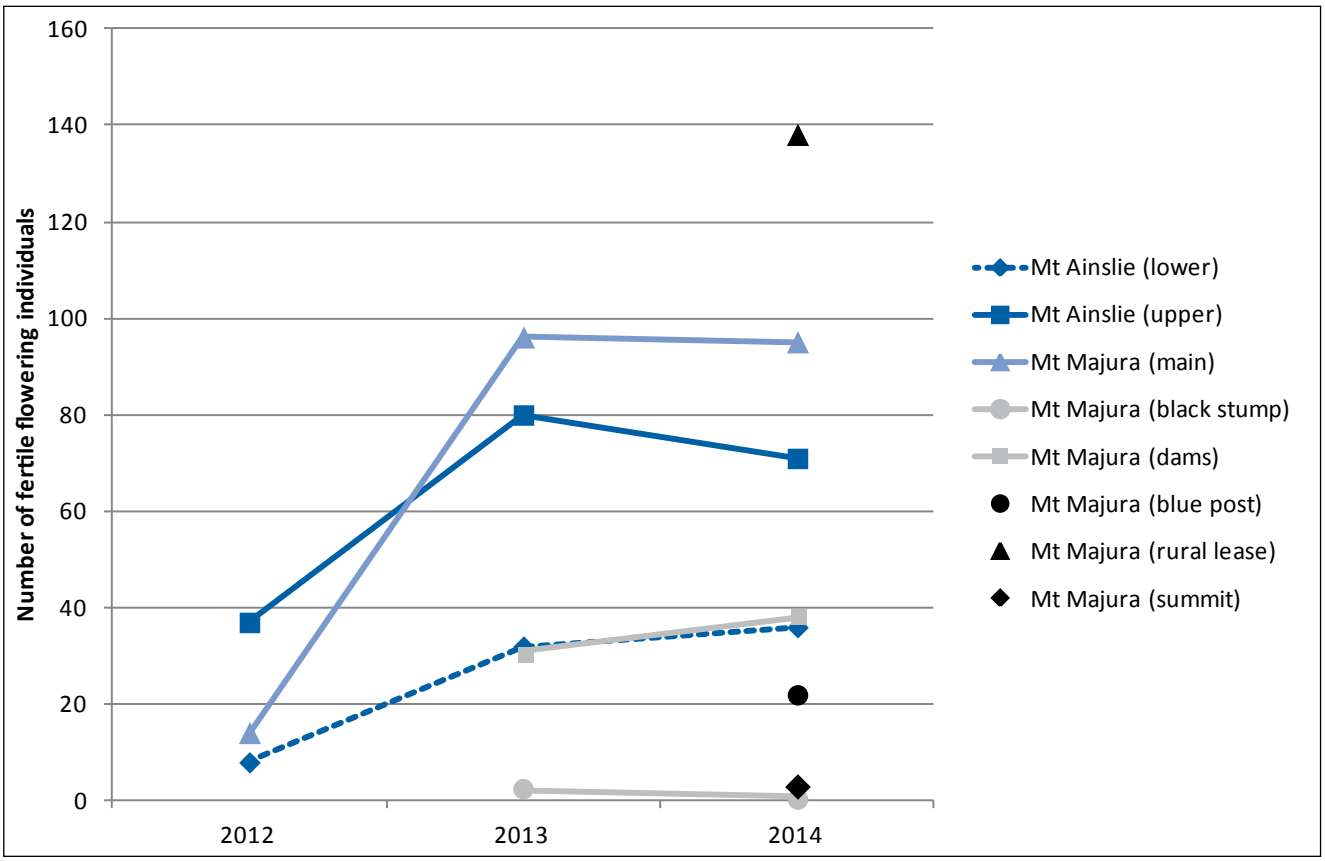
The Canberra Spider Orchid (*Arachnorchis actensis*) is listed nationally as Critically Endangered under the EPBC Act and locally as Endangered and a Special Protection Status species under the *Nature Conservation Act 1980*. It is a terrestrial orchid that grows singly or in small colonies to a height of 40–90 millimetres.

All three extant populations of this species are in the north of the ACT. The first is spread along the slopes of Mt Ainslie and Mt Majura. The second, more recently discovered population, is within the Majura Valley on land managed by the Department of Defence as the Majura Training Area. The third and most recently discovered population is to the east of the Majura Valley in the Kowen Escarpment Nature Reserve. While there are two other records of the species in the suburbs of Campbell and Aranda before their development, it has not been recorded in these areas for over a decade. The species is not known outside the ACT.

The species is monitored on Mt Majura and Mt Ainslie during the flowering season with counts of plants occurring in the known population areas. Details recorded include numbers of fertile flowers, pollination rates and incidence of grazing. These counts are conducted by Dr Peter Milburn.

During the prolonged drought conditions in the early 2000s very few individuals of *A. actensis* were recorded at any known populations. In the past six years there have been clear signs of recovery across the populations; numbers appear stable with expected fluctuations due to seasonal conditions. More individuals were recorded in 2014 than in any previous year (Figure 2.3).

Figure 2.3 Total counts of fertile Canberra Spider Orchid (*Arachnorchis actensis*) at Mt Ainslie and Majura (2012 – 2014).



Members of the public discovered two new sub-populations of *A. actensis* during the 2014 flowering season; one is outside of the nature reserve at Mt Majura and the other in the eastern foothills of Mt Ainslie. Another small new population was located by a member of the public in Kowen Escarpment Nature Reserve. The sub-population at Mt Majura was inspected by CR staff in September 2014, with 138 plants recorded over a 100 x 10 metre area. The remaining sub-populations have only a few plants each and will be visited and inspected by CR staff in spring 2015.

Two fenced enclosures and small cages have been successfully used to reduce damage caused by kangaroos and rabbits to populations on Mt Majura and Mt Ainslie. Habitat conditions are monitored annually and are maintained or improved by management actions and avoidance of potential threats. A translocation plan and EPBC assessment have been written by CR in preparation for a translocation of this species but further work is required to determine pollinator distribution and habitat characteristics before planting occurs. This work will be undertaken by an ANU post-graduate student and staff from the National Herbarium.

2.7 Ginninderra Peppercress monitoring

Ginninderra Peppercress (*Lepidium ginninderrense*) is endemic to the ACT. First described in 1970 from a single collection in the suburb of Reid, it was not seen again until it was found in 1993 on the floodplain of Ginninderra Creek in the Belconnen Naval Transmission Station. The Reid population has not been seen since 1970 and is likely to be extinct. The only extant population was the Naval Station until October 2013 when a small population was located in an area of Special Purpose Reserve in Mitchell.

The Defence Department, which manages the Naval Station, monitors this species. This population has varied considerably, from a low of less than 50 plants in 1997 to a high of 3523 in 2006. The latest estimate is 1137 plants in 2009.

CR staff conducted a population census at the Mitchell site in October 2012, counting 50 plants. All were tagged to help determine the species' lifecycle characteristics. Additional sub-populations were subsequently found by local botanists, some of whom collected abundance information. For example, in 2014 a consultant reported counting four sub-populations including the plants tagged by CR. He located 32 individuals in the tagged sub-population (a decline of 18 plants) and another 72 plants scattered across three additional sub-populations. In 2015 CR undertook a more comprehensive survey of the North Mitchell grasslands, finding five sub-populations, some of which are fragmented by areas of unsuitable habitat. Where the plants were tagged in 2012, 47 individuals were counted. A total of 377 plants were counted across all the sub-populations. Seedlings were observed and many plants were carrying seed. Ginninderra Peppercress at North Mitchell is largely restricted to small scalds, sites with little to no vegetation on a hard packed gravelly clay B horizon where the topsoil layer has been removed through some form of prior disturbance.

Seed was collected by the Australian National Botanic Gardens (ANBG) from 406 plants from the Lawson population on a number of occasions between 2002 to 2008; seed has been successfully germinated from 307 of these individuals. By 2013 the seed bank at the ANBG contained in excess of 99,750 Ginninderra Peppercress seeds, including over 500 from the North Mitchell population. New accessions to the seed bank were made in 2015.

In spring 2013, Greening Australia, CR, ANBG and PCS translocated plants grown from seed collected or originating from the Lawson population into Crace and Dunlop Nature Reserves; Crace received 1050 plants and Dunlop approximately 500. Unfortunately, despite follow-up watering by Greening Australia, it appears that both translocations failed as no live plants have been observed at either site since the end of summer 2013. Factors that could have contributed to this failure include the potting mix, which may have become hydrophobic after planting, especially during a hot summer with 47 days reaching a temperature of 30 degrees or more, and a very dry February and March. Further translocation efforts may occur to trial other ways of establishing new populations of Ginninderra Peppercress.

Figure 2.4 Minister for the Environment, Simon Corbell, planting Ginninderra peppercress at Crace Nature Reserve with ACT Government and Greening Australia staff.

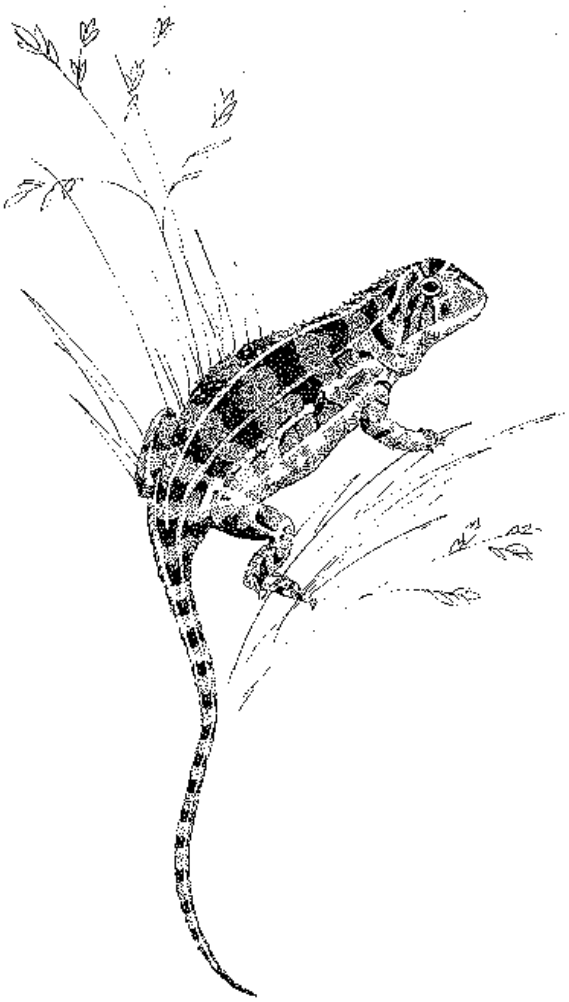
2.8 Grassland Earless Dragon monitoring

The Grassland Earless Dragon (*Tympanocryptis pinguicolla*) is an endangered lizard that was once broadly distributed across south-eastern Australia but is now restricted almost entirely to a few remnant patches of Natural Temperate Grassland in the Canberra–Queanbeyan region and the Monaro grasslands in NSW. In the ACT the species occurs as two separate populations; one in the Majura Valley and one in the Jerrabomberra Valley. Loss or modification of the Natural Temperate Grassland habitat is the main cause of decline.

Grassland Earless Dragons are monitored in the ACT to determine trends in population size and distribution. This information is used to guide conservation programs and inform urban development planning. Grassland Earless Dragons have been monitored annually at two key sites for the species; the Majura Training Area and the Jerrabomberra West Grasslands Reserve. Since 2009 the species has been monitored in the Jerrabomberra East Grasslands, and more recently (since 2013) monitoring has been undertaken on the property 'Cookanalla' in the Jerrabomberra Valley. The species has also been intermittently surveyed at a number of other sites in the ACT where it is known to occur.

Monitoring involves the use of plastic artificial burrows developed by CR that mimic the small burrows used by the dragons; these artificial burrows are now the standard survey technique used in other jurisdictions. They enable the species to be detected in the field and the population size at sites to be estimated. At each site around 200 artificial burrows are checked three times a week for 4–5 weeks. The program for 2013–2015 followed a similar program for previous years. Monitoring is usually undertaken by two to six persons during February and March.

Figure 2.5 Grassland Earless Dragon.



During the 2002–2009 drought period, monitoring results indicated that numbers of Grassland Earless Dragons in the ACT declined to low levels, raising concerns about the survival of the species in the wild. A captive population was established at the University of Canberra to investigate aspects of the ecology of the species, husbandry techniques and to serve as an 'insurance' population in the event wild populations became extinct. Following the return to normal rainfall years, populations of Grassland Earless Dragons in the wild are showing encouraging signs of recovery. The monitoring program has highlighted the sensitivity of this species to major environmental disturbances such as drought and loss of grass cover due to overgrazing.

2.9 Grassland Earless Dragon habitat monitoring

The main habitat area for Grassland Earless Dragon at Jerrabomberra West Nature Reserve was fenced at the end of the last drought to exclude kangaroo grazing and provide a grassy refuge area for Grassland Earless Dragons. Subsequent years of higher rainfall has resulted in an increase in grass biomass in the ungrazed fenced area, leading to concerns that the uniformly high level of grass biomass in this area was becoming unsuitable habitat for Grassland Earless Dragons (which appear to require grass height, or grass biomass, at intermediate levels rather than very short or very long).

In conjunction with PCS, CR began investigating methods to promote variation (heterogeneity) in the structure (cover and height) of the grass sward at Jerrabomberra West Grassland. Rather than a uniformly high dense sward, a heterogeneous sward has grass of different heights and contains grass tussocks and inter-tussock spaces which allow a diverse range of other native plants to grow. These heterogeneous conditions suit Grassland Earless Dragons and other animals that live in grasslands.

PCS and CR undertook small-scale patch burning in Grassland Earless Dragon habitat in 2012, 2013 and 2014 with the aim of encouraging heterogeneity in structure and in plant species composition. Patch burning created a mosaic of burnt areas (each burn patch being several metres across) and unburnt areas. CR implemented a monitoring project to measure changes in grassland structure (cover and height) associated with changes in these management treatments. Monitoring of the changes to vegetation structure and plant species composition is continuing, as is monitoring of Grassland Earless Dragon numbers at these sites.

2.10 Grassland Earless Dragon captive colony and research

The University of Canberra (UC), in partnership with CR, has been investigating potential mechanisms behind the recent population decline of Grassland Earless Dragons in the ACT and nearby NSW during the 2002–2009 drought. Hypotheses include: (1) dry soil causing desiccation and death of the buried eggs, and (2) increases in higher ambient temperatures forcing the lizards to seek shelter for longer periods, which reduces the time available for foraging and other activities.

To date this project has achieved the following:

- The colony of Grassland Earless Dragons has expanded to more than 50 individuals, including successful breeding of the first generation of captive born animals. Much has been learned about the species breeding biology and social behaviours.
- 25 individuals have been released back to the wild to investigate successful techniques for releasing individuals to the wild. Individuals were radio tagged and tracked for six weeks following release, providing detailed information on habitat selection, home range and dispersal.
- Skin temperature and activity data have been collected on 432 days for 29 free-ranging Grassland Earless Dragons using temperature-sensitive transmitters. Daily activity duration was greatly reduced on days that reached high ambient temperatures (>37°C), when temperatures on open ground exceeded 50°C, as individuals were driven to seek thermal refugia in arthropod burrows or tussocks for the most of the day. Long periods of high ambient temperatures could have adverse effects on the species as they may be unable to obtain enough food to support their metabolic needs.
- The metabolic rates of Grassland Earless Dragons has been measured in four seasons. Metabolic rates increase exponentially with temperatures, as expected for all ectotherms, but show a marked increase at temperatures over 38°C.
- More than two years of continuous data have been collected on microhabitat temperatures in ACT grasslands using more than 2000 'iButtons' (miniature temperature probes). Preliminary analysis indicates that burrow temperatures are at least 20 °C lower than above ground temperatures on hot days with differences being even more pronounced in areas with high grass biomass. Temperatures in the base of grass tussocks are as much as 10°C lower than on open ground.
- A study was completed on the genetics of 204 Grassland Earless Dragons that provides strong evidence that long historical isolation and the recent impacts of urbanisation have led to genetic differentiation. There appear to be three distinct genetic groups for Grassland Earless Dragons: (1) a northern Canberra group which occurs in the Majura Valley; (2) a southern Canberra group which occurs in the Jerrabomberra Valley and nearby areas close to Queanbeyan; and (3) a Monaro group which occurs on the Monaro plains in the vicinity of Cooma.

2.11 Little Eagle research and monitoring

Up to 100 sightings are recorded by bird observers each year of non-breeding Little Eagles, which tends to obscure the true status of the species in the Territory. Declared vulnerable, the Little Eagle has been recorded throughout the ACT but forages mainly in the northern half of the Territory and breeds only on the lowlands, which are increasingly occupied by Canberra. In recent years only one or two potential breeding pairs have been found but three were found in 2015. Two of these pairs are nesting within proposed development sites, which is a potential threat to the eagles; likewise, their presence is a potential obstacle to the development.

Little Eagles pair for life and build multiple nests in a territory, rotating to a different nest every few years. They consume their prey on a perch, sometimes using one of the inactive nests for this. These behaviours have sometimes led to unduly optimistic assessments of the likely effect of development. Some pairs have tolerated suburbs to within about ¾ km, but development has also caused abandonment of breeding territories, as at East O'Malley and Gungahlin Hill. To protect nest trees from disturbance is insufficient; a breeding pair also requires its foraging areas to be protected.

The diet of Little Eagles is fairly well known (mainly rabbits and middle sized birds), but there has been no study of Little Eagle movements. Such information is potentially valuable for the conservation of the species generally and is regarded as critical for retention of this species in the ACT in the context of the urban development proposals, and for determination of the likely environmental impact of proposed development.

The affected developers have provided funds for light-weight satellite-GPS tracking devices and associated equipment. Starting in 2015, it is hoped to define the movement patterns of the adult Little Eagles over several months. The capture and instrumentation of eagles is challenging, so the team has first obtained some experience on the more common Wedge-tailed Eagle.

Another possible threat to Little Eagles is the rabbit control agent Pindone, which is used in preference to 1080 for near-urban rabbit control because it poses a lower risk to dogs and people. Toxicity testing indicates that Little Eagles and Wedge-tailed Eagles would be killed if they consumed a rabbit that had recently eaten a meal of carrot treated with Pindone. Information about Little Eagle foraging behaviour (e.g. how far they forage from a nest) would help manage the risk so, for example, Pindone could be withheld in areas within a certain radius of known nest sites. The movements study from the sites proposed for development has the potential to be widely useful.

