ACT Government




CONSERVATION PLANNING AND RESEARCH PROGRAM REPORT 2011–13

Technical Report 29

December 2013

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Front cover: Photos taken by CPR Staff or collaborators: Bettong; Snowgum Woodland; Grassland Earless Dragon; Tharwa Engineered Log Jam.

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OVERVIEW

The Conservation Planning and Research unit has 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 1980* and the *Planning and Development Act 2007*. This report presents the unit's projects from July 2011 to June 2013.

This program report summarises 57 projects spanning all of the elements of the unit; 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 restoration** – 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 unit 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).

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1 INTRODUCTION

Figure 1.1 Superb Parrot

This report provides an overview of the nature conservation programs for the Conservation Planning and Research section for the year July 2011 to June 2013.

Conservation Planning and Research (CPR) is a section of the Nature Conservation Policy Branch within the Environment and Sustainable Development Directorate (ESDD) of the ACT Government. CPR 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, CPR undertakes or supports a range of monitoring and research programs including wildlife research, ecological survey, social research, biodiversity monitoring and preparing and guiding the implementation of threatened species action plans. CPR also undertakes or supports key on-ground actions to assist the recovery of threatened species, such as captive breeding programs.

A slight structure change that occurred in 2012 was the splitting of the unit into Conservation Research and Conservation Planning, each led by a manager. However, the section continues to operate as a cohesive unit to integrate both conservation planning and conservation research.

2 THREATENED SPECIES

Monitoring the distribution and, in some cases, abundance of threatened species and ecological communities is a core CPR activity. 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 Flora and Fauna committee, other ACT and Commonwealth Government agencies, non-government organisations and the public. Monitoring programs have led to CPR implementing on-ground recovery actions such as threatened plant translocations, a breeding program for Corroboree Frogs, habitat restoration and translocation of Eastern Bettongs from Tasmania to suitable habitat at Mulligans Flat Sanctuary.

During this period, a number of reports on implementation of actions in the action plans were prepared for the Flora and Fauna Committee. Also, species action plans were revised or written (full list of action plans at Appendix 1). These were:

- Four reports on the implementation of action plans – Brush-tailed Rock-wallaby, Lowland Native Grassland Conservation Strategy, *Gentiana* and the Aquatic and Riparian Strategy.
- Five new action plans were written, drafts released for public comment and the final action plans released – Brindabella Midge Orchid, Canberra Spider Orchid, Glossy-Black Cockatoo, Little Eagle and Murrumbidgee Bossiaea (November 2013).
- Two existing action plans were reviewed – Northern Corroboree Frog and Smoky Mouse.

2.1 Bettong reintroduction

A major achievement during the reporting period was the reintroduction to the ACT of the Eastern Bettong. This small kangaroo is a component of woodland ecosystems that is likely to prove vital in the long term, but one which has been missing from the Australian mainland for at least 70 years, due mainly to predation by the European Red Fox. Fortunately, populations of Eastern Bettongs survive in Tasmania and are genetically close to the local animals whose bones have been found in caves around the region.

Figure 2.1 Not a Bettong!
Staff from ANU and the Conservation Research Unit in Tasmania releasing bettong bycatch, a Long-nosed Potoroo. All work on Eastern Bettongs is at night because the species is prone to stress-related injury if left in traps after first light. For the same reason, no photos were taken of bettongs in traps.

ACT Government staff made seven trips to Tasmania, including five collecting trips into different 'genetic' regions. Support was provided by research partners from the Australian National University (ANU), contractors and the Tasmanian Government. The Eastern Bettong is a feisty and nervous species reputedly difficult to trap and transport without loss. Preliminary research established the appropriate dose of sedative

for the journey and specially designed crates minimised the risk of a bettong injuring itself. Sixty adult bettongs carrying 29 pouch young were successfully air-freighted back to Canberra on the same day they were trapped, and released that evening in either Mulligans Flat Woodland Sanctuary or Tidbinbilla Nature Reserve. Every effort was made to ensure the source population was unharmed and the transported animals arrived in good condition. Health checks of the arriving animals by a veterinarian provided a remarkable number of insights including identification of a new bettong parasite species and pathogens. Most of these results have now been published for the first time (Portas *et* al. 2014).

Eastern Bettongs eat mainly native truffles (hypogeal mycorrhizal fungi). These underground fungi enable woodland trees to extract nutrients from infertile soil, and their spores are distributed by the bettongs. Potentially critical knowledge for future restoration of woodlands is to understand the role of the bettongs in the ecology of the truffles, the role of the truffles in enabling woodland trees to thrive, and the role of the digging by the bettongs in soil processes and plant germination. An Australian Research Council (ARC) linkage agreement between the Conservation Research unit and the Fenner School at ANU and other partners is enabling high quality research to be conducted on these and other woodland restoration questions (see other item on Mulligans Flat Woodland Sanctuary).

2.2 Birds – Threatened woodland bird ecology research (ANU)

Figure 2.2 Regent Honeyeater

With funding from the ACT Government, two PhD studies on threatened woodland birds were undertaken through the Australian National University (ANU) Fenner School of Environment and Society, a nationally prominent research and teaching facility in the area of environment and sustainability. The aim of these PhD studies is to investigate why woodland birds in urban and non-urban landscapes in the ACT region are apparently continuing to decline and to identify principles for protected area management and for urban planning design that are sympathetic to woodland bird conservation.

PhD No.1

The lower Molonglo Valley is planned as the next area for major suburban development in the ACT. It is a recognised 'hotspot' for woodland birds, and provides habitat for eight threatened species and a number of bird species identified as declining in south- eastern Australia. This PhD explored patterns of landscape use by woodland birds in the Molonglo Valley and urban Canberra, investigating what vegetation and land use features influence the presence of woodland birds in these areas. The aim is to identify ways to better incorporate woodland bird conservation into urban design early in the planning process. This PhD has been completed and has resulted in a number of scientific papers relevant to urban planning.

PhD No. 2

There is some evidence that woodland bird species are continuing to decline, both on and off reserve. Habitat quality is strongly influenced by current and past land management activities (particularly burning and grazing regimes, removal of fallen timber etc.). A key question for park managers is whether the current management activities are appropriate for maintaining or enhancing the habitat quality of woodlands and particularly halting the decline in woodland birds. This PhD aims to determine whether or not woodland birds are continuing to decline in protected and unprotected areas and gain a better understanding of what management practices are appropriate. This PhD is nearing completion.

2.3 Brindabella Midge Orchid

Figure 2.3 Brindabella Midge Orchid

The Brindabella Midge Orchid (*Corunastylis ectopa*), first discovered in 1992, comprises a small population of approximately 70 plants (Figure 2.3). It is known from only one location in the ACT, and is currently listed as endangered under the ACT *Nature Conservation Act 1980*, and critically endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Brindabella Orchid site was burnt in the 2003 wildfires and the population appears to have declined in the years following the event. In 2004 CPR initiated an annual survey of the species' known location to monitor changes in its population.

In autumn 2013 CPR conducted annual monitoring of the Brindabella Midge Orchid population, aiming to:

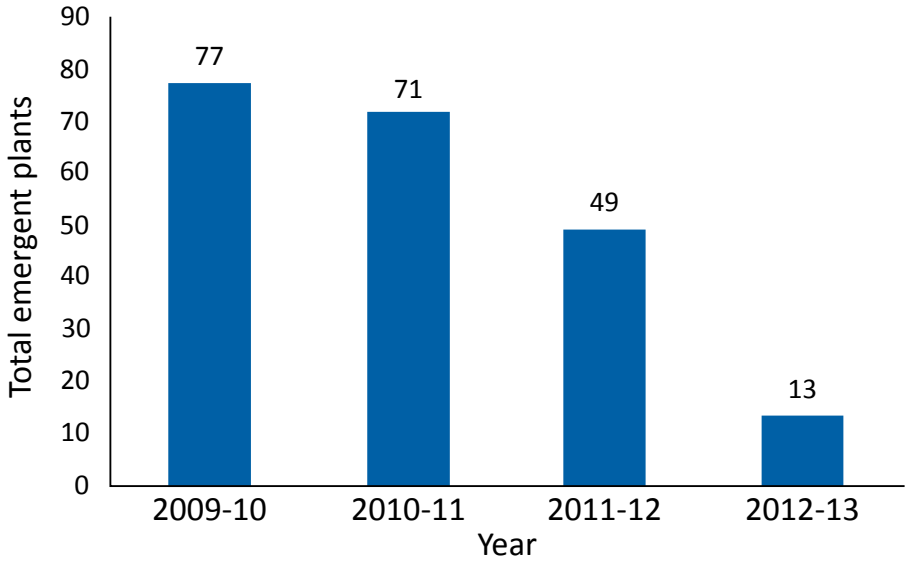
- re-establish a repeatable method for aligning the survey transect
- locate and count any orchids that had emerged as a formal population survey for 2013
- inspect sediment build up and vegetation growth in the adjacent table drain and decide on a plan for site works to be carried out by Parks and Conservation Service (PCS) staff within the Territory and Municipal Services Directorate.

Key findings

- The minimum number of plants known to have emerged in 2013 was 13 (Figure 2.4), indicating a continuation of the decline in emerging plants observed since 2009–10 (Figure 2.4). Both the March and April surveys included plants at a range of life stages including fruiting plants present on 21 March. One flowering plant was observed on 5 March indicating the majority of shoots emerged in early to mid-March.
- No additional populations were observed in the general area despite a moderate search effort in similar terrain positions within several kilometres of the known population.
- PCS staff noted emergent individuals throughout the winter months, well outside previously documented emergence of Brindabella Midge Orchid at the site. Consideration will be given to broadening the formal monitoring period in future years.

Figure 2.4 Brindabella Midge Orchid abundance

Total count of Brindabella Midge Orchid plants over the last four years. Note that in 2012–13 the monitoring methodology was changed due to site factors and data for this year represents the minimum number known to have emerged rather than a total count.



The decline in number of emerging plants in past few years is difficult to interpret given the lack of other populations in the ACT with which to compare. However it is important to note that counts of emergent plants do not equate to an estimate of the population of live plants. Emergence and flowering of many orchid species is known to vary widely from year to year and has been reported for other threatened Australian and international orchid species. Climatic factors as well as past flowering history of individual plants may play a role in this inter-annual variability. As noted in previous monitoring reports, little is known about the ecology, life cycle and preferred conditions of this species and active management is required to improve the conservation prospects of the Brindabella Midge Orchid.

In 2013, as part of an active approach to increasing knowledge of the orchid, CPR collaborated with botanists from the Australian National Botanic Gardens (ANBG) to attempt ex-situ cultivation. Fruit from two plants were harvested for seed germination experiments aimed at providing an ex-situ 'insurance' population at the ANBG and to provide more information on germination requirements.

2.4 Button Wrinklewort monitoring

Qualitative surveys were undertaken in December 2012 to record the habitat conditions of the known Button Wrinklewort (*Rutidosis leptorrhynchoides*) populations and identify any threats and mitigation actions that were required. The estimates are given in Table 2.1. While estimates provide a representation of the true population size at each location, estimates are often out by an order of magnitude when compared to counts of individuals. Resource constraints do not currently permit an individual count of this species so estimates continue to be used to give an 'impression' of population health.

Figure 2.5 Button Wrinklewort at the Baptist Church site, Kingston

Table 2.1 Survey for Button Wrinklewort

Location	Observation	Threats	Recommended Action
Kintore Street	No plants found; good native forb and grass cover and diversity	Mowing	Resurvey Dec 2013
Baptist Church Kingston	6 plants in narrow unmown strip at edge of carpark; area of occupancy has declined markedly since records were first kept as a result of the area being used as a carpark	Car parking, mowing	Improved management of car park
St Marks, Barton	Estimated 40-50 plants, all flowering and healthy; distribution unchanged; grass very thick in places	Biomass accumulation, woody weeds	Burn the site, weed removal
Campbell Offices	Estimated 80-90 plants found in 6 extant sub-populations; no plants found in one previously recorded small sub-population	Weeds (St John's Wort)	Weed control
Tennant Street Fyshwick	Estimated approx. 100 individuals; area in good condition with minor wild oats encroachment	Minor weeds	Weed control
Woods Lane	Estimated 80-100 individuals formerly spread across 3 sub-populations; no plants located at the northern most population in 2013 which has been impacted by road work and weeds; southernmost population appears healthiest	Road construction, infrastructure development, weeds (St John's Wort, Wild Oats)	Improve roadside signage, weed control and translocation
Stirling Ridge	Estimated populations are 1500-2000, noting difficulty in estimating large populations over such a big area; overall this site is in good condition with some weed issues	Weeds	Weed control
Attunga Point	Estimated 40-50 individuals in fenced-off location with good native species cover		
Blue Gum Point	Estimated 250-300 plants; area is impacted by regular mowing and weeds	Mowing, weeds	Weed control and improved mowing regime
State Circle	Estimated 120-200 individuals; site in good condition but some weeds present	Weeds (St John's Wort, Cootamundra Wattle)	Weed control
Crace	Site in good condition		
HMAS Harman	Site not monitored by ACT Government		
Majura Training Area	Site not monitored by ACT Government		
Jerrabomberra East Nature Reserve	Translocated population in good condition		
Red Hill	Sites in good condition with little change in population size		

2.5 Glossy Black-Cockatoo – Action plan and habitat restoration

The Glossy Black-Cockatoo was declared a vulnerable species in the ACT in 2010 under the *Nature Conservation Act 1980*. An action plan for the species was released for public comment in 2013. The final Glossy Black-Cockatoo Action Plan was released in December 2013.

Figure 2.6 Glossy Black-Cockatoo

Glossy Black-Cockatoos are highly specialised in their food choice, feeding almost exclusively on the seeds of sheoak species. In the ACT and region the birds are dependent on Drooping Sheoak (*Allocasuarina verticillata*) as their principal food source, and the distribution of the birds typically reflects the distribution of this food tree. Glossy Black-Cockatoos are also dependent on large hollow-bearing eucalypts for nest sites.

The Glossy Black-Cockatoo has declined nationally and it is now rare or has become locally extinct in many parts of its former range. The main apparent threat to the Glossy Black-Cockatoo is the degradation, loss and fragmentation of foraging and breeding habitat. In particular the loss of canopy seed banks of Drooping Sheoak by clearing or regular burning, as well as poor regeneration of these trees due to grazing, can significantly reduce available food sources. Loss of hollow bearing nesting trees within the proximity of feed tree stands is also likely to be a significant impediment to successful breeding.

The major conservation action identified in the action plan is to protect habitat for the species, in particular significant stands of Drooping Sheoak (food trees) and large eucalypts with potential nesting hollows. Other actions include expansion of current stands of Drooping Sheoak and identifying areas where new stands of Drooping Sheoak can be established.

From May to July 2011 close to 6000 *A. verticillata* seedlings were planted within reserves in the south of Canberra. In a collaborative effort, staff from PCS, CPR and Greening Australia planted 2500 seedlings at Isaacs Ridge Nature Reserve, 2500 at Tuggeranong Hill Nature Reserve and 900 at Farrer Ridge Nature Reserve. Red Hill Regenerators also undertook a small planting and in 2013 NSW Landcare groups planted a few hundred trees in Googong Foreshores as part of a catchment-wide strategy to improve habitat for the Glossy Black-Cockatoo.

2.6 Golden Sun Moth translocation

The Golden Sun Moth (*Synemon plana*) is listed as endangered in the ACT, NSW and Victoria and critically endangered nationally. Larvae spend between one and three years underground feeding on roots of native grasses (wallaby grasses) and introduced Chilean Needlegrass. The adults (which have bright yellow on their hind-wings) emerge in late spring during the middle of warm, sunny days (hence their name) and live for only a few days, during which time they do not feed (adults do not possess functional mouthparts). Although male Golden Sun Moths are strong flyers, females almost never fly, preferring to stay on the ground waiting for the flying males to find them. Eggs are laid at the base of tussock grasses and the larvae hatch and burrow down amongst the roots. Because of the sedentary behaviour of females the species does not readily disperse and colonise other habitat areas. Small areas of non-habitat (such as house blocks) are likely to pose a major barrier to the dispersal of the species.

As part of a development offset (under the EPBC Act) at Forde, the Canberra Investment Corporation Ltd provided funding to investigate possible methods for the translocation of the species. The University of Canberra (UC), in collaboration with CPR, has successfully completed the first stage of this project, which is to translocate Golden Sun Moth larvae from soil in the field to a 'nursery', a glasshouse at the University of Canberra. The larvae were kept alive in soil in the glasshouse for nine months until their emergence as adult moths in spring 2012. The second stage of the project is to translocate larvae from the field and from the glasshouse to a suitable field site to determine whether these larvae survive and emerge as adults.

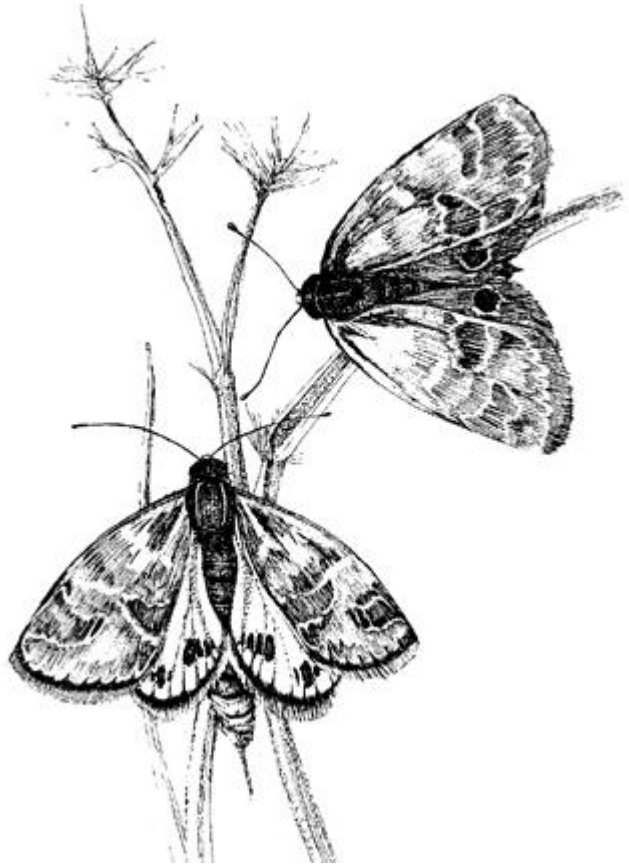
Figure 2.7 Golden Sun Moth

2.7 Golden Sun Moth Strategic Conservation Management Plan

In 2012, the Golden Sun Moth Strategic Conservation Management Plan was completed. This plan reviews the distribution, abundance, ecology and status of the Golden Sun Moth in the ACT and provides conservation and management recommendations. The Golden Sun Moth is known from 73 sites within the ACT, with a total habitat area of around 1800 hectares. This equates to about 12% of the known national habitat and about a third of the known sites.

The greatest threat to Golden Sun Moth habitat in the ACT is clearance for urban or infrastructure development. Of the 1800 ha of habitat, 378 ha (21%) is approved or proposed for clearance, while a further 23% of the habitat occurs on Commonwealth land and has an uncertain future. Around 850 ha (or 47% of the total habitat) is within existing or proposed nature reserve or existing or proposed offset areas. The management plan concluded that most of the potential habitat for this species within the ACT has already been surveyed and identified.

Figure 2.8 Drawing of Golden Sun Moths



The management plan recommends the Golden Sun Moth retain its endangered status and that key habitats should be protected and enhanced through restoring habitat connections between them. The plan also identifies key research that should be supported. In line with plan recommendations, a long term monitoring methodology and implementation program has been developed. Relevant Commonwealth authorities have been provided with the plan and have been encouraged to take actions consistent with the recommendations.

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 it is now restricted almost entirely to a few remnant patches of Natural Temperate Grassland in the ACT and nearby NSW. In the ACT the species is found in two disjunct populations, one in the Majura Valley and one in the Jerrabomberra Valley. Loss or modification of habitat (Natural Temperate Grassland) is the main cause of decline.

