An Overview of Protected Areas Conservation Effectiveness Monitoring Programs, with Particular Reference to Australian Capital Territory

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By

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Executive Summary:

Protected areas are regarded as the most important ‘units’ for in situ biodiversity conservation, and yet despite considerable progress towards the global target of having 17% of the world's land area within protected areas by 2020, the world’s biodiversity continues to decline. Regular monitoring and evaluations of protected areas can help managers understand the extent to which objectives have been achieved, values been protected, threats abated. However, there are a lack of uniformed standards on how to monitor conservation effectiveness, thus calls for more efforts to accumulate experiences from practicing.

Within Australia, the Directions for the National Reserve System indicates that ‘protected area agencies should establish programs, such as State of the Parks (SoP) to assess and report on the management of protected areas within their jurisdiction’. In 2017, the ACT government issued the Conservation Effectiveness Monitoring Program (CEMP) that aims to develop biodiversity-monitoring plans, detect changes in ecosystem conditions and evaluate effectiveness. We regard CEMP as an important step towards the adaptive conservation management in ACT, which has the potential effects to integrate bio-monitoring projects and provide timely feedback. In reviewing the technical reports, and by comparing with similar projects in Australia and abroad, this study discusses problems found, as well as suggesting possible improvements.

By comparing effectiveness evaluation cases worldwide, an adaptive conservation management model with key success factors was developed, however, at the current stage, there are a lack of practical experiences to show the best way to feedback evaluation results into management planning and actions, the priority workshop done by CEMP is a potential effective practice. A gap analysis showed that some threatened species and threatened woodlands were covered insufficiently by protected areas in the ACT, thus all groups need to draw more attention to, and build support for, the nature values we are trying to preserve.

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Abbreviation

ACT	Australian Capital Territory
CEMP	Conservation Effectiveness Monitoring Program
CR	Conservation Research
IUCN	International Union for Conservation of Nature
METT	Management Effectiveness Tracking Tool
NRS	National Reserve System
NSW	New South Wales
PA	Protected Areas
PAME	Protected Areas Management Effectiveness
PCS	Parks and Conservation Service
QPWS	Queensland Parks and Wildlife Services
RAPPAM	Rapid Assessment and Prioritization of Protected Area Management
SOPR	State of Parks Report

VBMF	Values-Based Management Framework
WWF	World Wildlife Fund

1. Introduction

1.1 Protected areas conservation effectiveness evaluation——what and why

Protected areas (PAs) in IUCN's definition is '*a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values*' (Dudley 2008, p2). In today's severe situation where biodiversity is rapidly declining worldwide, protected areas are regarded as the most important 'units' for in situ biodiversity conservation (Barber et al. 2012, Barnes et al. 2017, Waldron et al. 2017). The forms of protected areas are diverse, so do their conservation values and management needs. IUCN has suggested 6 management categories for protected areas worldwide, ranging from strict nature reserve (Ia), national park(II) to protected landscape(V), protected area with sustainable use of nature recourses(VI), while in practice, management systems differs according to the countries' features (Dudley et al. 2010).

As the establishment of protected areas (PA) continues to grow, the development of protected areas in the world is transitioning from quantity expansion stage to quality assurance stage, calls for the needs to evaluate the management effectiveness to ensure the best conservation outcomes and resource investment (Hockings et al. 2006). Are the values being maintained? Threats being eliminated? Conservation objectives being achieved? These questions are what we try to answer in an effectiveness assessment (Cook and Hockings 2011). However, protected areas effectiveness assessment is a relatively new concept, started in 1990s among several world-leading international organizations, such as IUCN (Hocking 2000, Hockings 1998) and WWF (Ervin 2003). According to their needs and the data availability, evaluations that time were mainly rapid, qualitative (through interviews, questionnaires) at a relatively broad scale. Such evaluation can meet short-term management needs, but fail to detect changes in ecosystem and biodiversity

conditions in a robust way. In recent years, conservation agencies are increasingly embedding long-term monitoring programs into effectiveness evaluations, to enable evidence-based decision-making and timely response to ecological changes (Lindenmayer 2009, Brawata 2017a). Such evaluation projects are the focuses of this study.

1.2 Brief introduction of protected areas in Australia

Australia has one of the most diverse collections of plants and animals in the world, home to more than one million known species, with many endemic to this continent (Hobbs 1996). However, Australia also has one of the highest loss of species, thus effective actions on biodiversity conservation in Australia has global significance. The National Reserve System is Australia's network of protected areas including Nature Reserves, National Parks, Indigenous Protected Areas, Marine Reserves, and Non-Government Managed Reserves. By 2016, protected areas in NRS reached 1.5 billion hectors, take up nearly 20% of the terrestrial land (Table 1). In 2004, the National Reserve System Directions Statement indicates that protected area agencies should establish programs such as State of the Parks (SoP) to assess and report on the management of protected areas within their jurisdiction (Natural Resource Management Ministerial Council 2005). Since then, many states are developing their own conservation assessment and adaptive management system with different progress.