2.12 Murray Crayfish 2015 survey

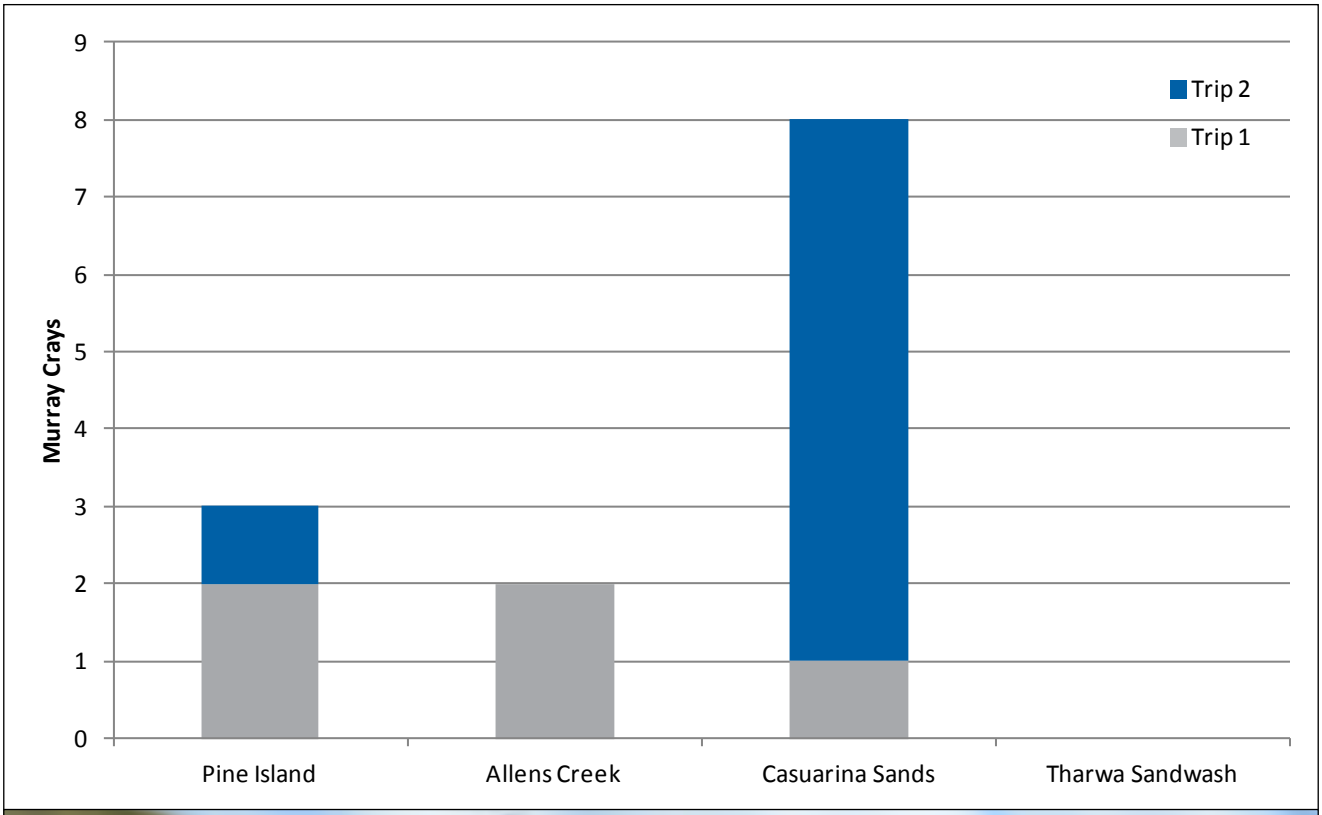
Murray Crayfish (*Euastacus armatus*) is the largest and most widely distributed of all species from the genus Euastacus and is listed as vulnerable in the ACT. An initial survey of this species in 1988 revealed that, despite evidence of distribution throughout the length of the Murrumbidgee River within the ACT, catch rates were patchy and low in comparison with other parts of their range.

In response to these findings the ACT Government banned fishing of Murray Crayfish in 1993 and put in place a monitoring program. Twenty five years after the initial survey and 20 years following the closure of the fishery, a review of the monitoring program has revealed that the species is still at risk.

Guided by a 2013 report about the sampling methodology for this species, a survey was conducted for Murray Crayfish in 2015. Four sites along the Murrumbidgee River were sampled on two occasions, in May and June. Sampling consisted of setting 20 hoop-style baited lift nets and checking and moving the nets every 30 minutes.

The survey indicated that Murray Crayfish in the ACT are still in low numbers and have a patchy distribution (Figure 2.6). Thirteen crays were caught, most at Casuarina Sands. No crayfish were caught at Tharwa Sandwash, despite having being caught at this site in previous surveys.

Figure 2.6 Murray Crayfish caught during 2015 Monitoring.



2.13 Murrumbidgee Bossiaea

Murrumbidgee Bossiaea (*Bossiaea grayi*) (Figure 2.7) was first described in 2009 when four new species were taxonomically split from *B. bracteosa*. In 2012 Murrumbidgee Bossiaea was declared a threatened plant species in the ACT under the *Nature Conservation Act 1980*. Accordingly, an action plan (No. 34) was created to define conservation measures for the species that include survey and monitoring of the population.

In spring 2013 a survey was conducted to confirm the presence and size of Murrumbidgee Bossiaea populations at a number of ACT locations. The survey resulted in ten discrete population clusters being located with an estimated total population size of between 2700 and 2900 individuals. While no formal survey was undertaken in 2014, all population clusters along the Paddys River and one individual at the Cotter River Camp Ground were inspected for signs of plant health and site disturbance.

To enhance the plant's long-term conservation prospects, a collaborative partnership was established between the ANBG and EPD, with assistance from National Seedbank volunteers to collect seed from the two largest population clusters on the Paddys River in late 2014. Bags sown by the National Seedbank volunteers were placed over 120 branches bearing ripening pods in November, with the seeds harvested following dehiscence a month later.

The Australian Native Plant Society (ANPS) expressed interest in undertaking a germination trial of the cleaned seed. This provided an opportunity for a practical outcome from the collection by potentially filling a critical knowledge gap; to utilise the stored seed most effectively for conservation purposes it is important to understand the mechanisms by which the seed germinates most efficiently. Seed germination trials were conducted in collaboration with the National Seed Bank, and ANBG between March and July 2015. Seed was treated to promote germination by manual nicking with a scalpel, manual scarification with glasspaper, microwaving or immersion in hot water (95°C for two minutes). Untreated seed was included in the trials as a control. The treatments that resulted in the most germination were manual nicking with a scalpel and the hot water treatment. However, the hot water treatment results varied depending on whether seeds were surface disinfected with ethanol and bleach or not. Manual nicking of the seed coat is the recommended treatment to promote germination of Murrumbidgee Bossiaea until further trials are conducted.

Key findings/outcomes

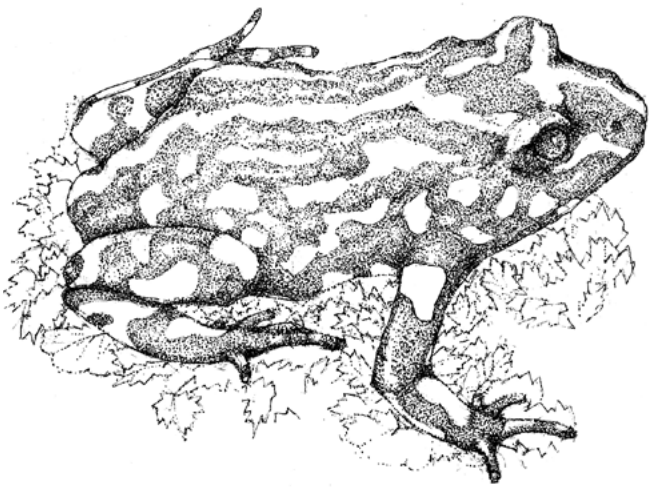
- Of the eleven discrete population clusters located during the 2013 surveys, five were reinspected along the Paddys and lower Cotter Rivers in 2014. Populations above the alluvial flats remain consistently in better condition than those lower down on alluvial soils. The second largest population included some individuals suffering from a form of 'dieback' in a defined geographic area. No obvious cause for the dieback was evident at the site. Progression or recovery is being monitored and further investigations are underway to determine the cause of poor plant health at these sites.

Figure 2.7 Murrumbidgee Bossiaea.

- Successful collaboration between government and non-government organisations has resulted in progression of listed items in Action Plan 34, including development of ex situ conservation measures.
- 21,695 Murrumbidgee Boassiaea seeds were successfully harvested and stored for ex situ conservation purposes at the National Seedbank, Canberra. A small proportion of this seed was utilised in germination trials by ANPS.
- Preliminary germination trials of Murrumbidgee Boassiaea seed has shown that pre-treatment of seed improved germination relative to untreated (control) seed, with immersion in hot water resulting in the highest germination percentage compared to any other treatment.

2.14 Northern Corroboree Frog – monitoring, captive breeding and release

Figure 2.8 Black and white drawing of a Northern Corroboree Frog.



Northern Corroboree Frogs (*Pseudophryne pengilleyi*) are striking black and yellow frogs that inhabit the higher elevation areas of Namadgi National Park and nearby NSW. CR has intermittently monitored Northern Corroboree Frog populations in the ACT since the mid-1980s and more intensively since 1996. This monitoring revealed a major population crash in the late 1980s and early 1990s, with less than 50 individuals currently estimated to remain in the wild in the ACT from the original population of many thousands. The closely related Southern Corroboree Frog, which occurs in the Snowy Mountains around Mt Kosciusko, has suffered a similar catastrophic decline. The decline is due to the spread of the introduced Amphibian Chytrid Fungus, a pathogen that has caused declines, and in some cases extinction, of frogs worldwide.

Monitoring of Northern Corroboree Frogs is undertaken by four to 12 people in early February each year. The frogs are monitored by counting the number of calling males at breeding sites (sphagnum moss bogs and other wet areas) during the annual summer breeding season (January to March) at key breeding sites in the Namadgi National Park, includinh Ginini Flats, Cheyenne Flats and Snowy Flats.

In 2003, CR established a captive population of Northern Corroboree Frogs at Tidbinbilla Nature Reserve from eggs collected in the wild. The objective is to maintain a captive colony of Northern Corroboree Frogs as an insurance against extinction in the ACT. The captive population currently has around 1000 individuals, most of which are from successful captive breeding.

There are now too few Corroboree Frogs remaining in Namadgi National Park to breed and maintain wild populations. Juvenile Corroboree Frogs bred in captivity have been released to sphagnum moss bogs in Namadgi National Park since 2011 to determine whether such releases can bolster wild populations and promote breeding and development of natural resistance to Chytrid Fungus. Monitoring in 2015 has shown that some of the juvenile frogs released in 2011 had reached breeding age and begun calling. While the number was low (about 10% of the number released in 2011), the results are encouraging as they demonstrate captive-bred frogs can survive in the wild for several years to reach breeding age. The next stage of the recovery program is to determine overall survivorship of frogs released during subsequent years and whether the offspring of captive frogs will successfully breed in the wild.

2.15 Small Purple Pea monitoring

Five sites within the urban areas of Canberra have been known to support populations of the Small Purple Pea (*Swainsona recta*). The largest population, in the Mt Taylor Nature Reserve, has had over 300 individual plants recorded since surveying began in 2001. This site was severely burnt in the 2003 fires. A small population of approximately 20 plants exists on a vacant urban block in the suburb of Kambah which has been fenced to protect the population. Small numbers of plants have been recorded in the past at sites on Long Gully Road, a rural block on Caswell Drive and at Farrer Ridge.

The 2014 survey of *Swainsona recta* consisted of two counts of the Kambah and Mt Taylor sites on 15 and 22 October. Caswell Drive was inspected on 16 October by Biosis ecologists. The Mt Taylor population was inspected from early October to determine the beginning of the flowering period. As in 2013, in 2014 flowering occurred in October—at the time expected from the species description—in contrast to the 2010–2012 seasons in which flowering began later in October and peaked in November.

At McTaggart Street, Kambah, plants were located using previous mapping and measurements. No new plants were found, with the survey recording very similar numbers to previous seasons (Table 2.2). An ecological burn was conducted within the *Swainsona* habitat during June 2013 as a part of the annual TAMS Bushfire Operations Plan, to reduce the density of Kangaroo Grass, *Themeda triandra*. This burn followed a patchy, low intensity burn in June 2011. The intention was that the change in structure and biomass (Figure 2.9) could potentially encourage the re-sprouting of dormant individuals and germination of new *S. recta* and other native forbs. Many forb species were seen in high numbers in spring 2014, such as *Bulbine bulbosa, Stackhousia monogyna, Thelymitra sp*. and *Drosera peltata* (Figure 2.10).

Figure 2.9 ***Swainsona recta* habitat in the suburb of Kambah in Spring 2013 after the ecological burn carried out in June 2013.**

Figure 2.10 ***Swainsona recta* habitat in the suburb of Kambah in spring 2014.**

The general site condition and diversity is very good with large numbers of disturbance-sensitive forbs present in spring 2014. At this early stage it would appear there has been a positive response to the most recent burn with widespread flowering and growth from native species and limited spread of broadleaf and woody weeds. A total of 23 individual plants have been tagged at this site, with many of these individuals not recorded for a number of years and no new plants identified since 2003.

Table 2.2 ***S. recta* abundance, McTaggart St, Kambah ACT.**

Year	2000	2001	2002	2003	2004	2009	2010	2011*	2012	2013*	2014
Total plants	10	7	10	7	10	7	8	8	1	9	8

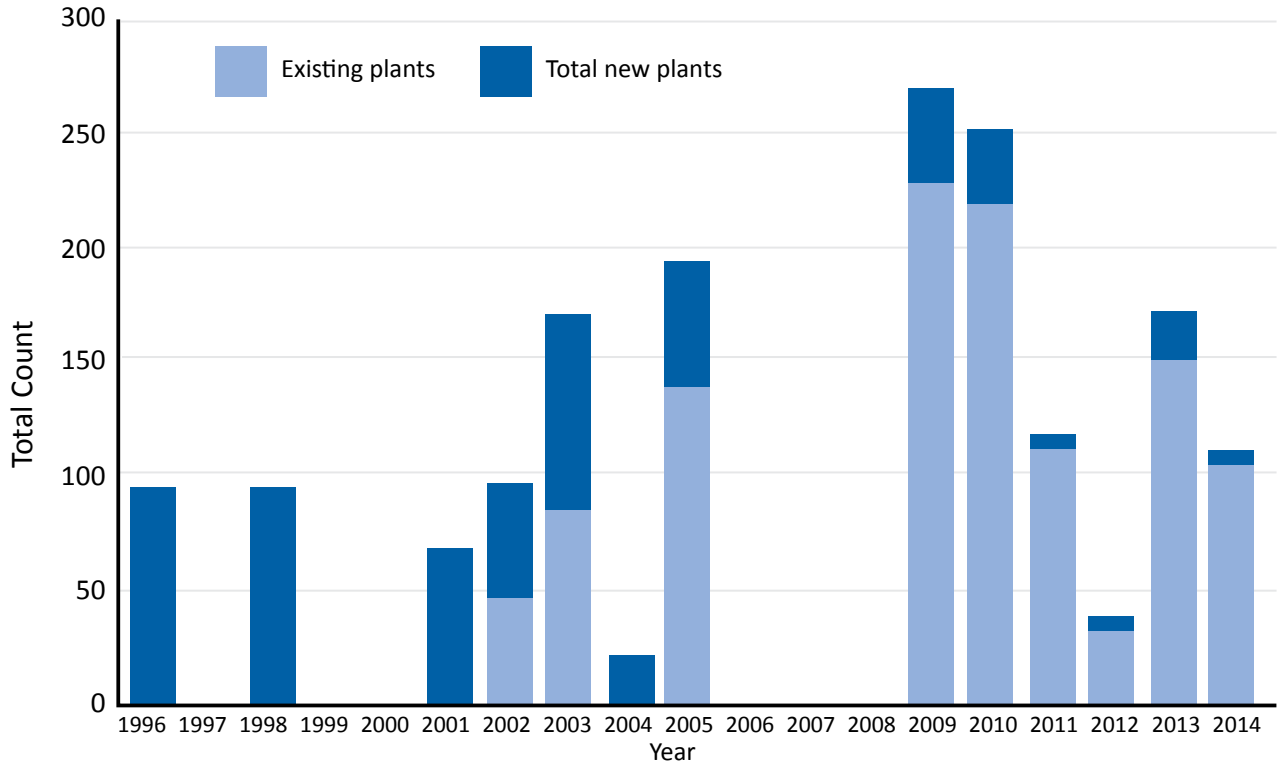
**Ecological burn in June of this year.*

At Mt Taylor, counts of the site were conducted by flagging the permanently marked corner pegs and sweeping the area with a line of people. Metal detectors were used to locate tags buried by soil movement. All tag numbers and associated plant life stages were recorded and untagged plants marked with new tags.

After a significant increase in abundance of the Mt Taylor population in 2013, 2014 saw a decrease of over 34% (Figure 2.11). There have been no clear long-term trends of either an increase or decrease in the overall abundance, with annual fluctuations such as these common in small populations. Factors that may have influenced these variations include rainfall, predation of plants, ground temperatures, moisture levels and intra-specific competition. It is likely the changes are due in part to natural population fluctuation; *S. recta* is known to have dormancy periods of anywhere from 1 to 9 years (Briggs and Müller, 1999). It should be noted that in 2004, to avoid overly trampling the site and new regrowth after the fire in 2003, a full survey was not carried out; only untagged plants were recorded and tagged (see Figure 2.11). Recruitment levels have steadily dropped since the peak abundance in 2009. Burning parts of the Mt Taylor site will be considered if the population continues to decline in 2015 and the Kambah plants continue to show no detrimental effects from the 2013 burn.

At Caswell Drive, a search made within a 50 metre radius of the known population located two plants. These appeared to be the same individuals located in 2013 but the plants at this site have not been tagged.

Figure 2.11 **Abundance of new and reoccurring *S. recta* at Mt. Taylor, ACT.**



Newly tagged plants are represented by the dark portion of each total count and previously tagged plants are represented by the lighter portion of each total count.

2.16 Striped Legless Lizard surveys

Striped Legless Lizards (*Delma impar*) are known to occur in four discrete places within the ACT: the Gungahlin area, the southern half of the Majura Valley, land adjacent to Yarramundi Reach on Lake Burley Griffin and in the Jerrabomberra Valley. The lizard is also known from seven sites in New South Wales, two in South Australia and around 70 in Victoria. Nearly all sites outside of the ACT are considered to support less than, at most, a few hundred animals.

Striped Legless Lizards were surveyed in the Gungahlin grassland reserves (Crace, Mulanggari , Gungaderra) and the proposed reserve of Kenny in 2012 and 2013. Based on the survey results, the size of the Striped Legless Lizard population across these areas was estimated to be around 10,000 individuals. Striped Legless Lizards were surveyed in the Jerrabomberra and Majura Valleys in 2014, which confirmed the species occurs at low density but is widespread in these valleys. At least two Striped Legless Lizards were observed within Yarramundi Reach on Lake Burley Griffin, confirming the ongoing survival of the lizard within this small grassland remnant.

Figure 2.12 Striped Legless Lizard.

2.17 Superb Parrot survey

Baseline information on the location of Superb Parrot (*Polytelis swainsonii*) breeding areas within the ACT and/or the interactions of nesting birds with potential hollow competitors has been obtained within the ACT since 2009. Breeding is concentrated in two areas, the Central Molonglo Valley and on Throsby Ridge in Gungahlin. Breeding in the Throsby area appears to have been stable over this time, while that of the Molonglo Valley appears to have occurred over a widening area.

Figure 2.13 Throsby Ridge Superb Parrot breeding area.

Research will commence during the 2015 breeding season into why Superb Parrots select particular breeding locations, their nest site fidelity and fecundity and whether these are impacted by nearby urban development, and how management actions may improve the suitability of habitat and breeding success.

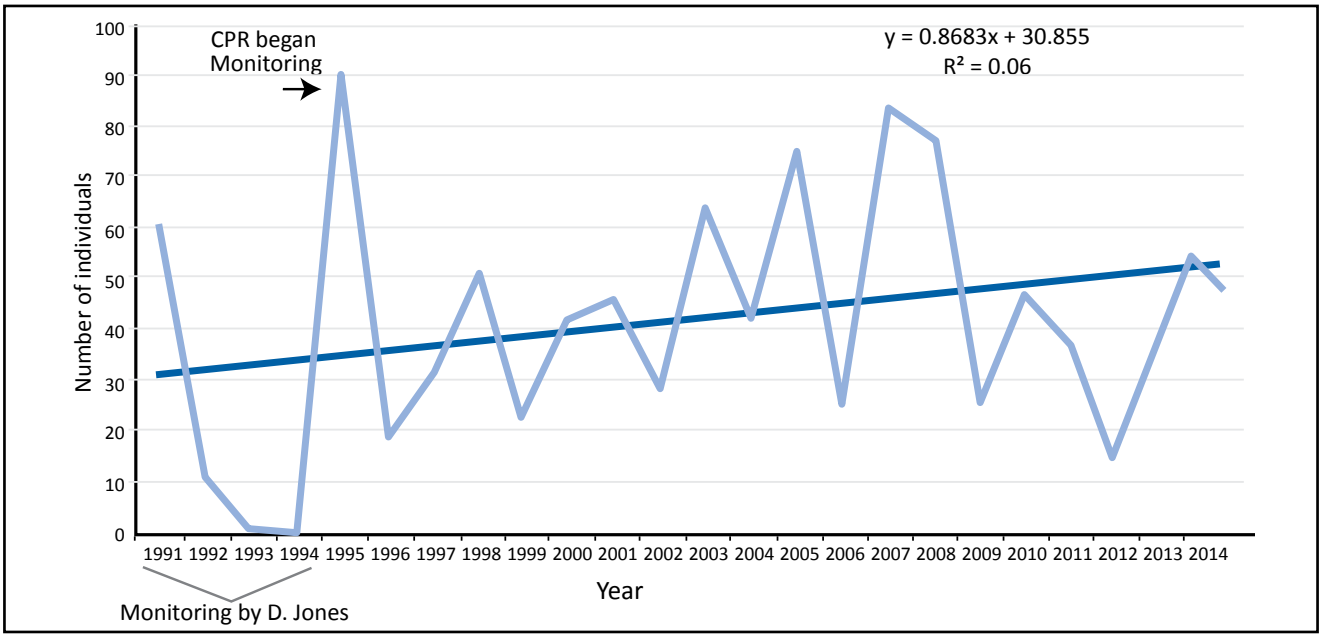
2.18 Tarengo Leek Orchid monitoring

The Tarengo Leek Orchid (*Prasophyllum petilum*), is a slender ground orchid found in only five locations in grasslands and grassy woodlands of the Southern Tablelands of the ACT and NSW. Hall Cemetery contains the only population of *P. petilum* in the ACT. Little is known about the specific ecology and requirements of this orchid. The fragile nature of small populations means the in-situ conservation and monitoring of the Hall Cemetery population is crucial for the survival of the species in the ACT. Management requirements for grave digging, vehicle access and movement, weed control and mowing are outlined in the Hall Cemetery Management Plan that was developed in 2005 and updated in 2013.