Figure 2.9 Drawing of Grassland Earless Dragon

Grassland Earless Dragons are monitored annually at key sites in the ACT to determine trends in population size and distribution. This information is used to guide conservation programs and to inform urban development planning. Grassland Earless Dragons are regularly monitored at two key sites for the species in the ACT, the Majura Training Area (monitored by CPR) and the Jerrabomberra West Grasslands Reserve (monitored by UC as part of a research study). The species is also intermittently monitored 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 CPR that mimic the small burrows used by the dragons, and are now the standard survey technique used in other jurisdictions. These artificial burrows 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 per week for four to five weeks. The program for 2011–2013 follows a similar program for previous years. Monitoring is usually undertaken by two to six people during February and March each year.

2.9 Grassland Earless Dragon captive breeding program (University of Canberra)

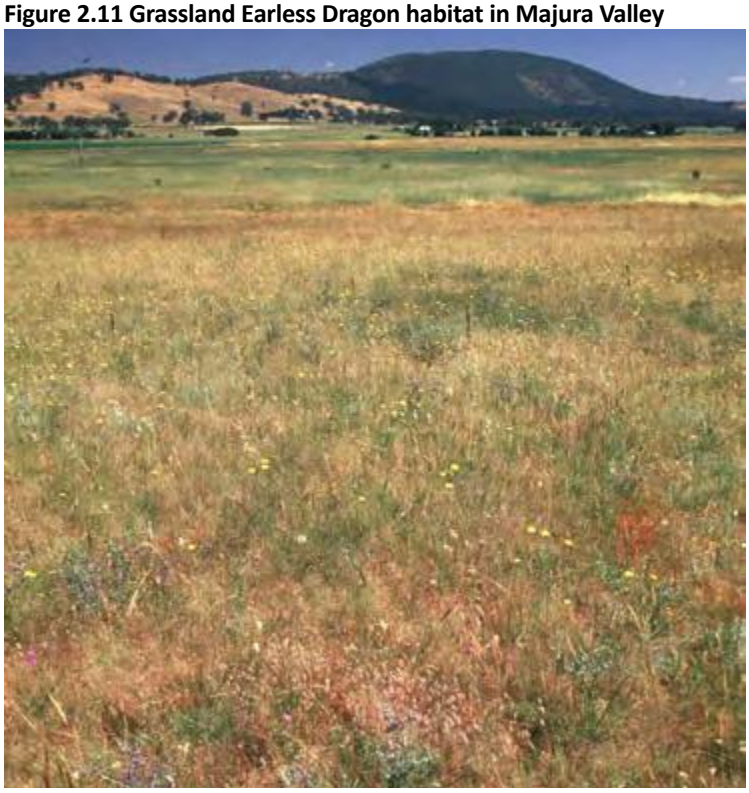
Figure 2.10 Grassland Earless Dragon

The University of Canberra (UC), in partnership with CPR, is investigating potential mechanisms behind the recent population crash of Grassland Earless Dragons (*Tympanocryptis pinguicolla*) in the ACT and nearby NSW as recorded during 2004–09. One hypothesis is that increases in ambient temperatures force the lizards to seek shelter for longer periods, which reduces the time available for foraging and other activates. So far, this project has:

- established a colony of Grassland Earless Dragons with the aim of creating an 'insurance' population and for use in non-invasive behavioural studies
- attached temperature-sensitive transmitters to free-ranging Grassland Earless Dragons to record skin temperature and activity in relation to ambient thermal conditions. Preliminary results suggest that at ambient temperatures greater than 40°C, activity of the lizards is reduced to 2–3 hours per day. Long periods of high ambient temperatures could have adverse effects on the species
- distributed 'ibuttons' (miniature temperature probes) throughout ACT grasslands to collect temperature data under different habitat conditions. Preliminary analysis indicates that burrow temperatures are at least 20°C lower than above ground temperatures during hot conditions with differences being even more pronounced in areas with high grass biomass
- studied the genetics of grassland earless dragons from 204 individuals (including tissue samples collected some years ago before the population crash) to investigate the relatedness of separate populations. The study shows marked differences in allele frequencies and evidence of genetic differences between the lizard populations.

2.10 Grassland Earless Dragon habitat monitoring

Figure 2.11 Grassland Earless Dragon habitat in Majura Valley



The main habitat area for Grassland Earless Dragon at Jerrabomberra West Nature Reserve was fenced to exclude kangaroo grazing at the end of the last drought. Since then the ACT has had a number of years of higher rainfall resulting in a large buildup of biomass in the un-grazed habitat. Concerns were raised that the high level of biomass was having a negative impact on Grassland Earless Dragons. PCS developed a plan to reduce biomass within the kangaroo exclosure fence by patch burning and sheep grazing. CPR developed a monitoring project to measure changes in grassland structure (cover and height) associated with changes in these management treatments. The aim of this monitoring is to quantify the optimum structure for Grassland Earless Dragon. The first monitoring was completed in December 2012.

2.11 Little Eagle and Wedge-tailed Eagle research

Figure 2.12 Drawing of a Little Eagle

The Little Eagle (*Hieraaetus morphnoides*) Action Plan was released for public comment in February 2012 and the final plan was released in December 2013. A series of actions were identified for increasing knowledge of this species. CPR provided $5,000 for tracking equipment to support research being undertaken by an Honours student at UC.

The capture and handling of eagles is neither easy nor risk-free. No Australian species of eagle had ever been fitted with GPS or radio tracking equipment before, so it was decided to start with the Wedge-tailed Eagle because there is only one breeding pair of Little Eagles remaining in the ACT. The eagles proved better at evading capture than expected, and none were able to be caught for the tracking program. Eventually, a young Wedge-tailed Eagle rescued by Ranger Richard Milner was fitted with a GPS device and released, providing valuable insights and tracking experience. However, much remains to be learnt of the movement behaviour of Little Eagles and Wedge-tailed Eagles.

It is important for private and government land managers to control rabbits but in some cases this may create risks for eagles, including the threatened Little Eagle which specialises in hunting rabbits. The rabbit control agent 'Pindone' is preferred for near-urban rabbit control because it poses lower risk to dogs and people and there is an antidote, but Little Eagles and Wedge-tailed Eagles may be affected if they consume a rabbit that has recently eaten a meal of carrot treated with Pindone. Improved knowledge of eagle hunting territory, e.g. whether it is within a certain radius of known nest sites, would assist in identifying areas that should be avoided in Pindone programs.

2.12 Murray River Crayfish – Survey methods assessment

Figure 2.13 Murray River Crayfish, Murrumbidgee River, ACT

Murray River Crayfish (*Euastacus armatus*), the largest and most widely distributed of all species from the genus Euastacus, 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 River 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 the species is still at risk. Additionally, it appears that modification to the monitoring program may be necessary to achieve additional insight into Murray River Crayfish populations in the ACT. Trials of different monitoring methods have revealed that using hoop nets with 30 minute 'soak' (submergence) times, and increasing the number of 'lifts' (out of the water) per net, would improve monitoring efficiency. Additionally, sampling sites on multiple occasions in one season is likely to provide better insight into Murray River Crayfish populations.

2.13 Murrumbidgee Bossiaea

Figure 2.14 Murrumbidgee Bossiaea

Murrumbidgee Bossiaea (*Bossiaea grayi*) 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, Action Plan 34 was created in order 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.

Information was also collected on critical habitat parameters and any perceivable threatening processes. This information will be used to inform management of the species in the ACT, as well as to inform the development of a long-term monitoring strategy.

These surveys resulted in ten discrete population clusters being identified in the ACT with an estimated total population size of between 2700 and 2900 individuals. Five distinct population clusters occur on the Murrumbidgee River, four distinct populations on the Paddys River and one plant occurs on the lower Cotter River. The species was recorded at elevations between 445 metres and 575 metres. The main driver of where population clusters occur appears to be landscape position and soil type, with all sites located within incised river valleys, mostly on steep, rocky and skeletal soils.

The overall population size of Murrumbidgee Bossiaea suggests the immediate loss of the species is unlikely except in the event of an unforeseen impact. However there are a number of small disjunct population clusters on the Paddys and Cotter rivers that are highly vulnerable and their loss could lead to a range reduction. Given that all population clusters are so disjunct it is not clear if any genetic separation has occurred.

Most population clusters occur within reserved land, though three are outside of reserve (which includes the two largest groups) within land designated as Mountains and Bushland (NUZ5) under the ACT Territory Plan.

The major identified threats to the species include competition from native shrubs, low numbers and the isolation of some population clusters. Future activities include seed collection for germination trials and to propagate seedlings for ex-situ plantings.

2.14 Northern Corroboree Frog – Monitoring, captive breeding and release

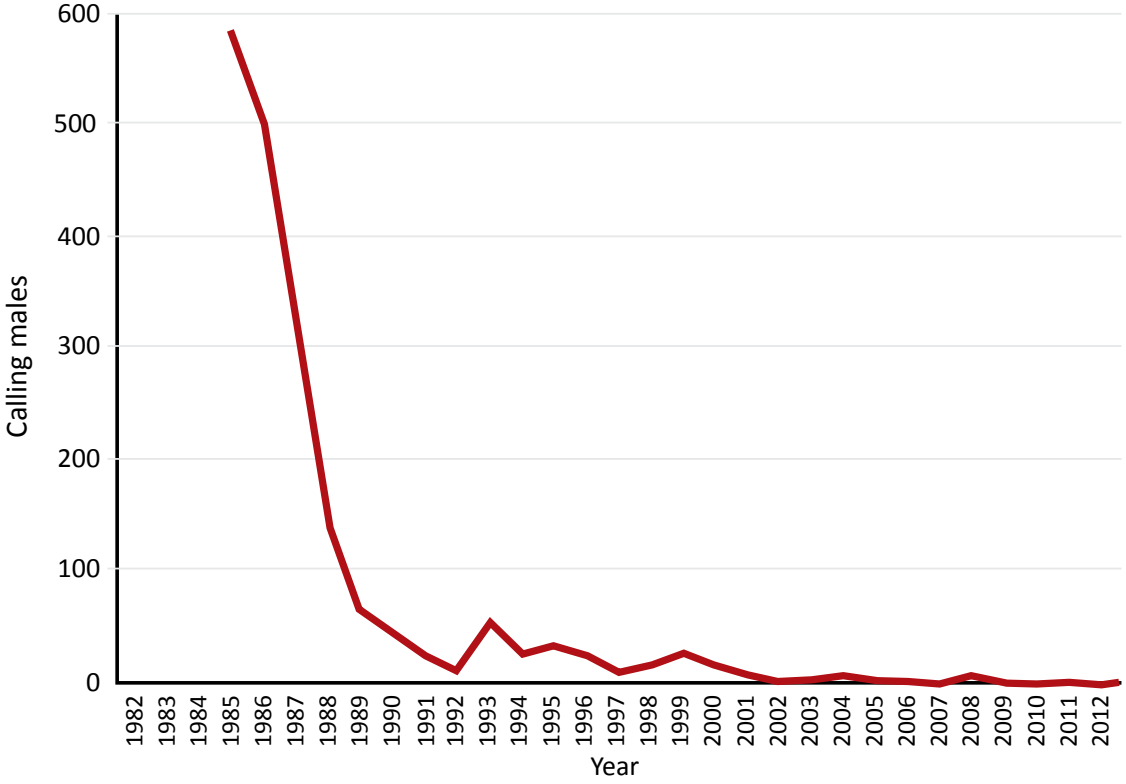
Northern Corroboree Frogs (*Pseudophryne pengilleyi*) inhabit the higher elevation areas of Namadgi National Park and nearby NSW. Northern Corroboree Frog populations in the ACT have been intermittently monitored by CPR since the mid-1980s and more intensively since 1996. This monitoring revealed a major population crash in Corroboree Frogs in the late 1980s and early 1990s. There are currently estimated to be less than 50 individuals remaining in the wild from the original population that numbered many thousands. The decline in the population 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.

Figure 2.15 Northern Corroboree Frog monitoring
Monitoring of wild populations of Corroboree Frogs (left) and juvenile Northern Corroboree Frog bred in captivity (right) at Tidbinbilla.

Monitoring is undertaken by between four and twelve 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–March) in Namadgi National Park. Monitoring is done at key breeding sites in the ACT, which includes Ginini Flats, Cheyenne Flats and Snowy Flats.

In 2003, CPR established a captive population of Northern Corroboree Frogs from eggs collected in the wild. The objective of the program is to maintain a captive colony of Northern Corroboree Frogs as an insurance against extinction in the ACT. The captive population of Northern Corroboree Frogs held at Tidbinbilla Nature Reserve currently has around 500 individuals, some of which are from successful captive breeding.

Figure 2.16 Corroboree Frog abundance
Annual number of calling males at one site (Ginini Flat West) in Namadgi National Park. In 1985 there were more than 500 males calling, but since 2002 there has been fewer than 5 males calling during annual surveys.



It is likely that 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 back to sphagnum moss bogs in Namadgi National Park in 2011 and 2012 to determine whether such releases can bolster wild populations and promote breeding and development of natural resistance to Chytrid Fungus. The effect of releasing captive bred Corroboree Frogs on increasing population size and promoting breeding will not be known for several years.

2.15 Small Purple Pea monitoring

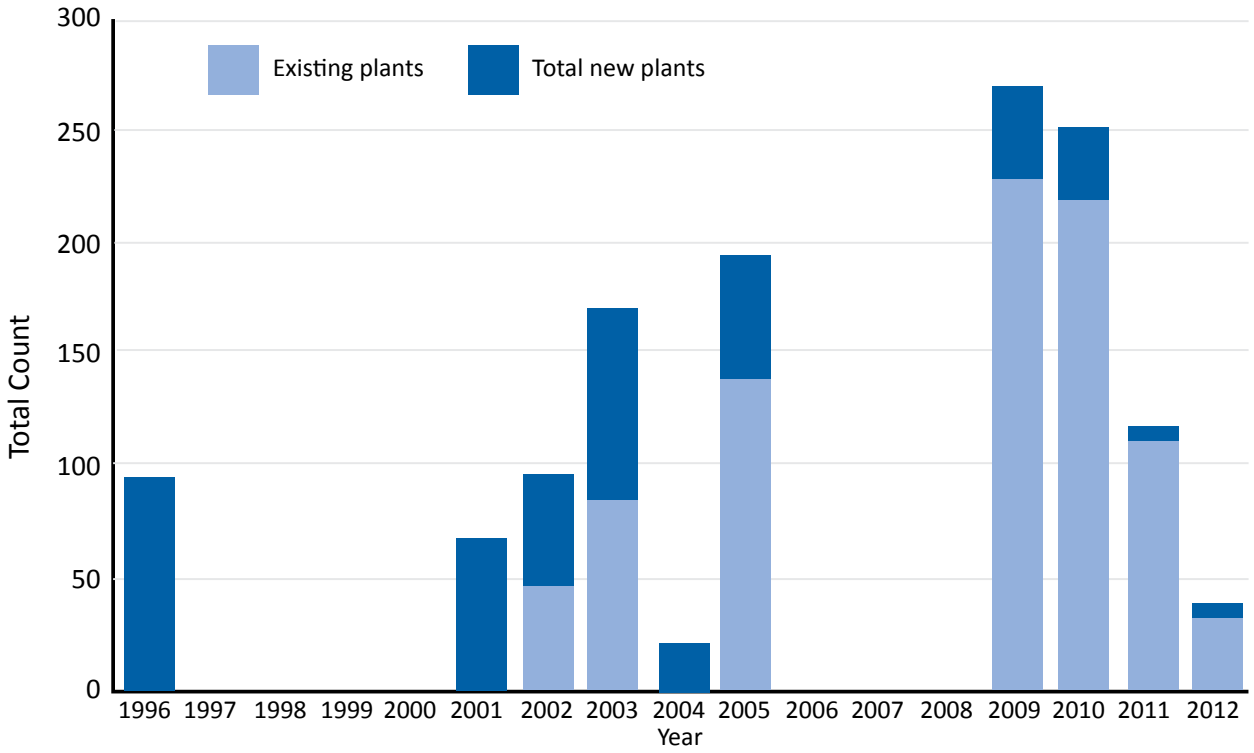
Five sites within the urban areas of Canberra have been known to support populations of the endangered Small Purple Pea (*Swainsona recta*). The largest of these populations occurs in the Mt Taylor Nature Reserve, with over 300 individual plants recorded since surveying began in 2001. This site was severely burnt in the 2003 bushfires. A small population of approximately 10 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 also been recorded in the past at sites on Long Gully Road, a rural block on Caswell Drive and at Farrer Ridge.

The 2012 survey of the Small Purple Pea consisted of two counts of the Kambah site on 15 November and 23 November, and four counts of the Mt Taylor population from 1 November until 21 November. Long Gully Road was inspected on 15 November along with the perimeter of the future Southern Cemetery site to determine the habitat suitability or presence of *S. recta* at that location. The Mt Taylor population was inspected from early October to determine the beginning of the flowering period. As in 2010 and 2011, the late timing of flowering season may have been due to high winter and spring rainfall.

The Kambah plants were located using previous mapping and measurements. New plants were not found at this site. An ecological burn was conducted within the Small Purple Pea habitat during June 2011 as a part of the annual TAMS Bushfire Operations Plan to reduce the density of Kangaroo grass (*Themeda triandra*). The burn was patchy and had a low intensity (Figure 2.17 Photo A). It is hoped that the change in structure and biomass (Figure 2.17 Photo B) will encourage the re-sprouting of dormant seed and germination of new Small Purple Pea plants at this site.

Figure 2.17 Small Purple Pea habitat
Photo A (left) burn carried out in June 2011 in Small Purple Pea habitat in the suburb of Kambah. Photo B (right) after the burn (Spring 2011).

Figure 2.18 Abundance of new and reoccurring Small Purple Pea at Mt. Taylor
Newly tagged plants are represented by the hatched portion of each total count and previously tagged plants are represented by the dark portion of each total count.



Abundance records indicate that while the Mt Taylor population had been stable, with numbers steadily increasing since plants were first tagged in 2001 (Figure 2.18), in 2011 there was a 53% decrease in abundance from the previous year. The 2012 season saw another decrease in abundance, this time of 68%. A number of factors may be influencing this decline including rainfall, predation of plants, ground temperatures and moisture levels and intra-specific competition. It is possible that it is in part due to natural population fluctuation as *S. recta* is known to have dormancy periods of anywhere from 1 to 9 years (Briggs and Müller, 1999). It should be noted that records indicate 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 above).

2.16 Southern Brown Bandicoot distribution in the ACT region

Figure 2.19 Southern Brown Bandicoot

Southern Brown Bandicoots Southern Brown Bandicoots (*Isoodon obesulus obesulus*) were rediscovered in the ACT in 2002 when fur was recovered beneath the nest of a Wedge-tailed Eagle by researchers from UC. The next year, bones of two bandicoots were recovered from a different eagle nest. All three remains were of the Southern Brown Bandicoot, which is a declared threatened species by the Commonwealth and in every state where it occurs.

Eagles do not forage far from the nest when they have young, which was the case when these remains were found. Therefore, PCS commenced a fox baiting program in areas judged likely to be the source of the bandicoots. During the next few years, volunteers were mustered at various times to collect fox and dog scats which were analysed for prey remains in the hope of narrowing down the search area.

In 2012 computer mapping identified all patches of thick shrubby vegetation within 20 km of both eagle nests and 10 km of either nest. All patches were laboriously searched on foot for bandicoot diggings. Where diggings were ambiguous in origin, camera traps were set with peanut butter baits. No bandicoot was detected although some other fauna records of interest were obtained, e.g. Rosenbergs Monitor, an uncommon goanna species. The origin of the predated bandicoots will likely remain a mystery for some time.

2.17 Spider Orchid monitoring

The Canberra Spider orchid (*Arachnorchis actensis*) is a small terrestrial orchid that flowers sporadically across parts of Mt Majura and Mt Ainslie Nature Reserves. Another population of this species exists on land owned by the Department of Defence at the Majura Training Area. CPR does not have access to the Defence land so only plants within Mt Majura and Mt Ainslie Nature Reserves are monitored.

The species is difficult to monitor because it is small and relatively cryptic, flowers for only a short period of time and is diffusely distributed. It is also difficult to predict the rate of flowering each year. Since 2009 CPR has helped co-ordinate a monitoring and management program with a local naturalist with an exceptional knowledge of the species. CPR has provided liaison with PCS and materials for grazing exclusion cages and the naturalist has counted plants and placed grazing exclusion cages. This practice has been effective given the time involved, e.g. to judge where and when the plants will grow each year. Having a single person access and work in the flowering locations reduces unintentional damage to small and fragile plants.

The limitation of this method is that quantitative data is not always collected consistently for this species, nor is it always provided to CPR. As a result, CPR cannot currently provide annual population counts or trends for this species. However, the following observations have been made by the volunteer naturalist:

- **2009** Mt Majura main colony had over 50 plants but a flower predation rate of over 92%. The Black Stump site had 7 flowering plants and small numbers of plants were observed in a number of locations, including one site where they had not been seen for 10 years. Plants were observed on Mt Ainslie for the first time in a number of years.
- **2010** Mt Ainslie supported at least 105 plants though the flowers of approximately 50% of these plants suffered predation. Mt Majura supported several hundred plants split among its many colonies.
- **2011** 78 plants were caged in late winter to reduce predation on Mt Ainslie and another 10 plants remained uncaged. A dry period in spring caused flowers to be aborted and in September, only 10 of the caged Ainslie plants were in flower. In the main Mt Majura population, 87% of the plants were caged.

2.18 Spotted-tailed Quoll survey

Records of Spotted-tailed Quolls (*Dasyurus maculates*) in the ACT are sparse and comprise ad hoc records such as roadkills and distressed animals which have retreated up trees to escape backyard dogs. Official ACT quoll surveys have never recorded quolls; however, searches for quoll latrines in the 1990s found a few isolated scats which were found to contain quoll DNA. The majority of these records and a batch of the anecdotal records were in the vicinity of the former 'Gudgenby' property in the centre of Namadgi National Park. That is, they were in the combined catchments of Rendezvous Creek, Middle Creek, Bogong Creek, Hospital Creek and the upper parts of the Gudgenby River.

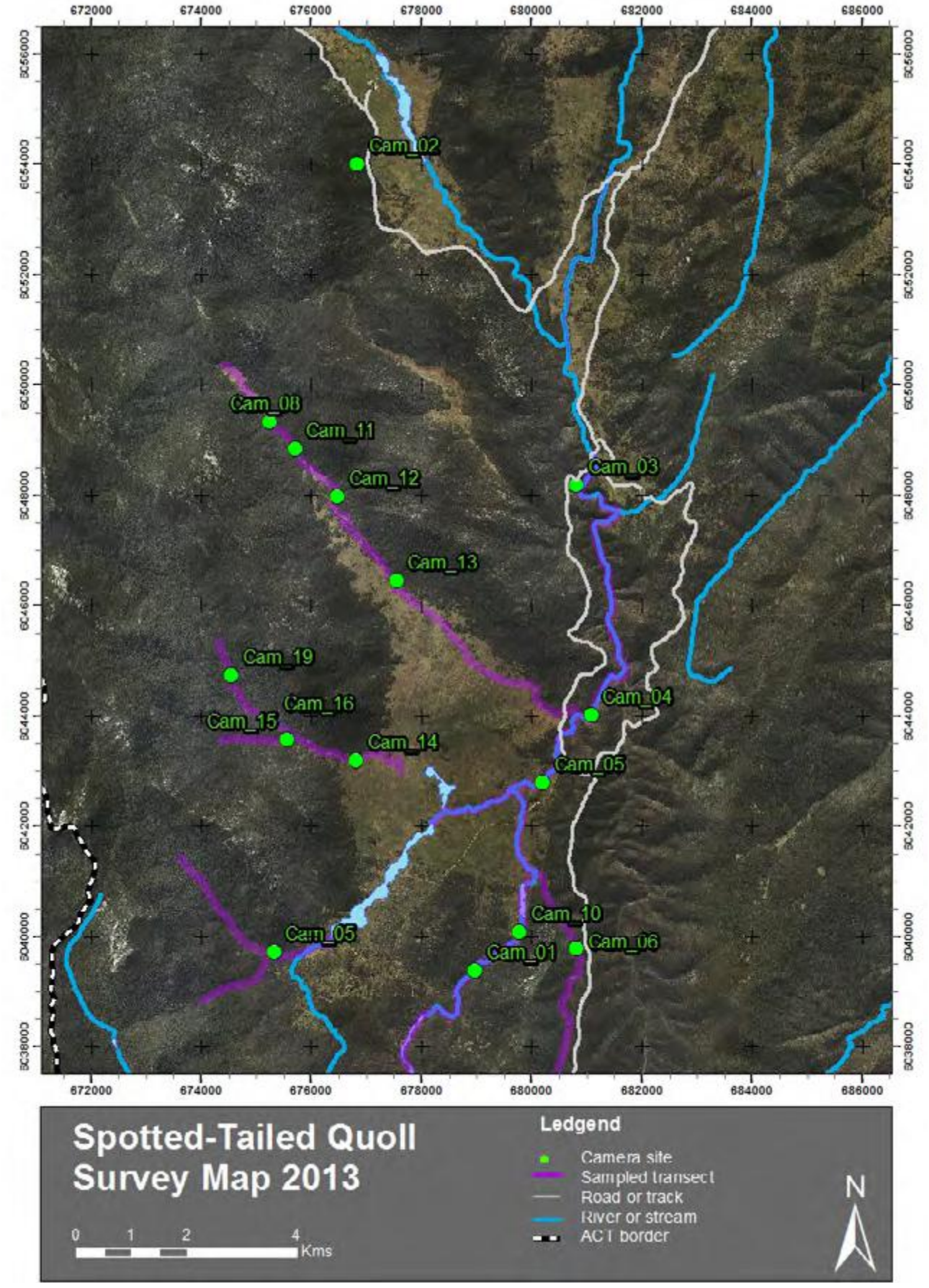
Figure 2.20 Spotted-tailed Quoll
Photo by Esther Beaton

By 2013, a long time had elapsed since the last ACT survey. In the meanwhile, research by Dr Andrew Claridge in the NSW Office of Environment and Heritage had revised the thinking on survey methods. An additional survey of the Gudgenby catchment down to Glendale Crossing was possible within the budget allocated for additional surveys for rare mammals. With volunteer input, an experienced operator in NSW quoll survey methods walked every creek line in the catchments searching for possible latrine sites, and Andrew Claridge and CPR staff searched together for one day. Twenty wildlife cameras were placed for three months (June–August 2013) on the most promising of latrine sites. A rock ledge in the nearby Orroral Valley was also included in the survey because a quoll scat had previously been found there. With this level of survey effort, if quoll abundance had remained unchanged from the 1990s, a good number of positive records were expected.

The result was disappointing, with no evidence of quolls at any of the sites and abundant evidence of foxes and dingoes on many. It was concluded that the quoll population is no longer occupying the lower parts of the Gudgenby landscape but, hopefully, some individuals are persisting in the higher and more remote areas. Possible reasons for the result are that:

- the species is sensitive to adverse environmental circumstances as the ACT is only marginal habitat for quolls; Gudgenby is near the upper altitudinal limit for this species and the geology is not ideal, and all possible latrine sites were 'Class 1' on Dr Claridge's 5-point scale, except an isolated Class 3 site on Gudgenby River and one of Class 5 on Middle Ck; and
- the recently increased abundance of rabbits, and hence foxes, at Gudgenby may be resulting in low quoll abundance at this time.

Figure 2.21 Quoll survey map. Creek lines walked and camera trap locations used in the 2013 quoll survey.



When funds and time permit, further survey should be conducted in the Molonglo and lower Murrumbidgee areas, which have the next highest concentration of previous quoll sightings.

2.19 Striped Legless Lizard surveys

In the ACT, Striped Legless Lizards (*Delma impar*) are known to occur in four discrete places: the Gungahlin area, the Majura Valley in the vicinity of the airport, 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 are considered to support less than at most a few hundred animals.

In the 1990s it was originally proposed to build houses and a town centre over some of the largest patches of Striped Legless Lizard habitat known in Australia. Fortunately the ACT Government decided to move the Gungahlin Town Centre away from key habitat and reserved over five square kilometres of grassland to protect the Striped Legless Lizard.

Recently Crace, Mulanggari and Gungaderra grassland reserves were resurveyed to determine how well they were protecting the lizard. In spring and early summer of 2012, 1460 roofing tiles were placed across the three reserves in 38 grids of 30 or 50 tiles each. Tiles were checked for sheltering lizards on 10 separate occasions. Like fingerprints, each lizard has a distinctive arrangement of scales on its head, so by photographing the head of every lizard observed, repeat observations of the same lizard could be determined.

Figure 2.22 Striped Legless Lizard

A total of 251 Striped Legless Lizards were identified from 323 observations. Of the 71 recaptures 54 (76%) were under the same tile. Only six of the recaptures were further than 10 m apart and only one greater than 20 m. To estimate the populations of lizards in each reserve it was assumed that every lizard within a grid and within 10 m of a grid was captured. Given that only 29% of animals were recaptured, this is likely to be a conservative assumption. Nevertheless, the average density of lizards within those grids comprising 50 tiles was calculated as 22.3/ha at Crace, 30/ha at Mulanggari and 37.8/ha at Gungaderra. If we multiply these figures by the area of habitat in each reserve, then the estimated populations are 2899 (Crace), 4200 (Mulanggari) and 9072 (Gungaderra). These are all amongst the largest populations and highest densities for this species ever recorded.

2.20 Sub-alpine Herb

This small annual sub-alpine herb (*Gentiana baeuerlenii*) lacks a common name and occurs in the inter-tussock space of moist tussock grassland and sedgeland in association with groundwater seepage. *G. baeuerlenii* has been found in only one location in the ACT, on the lower slopes of a broad sub-alpine valley, in very small numbers and has not been observed at the site since 1994. The species is currently listed as endangered under the ACT *Nature Conservation Act 1980*, and critically endangered under the *Commonwealth EPBC Act 1999*.

CPR ecologists and PCS rangers have conducted regular surveys for *G. baeuerlenii* over several years, most recently in 2013. During this latest survey it was observed there was thick grass cover and thatch, which could inhibit germinating or emergence of *G. baeuerlenii* and other small herbs and grassland species. Consequently, site management is planned for 2013–14 including consideration of an ecological burn over part of the site and adjacent similar habitat.

Figure 2.23 *Gentiana baeuerlenii* exclosure
Grazing exclosure protecting the only known *Gentiana baeuerlenii* population.

2.21 Superb Parrot survey

Superb Parrot (*Polytelis swainsonii*) breeding within the ACT is concentrated in two areas, the Central Molonglo Valley and Throsby Ridge in Gungahlin. Nest sites in the Molonglo Valley were mapped in 2011. The Throsby Ridge area was surveyed in 2009, 2010 and again in 2012 with all nest sites identified. This information was utilised in the Gungahlin Strategic Assessment, whereby the extent of the proposed new suburb of Throsby was considerably reduced to ensure proposed development was no closer than 100 m from any known nest tree. The development edge will be further than 500 m from most nest trees.

To support the Gungahlin Strategic Assessment, two CPR technical reports were written; Technical Report 24 – The Extent and Significance of Gungahlin's Biodiversity Values (Mulvaney 2012) and Technical Report 25 – Box-gum Woodland in the ACT (Maguire and Mulvaney 2011).

Figure 2.24 Throsby Ridge Superb Parrot breeding area

Information on the number and consequences of competitive interactions between Superb Parrots and other potential hollow competitors (Galah, Eastern Rosella, Crimson Rosella, Red-rumped Parrot, Little Corella and Indian Myna) has also been collected at Throsby. This will establish a baseline measure of the competitive interactions between the Superb Parrot and tree-hollow nest site competitors prior to construction of Throsby. It will allow consideration of whether the development of Throsby has led to increased competition for the tree hollow resource.

2.22 Tarengo Leek Orchid monitoring

Hall Cemetery contains the only population of Tarengo Leek Orchid (*Prasophyllum petilum*) in the ACT. The site is a grassy woodland dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*Eucalyptus blakelyi*), part of an endangered ecological community under the ACT *Nature Conservation Act 1980* and the *Commonwealth EPBC Act 1999.* There is little known about the specific ecology of this orchid. Management requirements for grave digging, vehicle access and movement, weed control and mowing are outlined in the Hall Cemetery Management Plan that was developed by CPR in 2005. 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.

From mid-October 2012 the site was visited weekly to detect flowering. Three full surveys of the eight areas known to contain orchids were carried out on 29 October, 5 and 12 November. Surveying was conducted by sweeping the numbered areas with metal detectors to locate the metal tags. The status, life stage and presence/absence of each orchid with a metal tag were recorded on the existing inventory of tag numbers. Each area was also carefully inspected for new untagged orchids. Any new orchids discovered in flower were identified by placing a new numbered tag in the ground.

The abundance of the flowering population at Hall has fluctuated widely since monitoring began in 1991. This trend was again evident in the most recent annual survey, with yet another decrease in the total flowering plants recorded, from 37 in 2011 to 15 in 2012 (Figure 2.25). No obvious link has been identified between marked fluctuations and the preceding years' abundance or environmental factors. Recruitment in the population is quantified by looking at the number of flowering plants not recorded in previous years (i.e. those without metal tags). Six new individuals were recorded in 2012, which is lower than in 2011 when 20 new individuals were detected. This matches a decrease in the total number of individuals recorded in 2012 overall (Figure 2.26).

Figure 2.25 Tarengo Leek Orchid abundance
Tarengo Leek Orchid abundance at Hall Cemetery as total counts of flowering individuals per year.

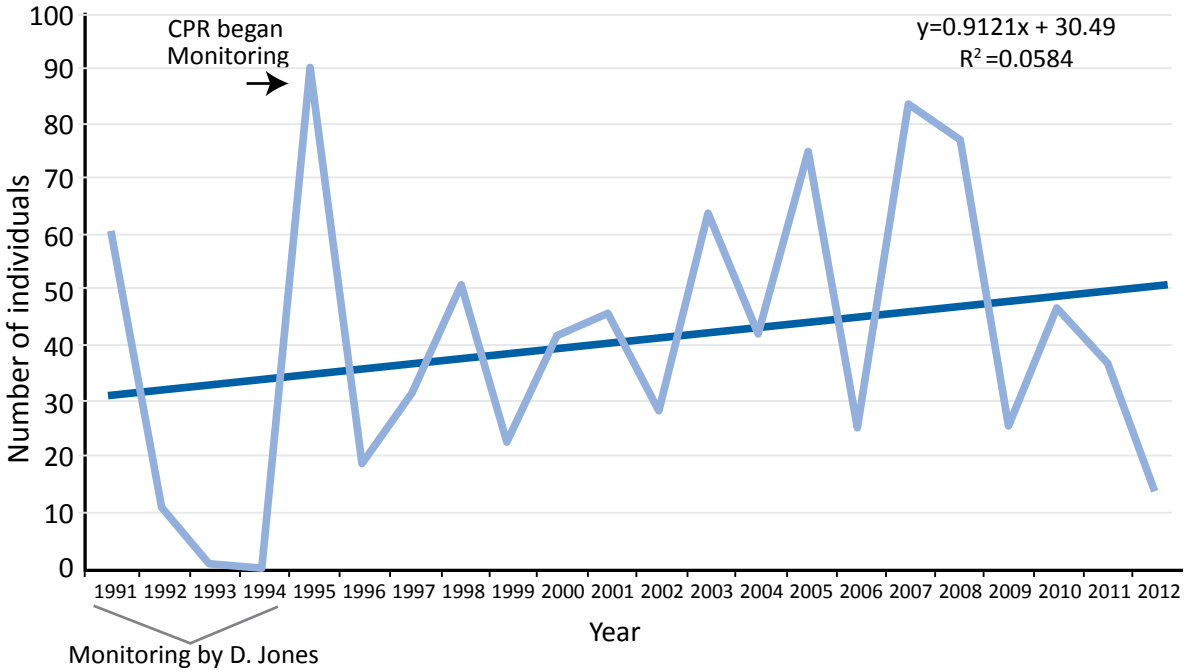
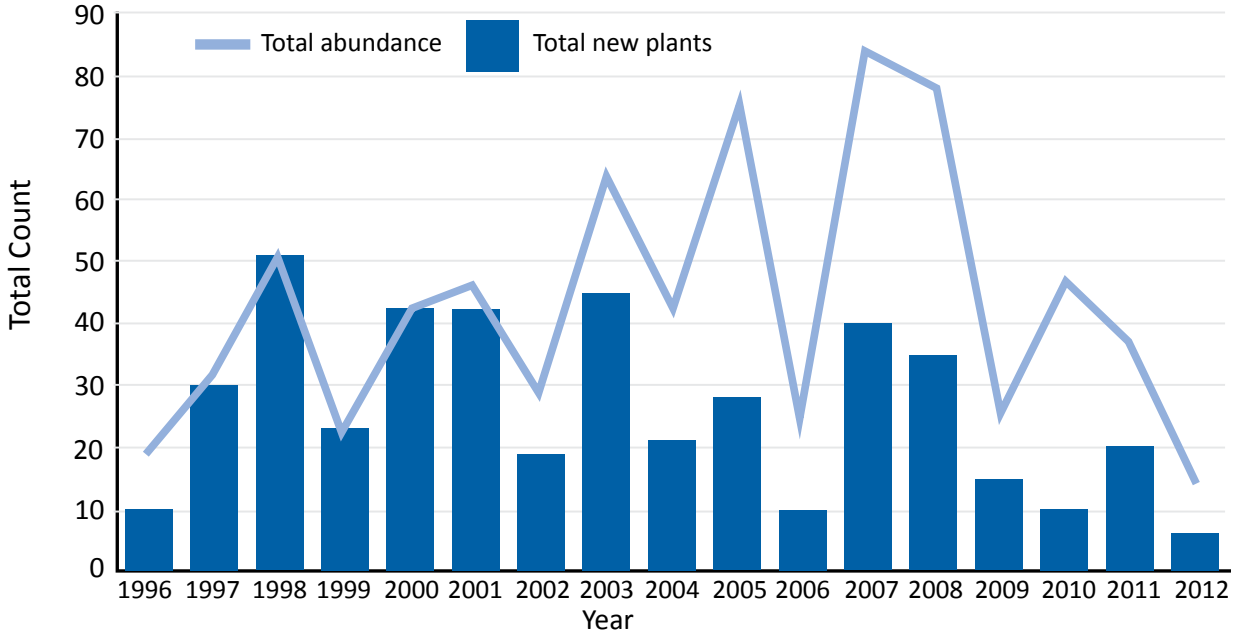


Figure 2.26 Tarengo Leek Orchid recruitment
Recruitment of flowering Tarengo Leek Orchid at Hall Cemetery shown as the number of previously unrecorded ('new') plants per year in relation to the total abundance per year.



The annual mowing routine conducted by ACT Public Cemeteries Authority staff during autumn was updated on advice from CPR to mow all orchid habitat and high quality grassland before moving into weed dominated areas. This will hopefully slow the spread of weed species into these higher quality areas. Advice was also provided to the Friends of Grasslands group (FOG) regarding their biannual woody weed removal activities in the area. In the past, as a part of this work, FOG members have removed all eucalypt regeneration that occurs within the Cemetery grounds with the aim of protecting orchid habitat. Discussion between CPR, FOG and the Cemetery's head groundsman resulted in conditions being set for the retention of a number of saplings, including the number of trees, species, health condition and location. These management changes will be included in the Hall Cemetery Management Plan by CPR.

2.23 Trout Cod restocking

Trout Cod (*Maccullochella macquariensis*) is listed as endangered in the ACT under the *Nature Conservation Act 1980* and nationally under the *Commonwealth EPBC Act 1999*. The species died out 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 following locations: Murrumbidgee River at Angle Crossing from 1996 –05; Murrumbidgee River at Kambah Pool from 2006–08; and Cotter River at Bendora Reservoir in 1989-90 and 1992.