From mid-September 2014 the site was visited weekly to detect flowering. Three full surveys of the eight areas known to contain orchids were carried out on 8, 16 and 21 October 2014, with the remainder of the Cemetery searched for potential new areas. Surveying involved visually scanning each area for orchids and sweeping with metal detectors to locate the metal tags of previously identified orchids. The life stage, condition and presence/absence of each orchid with a metal tag were recorded on the existing inventory. Any new orchids discovered in flower were identified with a new numbered tag in the ground.

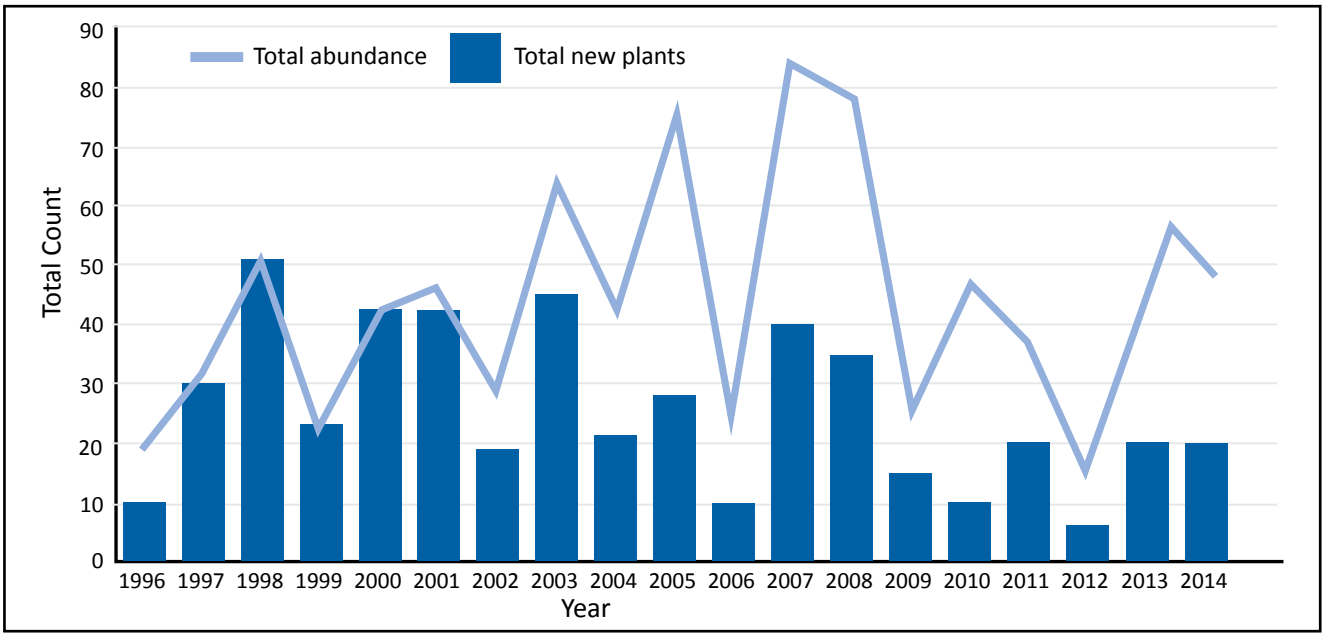
A decrease of 12.7% was recorded in the total number of flowering plants after a significant increase in the previous year (Figure 2.14). The abundance of the flowering population at Hall has fluctuated since monitoring began in 1991. No obvious link has been identified between marked fluctuations and the preceding years' abundance or environmental factors.

Figure 2.14 Hall Cemetery Tarengo Leak Orchid (Prasophyllum petilum) abundances as total counts of flowering individuals per year.



In 2014, 20 new individuals were recorded, the same as 2013, although it represents a higher percentage (41.6%) of the overall abundance of flowering plants for the year (Figure 2.15).

Figure 2.15 Recruitment at Hall Cemetery shown as the number of previously unrecorded ('new') plants per year in relation to the total abundance per year.



The abundance of *P. petilum* at Hall Cemetery has once again fluctuated markedly from the previous season. The unpredictable nature of populations of this genus means it is not possible to forecast the spring flowering response. Given the variable nature of the population, management procedures need to be regularly reviewed.

2.19 Trout Cod stocking and monitoring

Trout Cod (*Maccullochella macquariensis*) is listed as endangered in the ACT under the *Nature Conservation Act 1980* as well as nationally under the EPBC Act. The species became extinct in the Canberra region in the 1970s. Conservation stocking has been undertaken in a number of waterways as part of the National Recovery Plan for Trout Cod in an effort to re-establish the species in its former range.

In the ACT Trout Cod have been stocked in: the Murrumbidgee River at Angle Crossing (1996–2005); the Murrumbidgee River at Kambah Pool (2006–2008); and the Cotter River at Bendora Reservoir (1989–1990). Stocking has not occurred in the ACT region since 2008.

CR monitors the success of these stockings and the status of the upper Murrumbidgee River Trout Cod population as part of the threatened species monitoring program. The Murrumbidgee releases are surveyed through the biennial Murrumbidgee monitoring program and Bendora Reservoir is also surveyed.

Two Trout Cod adults caught in 2015 at Kambah Pool were tagged with a Passive Integrated Transponder and dorsal tagged for future assessment of individual fish. A potential hybrid was captured just above the ACT border near Michelago, which suggests the species does not exist in sufficient density to find a suitable breeding partner in the upper Murrumbidgee. No Trout Cod were caught in Bendora Reservoir in 2014.

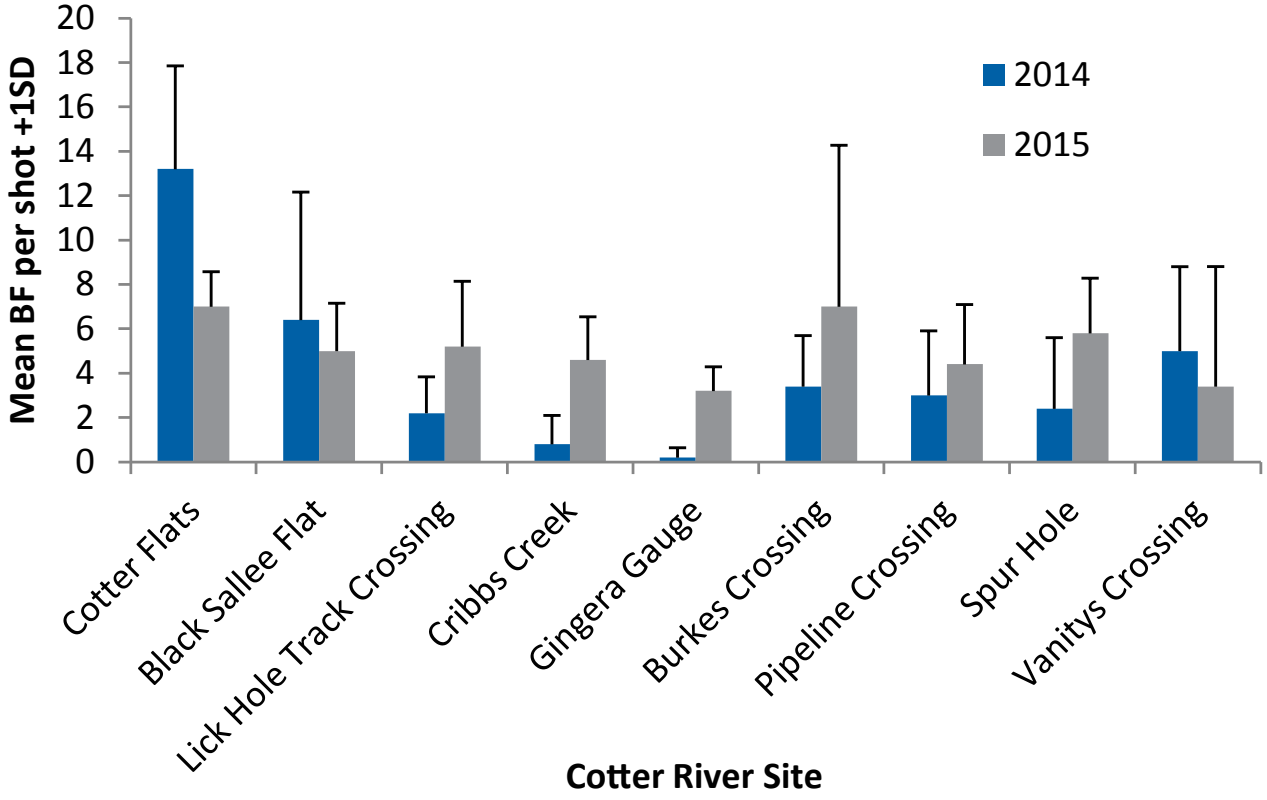
2.20 Two-spined Blackfish monitoring

Figure 2.16 Two-spined Blackfish in the Cotter River.

CR has undertaken a Cotter River monitoring program on the Cotter River since 2001 and in Bendora Dam since 1995. The program is part of a larger project looking at environmental flows in the Cotter River and threatened species in the ACT. The program fulfils monitoring obligations under the Ribbons of Life ACT Aquatic Species and Riparian Zone Conservation Strategy Action Plan 29. In 2014, 15 sites were surveyed including Bendora Dam and non-Cotter reference sites. In 2015, 12 river sites were surveyed including sites for prescribed burn monitoring; sites not surveyed included above and below Bendora, Bendora Dam and non-Cotter reference sites. Fish were surveyed using backpack electrofishing.

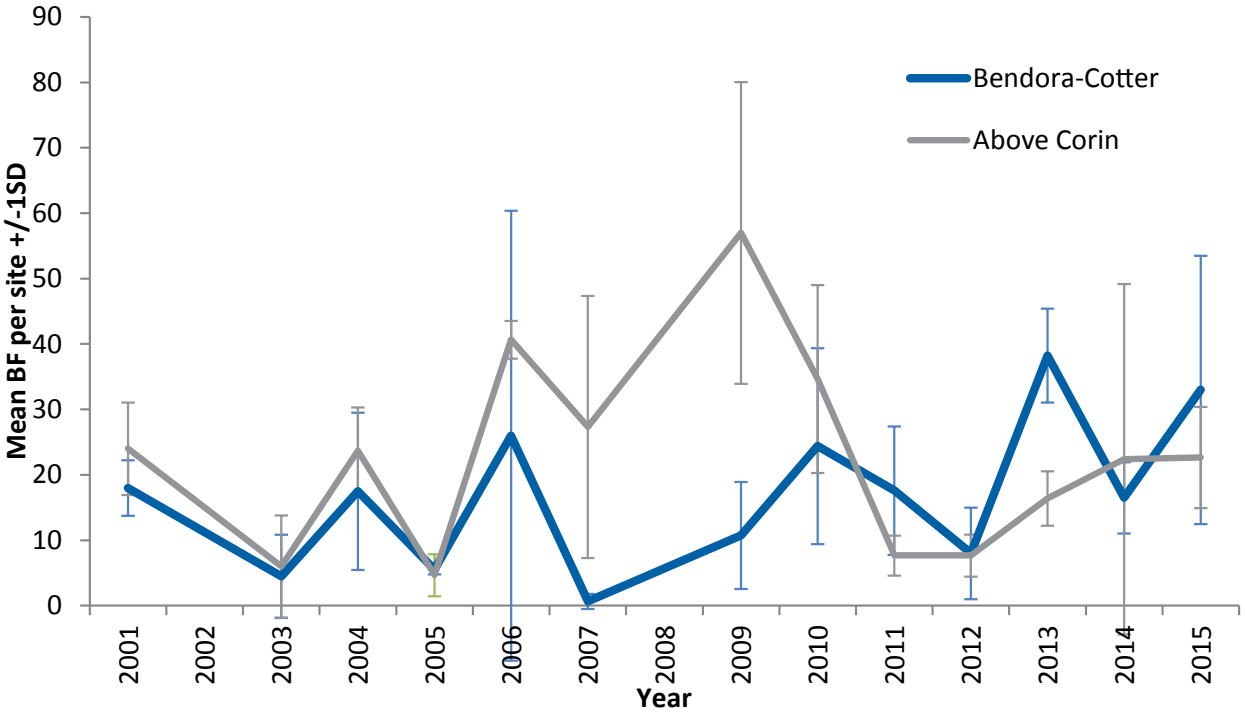
A total of 277 Two-spined Blackfish (Blackfish) and four Macquarie Perch were recorded in 2014. A total of 364 Blackfish and 13 Macquarie Perch were recorded in 2015. Generally Blackfish were reasonably consistent across sites for 2015 (Figure 2.17); Blackfish across sites for 2014 were quite variable particularly in the unregulated sites (Figure 2.17).

Figure 2.17 Mean Blackfish captures per back pack electrofishing shot (30 metres) for each site sampled on the Cotter River for both 2014 and 2015.



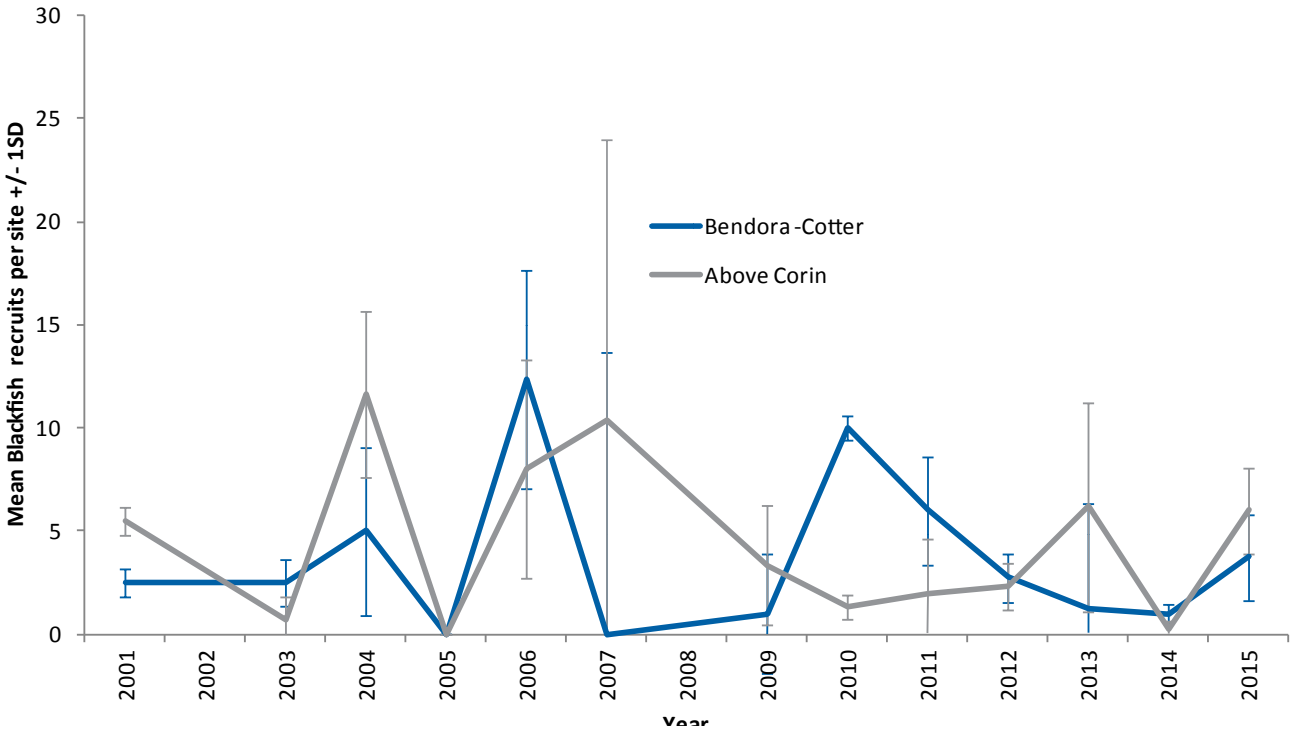
Blackfish are beginning to demonstrate a general increase in abundance since the low numbers captured in 2011–12 (Figure 2.18). Sampling in 2014 suggested poor breeding success in both the regulated and unregulated sites as juvenile numbers are low (Figure 2.19). The reason for this result is unclear as there has been recovery time since the 2011 flood and the earlier millennium drought. Fortunately the 2015 survey does indicate an increase in both overall abundance and more successful breeding for both regulated and unregulated sites (Figure 2.18).

Figure 2.18 Mean number of Blackfish (recruits and adults) recorded per site for each river management type.



Sites Bendora–Cotter are regulated and above Corin are unregulated sites. The data presented are from sites that were relatively consistently sampled across years.

Figure 2.19 Mean number of Blackfish recruits (Fish < 80mm) captured per site for each river management type; sites Bendora-Cotter are regulated and above Corin are unregulated sites.



The data presented are from sites that were relatively consistently sampled across years.

2.21 Tuggeranong Lignum monitoring and translocation

The Tuggeranong Lignum (*Muehlenbeckia tuggeranong*) was first described in 1997 after being discovered by Mallinson on the eastern bank of the Murrumbidgee River in the Pine Island Reserve near Tuggeranong, ACT. Initially one female and two male plants were recorded. Thorough surveying located another four male plants in two more locations within the reserve. A single plant was also observed in 1999 in Red Rocks Gorge, but follow-up surveys have failed to locate it. Red Rocks Gorge and the three most southerly locations of *M. tuggeranong* at Pine Island were all severely burnt during the 2003 bushfires. All five plants affected by fire at Pine Island have recovered.

Since 1999 a series of surveys and opportunistic sightings have identified 13 individual wild plants on the eastern bank of the Murrumbidgee River. No plants are known to persist on the western bank of the river. All 13 plants were still alive in 2013. A survey in February 2015 found 12 plants were still alive; a male plant, first observed in 1997 on the banks of the Murrumbidgee, appears to have died. This plant was in an area subject to a great deal of disturbance due to flooding and movement of sand and was also being encroached upon by Blackberry.

Translocation of clonally grown Tuggeranong Lignum has been attempted on a number of occasions since 2010. Initially 93 plants were translocated into the Murrumbidgee River Corridor in locations close to the wild plants. None are known to have survived, with possible causes for this failure including extensive flooding and heavy weed infestation at the site. In 2013 CR staff translocated 19 plants into suitable habitat on Point Hut Hill and another 17 plants into Bullen Range Nature reserve near the old record from Red Rocks Gorge. All plants translocated into Bullen Range have since died, but as of February 2015, 10 plants still persisted at Point Hut Hill. Anecdotal observations of these plantings indicate that plants on sheltered southerly aspects appear to survive longer than other aspects.

In 2013 CSIRO delivered the results of genetic testing undertaken to identify how many wild individuals there are (plants sprawl across each other in some sites making it difficult to determine numbers by observation) and how many of these genotypes are reflected in the surviving translocated plants. Unfortunately, the results were inconclusive due to the limited number of loci that could be used in the analysis.