The success of these stockings and the status of the upper Murrumbidgee River Trout Cod population are monitored by CPR as part of the threatened species monitoring program. The Murrumbidgee releases are surveyed through the biennial Murrumbidgee monitoring program. Bendora reservoir is also surveyed. Three Trout Cod were caught during the 2011 monitoring survey; one each at Kambah Pool, Angle Crossing and Bendora Reservoir. The Trout Cod caught at Angle Crossing on the Murrumbidgee River was a juvenile (118 mm). Angle Crossing was last stocked in 2005 and this fish is the first to be recorded at this site since 2006. The juvenile fish represents the first indication of successful natural breeding at any site in the upper Murrumbidgee River since stocking commenced in the mid 1990s.

The juvenile Trout Cod captured at Angle Crossing has raised the potential for impact on this newly recruiting population from the extraction of water by the Murrumbidgee to Googong Pipeline. Extraction pumps are known to cause significant mortality in larval and juvenile fish. ACTEW, with the University of Canberra, is conducting projects to gain information on Trout Cod in the area to better understand the potential impact of the Murrumbidgee to Googong Pipeline pumping. Monitoring of the species in the Murrumbidgee River and Bendora Reservoir will continue to assist management actions undertaken for this species.

2.24 Two-spined Blackfish monitoring

Figure 2.27 Two-spined Blackfish in the Cotter River

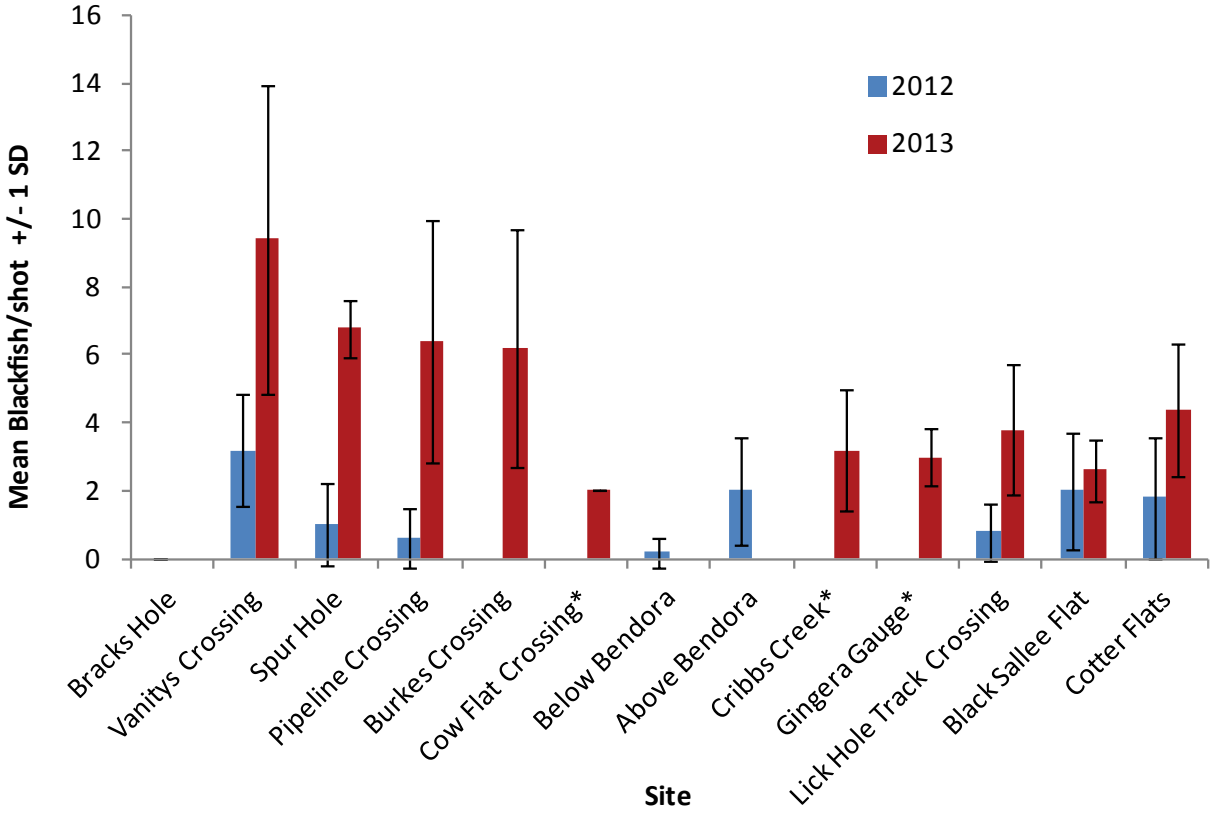
Two-spined Blackfish (*Gadopsis bispinosus*), listed as vulnerable in the ACT under the *Nature Conservation Act 1980*, are restricted to the Cotter River Catchment within the ACT. Threats to the ACT population include sediment loads and flow conditions as well as drought and exotic species (ACT Government 2007). A key recovery action in the Two-spined Blackfish Action Plan is to monitor the condition of the population (in particular recruitment) in order to inform adaptive flow and catchment management decisions in an effort to minimise impacts on the Cotter River population.

An annual Two-spined Blackfish monitoring program has been undertaken by CPR on the Cotter River since 2001 and in Bendora Dam since 1995. Sampling is undertaken using electro-fishing survey methods. Due to uncertainty of sampling, confidence intervals are provided in presenting data. Additional sites were sampled in 2013 to provide additional baseline data for a prescribed burn that occurred on the eastern side of the Cotter River from Lick Hole Crossing to Corin Dam. A total of 58 Two-spined Blackfish were sampled in 2012 excluding Burkes Crossing and non-Cotter reference sites. A total of 228 Two-spined Blackfish were recorded in 2013. Sites not sampled in 2013 included above and below Bendora, non-Cotter reference sites and Bracks Hole, which was flooded from the enlarged Cotter Dam and will not be sampled in future.

The low numbers of Two-spined Blackfish caught after 2009 continued into 2012 at both regulated and unregulated sites. However, the 2013 sampling found numbers of fish caught to have increased compared to 2011 and 2012. Two-spined Blackfish less than 80 mm total length are considered recruits or young-of-year from this season. Of the total number caught, 25 in 2012 and 36 in 2013 were less than 80 mm total length. In 2012 the level of recruits was low again, similar to 2011. This was likely to be a combination of drought followed by extreme high flows during the breeding season.

Figure 2.28 Blackfish captures – catch per unit effort

Catch per unit effort (or per electrofishing shot) of Two-spined Blackfish individuals across the standard sites that were sampled. Sites marked with '*' were specially sampled to monitor the effects of prescribed burns in March 2013. In 2012 Burkes Crossing was not sampled and 2013 Bracks Hole was not sampled. In 2012 Bracks Hole was sampled and zero Two-spined Blackfish were captured. Confidence intervals are shown.



Recruitment in the unregulated and regulated reaches was similar in 2012. However, in 2013 the recruits in the unregulated section of river increased, suggesting a good breeding season. In comparison, the recruits in the regulated section of river declined, possibly because of the high flows during breeding season which, for the regulated river section, is earlier than the unregulated river section. Monitoring of this species will continue to ensure that river management and catchment pressures do not result in decline of this species.

Figure 2.29 Two-spined Blackfish captures – adults and recruits

Mean number of Two-spined Blackfish (adults and recruits) recorded per site for each river management type: Cotter regulated, Cotter unregulated and non-Cotter reference 2001–2011. The 2013 data graphed here does not include the additional pre-burn sites that are shown in Figure 2.25.

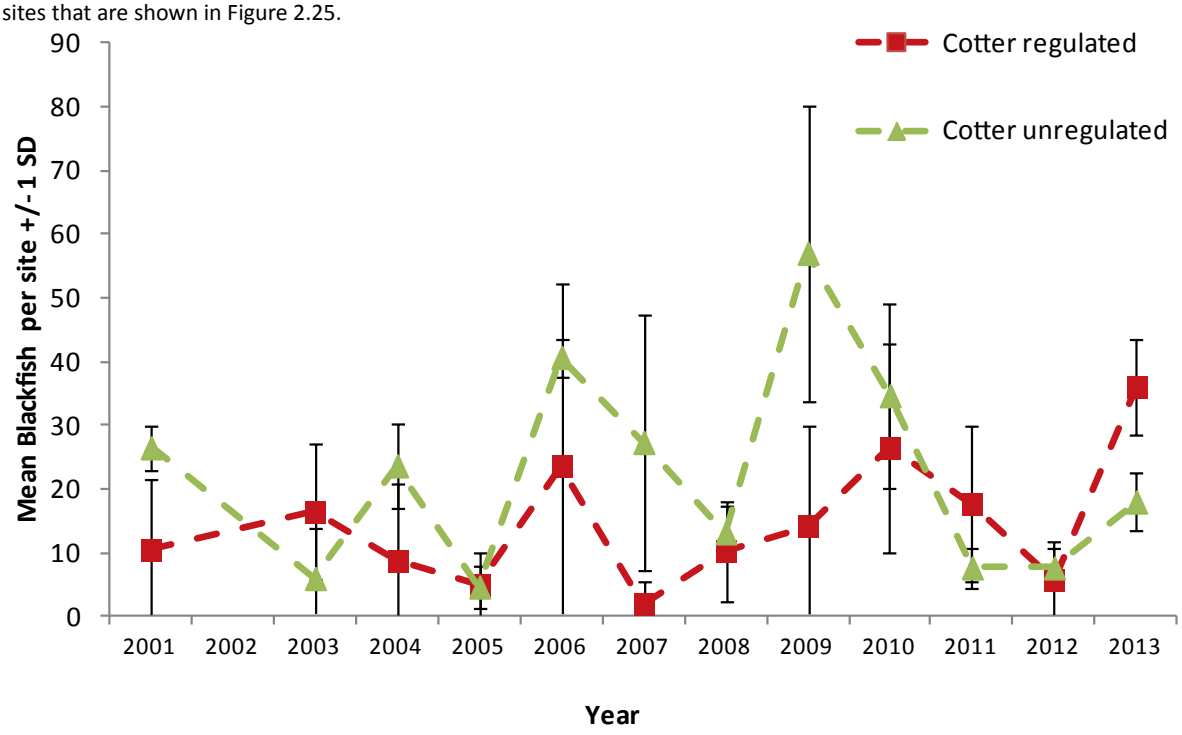
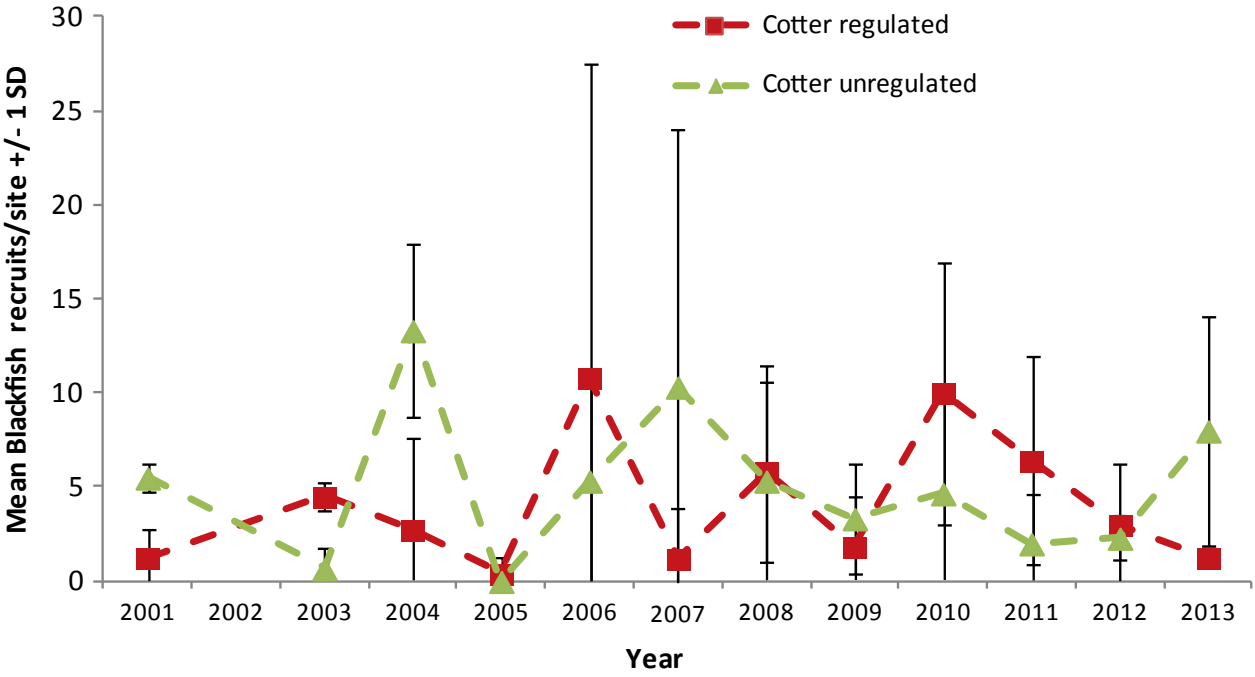


Figure 2.30 Two-spined Blackfish captures - recruits

Mean number of Two-spined Blackfish recruits recorded per site for each river management type: Cotter regulated, Cotter unregulated and non-Cotter reference 2001–2011. The 2013 data graphed here does not include the additional pre-burn sites that are shown in Figure 2.26.



2.25 Tuggeranong Lignum monitoring and translocation

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

On 18 October 2010, 68 clonally propagated plants were planted in four suitable areas along the eastern river bank within the reserve. Each plant was marked with a unique number on an aluminium tag. Staff from CPR, PCS and ANBG participated in the planting. PCS staff planted a further 25 plants in a fifth area on 23 October 2010 with members of the Parkcarers of Southern Murrumbidgee (POSM) group. Field observations of the wild plants and planted populations were carried out on 3 and 10 May 2012. The results of this work for the planted populations are in Table 2-2. Wild plants and planted populations were located using GPS references and individual plants within the planting areas were located using a metal detector to find the metal identification (ID) tags of each plant. The condition of each plant found was recorded. Photographs of each wild plant and the locations of surviving planted individuals were taken using a camera with GPS capabilities.

Table 2.2 Summary statistics for planted *Muehlenbeckia tuggeranong* populations at Pine Island Reserve in autumn 2012

Area ID	Total No. Planted	Total Found	Total Dead (Found)	Total Alive (Found)	Survival Rate (% of Found)
P_a	16	13	7	6	46.1
P_b	17	4	1	3	75
P_c	25	4	1	3	75
P_d	10	4	1	3	75
P_e	25	7	3	4	57.2
TOTALS	**93**	**32**	**13**	**19**	**59.3**

The sites were visited again on 31 May 2012 to place aluminium ID tags for the wild plants and to take samples from each plant for genetic testing by the Australian National Herbarium. The results of this work will help determine how many individual wild plants actually exist, as it is impossible to determine from a visual inspection, and which wild plants the surviving plantings are cloned from. During this work, a further two wild plants were located downstream of the central car park. Another search of the Red Rocks Gorge location failed to locate the previously recorded individual. The habitat at the recorded location was not suitable for Tuggeranong Lignum therefore it is possible the location coordinates are an estimate.

Plantings

Large floods during the spring and summer of 2011–12 caused a great deal of disturbance in the Murrumbidgee River corridor. Many of the planting sites were subject to extensive scouring and deposition of large volumes of flood debris. In addition, the growth of African Lovegrass (*Eragrostis curvula*) was encouraged by this warm season rainfall.

Up to two thirds of all individuals planted over the five areas and their markers may have been washed away in flood events over the past two years. Just over one third were located during the search of the areas and, of these, nearly 60% were alive.

A number of management actions will be carried out to assist future monitoring and to preserve individual plants from grazing damage and weed infestation:

- All wild plants will be marked with unique numbered aluminium tags (as reported here) to assist in locating plants and record keeping.
- Some wild plants may benefit from being partly protected by exclosures to help prevent grazing by rabbits and macropods. This is to be discussed with PCS rangers.
- Weed control of African Lovegrass (*Eragrostis curvula*) and Blackberry (*Rubus discolour*) is recommended around some of the wild plants.
- Site visits to some plants on a two-monthly basis will be required to ensure invasive weed species (e.g. *E. curvula* and Soapwort, *Saponaria officinalis*) do not invade and overgrow the area.
- Genetic testing results will be reported on and used to address future management of the species.

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 regimes. The ACT recognises key threatening processes in managing threatened species and ecological communities systems.

CPR 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 Climate change and threatened plant species in montane bogs

The Australian Alps are under unprecedented threat from many processes, including climate change, and are a focus of a seed conservation and research program by the Australian National Botanic Gardens (ANBG). Within the Alps, the nationally listed (EPBC Act 1999) endangered ecological community 'Alpine Sphagnum Bogs and Associated Fens' (ASBAFs) will be particularly impacted by threatening processes due to the inherently small, fragmented and isolated populations. The ACT Government is providing support to assist the ANBG to (a) conserve plants of ASBAFs through genetically diverse, long term, ex-situ seed collections and (b) conduct research on the seed ecology and biology of bog and fen plants to better understand ecological drivers of recruitment in these communities to inform management and restoration practices.

Some highlights of this program are:

- During the summer (December 2012 – April 2013) ANBG staff and staff from CPR and PCS collected seeds from 18 of 32 'target taxa' (56%) named in the EPBC listing as 'typical' species that define the ecological community. Overall (including the target collections) 67 seed collections of 40 bog and fen taxa were made in the ACT.
- A series of laboratory experiments are being undertaken to better understand ecological drivers of seed germination in ASBAFs. Specifically, the ANBG is investigating effects of submergence, temperature, and pH on seed germination.
- A seed burial experiment has been established at Ginini Flats to reveal the longevity of seeds in peat and moss substrates in the field. The experiment will also reveal natural conditions that drive germination, the timing of germination (presumed to be spring), and any patterns of dormancy cycling.

Figure 3.1 Seed collecting at Snowy Flat, Namadgi National Park, ACT

3.2 Fallow Deer, Sambar and Red Deer

Three very different large animals are rapidly spreading through the ACT, with two likely to come to the attention of almost everyone in Canberra in the next 20 years. All are species of deer. CPR is providing advice to the PCS for establishing a sound monitoring program to record impacts and an index of abundance of Sambar. In addition, recording of ad hoc sightings and continuation of spotlight surveys of wildlife will provide an index of the inevitable spread of Red Deer and Fallow Deer.

An effective control method is needed that works in remote areas and meets requirements of humaneness and target specificity. Promising research that commenced in other states has been terminated due to other priorities and resource constraints.

3.3 Fire – Ecological review of the TAMS Bushfire Operational Plan

Each year, the TAMS Directorate 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. CPR 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.

In 2013 CPR assessed 475 proposed management activities listed in the 2013–14 BOP including fuel, access and infrastructure management. Assessments were conducted by CPR ecologists using spatial analysis techniques and appraisal of possible impacts, including site inspections where required.

Actions that were assessed as having the potential to cause adverse impacts on biodiversity have been highlighted to TAMS and recommendations for mitigating impacts listed in accordance with ecological guidelines. In many cases CPR 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 CPR's ongoing prescribed burn monitoring program. Advice and recommendations from the CPR 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 directorates (ESDD and TAMS) with funding provided from both to ensure fire management activities, particularly in nature reserves, are strongly aligned with conservation outcomes.

3.4 Fire – Prescribed burn monitoring

CPR maintains an ongoing monitoring program aimed at determining the impact of prescribed burning on vegetation composition and structure and landscape function in areas identified for fuel reduction in TAMS' BOP. CPR also monitors population responses to ecological burns programmed by CPR and implemented as part of the BOP.

Currently 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. The selection of sites for monitoring is undertaken on a priority basis that considers potential impacts and the natural assets within the burn area.