Following the loss of one of the wild individuals, CR and ANBG decided to collect material from all 12 wild plants and 10 translocated plants so Tuggeranong Lignum could be propagated in the ANBG. This project is designed to secure the current genetic diversity of the species by having at least one representative of each plant growing in the gardens' permanent collection. Additional material grown by the gardens may be made available for future translocation attempts.

3. THREATENING PROCESSES

A 'threatening process' is any process that threatens the survival, abundance or evolutionary development of a native species or ecological community. Examples of threatening processes include predation by the European Red Fox, damage by herbivores such as feral rabbits and deer, or inappropriate fire or grazing regimes. Some jurisdictions list 'key' threatening processes in legislation (such as NSW and the Commonwealth) whereas other jurisdictions (such as the ACT) recognise key threatening processes even though they are not listed in legislation.

The Conservation Research Unit (CR) provides ecological research input and management advice on a range of threats in the ACT, particularly when they have the potential to impact listed species and communities.

3.1 Deer – Fallow, Red and Sambar

CR is assisting the Parks and Conservation Service (PCS) with the government response to the increasing populations of three deer species in the ACT. Following on from work described in previous editions of this report, an experiment has been established to monitor impacts of Sambar deer (*Rusa unicolor*) on montane vegetation in Namadgi National Park using partial exclosures. The exclosures prevent access by large animals such as Sambar deer but not smaller herbivores such as wallabies and wombats. Baseline data on vegetation diversity and structure were collected in 2014 at eight exclosures and eight paired open plots in montane forest in the upper Cotter River catchment. These baseline data will enable comparison with future assessments and provide a basis for monitoring deer impacts on montane ecosystems by tracking differences in vegetation between plots accessible and plots not accessible to the deer.

Spread of deer species is being monitored by recording *ad hoc* sightings. Spotlight counts have also been established by PCS for Fallow Deer (*Dama dama*) in the Canberra area and Googong. CR input in 2015 led to a review and standardisation of spotlighting methods.

3.2 Fire – Ecological review of the TAMS Bushfire Operational Plan

Each year TAMS develops a Bushfire Operational Plan (BOP) outlining a works program for fire fuel management across the ACT. Works include grazing, slashing, prescribed burning and physical removal of fire fuels in strategic locations to reduce bushfire risk to built and environmental assets. CR conducts an ecological review of the BOP each year to determine if planned works could impact on ecological values, including listed threatened species and threatened ecological communities as well as rare and fire-sensitive species and communities.

Over the past two years, CR has assessed more than 500 proposed management activities listed in the 2013–14 and 2014–15 TAMS BOP. Treatments included proposed fuel, access and infrastructure management. CR ecologists conducted assessments using spatial analysis techniques and appraisal of possible impacts, including site inspections where required. Ecological assessment of the 2014–15 and subsequent BOPs have included a focus on potential impacts of large scale and rapid vegetation removal for fire access maintenance. BOP assessments have also had an increased focus on potential for biodiversity impacts as a result of large 'ridge top' burns in remote rural areas such as Namadgi National Park and Tidbinbilla Nature Reserve. In particular, CR has worked with fire management agencies to minimise burning in ecosystems that are below minimum inter-fire interval thresholds and also in long unburnt areas of Namadgi National Park that escaped the 2003 Canberra wildfires. CR continues to work closely with PCS and community groups such as ParkCare to identify and mitigate potential impacts of prescribed burning on natural assets in Canberra Nature Park, such as rare plants and areas of high habitat value.

Actions assessed as having the potential to cause adverse impacts on biodiversity have been highlighted to the land manager, and recommendations for mitigating impacts listed in accordance with ecological guidelines. In many cases CR also stipulates site-specific conditions to be included in works plans and addressed prior to implementation of these activities. Ecological outcomes of fuel management activities are assessed as part of CR's ongoing Prescribed Burn Monitoring Program (see following section). Advice and recommendations coming from the CR ecological assessment of proposed BOP activities are provided to the ACT Conservator of Flora and Fauna for consideration and further correspondence with TAMS.

This program is jointly managed across EPD and TAMS directorates with funding provided from both to ensure fire management activities, particularly in nature reserves, are strongly aligned with conservation outcomes.

3.3 Fire – Prescribed burn monitoring

CR maintains an ongoing monitoring program aimed at determining the impact of prescribed burning on biodiversity conservation values (including composition, structure and function of vegetation, terrestrial fauna habitat and aquatic species) in areas identified for fuel reduction in TAMS BOP. CR also monitors population responses to ecological burns programmed by CR and implemented as part of the BOP. As in previous years, the prescribed burn monitoring program aims to assess approximately 10% of planned burns each year using a combination of quantitative plot-based ecological assessments and qualitative or descriptive post-fire assessments.

Qualitative post-fire assessments report on the outcome of prescribed fires from an environmental perspective and provide feedback to fire management agencies as to how effectively burns have met ecological guidelines and other sensitivities highlighted in the BOP review stage prior to implementing. Quantitative plot-based monitoring is undertaken using a Before After Control Impact (BACI) design and aims to address a range of explicit monitoring and research questions, thereby providing new knowledge and insights to inform future fire management.

2013–14 monitoring

Twenty six hazard reduction burns were completed in the ACT over the 2013–14 season. The vast majority were conducted within Canberra Nature Park (CNP), and ranged from 1 to 31 hectares. The 2013–14 prescribed burn monitoring program undertook detailed quantitative monitoring on five (approximately 20%) of the 26 burns completed in the year and one rural burn that was not implemented due to wet conditions.

The 2013–14 prescribed burn monitoring program was supported by additional funding from TAMS enabling increased sampling effort. It consisted of three components:

- A retrospective or 'space for time' study of the effects of past fire regimes on the structure and composition of dry forest communities in CNP. This study involved collecting vegetation and habitat structure data from over 120 plots in dry forest on Black Mountain, Bruce Ridge, O'Connor Ridge and Aranda Bush. Plots were stratified by slope, aspect, time since last fire and fire frequency over the past 50 years.
- Establishment of 55 BACI monitoring plots to measure the effects of six prescribed burns; five burns in CNP (22 burn and 22 control plots) and one prescribed burn proposed for an area of subalpine woodland in southern Namadgi National Park (five burn plots and five control plots).
- Qualitative post-fire assessments were made at a number of other large rural and smaller urban prescribed burns to determine if stipulated ecological guidelines were met.

2014–15 monitoring

Seasonal conditions throughout late summer and autumn were conducive to prescribed burning and a significant number of burns were implemented by TAMS including a number of large rural burns in Namadgi National Park and Tidbinbilla Nature Reserve. Prescribed burn monitoring in 2014–15 included re-sampling 55 BACI plots in CNP and Namadgi National Park one year post burn, native bird surveys at a subset of 10 CNP BACI plots (one burnt and one control plot from each of five burns), detailed pre-burn assessments of ecological assets associated with the large rural burns in Namadgi, and qualitative post-fire assessments of four large rural prescribed burns in Namadgi to determine if stipulated ecological guidelines were met.

Aquatic assessment of one large rural prescribed burn on the Cotter River above Corin Dam in NNP was undertaken in 2015. Six sites were surveyed in early autumn as part of the Blackfish monitoring program. This included two sites below the burn area, two within the burn area and two above the burn area. Two of these sites have been sampled annually since 2013 and another three sites have been sampled since 2001. The sites were resurveyed in late autumn following the burn.

3.4 Fire – Post-fire recovery – Cotter Hut

CR continues to partner with the PCS to undertake post-fire recovery when needed. Using a rapid risk assessment approach that is being adopted in a number of south-east Australian states, the ACT is addressing risk in the environment following higher intensity burns.

In April 2015, the Cotter River prescribed burn, one of many identified in the TAMS Bushfire Operational Plan (BOP) for 2014-15, was undertaken. The burn contained a number of environmental assets (particularly a sphagnum moss bog) and was adjacent to the Cotter River. These assets were identified in the burn plan and actions taken in the planning of the burn to prioritise work in these areas. Variable weather conditions and increased fire behaviour resulted in some small spot fires and the fire crossing the Cotter River. Once contained, the burn area included approximately 175 hectares of additional area burnt in varying severity from patchy low intensity to high intensity crown scorch and crown consumption. Impacts of varying degree had occurred to the Alpine Ash forest, sphagnum moss bog, Cotter River, native flora and fauna habitat and native vegetation.

Processes for a rehabilitation and recovery plan were immediately initiated, with CR and PCS staff immediately meeting on site to assess risks to both the existing infrastructure, the environment and rehabilitation of dozer tracks.

A post-fire risk assessment was undertaken using the format of the post-fire risk assessment teams now operating in Victoria, NSW and ACT (the ACT/NSW Burned Area Assessment Team (BAAT)). A rehabilitation plan was compiled that provided an overview of all assets assessed under this rapid (1 day) risk assessment and the priorities assigned for future investigation and works.

The highest risks were found to be to the water quality in the Cotter River from the potential for sediment resulting from tracks and trails cut into native vegetation as containment lines. The highest priority actions were identified to be to mitigate this risk through the installation and maintenance of sediment control structures at points of highest erosion potential (i.e. where bulldozer lines and drainage lines intersect and road side drains). The rehabilitation plan was immediately implemented by PCS and monitoring in spring/summer will continue to assess whether further work is needed.

3.5 Kangaroos and their management – Community opinion poll

In 2015, Market research company Micromex was employed to undertake a telephone poll about kangaroo management. Similar polls have been undertaken in 2008 and 2011. Each survey polled approximately 600 randomly chosen Canberra adults. Based on advice from Micromex, this sample size was sufficient to answer the questions with good precision. The full results of the three surveys are available at www.tams.act.gov.au by searching 'kangaroos'.

The survey results in 2015 infer:

- Canberrans value the kangaroos in CNP but are aware of their impacts and have high support for conservation culling.
- Kangaroos are frequently seen, with as many as 28% of people having seen a kangaroo in the previous 24 hrs and 65% in the previous week.
- Awareness that the ACT has an exceptional abundance of kangaroos has increased strongly since 2011, with 69% rather than 37% of people believing there is a 'higher' to 'much higher' 'concentration' of kangaroos compared to the rest of Australia. Also, 75% of residents 'agree' to 'strongly agree' with an Australian Geographic article stating that Canberra is the best place in Australia to see kangaroos.
- 75% of residents believe the culling of kangaroos is 'humane' or 'very humane' in comparison to controlling other wild animals.
- There is some misunderstanding about reasons for government culls in nature reserves. Although 83% of residents correctly think that culling in nature reserves is carried out for the conservation of grassland and woodland ecosystems, a number of incorrect reasons are also thought to apply. This includes 80% believe the culling is done to prevent kangaroos starving during a drought, 56% believe it is done to reduce motor vehicle collisions, 32% believe it is done to preserve grass for livestock and 12% for sale of meat and skins.
- To apply fertility control methods to control the breeding of kangaroos in Canberra was thought 'important' to 'very important' by 76% of respondants.

Figure 3.1 Volunteer's (ParkCare) notice board defaced by anti-cull activists.

The Canberra community has a range of opinions about kangaroo management, but the random phone poll showed an overwhelming majority of Canberrans support the annual conservation cull in reserves despite some strong protests (Figure 3.1).

The same survey gathered data on the frequency of motor vehicle collisions with kangaroos. The responses indicate a more realistic estimate of collisions than insurance statistics, police reports or carcass numbers, which are all known to be underestimates. From the phone survey an annual average of almost 14,000 motor vehicle collisions with kangaroos is the current estimate.

This is substantially higher than the 2011 estimate of almost 6,000 collisions because: 8.2% of drivers reported collisions as opposed to 6% in 2011; the number of drivers has increased by over 19,000; and, for the first time, the 2015 survey took account of people who had had multiple collisions. Based on an average of 308,592 licenced drivers in the ACT during the three year period, the average number of motor vehicle collisions with kangaroos was estimated to be 13,985 per year over the last three years.

The likely magnitude of the under estimation from other sources of motor vehicle collision statistics is hinted at by the answers to questions about what happened after the collision. Insurance claims were made in 57% of cases and reports to police in 33% of cases.

3.6 Kangaroo – fertility control research

The ACT Government has supported research on fertility control for Eastern Grey Kangaroos since 1998. The most successful trial to date has been undertaken in collaboration with the Invasive Animals Cooperative Research Centre (IACRC) and CSIRO. In 2008, sub-adult female kangaroos resident at Belconnen Naval Transmission Station were capture-darted allowing the application of identification collars and ear tags and treatment with either GonaCon Immunocontraceptive Vaccine™ (16 animals) or a placebo injection (10 animals). Since treatment, animals have been monitored annually to determine their reproductive condition.

Results to date have demonstrated GonaCon™ to be effective in a high proportion of female Eastern Grey Kangaroos for a minimum of six years following a single injection (Table 3-1). All the treated kangaroos were infertile for the first three years after vaccination. In the fourth year, one treated animal starting breeding and has produced a young each year since. This result is extremely positive and GonaCon™ currently represents the most promising contraceptive trialled for use in this species. However, the high costs and resources required to capture and handle each individual to inject the vaccine and monitor their recovery from the anaesthetic limits the viability of this method for treating large free-ranging kangaroo populations. These costs and inefficiencies would be overcome if the vaccine could be delivered to kangaroos remotely.

Table 3.1 Percentages of females in each treatment group observed with young each year.

Treatment	2009	2010	2011	2012	2013	2014
GonaCon™	0%	0%	0%	7%	10%	10%
Sham Vaccine	100%	78%	100%	38%	63%	83%

With support from TAMS and CSIRO, CR is continuing to research the use of GonaCon™ for Eastern Grey Kangaroos. Trials are currently underway to develop a dart delivery technique so the vaccine can be administered remotely. The trials will investigate the most appropriate dart components for successfully expelling the viscous vaccine into the target muscle, develop a system to temporarily mark each animal to avoid individuals receiving multiple doses and assess the humaneness of the technique.

Further field trials will be conducted of hand injected GonaCon™, this time administered to adult females. Once the dart delivery system is devised, this method will be trialled on wild female kangaroos. At some research sites the kangaroos will be treated with either hand injected or dart delivered GonaCon™ or a placebo treatment to evaluate the effectiveness of the vaccine on an individual basis. At other sites, all or most of the females will be treated with GonaCon™ to assess the effect of the vaccine at a population level and to determine if it is an effective tool for limiting the rate of increase in these populations. Population growth rates and breeding levels will be assessed in untreated populations as comparison.

In preparation for the dart delivery field trials, 50 female kangaroos have been fitted with identification collars and ear tags (Figure 3.2). The collars and ear tags allow each kangaroo to be identified individually so that the success and duration of effect of dart delivered GonaCon™ can be accurately assessed. These kangaroos will be treated with dart-delivered GonaCon™ (or placebo) in 2016.

Figure 3.2 Female Eastern Grey Kangaroos fitted with identification collars and eartags.

3.7 Kangaroo – grazing and biodiversity within Canberra Nature Park

Kangaroos are an integral part of native grassy ecosystems. At some sites in the ACT, kangaroos can occur at high densities, resulting in potential impacts on the local flora and fauna. In the northern ACT, many reserves and other sites contain native grassy ecosystems, including large areas of Lowland Natural Temperate Grassland and Yellow Box – Blakely's Red Gum woodland protected under the *ACT Nature Conservation Act 1980* and the *Commonwealth EPBC Act 1999*. These sites require active management of kangaroo populations in order to maintain a range of values within these landscapes (Figure 3.3).

CR is continuing to investigate the impacts of kangaroo grazing on ground layer vegetation structure and biodiversity. This program involves individually assessing: 1) relationships between kangaroo density and pasture off-take (at 5–6 reserves where kangaroo numbers are stable and most accurately determined); 2) relationships between localised kangaroo grazing pressure and pasture structure; and 3) relationships between ground layer pasture structure and measures of biodiversity (assessed at approximately fifty 1 hectare research plots throughout the landscape).

Figure 3.3 Heavy grazing by kangaroos at Aranda Snowgums.

To date, a large dataset describing pasture off-take, ground layer vegetation structure and floristic and reptile diversity from various locations within CNP has been collected. Additional pilot surveys of birds and small mammals were undertaken in 2014–15. Formal analysis of the full dataset awaits sufficient sampling to allow 'landscape scale' patterns to be detected above the strong influence of between-year differences in weather patterns (and hence grass growth). A subset of the dataset was used to describe the habitat preferences of the Striped Legless Lizard (*Delma impar*) in a paper accepted for publication in 2015 (Howland et al. 2015). Other preliminary observations include a strong increase in pasture off-take with increasing kangaroo density at the reserve scale and changes in both reptile and floristics diversity in response to ground-layer vegetation structure in some years. Small mammal footprints were detected in tracking tunnels predominantly in association with high grass herbage mass.

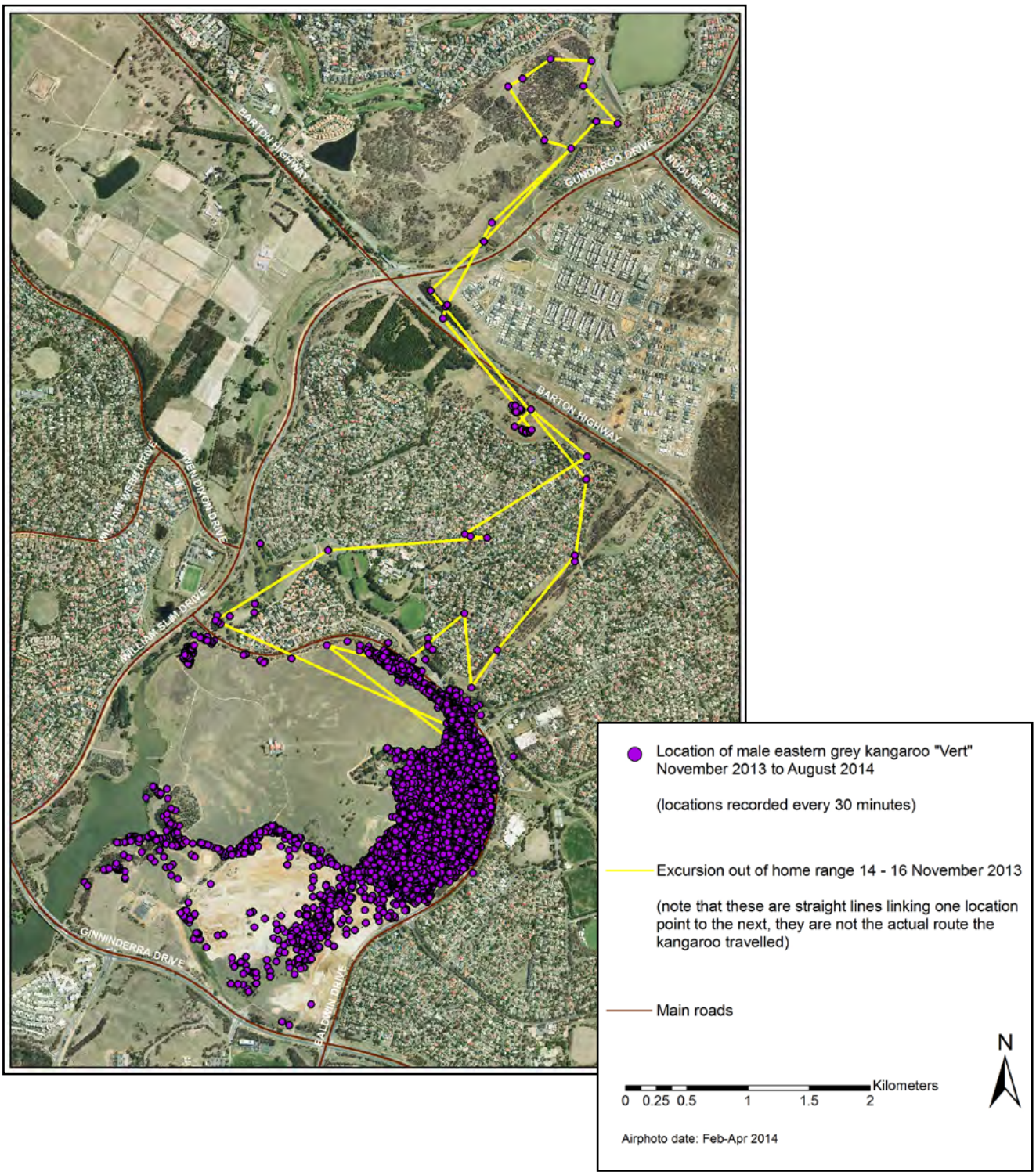
The details of this project's methods and key objectives can be found in the previous Conservation Research Program Report for 2011–13. Long-term data collected as a part of this study will enable government to make informed decisions regarding herbivore management for conservation at the landscape scale.