The prescribed burn monitoring program employs a variety of vegetation monitoring methods to determine the potential impacts and changes occurring at sites. The method used at each site is selected to maximise potential information, based on the target vegetation type, natural assets and potential impacts. Methods vary from full floristic composition and structure measures to simple photo monitoring. The more quantitative monitoring is undertaken using a Before After Control Impact (BACI) design principle of 'measurement, before and after disturbance'. This design involves surveys being undertaken pre-burn, immediately after burn for a fire severity indication, and then over a number of years post-burn at treatment (burnt) and control (unburnt) sites.

2011–12 monitoring

The 2011–12 prescribed burn monitoring program comprised 10 monitoring sites; nine fuel management sites and one ecological burn site. Both the monitoring and burning program for 2011–12 were hampered by the continuing wet conditions due to the La Nina climate experienced during the 2010–11 season. The 2011–12 season also saw higher than average rainfall and multiple intense storm events, which inhibited the TAMS fire unit from implementing many of the planned burns and rendered scheduled monitoring sites inaccessible. As a result, the planned monitoring program was significantly interrupted, with only two of the seven monitoring sites scheduled for burning successfully implemented.

2012–13 monitoring

In 2012–13, more than 40 prescribed burns were undertaken throughout the ACT Government estate ranging in size from less than one hectare (200 square metres) for some ecological burns to over 5900 hectares in the Smokers Trail area of Namadgi National Park.

The 2012–13 fire season included a relatively short but intense period of very high to catastrophic fire weather during late December to early January with a number of remote fires ignited by lightening. Of particular note were fires adjacent to the Ginini Flats Wetlands and near the summit of Sentry Box Mountain that had the potential to become much larger fires. CPR staff were involved in the suppression and rehabilitation of both these fires and a report on the rehabilitation of the fire near Ginini Flats Wetlands was coordinated by the unit. As a result of this commitment to fire fighting and wildfire rehabilitation it was not possible to fully implement quantitative monitoring across all of the new prescribed burns in 2012–13 particularly given the extent of the burns. Consequently CPR conducted qualitative post-fire assessments at a number of larger burns.

Potters Hill

The 2012–13 monitoring season saw the fourth and final monitoring episode for this prescribed burn that was implemented in 2006. Data were collected according to previous survey methods and are being analysed by CPR to shed light on the recovery of flora and habitat structure.

3.5 Fire – Australian Alps long-term monitoring for fire management

In 2012, the CPR unit collaborated with the Australian Alps Liaison Committee, NSW National Parks and Wildlife Service and Parks Victoria to compile data collected over a 10 year period on the effects of fire on woodlands and forests in the Australian Alps.

In 1996, 40 survey plots were established in three national parks in the Australian Alps: Kosciuszko National Park in NSW (the Merambego and Nungar groups of plots); the Alpine National Park in Victoria (the Buchan Headwaters Wilderness); and Namadgi National Park in the ACT. All but eight of the plots were burnt by the January to February 2003 bushfires in south eastern Australia. Post-fire site assessment and fire intensity surveys were completed in March 2003 and November 2003 and floristic surveys were conducted in subsequent years.

A report of the analysis and results to 2009 was prepared. In general, species richness recovered quickly, within a year or two on average for most sites. Many species present before the fires were reported in the two years after the fire as having re-established either vegetatively or from seed. There was some variation in recovery times across the different Alps survey regions. Overall, the results showed little floristic change in the medium to long term, a result that is consistent with other studies. There was slower recovery in the structural elements of the vegetation communities. The cover–abundance measure of structural recovery showed the mid-storey rapidly recovering and remaining well above pre-fire levels. This reflects the large amount of Eucalyptus and Acacia regrowth from epicormic regrowth and seed. The surveys also provided a wealth of data on the regenerative mechanism and the juvenile period for plant species that occur in the Alps region. The report (Kitchin *et* al. 2013) is available on the ESDD and Australian Alps web sites.

3.6 Fire recovery

Burned Area Assessment Team

The Burned Area Assessment Team (BAAT) is an 8–10 person multi-disciplinary team that undertakes a rapid (5 day) risk assessment of impacted areas following a bushfire. BAAT is a joint team between ACT and NSW with interest from Tasmania and South Australia, and includes staff from CPR.

The BAAT team addresses impacts on vegetation, fauna, soils, hydrology, heritage and assets (not property loss and destruction). They develop costed mitigation options and prepare a report for the land managers. In January 2013, the ACT–NSW BAAT team was deployed to the Wambelong fire in the Warrumbungle National Park. The team undertook a full risk analysis of ecological assets impacted by the fire and provided prioritised mitigation advice to the local National Parks and Wildlife Service office.

Figure 3.2 Coonabarabran fire assessment

Aftermath of high intensity fire and early signs of post-fire recovery in the Coonabarabran area. Photos from the Burned Area Assessment Team (BAAT) – ACT and NSW joint program.

3.7 Kangaroo fertility control – on-going research

Fertility control is being evaluated in a number of species worldwide as a non-lethal tool for managing wildlife overabundance. In the ACT, a successful contraceptive agent would likely have some application as an additional management option in managing overabundant kangaroos.

The ACT Government has supported fertility control research for Eastern Grey Kangaroos since 1998. In 2008, sub-adult female kangaroos resident at Belconnen Naval Transmitting 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 four years following a single injection (Table 3-1). All but one animal continued to be infertile for a fourth year of the study. This result is extremely positive and GonaCon™ currently represents the most promising contraceptive trialled for use in this species. Further research and development is required to develop a remote delivery technique for this contraceptive agent, which would increase cost-effectiveness by removing the need for individual animal capture.

Table 3.1 Percentages of females in each treatment group observed with pouch young at annual checks

Treatment	2009	2010	2011	2012
GonaCon™	0%	0%	0%	7%
Sham Vaccine	89%	100%	100%	38%

Figure 3.3 Anaesthetised kangaroos being treated with a fertility control agent

3.8 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.

A large project is researching the relationships between kangaroo grazing pressure and biodiversity. This multifaceted project includes annual estimates of kangaroo population density, biannual assessments of herbage mass, and annual estimates of herbage off-take, reptile species diversity and vegetation assessment within 19 reserves and conservation areas around urban Canberra. The results from these investigations will assist the ACT Government achieve key conservation goals according to scientifically-based herbivore management.

Kangaroo density estimation

Kangaroo population densities within Canberra Nature Park are estimated annually according to one of four methods. Direct and sweep counts are highly accurate when counting individual kangaroos in small, well-defined conservation areas such as those surrounded by suburbs or main roads. Where these reserve boundary prerequisites are not met, a 'sampling method' such as pellet counts or walked line transects is used instead, which allows researchers to estimate total population size based on counts in representative sections of the landscape.

Figure 3.4 Kangaroo mob at Gungaderra Grassland Reserve
Over 300 kangaroos were counted in a single group at Gungaderra Grassland Reserve during a sweep count in 2013.

Assessing herbivore off-take

In most unmanaged ecosystems, herbivores compete for limited resources. As a result, removing animals from the population to decrease grazing pressure will have little or no effect above a certain threshold as remaining individuals will increase their consumption to compensate for the reduced number of competing individuals. This so called 'numerical response' is being investigated by CPR (specifically in regards to Canberra's temperate climate) through the use of herbivore exclusion cages, which allow biannual assessments of the changes in pasture growth relative to changes in herbivore population density. Specially designed cages have been erected to determine the relative impacts of both kangaroos and rabbits, the major pasture consumers within Canberra's urban parks. So far 46 cage sets have been positioned across seven reserves.

Herbage mass estimates

Herbage mass estimates give an indication of the amount of plant matter present in various vegetation communities and across multiple reserves. Up to 120 quadrants (1 m^2) are inspected biannually per reserve with measurements being made of pasture structure and composition. From these measures, researchers are given an indication of the vegetation functionality, both in terms of kangaroo forage and as habitat for ground-frequenting animal species (e.g. reptiles, insects and some birds). Over 650 quadrants have been inspected across 11 research areas to date.

Figure 3.5 Checking shelter tiles for reptiles

Reptile abundance and diversity

Reptiles have been chosen as an 'indicator group' to provide information on the abundance and biodiversity of ground-frequenting animals within our research areas. Surveys are carried out in spring/summer of each year by checking grids of 30 roof tiles positioned at randomly allocated locations within urban reserves and conservation areas. Each tile is checked 5–10 times and its inhabitants are recorded in association with the surrounding vegetation structure (see 'Herbage mass estimates'). Sometimes, frogs or small mammals (such as the Common Dunnart) are found sheltering under tiles and these are also recorded. To date, over 9,000 tile checks have been completed within 11 research areas.

Vegetation assessment

This project will provide interim guidance on kangaroo densities for site management to protect floristic values of the vegetation of Lowland Natural Temperate Grassland and Yellow Box – Blakely's Red Gum woodland.

Other factors determining site condition

This study is primarily exploring relationships between kangaroo densities and vegetation (floristic) condition. However, along with kangaroo densities, vegetation community and structure, there are a number of historical management and landscape factors which may affect vegetation condition at a site or plot level. These include variation in historical grazing patterns, grazing impacts of other herbivores and omnivores, nutrient application, localised climatic conditions, time since fire, time since drought, seasonal variation, micro-topography, soil moisture, natural soil nutrient levels, aspect, slope and topography. Seasonality was partially accounted for by surveying at the same time of year (i.e. plots surveyed in November 2009 were generally surveyed in November 2012), though the spring-summer of 2009 no doubt varied from that of 2012. Grazing impacts of other herbivores were also partly controlled as no plots have been grazed by domestic stock since well prior to the original surveys in 2009. Ideally, plots may be sampled during times of extreme drought with separate analysis undertaken, as kangaroo densities necessary to maintain vegetation condition are likely to be significantly less in such conditions. All other factors are likely to affect vegetation conditions in ways that are difficult to calibrate for in a study of this scale.

Sensitivity of vegetation metrics

'Floristic value scores' developed by Rehwinkel (2007) were the main metric used to relate vegetation condition with kangaroo densities. This metric has the advantage that it provides a site value based on the presence of key indicator species, where other scores such as 'native species richness' may provide value to species which thrive in over-disturbed environments.

4 SURVEY AND BASELINE INFORMATION

CPR 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 advice to land managers and government agencies that is underpinned by information and sound science.

4.1 Animal ethics in research

All research activities involving animals require prior approval by a legally constituted Animal Ethics Committee (AEC). Universities and other large research organisations administer such a committees, which 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). The management and performance requirements for an AEC are carefully defined in the code. AECs require certain numbers of each of four classes of members to be present at each meeting, including veterinarians, members of community wildlife groups and lay members of the community, as well as research experts.

Given the expense of administering such a committee, CPR has long been fortunate to have been able to join the AEC at the University of Canberra (UC) and have its research proposals evaluated by the UC Committee for Ethics in Animal Experimentation. In return, CPR fills one of the Category B positions on the committee.

4.2 Cotter River larval sampling for Macquarie Perch

Figure 4.1 Sampling for young (larval) stages of Macquarie Perch

In 2008–09 a program of snorkelling for larval Macquarie Perch in Cotter River was developed. This program could not be undertaken in 2011–12 due to safety issues of very high flows during the breeding season. The program was run again in 2012–13, but due to unseasonably cold water temperatures, the larval Macquarie Perch were much smaller than anticipated and were only positively detected at one site (Vanitys Crossing). However, they were recorded in reasonable numbers at this site.

4.3 Monitoring native and introduced wildlife by spotlight

The longest-running ACT wildlife research program is the spotlight counting by PCS staff, with technical support by CPR. This program monitors abundances of twelve species, including species of the highest significance for conservation of ACT flora and fauna.

The program is challenged by reduced resources, with declines in both frequency (counts per year) and intensity (nights per count). Consideration of the aims of the project and analysis of the collected data, including species recorded, duration of records and consistency of counting method, identified ways to maximise efficiency of what monitoring can be done.

Eight sites stood out as being of highest priority, including the four experimental-style sites in Namadgi (Boboyan, Mt Clear, Orroral and Glendale), Googong Foreshores, Tidbinbilla (which has run for 37 years, the longest time), and Gudgenby (the relationship evident between Dingoes, European Foxes, Red-necked Wallabies and rabbits).

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 these count data, particularly its long-term recording period, is a strong reason for continuing the monitoring.

4.4 Mountain Cress monitoring

Mountain Cress (*Drabastrum alpestre*) is a herb or sub-shrub from the Brassicaceae family that generally grows at higher altitudes south from Bathurst in NSW. The only population of this species in the ACT is located near Cotter Caves. The population is physically divided by shrubby vegetation into two sub-populations which occur on open rocky scree slopes (referred to as the Top site and the Bottom site), which are then further divided into two main clusters of plants (referred to as the Upper and Lower patches). The population is jointly monitored by PCS and CPR via an annual count of individuals. The Bottom site was only observed in 2009 and has been monitored annually since then. NSW Office of Environment and Heritage has only located a handful of populations of this plant at similar altitudes in the local area and has no information of the regional conservation status of this rare species. The ACT population has been growing steadily across both its two sub-populations, however the 2012 count for the Top site was an order of magnitude lower than the previous year. This is thought to be partially due to heavy rabbit grazing. PCS is encouraged to undertake local rabbit control and continue its good work in monitoring and managing this species.

Table 4.1 Mountain Cress 2012 Cotter survey

Top site	2004	2005	2006	2007	2008	2009	2010	2011	2012
Upper	74	48	27	27	24	35	95	102	Combined Top/bottom
Lower	68	119	103	118	345	310	470	378	15

Bottom site	2009	2010	2011	2012
Upper	263	359	202	Combined Upper/lower
Lower	47	111	176	617

N.B. The 2012 monitoring did not record the figures separately across the Upper and Lower patches but combined all recorded individual plants into one figure.

4.5 Murrumbidgee River fish monitoring

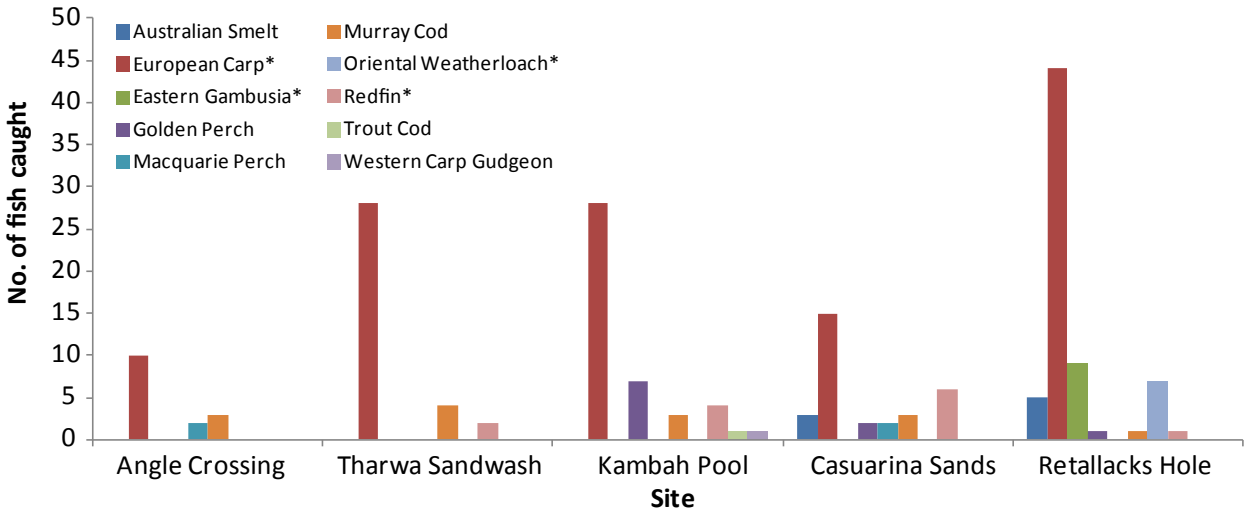
The Murrumbidgee River is the largest river in the ACT region. It supports a number of native fish species, including threatened species such as Trout Cod and Macquarie Perch and recreationally important species such as Golden Perch and Murray Cod (listed as special protection status in the ACT *Nature Conservation Act 1980* and vulnerable nationally in the *Commonwealth EPBC Act 1999*). These fish are threatened by a number of existing processes such as sedimentation, pest fish, illegal harvest and loss of habitat. 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.

Biennial surveys of the Murrumbidgee are undertaken by CPR to monitor the status of threatened and recreational fish species as well as pest species. The monitoring has also been used to complement the baseline pre-impact monitoring for the M2G project.

In 2013, 192 fish were captured from eight species including two ACT threatened species (Trout Cod and Macquarie Perch) and four pest species. Figure 4.2 shows the biomass of the catch for each site. Carp dominated all sites with between 67 and 97% of the biomass; however, nationally or ACT listed threatened species were still recorded at all sites. Murray Cod were recorded at all sites and this represents a range expansion for this species into habitats upstream of the ACT. The presence of juvenile Murray Cod at the Angle Crossing sites indicates successful breeding above of Gigerline Gorge, which was previously the upper extent of Murray Cod range in the Murrumbidgee River. Macquarie Perch were recorded at Angle Crossing and Casuarina Sands. The fish at Casuarina Sands are likely to be a result of fish being displaced from the large population in Cotter Dam during the overflow events in 2012. Their persistence at this site for over 12 month is encouraging and raises the potential that the species may establish in the Casuarina Sands reach.

Figure 4.2 Fish captures

Biomass of fish captured per site for the 2013 Murrumbidgee Fish Community Monitoring. Pest species have an asterisk*.



4.6 Kangaroo management and public opinion

In 2008 the market research company Micromex conducted a telephone survey on public opinion about kangaroo management in the ACT. Micromex conducted a similar survey three years later in 2011. In the intervening period, conservation culling had commenced in urban nature reserves, the Kangaroo Management Plan had been released as a public consultation draft then later as a final plan, the Commissioner for Sustainability and the Environment had recommended reducing overgrazing, including by kangaroos, as a matter of urgency in a report on native grassland and there had been a significant effort by the ACT Government to communicate with the public on kangaroo issues. The communication effort included participation of CPR ecologists in a one-hour documentary 'Kangaroo Mob' made by the independent (i.e. non-commissioned) company, 360 Degree Films. The full results of the survey are at www.tams.act.gov.au but, in summary, the main public opinion change from the 2008 survey was an increase from 59% to 70% of Canberra adults who supported conservation culling for the ongoing management of ecosystems.

4.7 Research on cat management in the ACT

As part of funding received from the Invasive Animals Cooperative Research Centre (IACRC), CPR commissioned a telephone survey in May 2011 on cat ownership and community attitudes to management controls.

The survey was designed by an overseeing committee comprising members from the IACRC, CPR, the Land Development Agency, ANU, TAMS and the RSPCA. The survey polled 1085 ACT residents (including 506 cat owners) and targeted a further 192 residents of the declared cat containment suburbs of Forde and Bonner. The survey found that ACT residents:

- are generally responsible cat owners
- strongly support cat containment in the ACT
- recognise the benefits of cat containment
- think cat containment is working
- think contained cats have fewer injuries and related vet bills
- favour control of stray cats.

4.8 Vegetation communities of the ACT

Figure 4.3 Example vegetation community description
u19A: Blakely's Red Gum - Yellow Box Tall Grassy Woodland of the ACTWestern South Eastern Highlands Bioregion

u19A: Blakely's Red Gum - Yellow Box tall grassy woodland of the ACT western South Eastern Highlands Bioregion

Scientific Name: *Eucalyptus blakelyi - Eucalyptus melliodora / Microlaena stipoides - Austrodanthonia racemosa - Elymus scaber - Themeda australis - Austrostipa scabra*

Plate u19A:

Type Location: The type location for this community in the ACT is in the northern section of Goorooyarroo Nature Reserve (AGD94 699084 6104829). At the time survey the area was heavily grazed and sheet erosion was evident following heavy rains. The site displayed moderate to high native species richness for this community type.

ACT community character: In NSW *E. albens* can be dominant but this species is not a component of u19A in the ACT.

Vegetation Description: Community u19A is a tall grassy eucalypt woodland dominated by Blakely's Red Gum (*Eucalyptus blakelyi*) and/or Yellow Box (*E. melliodora*). The shrub layer is sparse or absent and generally contains regenerating eucalypts, *Acacia implexa* or *Acacia dealbata*. The groundcover is grassy/herbaceous with grasses including *Microlaena stipoides, Elymus scaber, Themeda australis, Austrodanthonia racemosa, Bothriochloa macra* and *Poa sieberiana*, with degraded areas generally dominated by less palatable robust species such as *Bothriochloa macra* and *Austrostipa scabra*. Forbs include *Hydrocotyle laxiflora, Rumex brownii, Geranium solanderi, Oxalis perennans, Lomandra filiformis subsp. coriacea* and *Tricoryne elatior*. High condition sites tend to have a wide variety of forbs including *Microtis unifolia, Arthropodium minus, Dichopogon fimbriatus* and *Wurmbea dioica*.

Blakely's Red Gum - Yellow Box ± White Box tall grassy woodland occurs on flat and undulating fertile soils from north of Crookwell in the east through to west of Tumut in the upper slopes of the NSW South Western Slopes bioregion. In the ACT u19A is most common in the north east with the main distribution ranging from Gungahlin to Lanyon. Locally u19 grades into u17a [*Yellow Box ± Apple Box tall grassy woodland of the South Eastern Highlands*] to the south-east in the ACT. It also grades into a number of

CPR is developing a vegetation classification for the ACT that describes the native vegetation communities occurring in the Territory. The classification is modified from that described by the NSW Office of Environment and Heritage (OEH) in '*Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales, Version 1.1*' (2011). Additional field surveys and data analysis by CPR ecologists has lead to the definition of approximately 50 interim vegetation communities throughout the ACT. Each interim vegetation community will have a detailed description including a type location and will be compiled in a CPR technical report in 2014 (Figure 4.3).

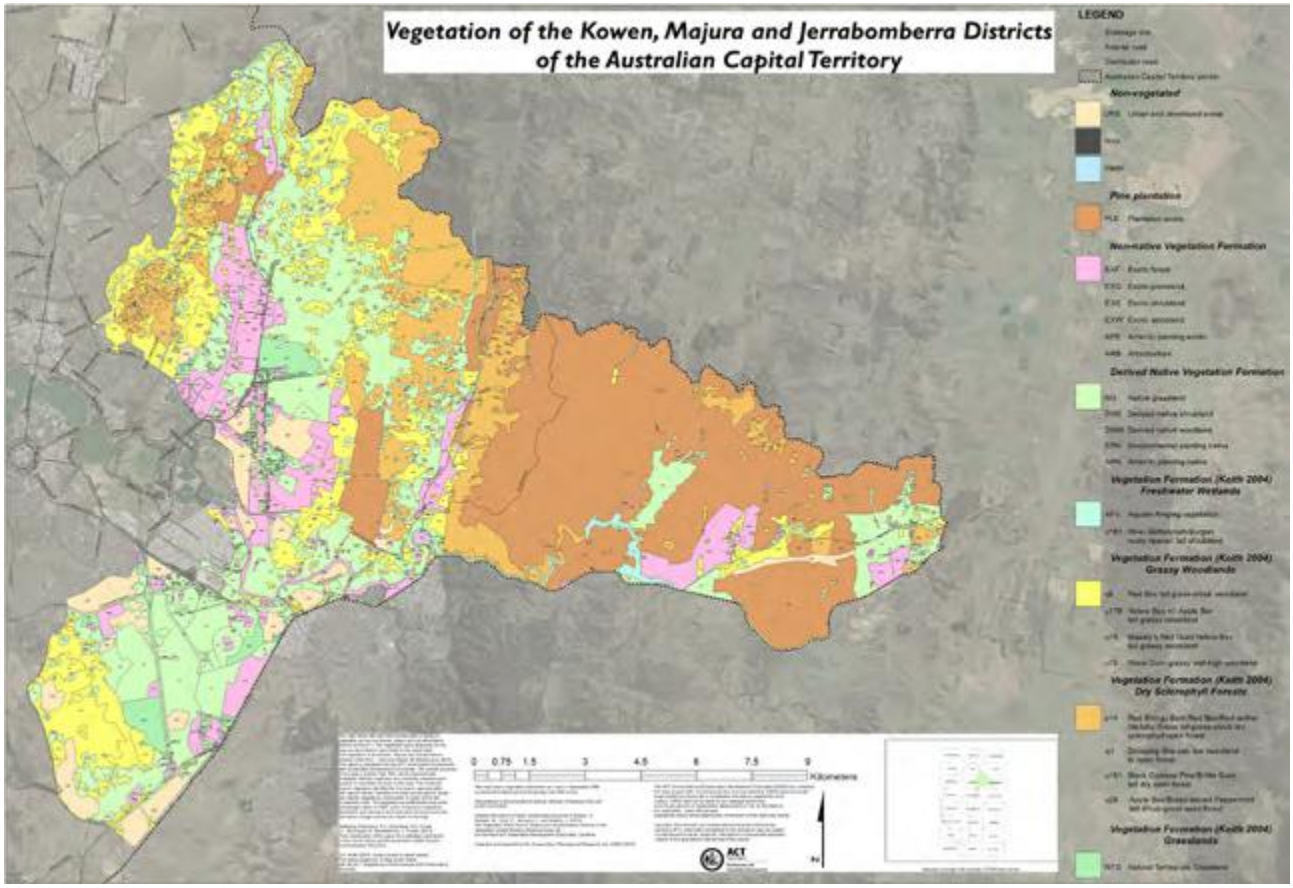
The Interim Vegetation Communities of the ACT report will inform vegetation mapping work being conducted throughout the ACT over the next two to three years. The mapping process will refine the definition of vegetation types enabling a definitive vegetation classification to be finalised on completion of mapping and validation work in 2015–16.

4.9 Vegetation mapping – Kowen, Murrumbidgee River Corridor, Namadgi National Park, Naas region

Mapping of vegetation commenced in the Kowen, Majura and Jerrabomberra Districts with the awarding of a contract to Foresense Pty Ltd to provide aerial photo interpretation of approximately 20,600 hectares of the vegetation of the target area. The vegetation was mapped according to vegetation community classification '*Plant communities of the upper Murrumbidgee catchment in New South Wales and the Australian Capital Territory*', produced by the NSW Office of Environment and Heritage. This mapping was completed in 2013.

An additional contract was awarded to Foresense to map approximately 15,000 hectares of vegetation in the Murrumbidgee Catchment of the ACT. This mapping is to be done using the same methods and classification as the Kowen mapping.

Figure 4.4 Vegetation communities
Communities map of the Kowen, Majura and Jerrabomberra Districts



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 to 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 its effectiveness has been unclear. Funding from the Murray Darling Basin Authority's Native Fish Strategy facilitated a trial of fish passage through the fishway. The project included the installation of an array of sensors on the fishway and the capture and PIT tagging of over 100 fish from four species. Fifty fish (41 European Carp and 9 Golden Perch) were placed in the lower section of the fishway and their ascent monitored by the sensor array. A number of problems were encountered, particularly the high flow velocity, lack of fish motivation and the difference in height from river flow level to the fishway entrance flow level being too great. A number of solutions to these problems were trialled. By placing the fish in the first cell and installing a baffle in the entrance slot, flow velocity and turbulence in the fishway were reduced and 100% of fish placed in the fishway achieved passage upstream. The results indicate that the fishway needs modification to operate effectively at low flow levels. Additional work is planned to increase the number of PIT tagged fish in the Murrumbidgee to assess population levels of native and pest fish and their movement over time and to guide regular monitoring.

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

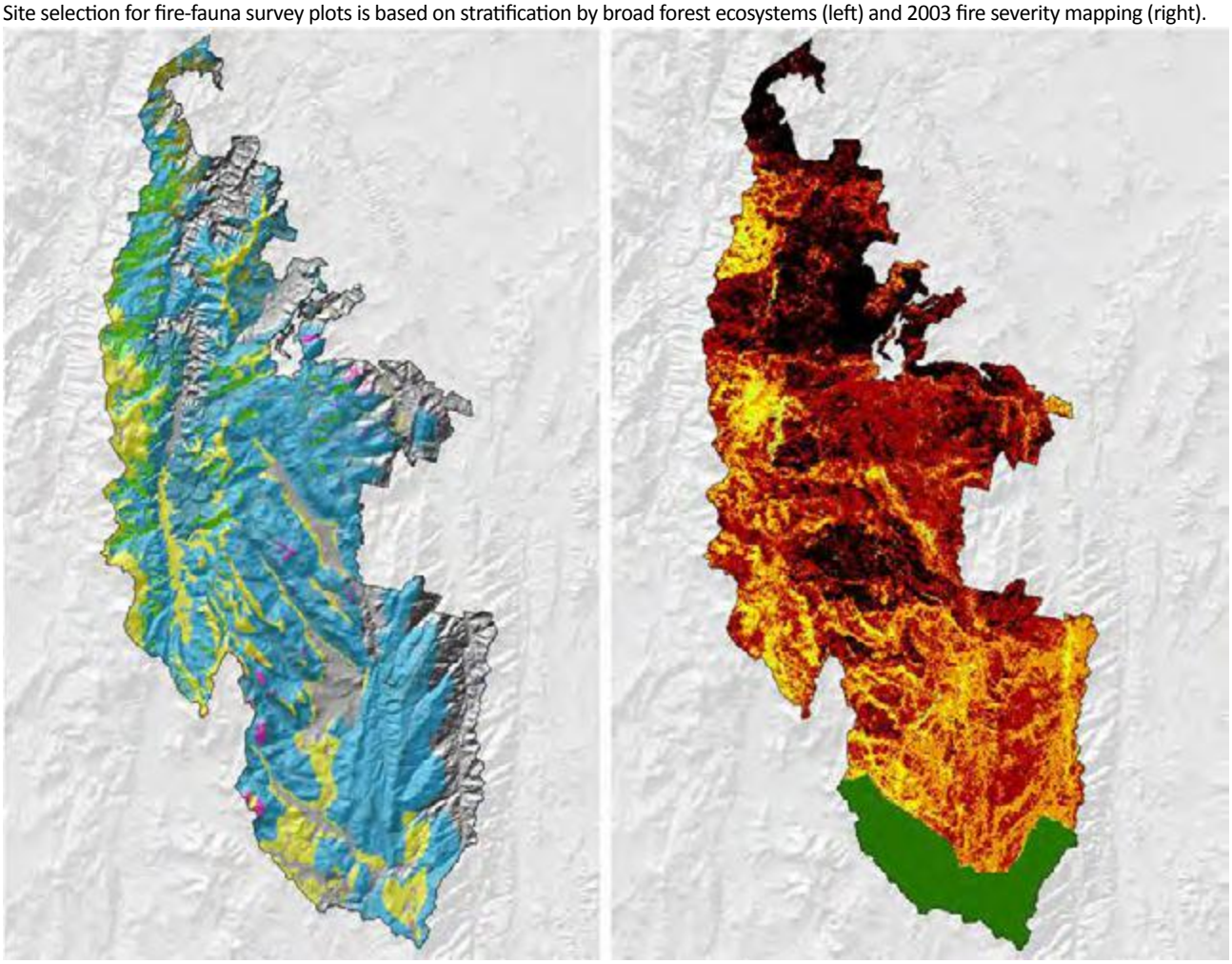
5.2 Fire and fauna – linking fire and habitat structure across the ACT

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. CPR has embarked on a fire-fauna research project that aims to collect data on the relationship 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 5.2).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 5.2 Stratification map of Namadgi National Park
Site selection for fire-fauna survey plots is based on stratification by broad forest ecosystems (left) and 2003 fire severity mapping (right).



5.3 Monitoring of Button Wrinklewort in Jerrabomberra East Nature Reserve

In 2010 PCS developed an experimental design for a trial translocation of Button Wrinklewort (*Rutidosis leptorrhynchoides*). The design aimed to test the following hypotheses:

1. Direct seeding of *Rutidosis leptorrhyncoides* and/or planting of nursery raised tubestock can be used to establish populations of the species using seed collected from local populations.

2. Seeds of *Rutidosis leptorrhyncoides* broadcast onto the soil are more likely to establish a long term viable colony than nursery raised tubestock planted at the site.

In 2010 plantings of tubestock and broadcasting of seed commenced in Jerrabomberra East Nature Reserve. In April 2012 CPR began monitoring of the plantings. Monitoring showed that *R. leptorrhynchoides* can be established at new sites by either direct seeding or planting tubestock. However, tubestock provides a much more rapid means of establishing a new population. Tubestock allows a colony to be established more quickly through higher survivorship; that colony also produces more flowering plants and a higher number of flowers per plant than direct seeding in the first two years. It is too early to tell if either population is recruiting or is self-sustaining in the long term. Tubestock also reduces the impact of seed collection on in-situ populations because for each seed collected from the wild, more plants are established in the new populations using tubestock than are established using direct seeding.

The planting of tubestock is the recommended method for future translocation projects involving *R. leptorrhynchoides* in the ACT.

Figure 5.3 Planted Button Wrinklewort
2012 monitoring of Button Wrinklewort tubestock (larger yellow flowers) two years after planting. Each individual plant is identified with a marker tag.

5.4 Seed collection and research into non-threatened lowland woodland grassland plants

Seed processing and quantification continued for collections of native understorey species made between October 2011 and February 2012. The purity (% of pure seed), mass (determined gravimetrically) and size (number of seeds calculated using purity and mass) of most collections have been determined and are detailed in Table 5.1. The remaining 2011–12 collections, and collections made in 2012–13 will be quantified and germination tested in late 2013.

Table 5.1 Summary of collection data.
Collection rating indicates the size and utility of collections and ratings of small or minimal suggest further collections are required to provide management options and to secure the species in ex-situ conservation.

Genus	Species	Accession purity (%)	Accession mass (gm)	No. of seeds	Collection rating	Germ. Test No.
Acacia	*genistifolia*	100	5.9260	267	Small	
Asperula	*conferta*					
Chrysocephalum	*semipapposum*					
Daviesia	*genistifolia*	100	1.1182	112	Small	
Daviesia	*genistifolia*	100	1.2563	110	Small	
Daviesia	*leptophylla*	99	0.0045	904	Minimal	
Daviesia	*mimosoides*	98	1.5430	266	Small	193/12
Daviesia	*mimosoides*	93	1.2012	287	Small	202/12
Desmodium	*varians*					
Dillwynia	*sericea*	98	1.2590	741	Minimal	200/12
Exocarpos	*strictus*	100	2.9983	143	Small	
Exocarpus	*cupressiformis*	100	3.2071	107	Small	
Glycine	*clandestina*	100	0.4024	85	Small	205/12
Glycine	*clandestina*	100	1.3674	470	Small	
Goodenia	*hederacea*	100	0.4379	317	Small	
Goodenia	*pinnatifida*	100	1.0814	230	Small	
Hypericum	*gramineum*	95	0.6550	69139	Optimal	190/12
Kunzea	*ericoides*	62	0.1802	1802	Satisfactory	
Kunzea	*parvifolia*					
Leptorhynchos	*squamatus*					
Mirbelia	*oxyloboides*	100	0.2151	49	Small	
Pelargonium	*australe*	100	0.0410	44	Small	
Pimelea	*curviflora*	100	0.2103	128	Small	197/12
Poranthera	*microphylla*					
Scleranthus	*biflorus*	100	0.2032	278	Small	
Stackhousia	*monogyna*	100	0.2626	133	Small	187/12
Swainsona	*recta*	100	NA	13	Small	78/12
Swainsona	*recta*	100	NA	1	Small	76/12
Swainsona	*recta*	100	NA	46	Small	77/12
Swainsona	*sericea*	100	0.0904	35	Small	
Triptolidiscus	*pygmaeus*					

NB: Blank cells denote tests that are yet to be conducted.

5.5 Technical Report on Drooping Sheoak in the ACT

Drooping Sheoak (*Allocasuarina verticillata*) has been identified as a main food source for the Glossy Black-Cockatoo (*Calyptorhynchus lathami*), which has been recorded feeding intermittently on *A. verticillata* trees in the ACT. A study of the distribution of *A. verticillata* across the northern ACT was instigated in 2009 to help inform the process of the listing of the Glossy Black-Cockatoo as a vulnerable species under the ACT *Nature Conservation Act 1980*. The aim of the study was primarily to determine the distribution of the Drooping Sheoak in Canberra Nature Park in the north of the ACT. The study also provided information regarding the ecological niche occupied by *A. verticillata*, giving an indication of its preferred environmental variables such as soil type, which in turn informed where planting is viable across the reserve system in the ACT.

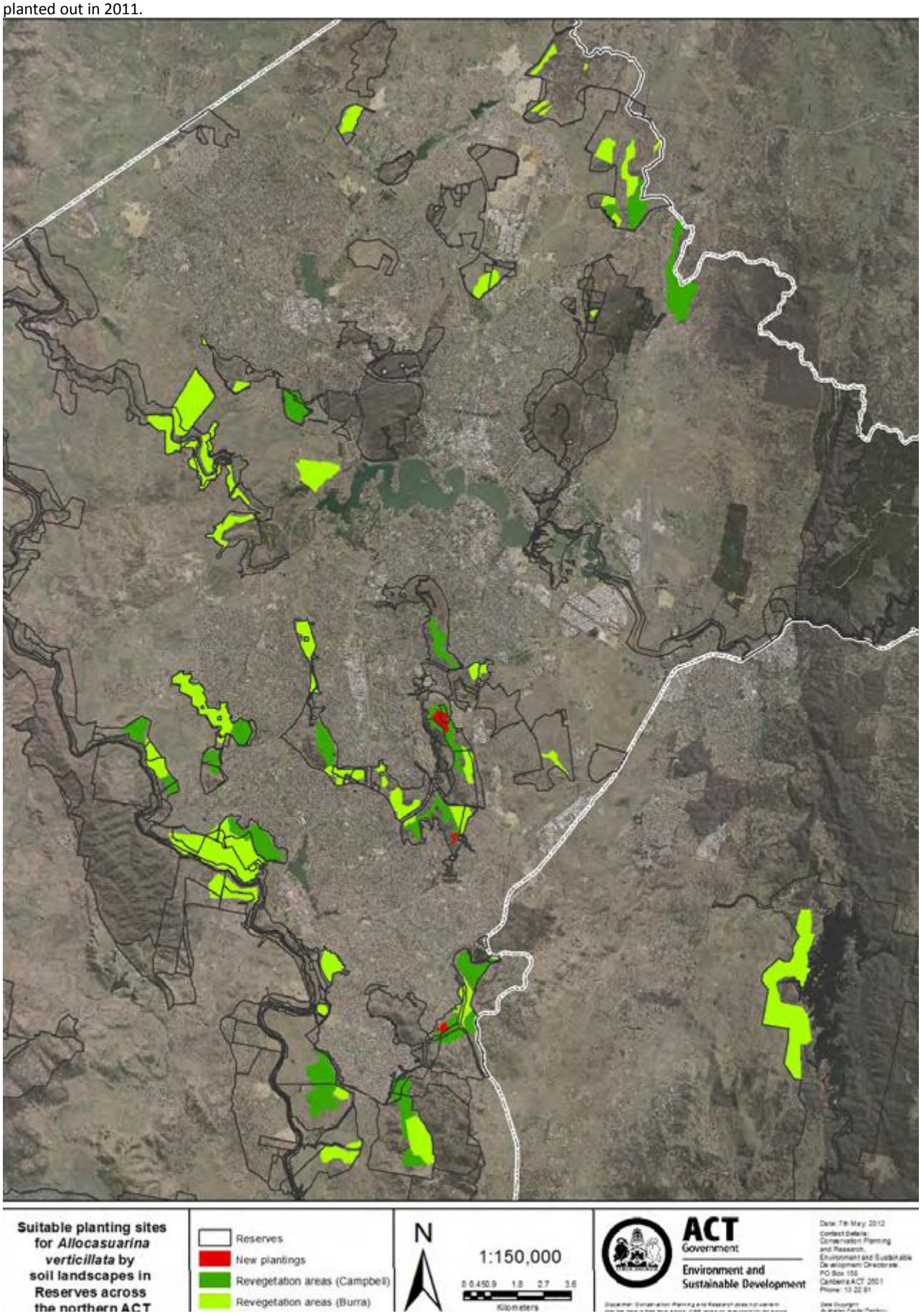
The 2009 study found that *A. verticillata* was restricted primarily to the Campbell soil landscape with minor occurrences in the Burra soil landscape. The verification of the ecological niche occupied by *A. verticillata* presented an opportunity for establishing additional stands in areas with similar environmental characteristics to supplement the existing foraging habitat of the Glossy Black-Cockatoo in the ACT. The concentration of cone-bearing trees along with the distribution of trees with high and low cone density throughout a site determines the suitability of the site as foraging habitat for the cockatoos.