3.8 Kangaroo – monitoring at Lawson South

In 2013, Iridium GPS collars were fitted to 12 Eastern Grey Kangaroos at the site of the new suburb of Lawson in Belconnen. This two year study, funded by the Land Development Agency, aimed to investigate the response of the resident kangaroo population to the urban development. While excellent base line data exists on the movement behaviour and home range of kangaroos in Canberra, before this study it was unknown how the kangaroos would respond to urban development of their habitat.

The collars record the location of each collared kangaroo every 30 minutes and transmit the data to a website every 12 hours, allowing for intensive, near-real time tracking of the kangaroos. Although data analysis will be undertaken when the last of the collars automatically drops from the kangaroos in September 2015, patterns are apparent in the data. Previous research, including some conducted in Canberra, showed Eastern Grey Kangaroos are faithful to remarkably small home ranges for such large animals that are capable of such rapid and sustained movement. This study is showing that site fidelity in this species is even stronger than suspected from previous studies.

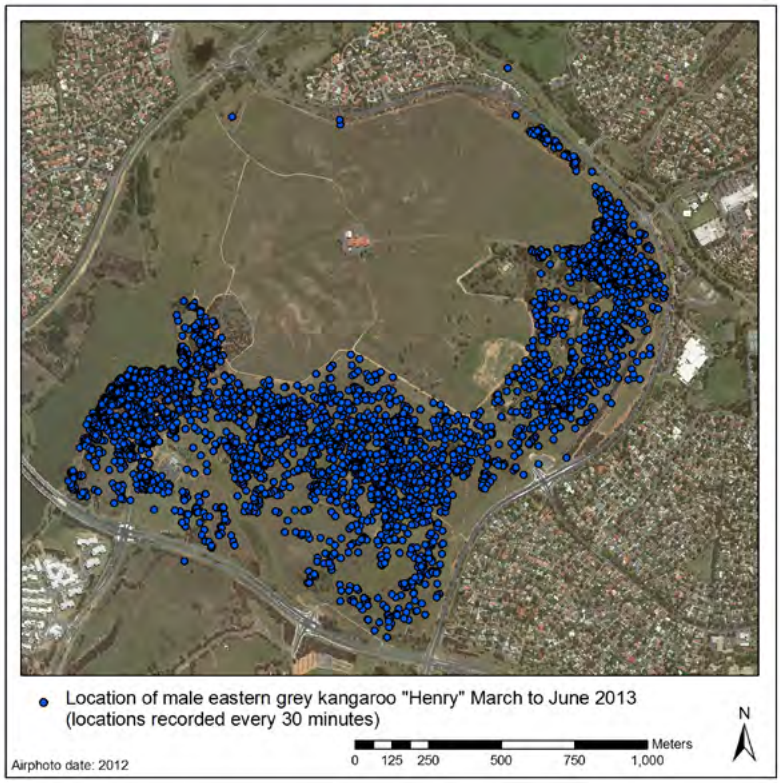
Figure 3.4 Excursion of a male kangaroo in November 2013.



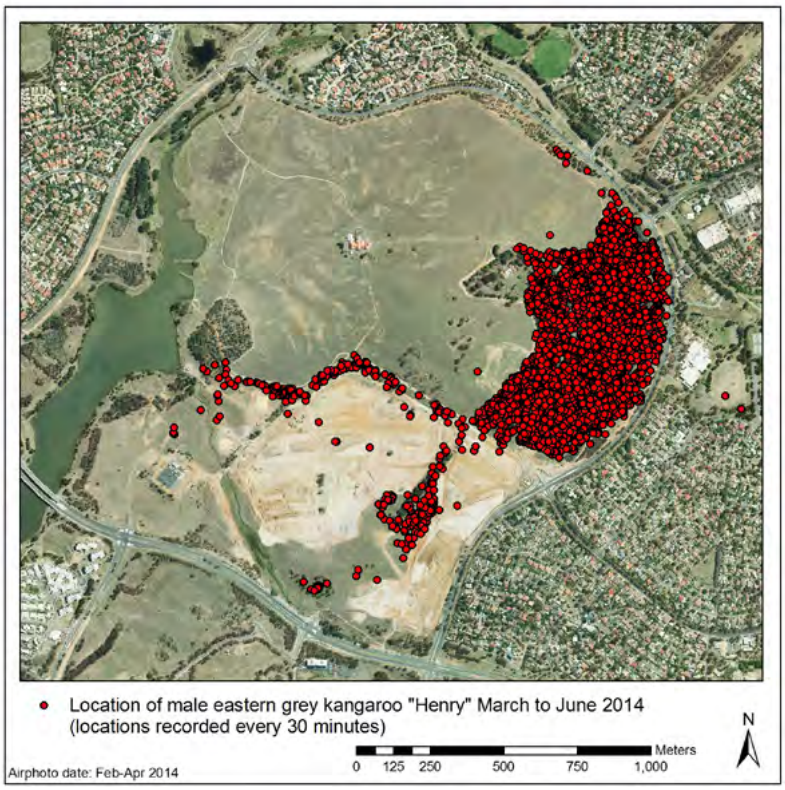
The kangaroo population has remained at Lawson South despite noisy construction machinery and extensive clearing of habitat. None of the collared kangaroos have permanently left the site, though some left the site for short periods. The longest and most interesting excursion off-site was by a male kangaroo that travelled in November 2013 through Kaleen and Giralang to the Percival Hill area, returning by a different route to Lawson. This excursion took 33 hours and he covered a distance of 12.9 km (Figure 3.4). This kangaroo has since made several other shorter excursions.

The population at Lawson has increased from 120 kangaroos in September 2012 to 166 kangaroos in November 2014. The kangaroos have modified their home ranges in order to avoid the construction areas (Figure 3.5); in some cases it appears they have reduced their home range size compared to before the development commenced. The kangaroos have not used the wildlife corridors to permanently move away from the site, nor have they fled the site on a daily basis in response to the construction machinery and attempted to return after construction ceases. While large areas of undeveloped land still exist on the site it appears possible the kangaroos will not attempt to move away. However, this could change when more houses are constructed and more residents and their dogs move into the suburb, or when a period of dry weather is encountered and the remaining habitat is no longer able to support the level of grazing now occurring.

Figure 3.5 Habitat use of a male Eastern Grey Kangaroo (a) before the commencement of development and



(b) during development.



4. SURVEY AND BASELINE INFORMATION

Conservation Research (CR) undertakes research projects (including survey and monitoring) to better understand ecological processes, the effects of management actions and, in some cases, to assess community views on particular aspects of conservation management. The aim is to provide information to land managers and government agencies that is underpinned by evidence and sound science.

4.1 Arboreal Mammal Spotlight Survey 2014

In 2014, CR collaborated with the Parks and Conservation Service in TAMS (PCS) to conduct an arboreal spotlighting survey in Namadgi National Park and Tidbinbilla Nature Reserve. The survey aimed to revisit sites surveyed after the 2003 wildfires and setup repeatable transects for a baseline for a long-term monitoring program.

The Technical Report: *Snape, M., Stevenson, B. And Evans, M. (2015) Arboreal mammal spotlight survey 2014* reports on the survey and is available on the EPD website www.environment.act.gov.au. The survey found a combination of spotlighting (from vehicles) and call-playback methods surveyed a range of species and increased detectability of the Yellow-bellied Glider, which is rarely sighted.

4.2 Animal ethics in research

Research activities involving animals require prior approval by a legally constituted Animal Ethics Committee (AEC). All large research organisations administer such a committee. The membership and conduct of the AEC must meet the requirements set out in the National Health and Medical Research Code of Practice 'Australian code for the care and use of animals for scientific purposes 8th edition' (http://www.nhmrc.gov.au/guidelines/publications/ea28) and must also comply with state or territory requirements such as the *ACT Animal Welfare Act 1992*. AECs require balanced numbers of each of four classes of members to be present at each meeting, including (A) veterinarians, (B) research experts, (C) members of community wildlife groups and (D) lay members of the community with no experience of animals or research.

Small organisations such as CR (representing biological research for which the ACT Government is responsible) are allowed by the Code to share with others in the AEC process. Given the expense of administering such a committee, the ACT Government has participated in the AEC at the University of Canberra and had research proposals evaluated there. In return, CR fills one of the Category B positions on the committee.

The AEC met 12 times in the period. Prior to the meetings members are provided with two kinds of applications to read: (i) applications and renewal applications for status as a person authorised to conduct research involving animals (90 in all including 43 from ACT Government); and (ii) applications for approval of research projects (46 in all including 11 from ACT Government). Projects are evaluated in two stages so that researchers have a brief opportunity prior to the meeting to respond by email to the initial questions and concerns from the committee. Five applications were withdrawn at this stage or remain pending.

During the period the university appointed a part-time veterinarian for animal welfare purposes. The veterinarian made numerous inspections of facilities and one field research visit to a project managed by CR.

4.3 Canberra Nature Map – Rare and uncommon plants in the ACT

In 2013 the ACT Flora and Fauna Committee established a draft list of 318 native plants considered rare and uncommon in the ACT. Of these, 4,000 existing plant records were collated by CR or Conservation Planning staff. Since 2013 the units have undertaken and supervised, in conjunction with TAMS Rangers and Parkcare and Bioblitz volunteers, targeted survey of ten of Canberra's nature parks. This has yielded a further 500 records of the rare and uncommon plants.

Volunteer Aaron Claussen attended two of the surveys and, following their completion, continued to provide CR's Dr Michael Mulvaney with many rare and uncommon records. With so many photos and GPS coordinates, Aaron needed a better way of managing his information and getting it to the ACT Government. Thus he developed Canberra Nature Map, an online database.

An observation is reported to the database by uploading an image from a smartphone or GPS enabled camera. The GPS location, date and author are automatically obtained during the upload. An observer also records abundance data and can suggest identification or leave it as unknown. Thirty-five volunteer and ACT Government experts moderate data entry and species identification for either a particular area (e.g. Black Mountain) or a plant group (e.g. Ferns). An observer is notified by email once identification is confirmed. Various mapping and database tools enable contributors to track their own records, view species distributions, or receive records for a particular reserve.

In the Canberra Nature Map's first year, over 200 people lodged 7200 plant and fungi reports including records of a further 2000 rare or uncommon species (40% of the total recorded over the previous 110 years).

Record highlights include:

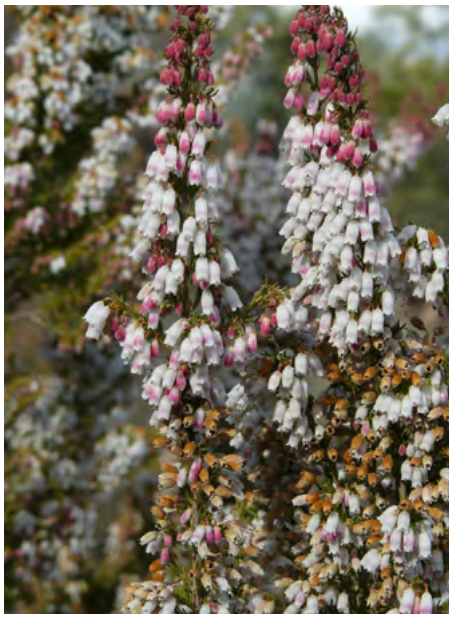
- three new populations of the endemic and endangered Canberra Spider Orchid
- new records for over a dozen species not recorded in the ACT for at least 50 years
- doubling or more the known ACT locations for over 30 rare plant species
- approximately 20 plants on the list are now found to be common
- new records of infestations of high risk weeds invading the ACT including of Spanish Heath, French Lavender, Clockweed, Cobblers Pegs, Sulphur Cinquiel, Moth Vine and Madeira Vine.

Canberra Nature Map is used daily in land management, development and conservation decisions. It has led to the eradication of new weed infestations, alteration in the timing or location of fire management activities, changes to development proposals and targeted conservation and restoration actions.

Currently, the map gets 1000 visits a day, 30,000 visits a month and over 300,000 hits a year. It is a widely used education and management resource. With the support of the ACT Government, the Canberra Ornithologist Group and the ACT Herpetological Association and other interested parties, Canberra Nature Map is being expanded to include birds, reptiles, frogs and butterflies.

Figure 4.1 **Trim Flat Sedge (*Cyperus concinnus*) previously only known in the ACT from a 1965 record from Reid. Now known through Canberra Nature Map from two locations on the Murrumbidgee.**

Spanish Heath (*Erica lusitanica*), plants on Farrer and Issaacs ridges have been destroyed following reporting.



4.4 Conservation Effectiveness Monitoring Program

The Conservation Effectiveness Monitoring Program (CEMP) aims to guide systematic assessment and evaluation of the condition of ACT nature reserves in response to management programs. The program provides a framework for linking biodiversity condition information with land management monitoring information to evaluate and report on the effectiveness of PCS programs in protecting biodiversity values in ACT nature reserves.

An initial review phase documented the extent of existing monitoring within the ACT reserve network, suggested an appropriate framework for monitoring at an ecosystem scale across eight broad ecosystems representative of natural environments in the ACT, and identified key gaps in existing monitoring programs that limit the ability to link conservation outcomes to ecosystem drivers and management effectiveness and decision making.

The program has progressed to the development of 'pilot' monitoring plans for two of the eight ecosystems. Draft plans have been developed for lowland native grasslands and for aquatic and riparian ecosystems. Development of these plans has been informed by expert reference groups consisting of PCS staff, EPD ecologists, university academics and community group representatives. Support for the project has been very high among the members of these groups and various other stakeholders including staff from PCS, EPD, ParkCare, ACT Conservation Council, ACT National Parks Association and university researchers.

Over the coming year, CEMP aims to complete the draft monitoring plans for lowland native grasslands and for aquatic and riparian ecosystems, develop monitoring plans for the remaining six ecosystems (lowland woodlands, lowland dry forests, upland montane grasslands, upland woodlands, upland forests, upland bogs and fens), develop detailed field protocols for selected indicators and metrics for each monitoring plan, and develop systems to compile, analyse and report on monitoring data to inform reserve management planning.

4.5 Eastern Bettong – current status of reintroduced population

The population of Eastern Bettongs (*Bettongia gaimardi*) introduced in 2010 to the fox and cat free Mulligans Flat Woodland Sanctuary (MFWS) achieved maximum performance for pouch occupancy, body condition and population growth rate. Quarterly trapping sessions, except in winter, revealed a population of 200 by the end of the period, with many of the original 32 founders still present. Only slight mortality has been observed.

The bettongs at MFWS have become a *de facto* ambassador species for conservation, with many political and community leaders having been introduced to them. Bettongs are frequently seen by the public and night tours run by the Capital Woodlands and Wetlands Trust are highly popular. A public relations campaign featuring 'Brian the Bettong' is being used by the Trust to attract public funding to extend the fox and cat free area and is giving a higher profile to both bettong conservation and Canberra, especially on Facebook, Twitter and Instagram.

It was originally assumed the sustainable capacity of MFWS was 100 to 200 bettongs. Work has commenced to consider the management of over-population, including establishment of an unfenced bettong population in an ACT area where foxes can be controlled. Discussions have commenced with interstate partners about the potential for experimental wild re-introduction of bettongs at those sites.

Eastern Bettongs were also introduced in 2010 to several large enclosures at Tidbinbilla Nature Reserve. This more intensively managed population has performed quite differently to the one at MFWS, with breeding slowed to almost zero. The 48 animals (from 28 founders) are being allocated into four different treatment groups, using active adaptive management to discern the reasons for the different population performance to those at MFWS.

4.6 Fire and fauna – linking fire and habitat structure across the ACT

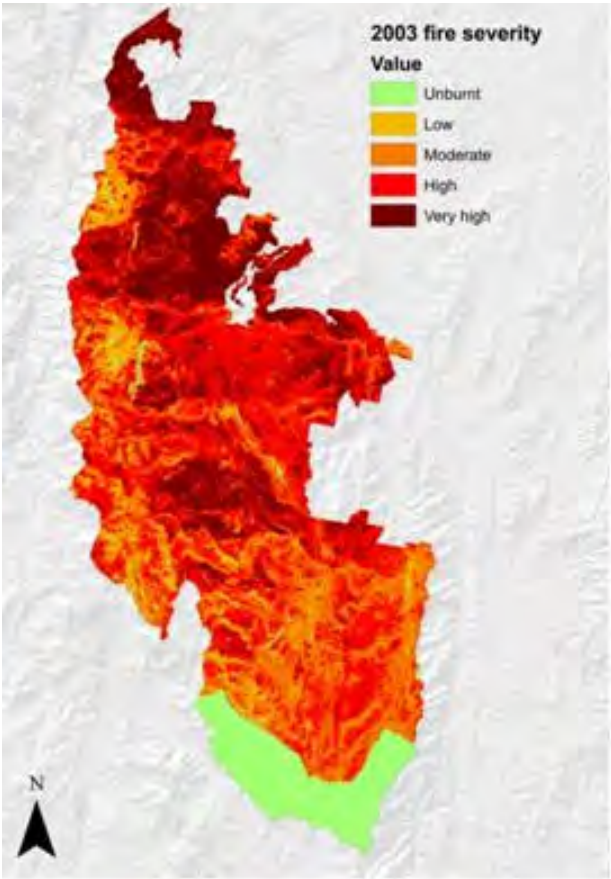
Fire management for conservation outcomes has largely been focused on the response of fire-sensitive plant species to wildfire and prescribed fire. Adopting a more comprehensive approach to biodiversity conservation requires that the ecological needs of fauna species also be considered in fire management and planning. CR is continuing research on the relationships between fire history, fauna diversity and abundance and habitat structure.

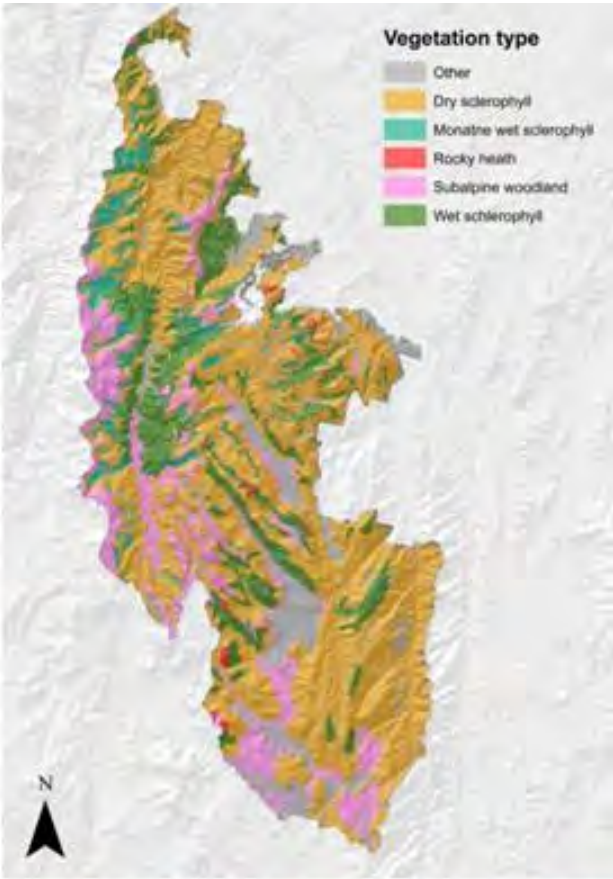
The fire–fauna research project includes field surveys of fauna diversity and habitat structure in a range of forested ecosystems throughout Namadgi National Park. Sites have been selected to represent a range of fire severity classes resulting from the 2003 wildfires as well as more recent prescribed fire and other environmental variables such as elevation, aspect and slope (Figure 4.2). To date 115 plots have been surveyed across four broad vegetation types; wet sclerophyll forest, montane wet sclerophyll forest, rocky heaths and subalpine woodland.

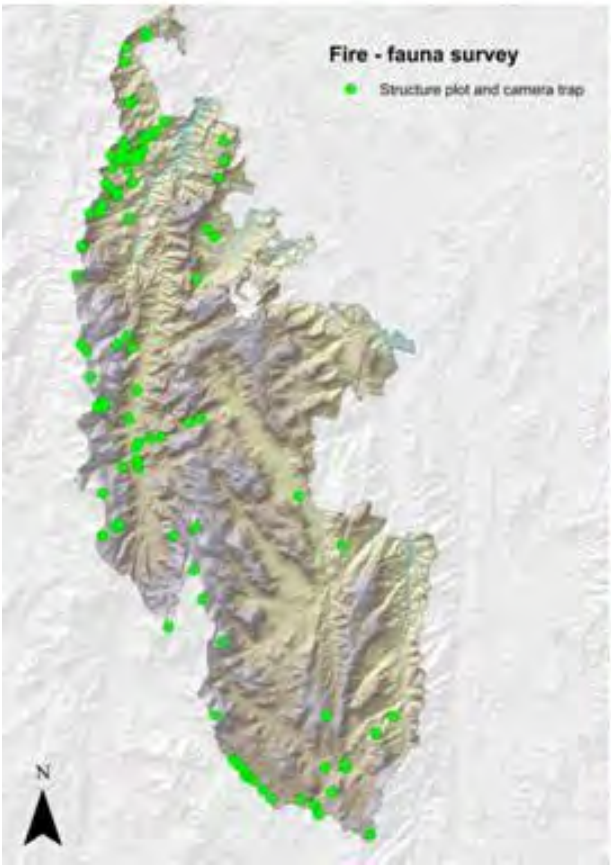
Preliminary data analysis has highlighted a clear legacy of the 2003 wildfires with habitat structure strongly linked to past fire severity in some ecosystems. Analyses also indicate the need for greater sampling effort in some vegetation and fire severity strata. Consequently, further surveys in 2015–16 will focus on increasing sampling density and on collecting data from dry sclerophyll forest. Sites within Namadgi National Park established as part of the Prescribed Burn Monitoring Program will also add data for the fire–fauna research project, further increasing sampling effort and providing data on the response of forest structure in montane ecosystems to subsequent burning.

The surveys will establish a relationship between fire severity, forest type, habitat values and fauna diversity. This understanding will feed into landscape scale modelling of biodiversity values and contribute to regional planning aimed at balancing conservation and fire management objectives.

Figure 4.2 Stratification maps of Namadgi National Park and staff surveying sites.







4.7 Longitudinal study of groundcover flora condition in select grassy ecosystem sites

In 2009 the Conservation Research unit commenced a project to measure floristic and vegetation structure attributes in lowland grassy ecosystems in a range of nature reserves and other areas of high conservation value. When collected over time, these measures can contribute towards the monitoring of ecosystem condition and potentially inform management practices. In the first year of data collection, 16 sites across the northern ACT region were selected for monitoring, encompassing 46 survey plots in lowland woodlands, grasslands and secondary grasslands. The 16 sites consisted of a range of land use types, including nature reserves, Department of Defence land and National Capital Authority land.

The plots were re-surveyed in 2012 and 2013, with Campbell Park added to the project in 2012 to replace Majura Training Area, which became difficult to access. In 2013 a further four sites were added to the project: Gungaderra Nature Reserve, Majura Nature Reserve, Mt Painter Nature Reserve and the Pinnacle Nature Reserve, bringing the total number of sites to 20 and encompassing 62 survey plots. In spring 2014, 24 survey plots were selected for re-surveying (Figure 4.3).

This data was analysed to examine trends in a range of floristic and vegetation structure attributes across these 24 plots. The data was analysed in two ways:

- Trends across plots, particularly in relation to vegetation structure type and year.
- Trends at the individual plot level.

Year to year differences were largely confined to the following:

- 2009: higher cover of bare earth, lower cover of perennial exotic grass within grassland plots, and higher cover of cryptogams within grassland plots.
- 2012: lower litter/dead vegetation cover than other years.
- 2014: lower cover of native perennial grass, and higher cover of annual exotic grass and exotic broadleaf compared to 2013.

Overall, there were more differences detected between vegetation structure types, particularly in relation to non-living structure categories:

- Woodlands: higher cover of litter/dead vegetation, higher cover of bare earth (cf. grasslands).
- Grasslands: low cover of rock, higher cover of perennial exotic grass, higher cover of exotic broadleaf (cf. woodlands).

Figure 4.3 Location of the 24 plots surveyed in 2014 across the northern ACT region.

Plot by plot trends were:

- The majority of plots exhibited relatively small percentage changes (less than +25%) in their Floristic Value Score (FVS) and native species richness between surveys (Table 4.1 (a), (b)). In particular, the majority of plots had relatively stable native species richness between years (Table 4.1 (b)): 73% of plots remained stable between 2009 and 2013; 79% plots remained stable between 2012 and 2013; and 92% of plots remained stable between 2013 and 2014.
- Between 2013 and 2014 there were slightly more plots (8 out of 24) that experienced declines in their FVS of over 50%, compared to the other two time periods (3 out of 19 plots) (Table 4.1).
- In contrast, a larger number of plots fluctuated in exotic species richness (Table 4.1(c)). Between 2009 and 2012, 11 out of 19 sites had an increase in exotic species richness of over 25%; whereas between 2012 and 2013, nine out of 19 sites declined in exotic species richness of over 25%. Between 2013 and 2014, exotic species richness tended to increase again with 16 out of 24 sites increasing by over 25%.

Table 4.1 Summary of percentage changes in floristic variables for plots: (a) Floristic Value Score; (b) Native species richness; and (c) Exotic species richness.

(a) FVS	**Plots**		
	2009–2012	2012–2013	2013–2014
>-100% decline	0	0	0
-100% to-50% decline	1	1	3
-50% to-25% decline	2	2	5
-25% decline to 25% increase (relatively stable)	11	13	13
25%- 50% increase	3	3	3
50% to 100% increase	2	0	0
> 100% increase	0	0	0
Total	19	19	24

(b) Native Species Richness	**Plots**		
	2009–2012	2012–2013	2013–2014
>-100% decline	0	0	0
-100% to-50% decline	0	0	1
-50% to-25% decline	1	2	0
-25% decline to 25% increase (relatively stable)	14	15	22
25%- 50% increase	4	2	1
50% to 100% increase	0	0	0
> 100% increase	0	0	0
Total	19	19	24

(c) Exotic Species Richness	Plots		
	2009–2012	2012–2013	2013–2014
>-100% decline	0	1	0
-100% to-50% decline	1	6	0
-50% to-25% decline	1	2	0
-25% decline to 25% increase (relatively stable)	6	9	8
25%- 50% increase	10	1	13
50% to 100% increase	1	0	3
> 100% increase	0	0	0
Total	19	19	24

The main conclusions from the analysis were:

- Overall, native species richness and the FVS remained relatively stable (less than +25% change) at most plots. Native species richness was the least responsive metric for detecting changes.
- Trends in the FVS were driven by the presence or absence of several Indicator Species, particularly Indicator Species 2, as well as their relative abundance. This suggests it is important to continue monitoring the occurrence and abundance of these species.
- Exotic species richness fluctuated to a greater degree, especially between 2013 and 2014 with two-thirds of plots showing a > 25% increase. Cover of exotic annual grasses and exotic broadleaves also increased significantly between 2013 and 2014. Some sites had an increase in significant weed species richness in 2014, although numbers remained low.
- Plots that showed considerable declines in both native species richness and the FVS during the most recent survey period (2013-2014) were:
  - DU02 (Dunlop Nature Reserve)
  - JW02 (Jerrabomberra West Nature Reserve, inside the exclosure)
  - GG02 (Googong Foreshores), where plant death and senescence were observed
  - PA01 (Mt Painter Nature Reserve).
- Several floristic and vegetation structural differences were identified between woodlands, secondary grasslands and grasslands, suggesting that future monitoring efforts should continue to consider them separately. Differences included species composition (with woodlands and secondary grasslands grouped together separately from grasslands, when ordinated); native species richness; Indicator Species 2 richness; the FVS; litter/dead vegetation cover; and bare ground cover.
- Some changes were associated with years; in particular 2009 had a higher cover of bare ground.

4.8 Long-nosed Bandicoot

Long-nosed bandicoots (*Perameles nasuta*), thought to have been extinct in the ACT long ago, were rediscovered in early 2015 when a road-killed carcass was found by a ranger beside Corin Dam road. The dead individual at first appeared peculiar, being substantially larger than the published size range for the species, but specimens as large were present in the Australian National Wildlife Collection, where this carcass was deposited. Funding and Animal Ethics approval will be sought for a future survey in the area (using methods that search for evidence of animal diggings and baited camera traps). Meanwhile, the possibility of volunteer surveys will be investigated.

4.9 Monitoring native and introduced wildlife by spotlight counts

The longest-running ACT wildlife research program is the spotlight counting by PCS staff, with technical support by CR. In this one monitoring program, abundances of twelve species are monitored, including species of the highest significance for conservation of ACT flora and fauna.

Some of the most important results for managers have been obtained from the data on species incidental to the original rabbit-related purpose for which the counts were commenced, such as Dingoes, Red-necked Wallabies and Eastern Grey Kangaroos. The value of the data, particularly its long-term recording period, is a strong reason for continuing the monitoring. The primary action by CR in this reporting period was provision of database assistance to PCS.

4.10 Mountain Spiny Crayfish of the ACT

Euastacus spiny crayfish (Figure 4.4) are endemic to eastern Australia and are distinguished from other crayfish, such as Cherax "yabbies", by large spiny claws or chelipeds and often have spines on the thorax and abdomen. The ACT has three species of *Euastacus* "spiny" crayfish. Two of these are montane species, *Euastacus rieki* and *Euastacus crassus*, inhabiting the streams and bogs in the mountain areas of the ACT. Relatively little is known about their biology or distribution in the ACT, however, they are known to require permanent water, be restricted by cool temperature and suspected of being long lived. Based on their habitat requirements, these two species are likely to be highly susceptible to the impacts of climate change, including increases in temperature and reduction in water availability. In addition, both species are listed as threatened or protected by other jurisdictions and at least one of the species is known to inhabit the endangered ecological community of the sphagnum bogs and fens, such as Ginini Flats, where they may play important roles in nutrient cycling and physical structure of the bogs.

This project was designed to trial potential methods of capture to detect crayfish and measure habitat for a wider distribution survey. Various methods of bait trapping and spotlighting were trialled at 12 sites surveyed between March and May 2014. Four sites were resurveyed at least once. A total of 52 spiny crayfish were caught from six of the sites; 19 *E. rieki* were collected, 17 from bog habitats and 2 from creeks, and 33 *E. crassus*, were collected from creek sites. No site was surveyed where both species were present. A number of sites were surveyed where no crayfish were recorded, particularly along the Cotter River, and three of the six sites that recorded crayfish only recorded one individual per visit. This indicates the populations of crayfish may be patchy and additional surveys will be required to define their distribution.

Figure 4.4 ***Euastacus crassus.***

Bait trapping in both creeks and bogs was the most effective method to capture *E. rieki* and *E. crassus*, catching 94% of crayfish in creeks and 65% in bogs. Spotlighting was also effective in bogs, recording the remaining 35% of crayfish, but not effective in creeks, with no crayfish being recorded using this method. There were no significant differences in the time of day or night the traps were set, allowing the distribution survey to be designed more efficiently for use of staff time and equipment.

The highlight of the survey was the recording of an egg-carrying (berried) female *Euastacus rieki* (Figure 4.5). This is the first time that any breeding characteristic of this species have ever been observed. Two large females were recorded from Snowy Wetland (both over 40 mm occipital carapace length (OCL)), and with 70-100 orange oval eggs. This indicates this species, like other *Euastacus* species, carry their eggs and juveniles over winter, despite the snow cover and frozen pool surfaces in the subalpine bogs.

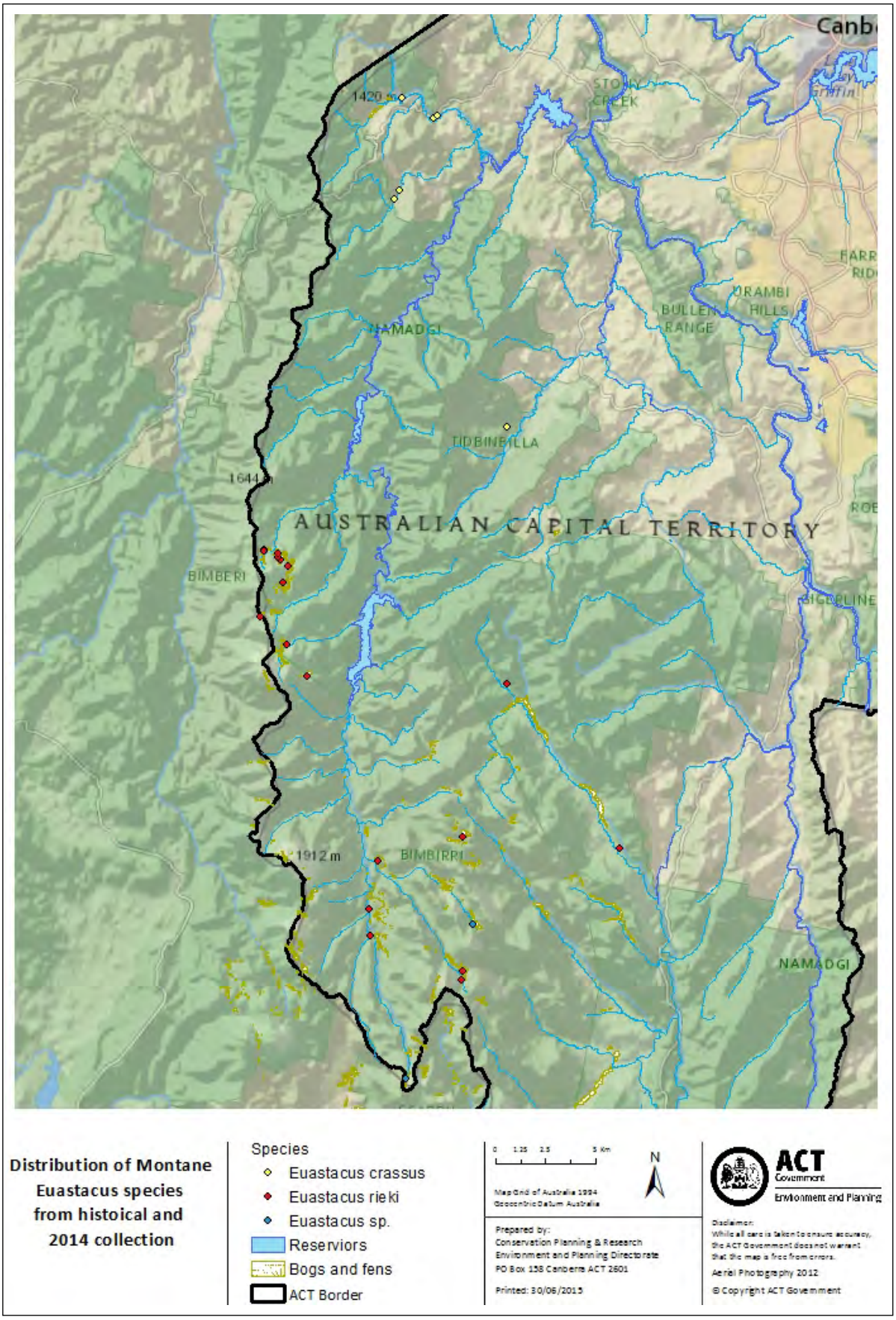
Figure 4.5 **Egg carrying (berried) female *Euastacus rieki.***

Laboratory identification of the crayfish collected in this study and previous opportunistically collected crayfish showed that external physical features were not particularly informative in determining species of crayfish. However, one internal feature was always distinctive and external colour, along with claw morphology, were also reasonably distinguishable. The distribution of the confirmed records of each species is shown below (Figure 4.6).

Additional investigation of techniques has been recommended to assess bias in collection methods and issues with escape from bait traps and quantitative survey. A broader distribution survey is planned for 2015–16 to determine the range of both species in the ACT. It is recommended this survey use overnight bait trapping to detect the presence of crayfish in creeks and use spotlighting in bogs as available.

This project was funded by the EPD Climate Change section and has been publicised on a specialist crayfish research blog and presented at the 2015 Eco Focus forum.

Figure 4.6 Distribution of confirmed records of *E. crassus* and *E. rieki* in the ACT.



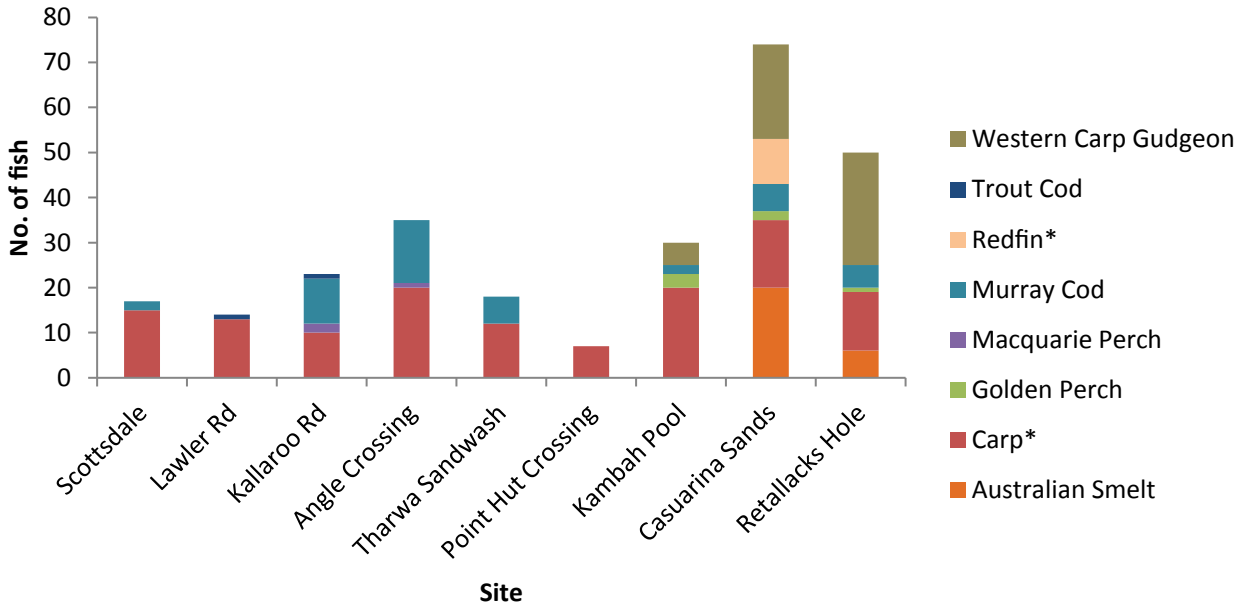
4.11 Murrumbidgee River fish monitoring

The Murrumbidgee River is the largest river in the Canberra region. It is impacted by a large number of current and historic threats in the ACT and upper catchment. These threats include water extraction and flow modification, erosion and sedimentation, degraded riparian vegetation, urban and rural pollution and invasive species. The Murrumbidgee still supports a number of native fish species, including threatened species such Trout Cod, Macquarie Perch and Murray Crayfish, and recreationally important species such as Golden Perch and Murray Cod (listed as Special Protection Status in the *ACT Nature Conservation Act 2014* and vulnerable nationally in the EPBC Act). The river is also part of the water supply network for Canberra, with both the Cotter Pump Station and the recently completed Murrumbidgee to Googong Pipeline (M2G) able to extract water from the river.

The Murrumbidgee Fish Monitoring program is undertaken biennially to monitor the fish populations in the Murrumbidgee River in the ACT region and inform management of threatened, pest and recreational fish species. In 2015 nine sites on the Murrumbidgee River were surveyed. The six sites within the ACT form part of the ACT Government's long term monitoring of the Murrumbidgee River. The other three sites are upstream of the ACT and, with several of the ACT sites, are surveyed as part of an ongoing baseline for Icon Water's M2G Pipeline Project. Many of the sites are within the Upper Murrumbidgee Demonstration Reach.