Potential planting sites within the reserve system were identified and mapped by determining which areas met the criteria of occurring on the Campbell or Burra soil landscape, being at least one hectare in size, having a presence of cone bearing *A. verticillata* or being within five kilometres of remnant stands and to fall outside of areas to be impacted by actions in the current Sub Regional Fire Management Plan (SRFMP). As a result of this work, 2860 ha within the reserve system were identified as suitable for future planting of *A. Verticillata* (Figure 5.3). The areas shown in Figure 5.3 show these suggested areas for revegetation on both Campbell and Burra soil landscapes. The Campbell soil landscape was determined to have more ideal areas for revegetation, comprising 975 ha, and the Burra soil landscape as 1886 ha. These areas are considerably larger than the current 960 ha distribution of *A. verticillata*.

From May to July 2011 close to 5000 *A. verticillata* seedlings were planted within reserves in the south of Canberra. In a collaborative effort, staff from PCS, CPR and Greening Australia planted 2500 seedlings at Isaacs Ridge Nature Reserve, another 2500 at Tuggeranong Hill Nature Reserve and 900 at Farrer Ridge Nature Reserve. As the seedlings mature it is planned to monitor a selection of individuals at each of the three reserves to determine survival and cone set rates. Evidence or sightings of Glossy Black-Cockatoo will also be recorded. Future revegetation efforts will take place on sites that also meet the ecological requirements identified for this species.

Figure 5.4 *Allocasuarina verticillata* map

Areas identified in reserves across the northern ACT as suitable for revegetation with *Allocasuarina verticillata* including locations planted out in 2011.



5.6 Tharwa fish habitat project–engineered log jams at Tharwa

The Murrumbidgee River in the vicinity of Tharwa is badly affected by a 'sand slug' which has substantially reduced river channel depth and smothered structural fish habitat such as rock and woody snags. In 2009–10 a consultancy report advised on ways to manage the sand problem in the Upper Murrumbidgee Demonstration Reach with the recommendation that Engineered Logs Jams (ELJ) be installed to improve fish passage and habitat. In early 2013, with funding from Caring for Our Country, ACT Greenhouse Strategy, ACTEW, Murray Darling Basin Authority and ACT Enviro-Grants, two ELJ were installed into the Murrumbidgee River near Tharwa and adjacent rock groynes improved. The primary objective of the project was to increase river channel depth past the structures improving fish passage and habitat in the area.

Figure 5.5 Installing log jams
Excavators working in tandem to place timber for the first Engineered Log Jam (ELJ).

Since the structures have been installed, river deepening has been observed and also measured with sonar equipment (Figure 5.7). River channel deepening allows fish to pass more easily along the river and improves access to refuge areas and breeding sites.

The in-stream fish habitat has also been improved through the addition of logs and large rocks, creating interstitial spaces of varying size that form the structure of the ELJs. The combination of smaller and larger spaces between logs or rocks provides habitat for both smaller and larger fish.

Project outcomes that will be monitored over the long term include fish and river channel depth monitoring. So far only baseline fish monitoring has taken place and one sonar run of the reach has been completed post ELJ construction. From the fish monitoring, the area around the ELJ mostly contained pest species such as carp and redfin. However, Murray Cod juveniles were found near the existing rock groynes. Also a large Murray Cod was sampled further upstream from the ELJ in a large deep pool near the Gigerline Gorge. This baseline monitoring indicates that native species are present in the area but are habitat limited, which is indicated by the juvenile cod only being found around rocks of existing rock groynes and the large cod being found in the only available deep pool in the area. Further monitoring will help to determine whether the ELJ have been successful at improving fish habitat.

Figure 5.6 Completed log jam structures
Viewed from the Tharwa Bridge. Note the darker water between the structures which indicates deeper water.

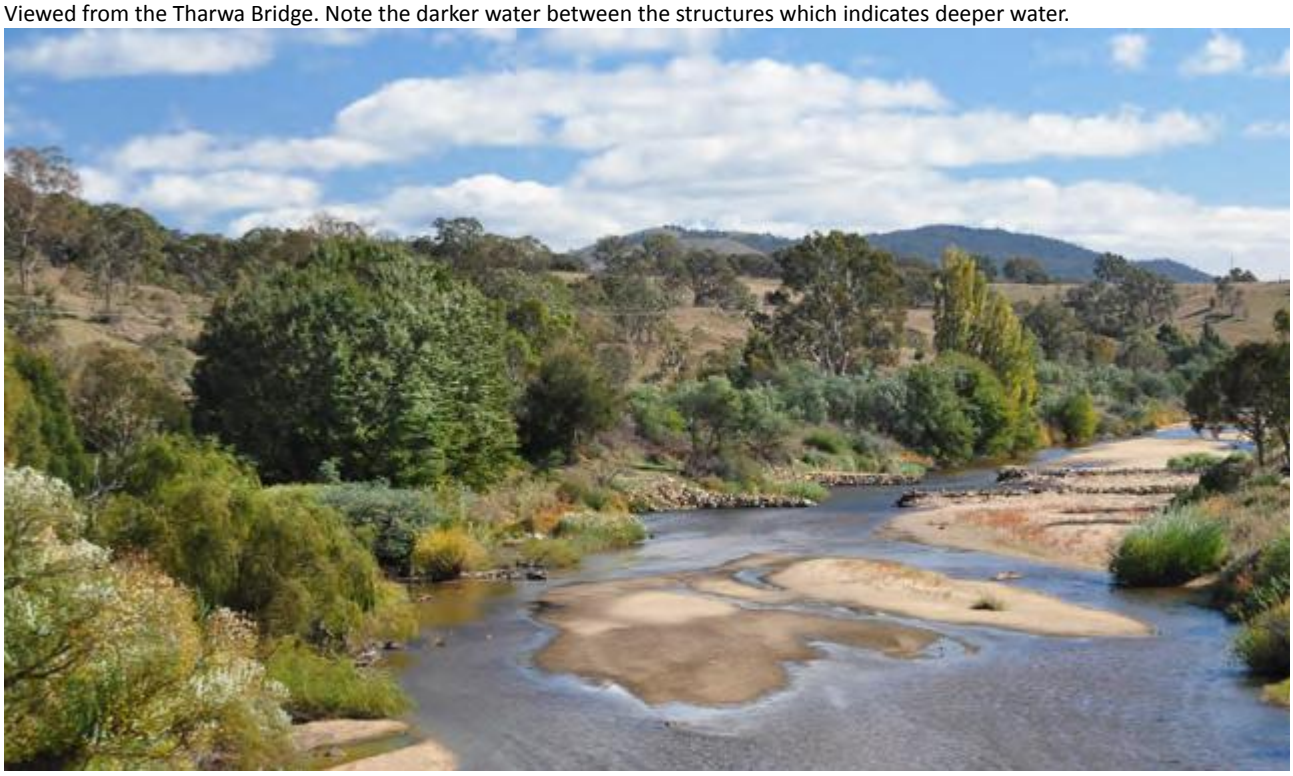
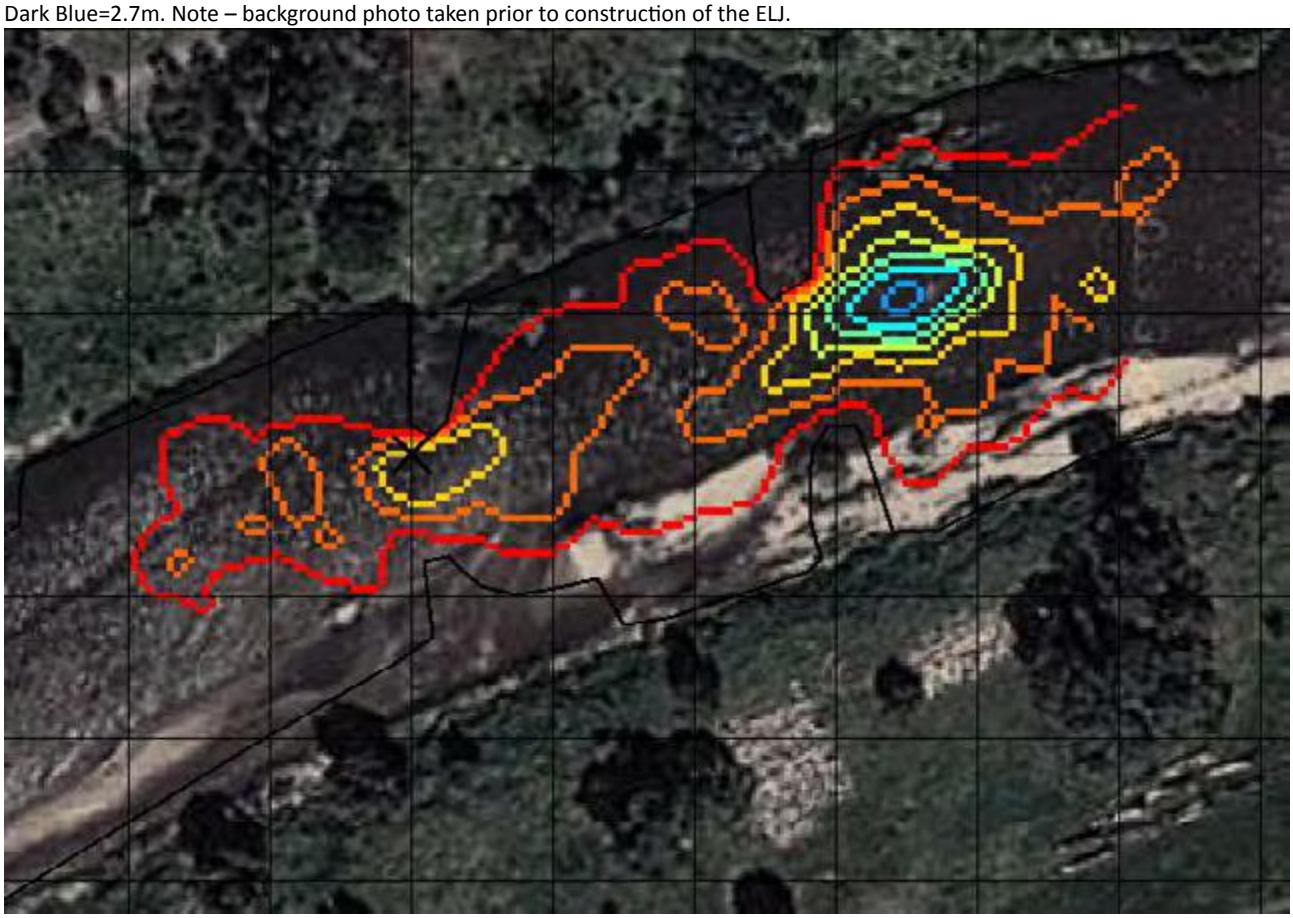


Figure 5.7 Sonar scan of the river channel past the log jams
Note that past the ELJ the river channel has substantially deepened compared to upstream of the structures. Legend Red=0.4m to Dark Blue=2.7m. Note – background photo taken prior to construction of the ELJ.



5.7 Threatened plant species seed collection and research

The Australian National Botanic Gardens (ANBG) entered into a three year Service Level Agreement with the ACT Government in September 2011. The ANBG will provide specialist seed banking, orchid conservation and propagation skills, and facilities to support the ex-situ conservation of rare and threatened plants of the Territory.

The project involves seed collection, seed banking and germination trials of Canberra Spider Orchid (*Arachnorchis actensis*), Brindabella Midge Orchid (*Corunastylis ectopa*), Tarengo leek Orchid (*Prasophyllum petilum*) and Mountain Cress (*Drabastrum alpestre*), and collecting and banking seed from in situ populations of a negotiated selection of the native understorey species.

Canberra Spider Orchid

Seeds collected from Mount Ainslie and Mt Majura are currently drying and will be processed in late 2013.

Brindabella Midge Orchid

In the previous reporting period, preliminary seed germination tests were established using a small amount of seed and four mycorrhizal fungi cultures. Two temperatures were trialled, but no germination has been recorded to date. To increase the likelihood of success, some seed was sent for testing by an orchid propagation expert at Wimmera Catchment Management Authority. Seeds were sown on Western's media enriched with banana, coconut and antibiotics. Protocorms (the first stage of germination) have been recorded and their formation indicates that seeds are viable. Leaf formation, the final stage of germination, may occur in 6–7 months. Completion of germination cannot be guaranteed because of the lack of knowledge of germination requirements of *Corunastylis* spp. It is likely that many experiments (altering fungi, temperature and nutrients) will be required to produce seedlings; however much more seed is required before experiments can be conducted.

Tarengo Leek Orchid

Hall: Seed was collected from one plant but much of this seed was poorly developed and surrounded by fungal growth.

Boorowa/Tarengo Travelling Stock Reserve: Eight plants were collected from the Tarengo Travelling Stock Reserve near Boorowa NSW. The material was processed and a considerable amount of seed extracted. To increase the likelihood of successful germination experiments, some seed was sent for testing by orchid propagation expert at Wimmera Catchment Management Authority. Seeds were sown on Western's media and protocorms have formed, indicating the collection contains viable seed. The quantity of seed collected from Boorowa also allowed the establishment of germination tests using fungal cultures from Boorowa. Protocorms have formed and two seeds have progressed to stage two of development. Further experimentation with media and fungal cultures, and more seed, are required to produce the right conditions for protocorms to progress through each stage to leaf development.

Mountain Cress

Genera in the Brassicaceae family exhibit a range of seed dormancy syndromes. A standard germination test was conducted. After 12 weeks one seed germinated and, once large enough, was transferred to the ANBG nursery. After experiencing some transplant shock the seedling has recovered well and has continued to establish. Physiological dormancy is the most likely seed dormancy syndrome preventing laboratory germination in this species. Further investigation of germination protocols is dependent on greater seed availability.

Reconnaissance field trips began in October 2013 to collect seed from Cotter Caves. Another population in NSW will be investigated as a potential source of seed for germination experiments. The use of cages to exclude predators and ensure seed is available at maturity will be investigated.

5.8 Upper Murrumbidgee Demonstration Reach (UMDR)

A number of activities were conducted by CPR as actions contributing to the UMDR Initiative. Between 2011 and 2013 these activities included the construction of two Engineered Log Jams (ELJ) in the Murrumbidgee near Tharwa (see 5.6 above), an assessment of the sampling methodology for Murray River Crayfish (*Euastacus armatus*; reported under Threatened Species Section) and assessment of the efficacy of the Casuarina Sands fishway to pass fish (see 5.1 above). An assessment of riparian vegetation in the NSW section of the Murrumbidgee River, particularly the gorge sections, was also conducted for the UMDR. This work was carried out by the Cooma Waterwatch facilitator and is reported at http://upperbidgeereach.org.au/umdr. Funding from the Native Fish Strategy in conjunction with Bush Heritage has also recently been obtained to employ a UMDR coordinator and conduct projects including weed control in the riparian zone and carp reduction at Scottsdale Bush Heritage property. These projects will be carried out during 2013–14.

5.9 Wildlife habitat connectivity

Connectivity conservation seeks to enhance wildlife habitat and habitat links across the landscape. It needs to consider both the habitat that an animal is able to live and breed in (habitat for settlement) and that which it can move through (habitat for dispersal). Restoring landscape connection is an increasing focus of Landcare activities responding to climate change and habitat fragmentation concerns. Recent CSIRO work suggests that most animals of southern Australian woodlands and forests will not usually cross a canopy gap of more than 100 m, and will not travel more than 1.1 km away from at least a 10 ha sized patch of suitable living habitat. Thus the extent and spatial arrangement of habitat and canopy is essential to understanding wildlife movement and how connectivity restoration can be most readily achieved.

Across the ACT, Spot 5 satellite imagery combined with radar measurements of tree density was used to establish a map of tree canopy, accurate to the single paddock tree scale. Woodland, forest and generalist habitat was mapped and rated through a combination of about 15 existing vegetation, street tree and landuse maps, through satellite foliage cover and tree density analysis, and the spatial relationship of a particular habitat patch to other patches of habitat. Large patches close to other habitat patches scored highly, while isolated small patches scored lowly.

An analysis was then repeated 550,000 times that took random pairs of points from within any two patches of habitat in the ACT and nearby region and asked what is the easiest route for a woodland, forest or generalist species to get from one point to the other? Paths through well-connected habitat were repeatedly utilised to connect differing habitat patch pairs, and these well used paths are identified as regional links.

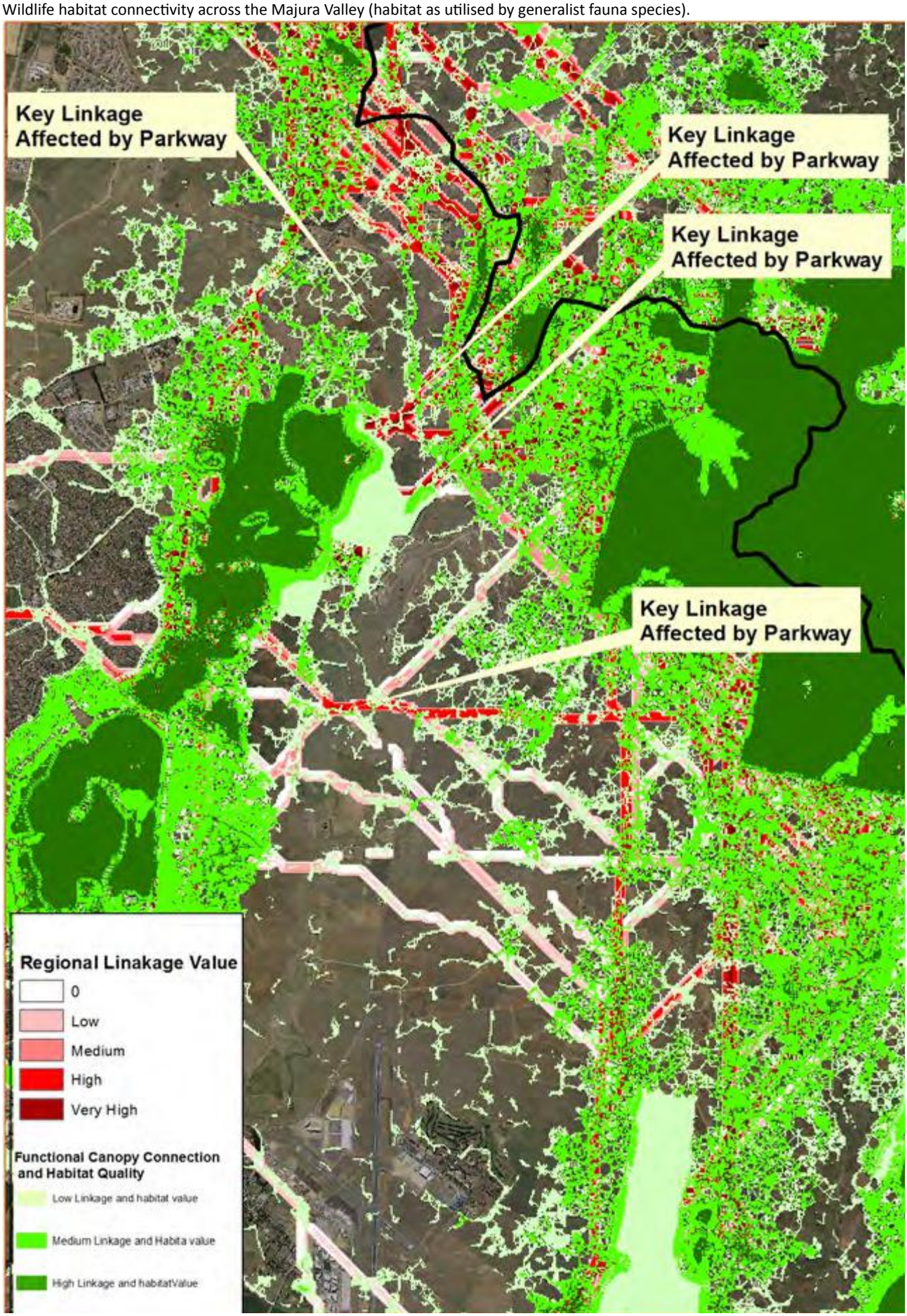
While regional links may be the least cost pathways they may not be able to be actually used by wildlife. This was checked by overlaying a map showing where connections between stepping stone trees exceeds 100 m (local links) and the distribution of habitat patches greater than 10 ha. Existing habitat patches of 5–10 ha were also identified as areas of potential restoration focus.