In 2015, 269 fish were captured from eight species including two ACT threatened species (Trout Cod and Macquarie Perch) and four pest species. Capture methods included boat electrofishing, overnight netting with fyke nets and bait traps. Figure 4.7 shows the numbers of fish caught for each site. Carp are present at all sites although in lower numbers than 2013. Nationally or ACT listed threatened species were recorded at all sites except Point Hut Crossing, which is affected by habitat degradation and fish passage barriers. Cod (either Trout Cod or Murray Cod) were recorded at all sites except Point Hut, and were well represented as juveniles. Macquarie Perch were recorded at the southern end of the ACT border and at a site further south in NSW, suggesting they successfully breed upstream of the ACT. Unfortunately, Macquarie Perch were not captured at Casuarina Sands or downstream, as they were in the 2013, suggesting that ongoing survival after fish were displaced from Cotter Dam is limited.

Figure 4.7 Number of fish caught during the 2015 Murrumbidgee River Monitoring (* indicates alien species). Sites are in order of upstream to downstream.



4.12 Southern Brown Bandicoot

The previous edition of this report mentioned an unsuccessful survey for this species. No further records of Southern Brown Bandicoots (*Isoodon obesulus obesulus*) came to notice in the ACT during the current period.

4.13 Vegetation mapping – eastern ACT

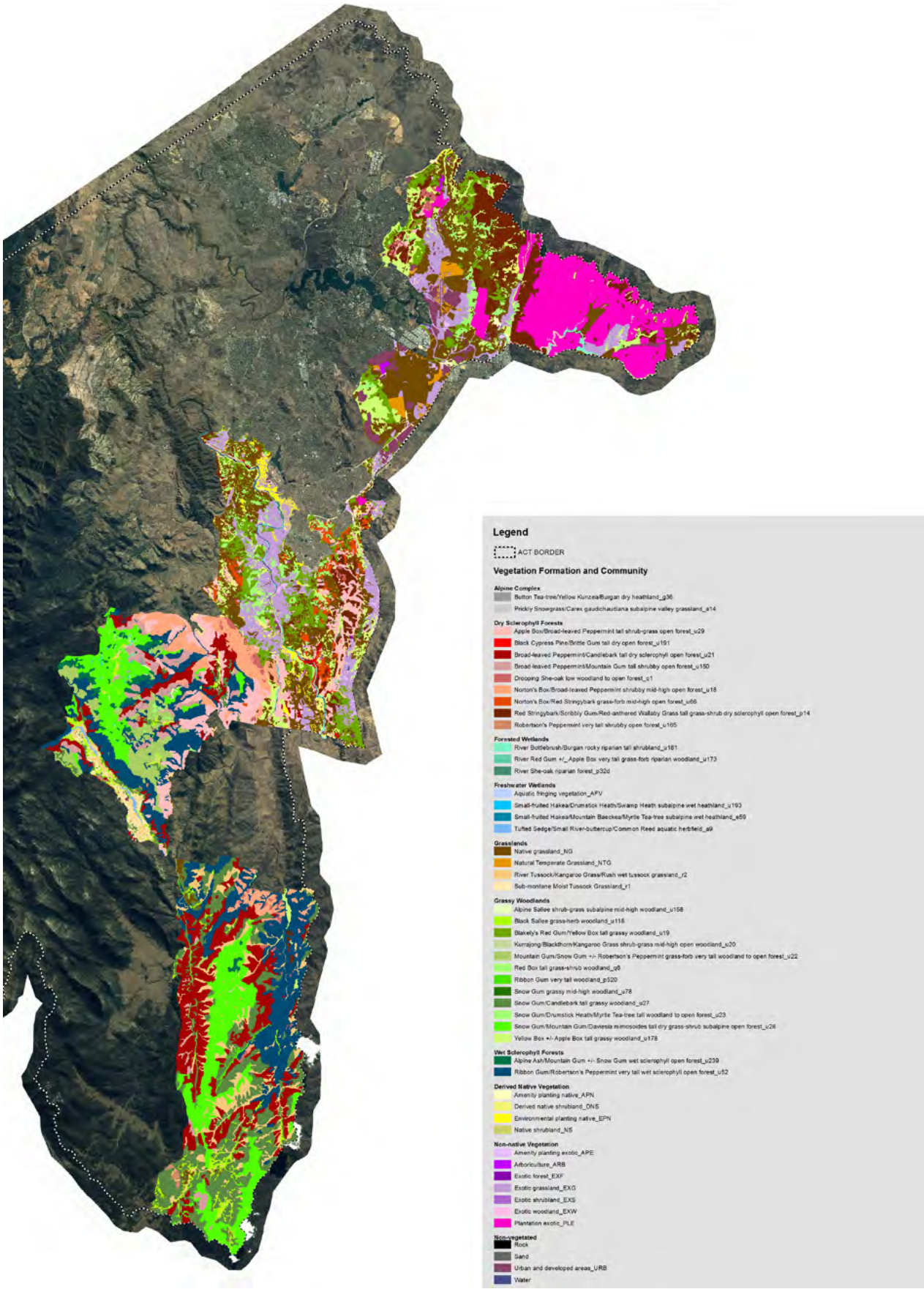
Mapping of the ACT's vegetation commenced in 2012 with the aim of producing a map that will meet the requirement of Product Class 5: Fine Classification/High Spatial Resolution/Full Floristics (as defined in the NSW Strategy for Vegetation Type Classification and Mapping, 2009). To date the project has mapped 73,740 hectares of the ACT, classifying the vegetation into 51 different mapping units including 33 native vegetation communities and a number of other classes of non-native vegetation and disturbed native vegetation (Figure 4.8).

The most widespread mapping unit is Native Grassland, which covers 9108 hectares. This mapping unit comprises a mixture of sites dominated by native grasses that may have been naturally treeless or may have been derived from woodlands or forests by clearing. The next most common mapping units are Ribbon Gum–Robertson's Peppermint wet sclerophyll forest (6859ha) and Snow Gum–Mountain Gum–*Daviesia mimosoides* sub-alpine forest (5954ha). Of the 33 native vegetation communities mapped in the project a total of 11 have distributions of less than 100 hectares. An assessment of the first 20,000 hectares of the mapping displayed an overall accuracy of 83%, with user accuracy (the probability that a randomly selected point classified as mapping unit 'x' by the map is found to be mapping unit 'x' by the user) varying from a low of 20% for Apple Box–Broad-leaved Peppermint dry sclerophyll forest to a high of 100% for Blakely's Red Gum–Yellow Box grassy woodland. These accuracy figures are preliminary and will change as the mapping progresses, but they provide valuable feedback on the mapping method.

The mapping is currently being used in the assessment of proposed fuel reduction activities, development assessment and the planning of fauna surveys.

Mapping of Namadgi National Park will be completed by June 2016, while mapping of the Naas Valley leasehold area will be completed by December 2016. Funding has yet to be allocated to map the lower Cotter area north to Goorooyaroo Nature Reserve (approximately 70,000 ha).

Figure 4.8 Vegetation mapping of the ACT as at June 2015.



5. ECOLOGICAL RESTORATION

Ecological restoration is the process of repairing damage to ecosystems to restore ecosystem composition, structure and function. In a practical sense, successful restoration requires a good understanding of the ecological deficiencies in the damaged ecosystem and the development of a program for carrying out restoration within a scientific or adaptive management framework so that success and failure can be evaluated.

5.1 Casuarina Sands fishway

Barriers to fish passage such as dams, weirs and road crossings are a threat to native freshwater fish. Fish need to move for many reasons including to breed, maintain population diversity, access refuge areas during drought and re-establish following disturbances. The ACT has a number of barriers to fish passage and four of them have fishways to allow fish to move through the barrier.

A vertical slot fishway was constructed on the Casuarina Sands Weir on the Murrumbidgee River when the weir was replaced in 2000 but it has been unclear whether it is effective. A project in 2013 found the fishway to be non-functional for passing fish, especially at lower flows when passage through the fishway would be more critical. Using funding from the Darling Basin Authority through the Upper Murrumbidgee Demonstration Reach initiative, a fishway designer was funded to assess the fishway and determine design modifications to improve its function. These modifications should be in place for the spring breeding season.

Figure 5.1 Casuarina Sands weir and fishway (left) and Golden Perch with dorsal tag (right).

5.2 Tharwa fish habitat project - Engineered Log Jams at Tharwa

Prior to upstream European occupation, the Murrumbidgee River channel past Tharwa would have predominantly had a base of pebble, cobble and bedrock that would have allowed fish passage and provided habitat for fish. A 'sand slug' derived from upstream clearing and erosion has substantially reduced river channel depth in the Tharwa vicinity and smothered structural fish habitat (Figure 5.2). In 2009–10 a consultancy report advised ways to manage the sand problem in the Upper Murrumbidgee Demonstration Reach, recommending installation of Engineered Log Jams (ELJ) to improve fish passage and habitat. 2013 saw the construction of two ELJ with the primary objectives of increasing river channel depth past the structures, improving fish passage and habitat in the area.

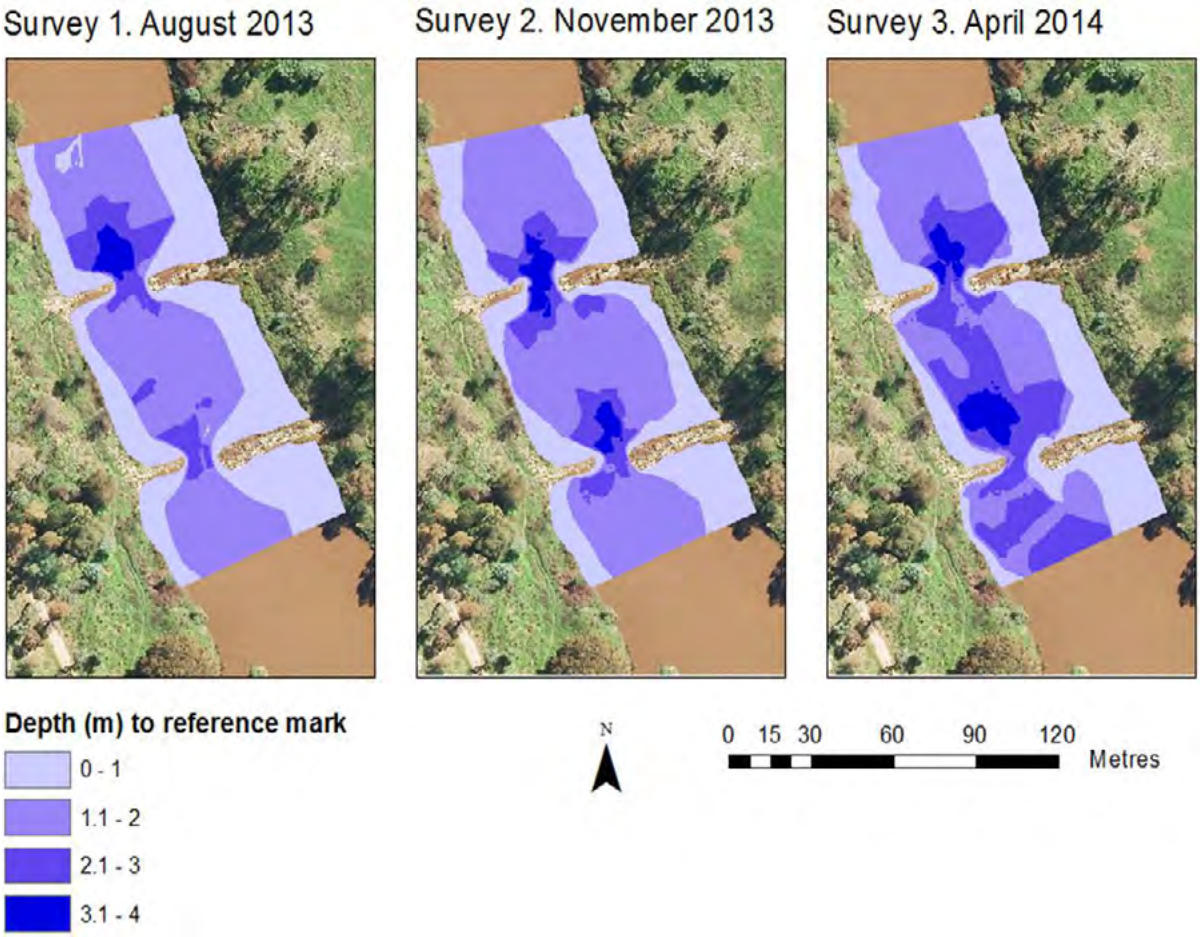
Figure 5.2 The Murrumbidgee River past Tharwa showing a channel significantly affected by sand. Image Google Earth 2002.

Figure 5.3 Engineered Log Jams a year after construction (2014).

The darker patches of water show the deeper water sections that have developed since ELJ construction (Figure 5.3).

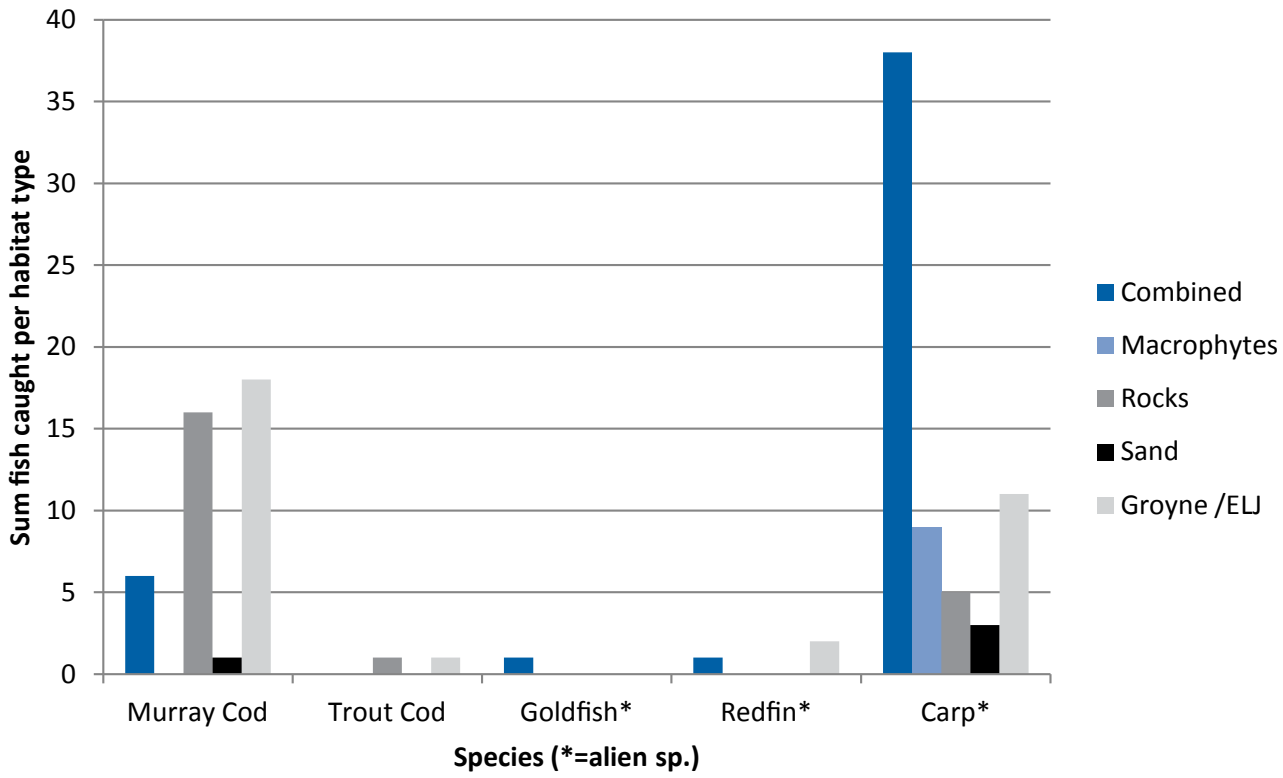
Sonar bathymetric monitoring of the structures since construction has found the ELJs to be successfully increasing the water depth through the river section where they were installed from approximately 45 centimetres to over 2 metres by increasing the velocity past ELJs and consequently sand scour rates (Figure 5.4). The Bathymetric surveys over time also show a slight improvement to the area with increasing depth.

Figure 5.4 2014 Bathymetric survey of the Murrumbidgee River past Tharwa at the ELJs.



The ELJs and nearby sites were sampled using boat electrofishing in 2014 and 2015 to look at the structures' effect on fish numbers. Sites sampled to assess the effect from the installation of the ELJs on fish populations included the reach near Tharwa where they were constructed, upstream at Tharwa Sandwash and downstream at Point Hut Crossing. The 2014 survey found that Murray Cod are the dominant species around the ELJs and groyne habitats and in rocky areas (Figure 5.5). In the ELJs, groynes and rocky areas, cod numbers are greater than carp. This is suggesting that in the absence of rocky habitat in this area of the Tharwa sand slug, cod have limited access to suitable habitat. When new rocky or woody habitat (i.e. ELJs/groynes) is introduced cod are attracted to and continue to exist around the introduced habitat. The introduced structural habitat appears to be less suitable for carp, however carp are still found in macrophyte and combined habitat areas (Figure 5.5).

Figure 5.5 Number of different fish species per habitat type sampled for the 2014 ELJ monitoring. 'Combined' habitat is a mix of habitat types, the 'groyne/ELJ' habitat are constructed habitats in the Tharwa reach.



6. RECREATIONAL ANGLING

6.1 Recreational fisheries stocking and monitoring

The ACT Government conducts an annual fish stocking program in accordance with the ACT Region Fish Stocking Plan 2015–20. In 2013–14, 18,730 Murray Cod were stocked into Lake Tuggeranong, 11,000 Murray Cod were stocked into Yerrabi Pond, and 20,636 Golden Perch were stocked into Gungahlin Pond. In the 2014–15 season, 39,000 Murray Cod were stocked into Lake Ginninderra.

Monitoring of the Canberra region stocked recreational fisheries is a rolling project that surveys the stocked lakes on a biennial basis using boat electrofishing. Monitoring of the fish communities provides data on the proportion of pest species, identifies growth and success of stocking events, identifies natural breeding events and allows for the detection of disease outbreaks and new pest species. CR surveyed Yerrabi Pond (two sites) and Lakes Tuggeranong (two sites) and Ginninderra (three sites) in the 2013–14 and 2014–15 field seasons.

The Fish Stocking Plan for the Australian Capital Territory was updated and reviewed in 2014. It outlines the numbers and species of fish to be stocked across the ACT for 2015 to 2020 and provides guidance for other stocking activities that may take place, such as research or conservation stockings. The Stocking Plan can be found at http://www.environment.act.gov.au/cpr/fish/fisheries_management/fish-stock-plan-for-the-australian-capital-territory-2015-2020

Figure 6.1 Murray Cod being measured during urban lake monitoring.

Figure 6.2 Capture of carp using boat electrofishing at Lake Ginninderra.

Figure 6.3 Boat electrofishing at Yerrabi Pond.

During monitoring of fish stocking at Yerrabi Pond, 327 fish were recorded from two native and three introduced species (Figure 6.4). Redfin were the most abundant species, comprising 65% of the total catch by number but due to their small size, only 5% of the biomass(Figure 6.5). Carp comprised 68% of the total biomass and this figure is likely to increase in future surveys. Carp were initially detected in Yerrabi Pond only in 2010 (Figure 6.6). The 2011–12 survey indicated the carp biomass in that waterbody at 18%, but that figure increased to 44% in the latest survey.

Figure 6.4 Fish caught during 2015 Urban Lakes Surveys.

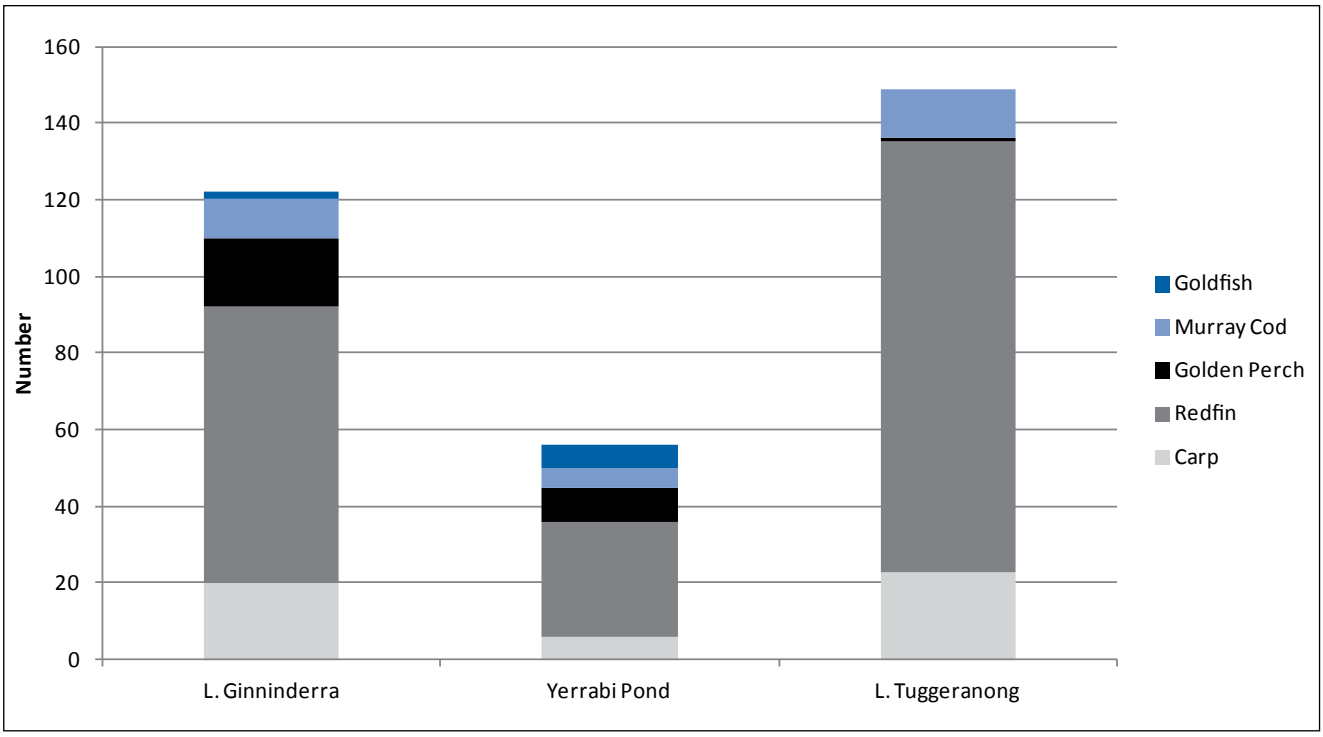
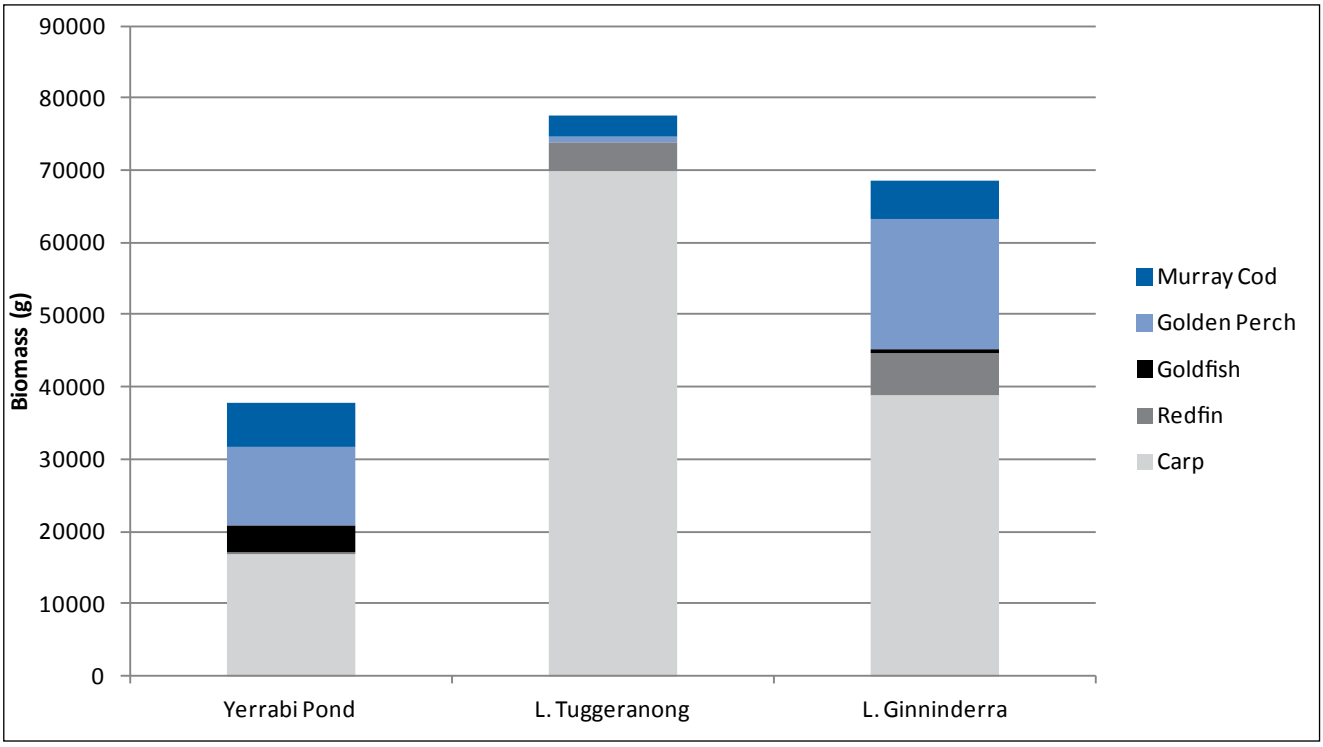


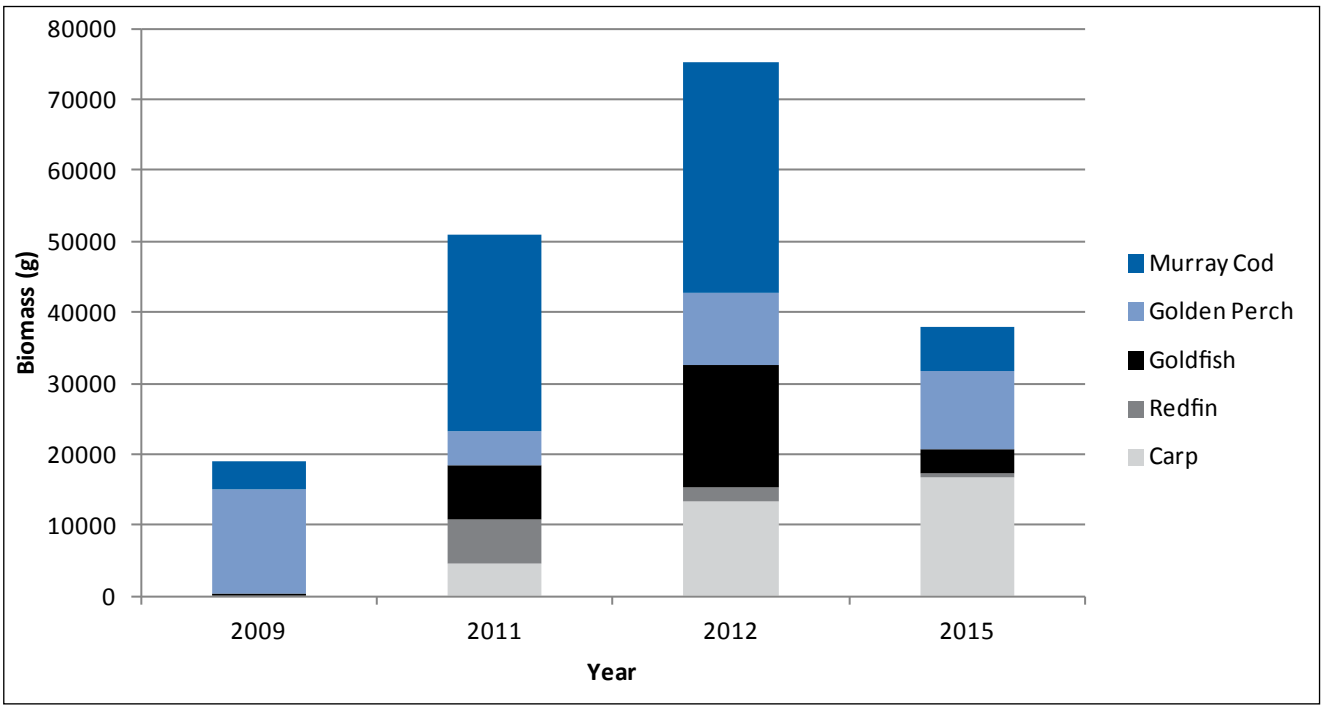
Figure 6.5 Biomass of Fish Caught During 2015 Urban Lakes Surveys.



In surveys of the urban lakes, the native angling species of Murray Cod and Golden Perch were detected in each of the sampled waterbodies (Figures 6.4 and 6.5). Twenty, out of a total of 28 Golden Perch, were above the minimum legal angling size of 30 centimetres with two fish above 50 centimetres.

In September 2014 a fish kill occurred in Yerrabi Pond, with over 100 moderate to large sized Murray Cod dying. This event is the likely cause of the decline in biomass of this species in the 2015 survey (Figure 6.6). It is also the cause of the rise in percentage terms of total biomass of Carp in the lake (Figure 6.6). Despite the removal of this number of Murray Cod, Yerrabi Pond still had the largest biomass of this species of any of the urban lakes surveyed.

Figure 6.6 Biomass of fish in Yerrabi Pond since introduction of electrofishing.



7. CONSERVATION PLANNING

7.1 Biodiversity advice

Conservation Planning and Conservation Research provide biodiversity information and advice on development proposals and planning processes, including major infrastructure projects, potential solar farm sites, residential and industrial developments, tourist and recreational facilities, on-reserve activities, structure plans, environmental management plans for construction and development control plans.

Advice is given on the biodiversity values present, how they may be impacted by the development and how the proposal could be altered, or an alternative approach taken to avoid significant adverse impacts. In situations where impacts are unavoidable, advice is provided on how these impacts can be minimised. Only after options to avoid and minimise impacts have been exhausted will advice be provided on how impacts may be best offset.

8. PLANS OF MANAGEMENT

Conservation Planning prepares plans of management for areas of public land within the conservation estate. A management plan outlines the values of an area and the policies and actions which aim to protect these values. It provides guidance to the ACT Government's park management agency and indicates to the ACT community and park visitors the primary objectives in managing the land. Plans of management are required under the *Nature Conservation Act 2014*.

8.1 Canberra Nature Park Reserve Management Plan

A new management plan is being prepared for Canberra Nature Park. A review of the current plan (released in 1999) and recommendations from the Commissioner for Sustainability and the Environment's investigation report into Canberra Nature Park are guiding the development of the new plan. The new plan will include:

- International Union for Conservation of Nature (IUCN) categorisation of reserves
- actions to improve condition and resilience
- implications of climate change
- opportunities for recreation, education and research, such as the Centenary Trail and Woodland Conservation Trust
- actions to strengthen community awareness and involvement, including through ParkCare.

8.2 Lower Cotter Catchment Reserve Management Plan

Work has commenced on a management plan for the Lower Cotter Catchment. The Auditor General's report on the Restoration of the Lower Cotter Catchment recommended including:

- incorporation of the elements of a Catchment Management Plan as articulated in the Australian Drinking Water Guidelines
- a clear statement of responsibilities of different agencies and agreed coordination processes
- definition of appropriate low impact recreational activities based upon a risk assessment.

Other key inclusions will be on management of pine plantations, management of fire risk, and consideration of management zoning.

8.3 ACT Sphagnum Bogs and Fens Management Plan

An ACT Bogs and Fens Management Plan is in preparation. Alpine Sphagnum Bogs and Associated Fens is a nationally endangered ecological community. The plan will address all ACT bogs and fens, which are mainly located within the Namadgi National Park. The plan will also meet the requirements of a Ramsar wetland management plan, as outlined in the *Nature Conservation Act 2014*, for the Ginini Flats Wetlands Ramsar site.

Appendix 1. List of Current Action Plans and Threatened Species

Action Plan No. and Name	Threatened Community and/or Species covered in the Action Plan	Date
Action Plan 5	A Subalpine Herb (*Gentiana baeuerlenii*)	1997 (Under review)
Action Plan 6	Northern Corroboree Frog (*Pseudophryne pengilleyi*) Revised Edition	1997–2011
Action Plan 22	Brush-tailed Rock-wallaby (*Petrogale penicillata*) Revised Edition	1999–2015
Action Plan 23	Smoky Mouse (*Pseudomys fumeus*)Revised Edition	1999–2013
Action Plan 27 Woodlands for Wildlife *ACT Lowland Woodland Conservation Strategy*	**Threatened Ecological Community** Yellow Box–Red Gum Grassy Woodland **Threatened plant species** Tarengo Leek Orchid (*Prasophyllum petilum*) Small Purple Pea (*Swainsona recta*) Austral Toadflax (*Thesium australe*) Hoary Sunray (*Leucochrysum albicans var. tricolour*) **Threatened animal species** Hooded Robin (*Melanodryas cucullata*) Brown Treecreeper (*Climacteris picumnus*) White-Winged Triller (*Lalage sueurii*) Varied Sitella (*Daphoenositta chrysoptera*) Painted Honeyeater (*Grantiella picta*) Regent Honeyeater (*Xanthomyza phrygia*) Superb Parrot (*Polytelis swainsonii*) Swift Parrot (*Lathamus discolor*)	2004
Action Plan 28 Vision Splendid of Grassy Plains Extended *ACT Lowland Native Grassland Conservation Strategy*	**Threatened ecological community** Natural Temperate Grasslands **Threatened plant species** Button Wrinklewort (*Rutidosis leptorrhynchoides*) Ginninderra Peppercress (*Lepidium ginninderrense*) **Threatened animal species** Striped Legless Lizard (*Delma impar*) Grassland Earless Dragon (*Tympanocryptis pinguicolla*) Golden Sun Moth (*Synemon plana*) Perunga Grasshopper (*Perunga ochracea*)	2005 (Under review)
Action Plan 29 Ribbons of Life ACT Aquatic Species and Riparian Zone Conservation Strategy	**Threatened plant species** Tuggeranong Lignum (*Muehlenbeckia tuggeranong*) **Threatened animal species** Pink-Tailed Worm Lizard (*Aprasia parapulchella*) Two-spined Blackfish (*Gadopsis bispinosus*) Trout Cod (*Maccullochella macquariensis*) Macquarie Perch (*Macquaria australasica*) Murray River Crayfish (*Euastacus armatus*) Silver Perch (*Bidyanus bidyanus*)	2007
Action Plan 30	Spotted-tailed Quoll (*Dasyurus maculatus*)	2005
Action Plan 31	Canberra Spider Orchid ()	2012
Action Plan 32	Brindabella Midge Orchid (*Corunastylis ectopa*)	2012
Action Plan 33	Glossy Black-Cockatoo (*Calyptorhynchus lathami halmaturinus*)	2013
Action Plan 34	Murrumbidgee Bossiaea (*Bossiaea grayi*)	2013
Action Plan 35	Little Eagle (*Hieraaetus morphnoides*)	2013

Appendix 2. List of Related Conservation Research and EPD Publications and Abstracts

Technical reports and Background papers

Environment and Sustainable Development Directorate (2013) Conservation Planning and Research, Program report 2011-13. **Technical Report 29**. ACT Government, Canberra.

Eyles, K. and Mulvaney M (2014) Responsible pet ownership and the protection of wildlife: Options for improving the management of cats in the ACT. A Background Paper prepared for the ACT Responsible Cat Ownership Steering Committee

Osborne, W and Evans, M (2015) Risk Assessment for the Importation of Native Reptiles into the ACT. **Technical Report 31**. Environment and Planning Directorate, ACT Government, Canberra.

Snape, M., Stevenson, B. and Evans, M. (2015) Arboreal mammal spotlight survey 2014. **Technical Report 30**. Environment and Planning Directorate, ACT Government, Canberra.

Journal articles written or co-authored by staff

Howland B., Stojanovic D., Gordon I. J., Stirenmann I., Fletcher D., Snape M. & Lindenmayer B. D. (2015) *Habitat preferences of the threatened striped legless lizard: implications for the management of grazing in grasslands. In review.*

Howland B., Stojanovic D., Gordon I. J., Manning A. D., Fletcher D. & Lindenmayer B. D. (2014) *Eaten out of house and home: Impacts of Grazing on Ground-Dwelling Reptiles in Australian Grasslands and Grassy Woodlands*. PLoS ONE 9, e105966.

Portas T., Fletcher D., Spratt D., Reiss A., Holz P., Stalder K., Devlin J., Taylor D., Dobroszczyk D., Manning A. D. (2014). *Health evaluation of free-ranging eastern bettongs (Bettongia gaimardi) during translocation for re-introduction*. J. Wildl. Dis. In press.

Abstracts

Clausen, A. and Mulvaney M. (2015) Canberra Nature Map – collection, management and validation of citizen plant data. Australian Citizen Science Association: Maximising the capacity of Citizen Science for Science and Society. A Fenner Conference on the Environment.

Cook, E. (2014) A decade of hunting dragons: monitoring Grassland Earless Dragon populations in the Majura and Jerrabomberra Grasslands of the ACT. Conservation Research Unit, ACT Government. Abstract for talk presented at Friends of Grasslands 2014 forum.

Evans, L., Beitzel, M. and Jekabsons, M. (2015) Status of Fish in the ACT. Conservation Research Unit, ACT Government. Abstract for talk presented at 2015 ACT EIANZ Forum on the State of Rivers, Creeks, Lakes and Ponds and Conservation Research 2015 Ecofocus Seminar.

Evans, L., Howson, T., Jekabsons, M. and Beitzel, M. (2014) What's the angle? Could trout angling benefit threatened native fish species in the ACT? Abstract for poster presented at the 2014 ASL and ASFB joint Conference.

Kitchin, M. (2014) Native plant species and community research, monitoring and mapping in the ACT. 2014 ACT EIANZ Forum on the State of Vegetation in the ACT.

Mulvaney, M. (2014) The moths and lizards that shaped Canberra. In proceedings of Grass half full or grass half empty? Valuing native grassy landscapes. Friends of Grasslands Forum pp 26 – 30.

On-line material

ACT Conservation research: the effects of kangaroo grazing on biodiversity (April 2015).
http://www.environment.act.gov.au/cpr/conservation-research/research.

Eco Focus (annual information seminar of the Conservation Research unit) – 2013 and 2014 abstracts.
http://www.environment.act.gov.au/cpr/conservation-research/report_series/eco_focus_abstracts.

Facts sheets

All facts sheets are available at:

http://www.environment.act.gov.au/cpr/conservation_and_ecological_communities/threatened_species_factsheets.

- Brush-tailed Rock-wallaby (May 2015)
- Murrumbidgee Bossiaea – a threatened species. (November 2013)
- Northern Corroboree Frog (July 2015)
- Rehabilitating ACT rivers: highlights from the last three years (October 2013)

References

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ACT Government (2007). *Ribbons of Life: ACT Aquatic Species and Riparian Zone Conservation Strategy*. Action Plan No. 29, Environment and Recreation, Territory and Municapl Services, Canberra.

Australian Government (1999). *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Department of Environment, Canberra.

Briggs, J.D. & Müller, W.J. (1999). *Effects of fire and short-term domestic stock grazing on the endangered perennial forb, Swainsona recta, in a secondary grassland bordering the Australian Capital Territory*. (Unpublished report for Environment ACT)

Howland B., Stojanovic D., Gordon I. J., Stirenmann I., Fletcher D., Snape M. & Lindenmayer B. D. (2015) Habitat preferences of the threatened striped legless lizard: implications for the management of grazing in grasslands. In review.