The first stage of a $3.5m ACT and region woodland restoration program (funding provided by the ACT and Commonwealth governments) has begun plantings across a 45 km2 area of hills and valleys from the Murrumbidgee River to Black Mountain, which is characterised by large but currently isolated woodland remnants. The analysis indicated that just 36 ha of targeted restoration plantings would be sufficient to enable wildlife to move across the landscape and between each remnant. The impact of this planting on wildlife will be monitored into the future, but the approach ensures that restoration is focused on those areas of most importance to wildlife movement.

The data and analysis is publicly available via ACTMAPi, and is being utilised to ensure development does not break key linkages; for example, wildlife crossing provisions have been built into to Majura Parkway at the key areas of wildlife connectivity.

Figure 5.8 Habitat connectivity map

Wildlife habitat connectivity across the Majura Valley (habitat as utilised by generalist fauna species).



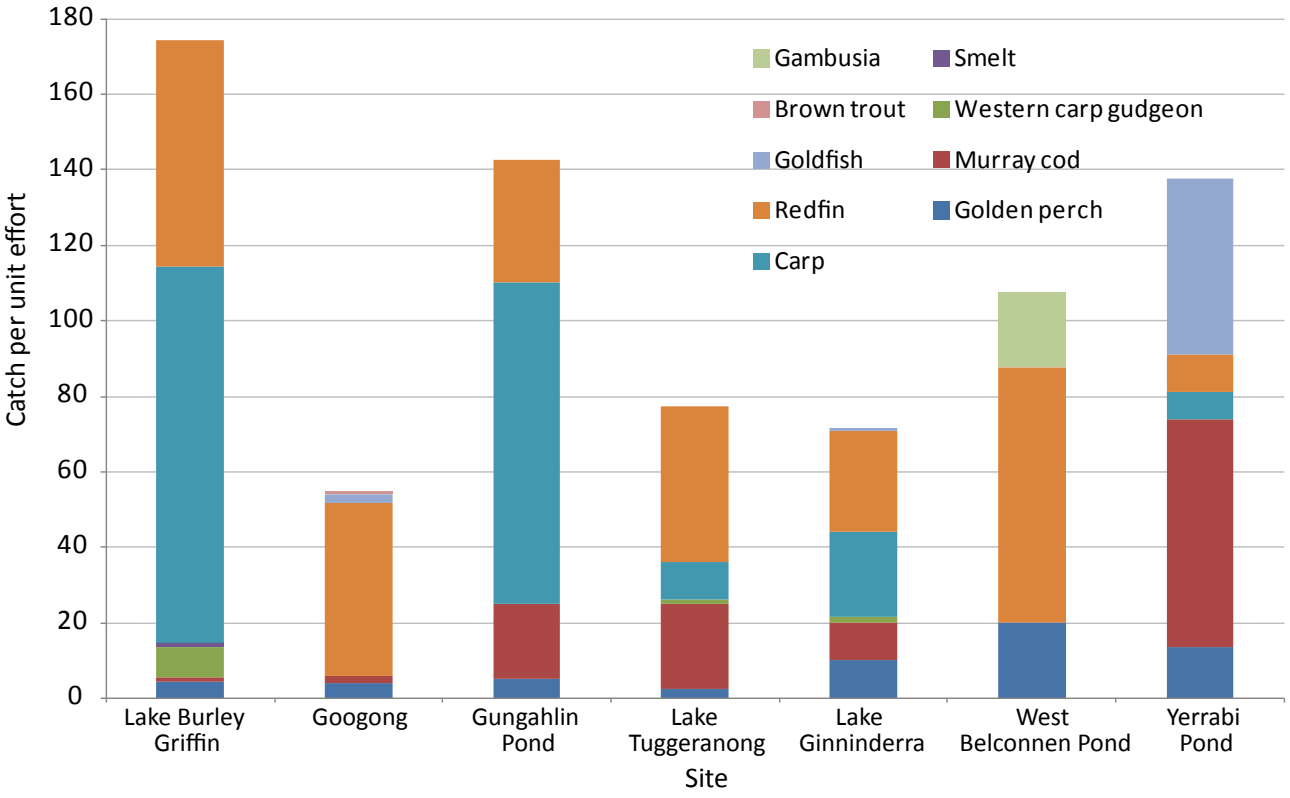
6 RECREATIONAL ANGLING

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 2009 –2014. In 2011–12, 37,000 Murray Cod were stocked into Lake Burley Griffin, 10,000 Murray Cod were stocked into Lake Ginninderra, and 8,500 Golden Perch were stocked across West Belconnen and Point Hut Ponds. In the 2012–13 season, 6,000 Murray Cod were stocked into Gungahlin Pond and 100,000 Golden Perch were stocked into lakes Ginninderra, Tuggeranong and Burley Griffin and Yerrabi, Gungahlin, West Belconnen and Point Hut ponds.

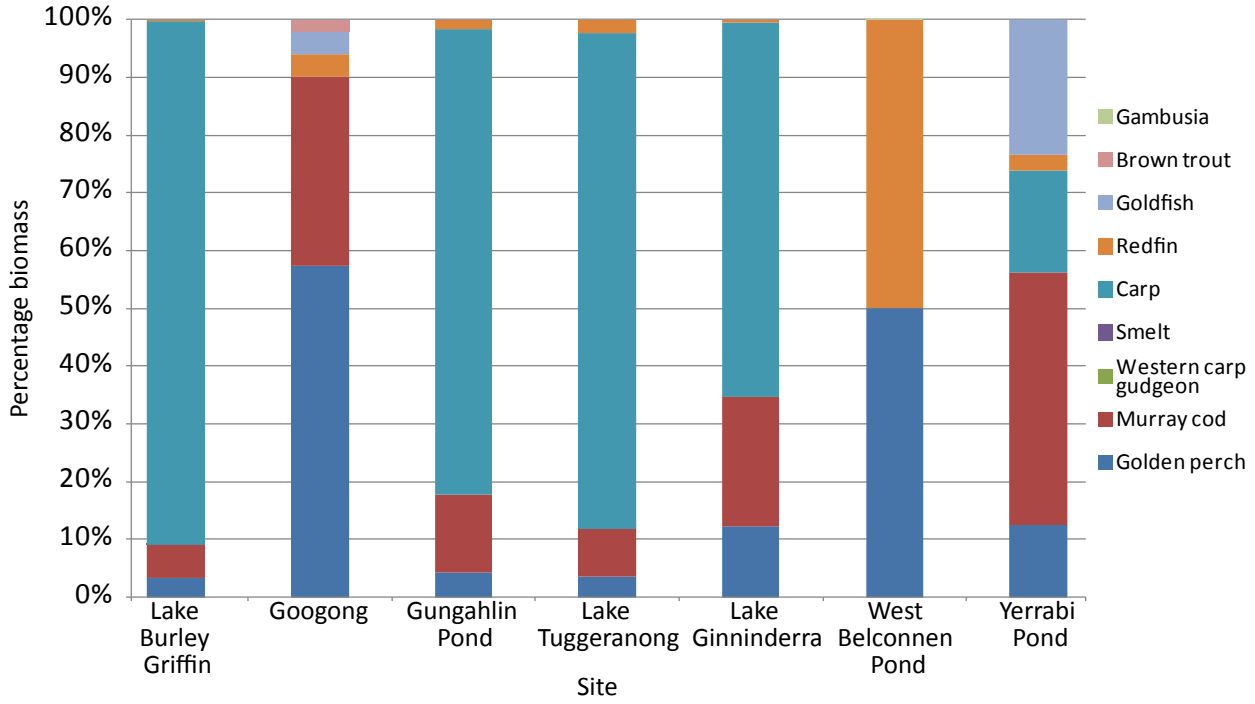
Monitoring of the Canberra region stocked recreational fisheries is a rolling project that surveys the stocked lakes on a biennial basis using boat electrofishing. Monitoring of the fish communities provides data on the proportion of pest species, identifies growth and success of stocking events, identifies natural breeding events and allows for the detection of disease outbreaks and new pest species. CPR surveyed all of the above urban lakes and ponds in the 2011–12 and 2012–13 field seasons.

Figure 6.1 Catch per unit effort during urban lakes monitoring 2011–13



A total of 819 fish were recorded from four native and five introduced species. Redfin and European Carp were the most abundant species, each comprising approximately 37% of the catch by number. Due to their much smaller size, Redfin comprised only 1.2% of the total biomass of 683.5 kg. Carp comprised 75% of the total biomass, despite not being present in Googong Reservoir or West Belconnen Pond. Carp have only been present in Yerrabi Pond since 2011, but already make up 18% of the biomass. This latter figure is likely to increase in the coming years. The maximum percentage of biomass as carp occurs in Lake Burley Griffin where it is at 91%. This is most likely due to a five year gap in the stocking program leading up to 2011. Lake Burley Griffin also returned the highest catch per unit effort of all the urban lakes (Figure 6.1).

Figure 6.2 Percentage biomass of species caught during urban lakes monitoring 2011–13



The native angling species of Golden Perch and Murray Cod were detected from all lakes where they have been stocked. These species made up the majority of the biomass in Googong, where carp are not present (Figure 6.2). Large Murray Cod (over the legal minimum angling length of 60 cm) were sampled from all lakes excepting Lake Tuggeranong. In addition to the regular monitoring, large Murray Cod were rescued from below the dam walls at Lakes Tuggeranong and Burley Griffin and relocated into the lakes. Recent fish stocking events appear to have been successful, particularly in Yerrabi Pond where 48 Murray Cod were caught. The majority of these were most likely from the January 2011 stocking. The placement of artificial habitat into Yerrabi in January 2013 will assist the survival of these fish. Apart from West Belconnen Pond, which was first stocked in 2011, the mean size of Golden Perch in each of the lakes was above the minimum legal angling length of 30 cm, with one individual in Lake Ginninderra reaching 56 cm.

7 CONSERVATION PLANNING

7.1 Biodiversity advice

CPR provides 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, construction environmental management plans 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, and only after options to avoid and minimise have been exhausted, will advice be provided on how impacts may be best offset.

7.2 Gungahlin Strategic Assessment

Most of the remaining native vegetation within Gungahlin is either endangered grassland or woodland, or habitat of species that are listed as threatened under the ACT's *Nature Conservation Act 1980* and/or the *Commonwealth EPBC Act 1999*. In planning for development, the key consideration under both ACT and Commonwealth legislation is to avoid and minimise impacts on listed entities wherever possible and to ensure their ongoing sustainability or viability is maintained or enhanced over the long term.

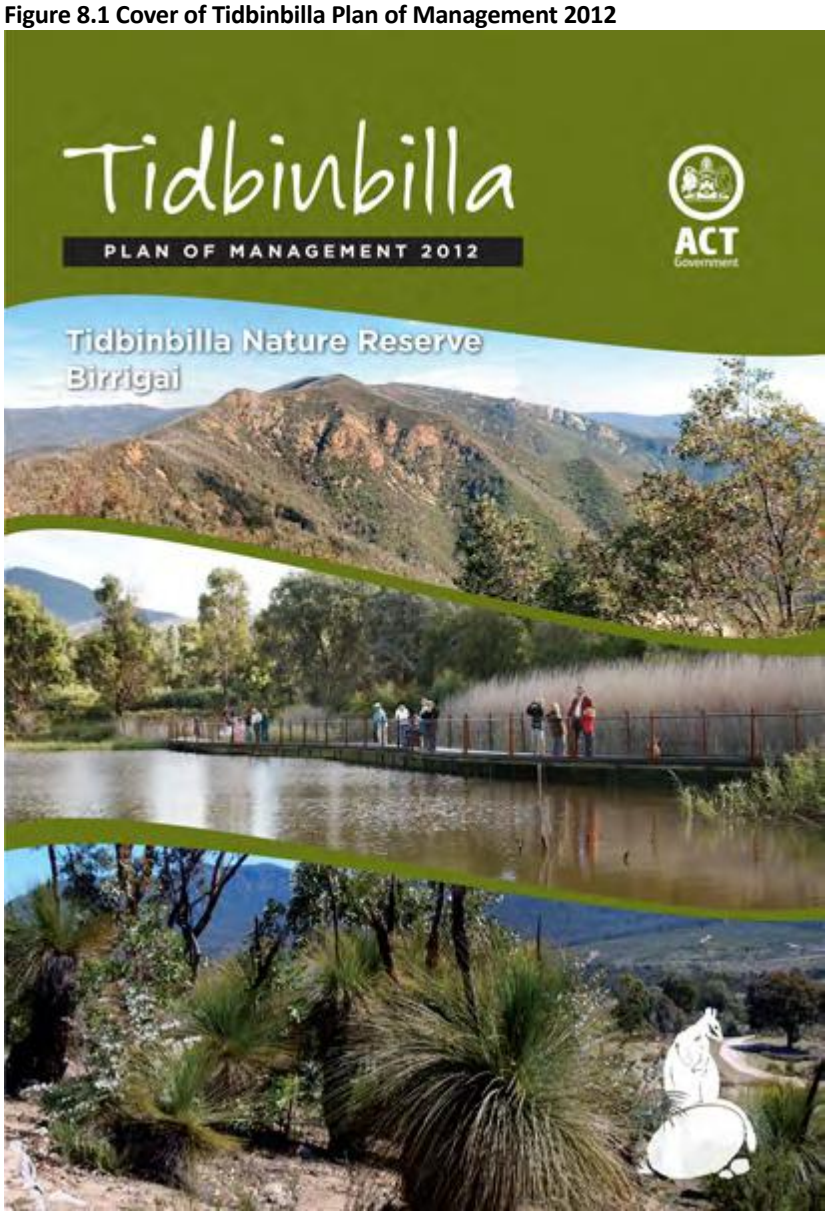
The Gungahlin Strategic Assessment allowed biodiversity values to be considered early in planning and development considerations and to take a comprehensive approach across a large area. CPR either undertook, supervised or assisted in surveys of vegetation, Striped Legless Lizard, Golden Sun Moth, Pink-tailed Worm-lizard and Superb Parrot across the planning area. A detailed report of Gungahlin's biodiversity values was provided as part of the planning process. Significant values were protected, largely through the addition of 660 ha to the nature reserve network.

8 PLANS OF MANAGEMENT

CPR 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 the values. A plan 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 *Planning and Development Act 2007*.

8.1 Tidbinbilla Plan of Management

Figure 8.1 Cover of Tidbinbilla Plan of Management 2012



Following the 2003 bushfire, the ACT Government made a decision to manage the Tidbinbilla Nature Reserve, Birrigai at Tidbinbilla (Outdoor School) and the nearby former pine plantation (Jedbinbilla) as one entity known as the Tidbinbilla precinct. All the land in Tidbinbilla is either National Park or Special Purpose Reserve under the *Planning and Development Act 2007*. The values of the area include a diversity of vegetation communities, experiential learning programs, a wildlife collection which provides educational opportunities, a high density of Aboriginal artefacts and evidence of early European settlement.

The Tidbinbilla draft plan of management was released for public comment in May 2010. Comments were incorporated into a revised draft plan which was referred to the Legislative Assembly Standing Committee on Planning, Public Works and Territory and Municipal Services by the Minister for Environment and Sustainable Development in April 2011. The Committee conducted an inquiry into the plan and released their report in April 2012. Following government consideration of the committee's recommendations, the final plan was tabled in the Legislative Assembly in August 2012 and came into effect in November 2012. A copy of the plan can be found at: http://www.legislation.act.gov.au/di/2012-193/current/pdf/2012-193.pdf

8.2 Googong Foreshores Plan of Management

The Googong Foreshores is managed by the ACT Government on behalf of the Commonwealth Government. The main purpose of the Foreshores area is to protect the water quality in the Googong Reservoir, which supplies drinking water to Canberra and Queanbeyan. The Googong Foreshores also protects significant natural and cultural heritage features including a number of threatened plant and animal species, the London Bridge Homestead (dating from 1879), the geologically important London Bridge Arch and evidence of occupation by Aboriginal people. The area has value for low key recreational activities and forms part of a corridor of relatively intact natural vegetation extending from the north-east of the ACT to the Tinderry Range.

In 2008, the Commonwealth Government leased the Googong Foreshores to the ACT Government for a period of 150 years and a condition of the lease is the preparation of a land and conservation management plan. The Googong Foreshores Plan of Management was completed in 2012 and sent to TAMS in August 2012.

8.3 Other Plans

Plans that have been commenced include the Canberra Nature Park Plan of Management (PoM), the Lower Cotter Catchment PoM and the ACT Bogs and Fens Management Plan.

The location of protected species and the significance of a particular habitat will be important matters to consider in the review of the Canberra Nature Park PoM, and when undertaking management and development actions on reserve.

Figure 8.2 Protected plants
Austral Trefoil (Lotus australis) (top) and Pale Flax Lily (*Dianella longifolia*) (bottom)

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
Action Plan 6	Northern Corroboree Frog (*Pseudophryne pengilleyi*) Revised Edition	1997 2011
Action Plan 22	Brush-tailed Rock-wallaby (*Petrogale penicillata*)	1999
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
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 No. and Name	Threatened Community and/or Species covered in the Action Plan	Date
Action Plan 31	Canberra Spider Orchid (*Arachnorchis actensis*)	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

References

ACT Government (1980). *Nature Conservation Act 1980*. Environment and Sustainable Development Directorate, Canberra.

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.

ACT Government (2007). *Planning and Development Act 2007*. Environment and Sustainable Development Directorate, 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)

Kitchin M., Wright G., Robertson G., Brown D., Tolsma A. and Stern S. E. (2013). *Long term monitoring for Fire Management – 10 years on for the Australian Alps fire plots.* Technical Report No 26, Environment and Sustainable Development Directorate, ACT Government. Canberra.

Lunt ID, Eldridge DJ, Morgan JW & Witt GB (2007). *A framework to predict the effects of livestock grazing and grazing exclusion on conservation values in natural ecosystems in Australia*. Australian Journal of Botany. CSIRO.

Mulvaney, M. (2012). *The Extent and Significance of Gungahlin's Biodiversity Values*: Technical Report 24. Environment and Sustainable Development Directorate, Canberra.

Maguire, O. & Mulvaney, M. (2011). *Box-gum Woodland in the ACT:* Technical Report 25. Environment and Sustainable Development Directorate, Canberra.

Office of Environment and Heritage (2011). *Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales. Version 1.1*. Technical Report. A Report to Catchment Action NSW. NSW Office of Environment and Heritage; Department of Premier and Cabinet, Queanbeyan.

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.

Rehwinkel, R (2007). *A Method to Assess Grassy Ecosystem Sites: Using floristic information to assess a site's quality*. Unpublished report to the NSW Department of Climate Change, Queanbeyan.