Table 1. Protected Areas in Australia-State and Territory levels

State and territory levels of protection (source: CAPAD 2016)						
Region	**Area (ha)**	**NRS (ha)**	**% of Jurisdiction Protected**	**Contribution to NRS (%)**	**Number of areas**	**Average size (ha)**
ACT	235,815	130,830	55.48%	0.09%	47	2,748
NSW	80,115,007	7,448,535	9.30%	4.95%	925	7,799

NT	134,779,163	33,514,060	24.87%	22.29%	84	398,977
QLD	172,974,215	14,601,431	8.44%	9.71%	1,162	12,566
SA	98,432,191	29,588,883	30.06%	19.68%	1,988	14,884
TAS	6,840,139	2,894,327	42.31%	1.92%	1,542	1,877
VIC	22,744,373	3,916,792	17.21%	2.61%	3,028	1,294
WA	252,701,298	58,777,768	23.26%	38.72%	1,779	33,040
External		40,164	0.00	0.03%	18	2,231
Australia	**768,828,859**	**150,918,390**	**19.63%**	**100.00%**	**10,590**	**14,251**

1.3 Research aims

To overview the conservation effectiveness monitoring programs of protected areas in Australia and abroad, compare frameworks and methods used. Analyze the conservation effectiveness-monitoring program (CEMP) in ACT comparatively, understand the progress, and discuss problems found. In addition, to understand the reserve system in ACT, from management framework to the coverage of biological and landscape diversity.

2. Review of the current Protected Areas conservation effectiveness monitoring programs

Many protected areas can make fulling, detailed management plans, but not all of them can be operated well on the ground. Effectiveness evaluation is essential as it shows the degree to which a PA is protecting its values and achieving its goals, however, there are lack of uniform set of standards on how to monitor conservation effectiveness, thus require more efforts to accumulate experiences from practicing. Many Protected areas in the world began to use long-term monitoring as a tool to provide important ecological insights on the conditions and dynamics of the ecosystem and species protected. There are multiple assessment tools developed by both governmental and non-governmental institutes. Ranging from rapid assessment

tools/scorecards which identify status and stress through qualitative methods (interviews & questionnaires) such as RAPPAM (Ervin 2003), METT(Hockings et al. 2003) , to long-term assessment tools which using quantitative approaches/monitoring to reveal ecological conditions and trends, such as State of Parks Reports, monitoring and reporting programs in PAs (Hockings et al. 2009, Mezquida et al. 2005, National Parks Service, 2017).

2.1 Methods

Trough literature reviews, compare cases from the following aspects: assessment focus and framework, indicators, reporting procedures, linkage between evaluation and on-the ground management. Summarize the valuable experience and common problems found. Cases selected in this study are mainly governmental driven State of Parks Reports, which are most comparable to the CEMP in ACT.

2.2 Findings

The analysis has compared 8 cases, including 5 cases within Australia (Tasmania, Victoria, New South Wales, Australian Capital Territory) and 3 cases abroad (Canada, U.S. and Finland) (Table 2). By comparing effectiveness evaluation cases worldwide, some of the common factors were found, such as the recognized role of evaluation in adaptive management (more often from cases in Australia), regular updating (often every 5 years), the need to link monitoring with evaluation and reporting, ecological approach used in the evaluation of nature resources. While cases at single park level or small state level are often more detailed in reporting conditions and trends.

U.S. has built the world first modern national park-the Yosemite National Park, and has the longest history in parks management by the National Park Service since 1916. The State of Parks Report in U.S. is provided at single park level based on monitoring and scientific approaches, indicators used are trying to contain all aspects, from nature with different ecosystem units and species, to visitors' experience and

infrastructure. Though detailed and complex, the indicators are lack of priority to the core conservation targets. Differently, the Values-Based Management Framework developed by Queensland, has evolved the evaluation results into management plans through priority classifications, and the Monitoring and Reporting System in Tasmania has identified priority areas (such as major budget projects) a step before monitoring.

According to above findings, an adaptive conservation management model with key success factors was developed, showing the role of evaluation and its linkage with other management process (Fig. 2).

Table 2 comparison of monitoring & evaluation programs

Region	Initiating agency	Assessment title/Reporting form	Framework/ Indicators/Data	Feedback to management/monitoring
Cases in Other Countries	Parks Canada	State of the Parks Report. Single park scale, start from 1990, updated every 5 years.	Ecological Integrity; Cultural Resources; Visitor Experiences; Qualitative assessment on condition and trend. Mainly monitoring data; interviews for visitor experiences;	The key issues identified from the report supposed to lead management plan, but differ from parks to parks, lack of evidence to show implementations of evaluation feedback.
	National Park Service, U.S. Department of the Interior	State of the Park Report, U.S. Single park scale, update every 5 years. (National Park Service 2014, National Park Service 2017a, National Park Service 2017b)	Using traffic light system to analysis the ecological conditions and trends. Indicators including nature resources, cultural recourses, infrastructure, visitor experiences. Data & analysis from scientific groups	Emphasis on monitoring and scientific research to provide condition and trends information, summarize key issues and challenges for management consideration in the report, but lack of priorities and robust plans.
	Metsahallitus, Finland	State of Finland Parks. National scale, first report published in	Management Effectiveness Evaluation (MEE) designed by IUCN, WWF. Mainly	A broad overview, lack of specific recommendations for management plans and

		2007, updated every 5 years (Heinonen 2007)	report condition(park amount, type), using management statistics;	guidance on monitoring.
Cases in Australia	Parks and Wildlife Service(PWS), Tasmania (2013)	Evaluating Management Effectiveness-Tasmania Monitoring and Reporting System State scale, first report in 2013.	Adaptive management framework with Key Performance Areas (KPAs) identified. Mainly monitoring data; also use expert knowledge, sequencing photographs where measured evidence is not available	Prioritizing monitoring activities and their evaluations, significant initiatives and major budget projects (such as eradicate feral rabbits from Macquarie Island). (Jones 2015) Heavily reliant on government resources.
	Department of Environment and Conservation, NSW	State of Parks Report, New South Wales State scale, started in 2001 (Department of Environment and Conservation 2005, Hockings et al. 2009)	IUCN-WCPA framework, qualitative data (interviews, questionnaires) used.	Report conditions and performance as state level, only have rough future directions as the end of the repot.
	Department of Environment, Climate Change and Water NSW(2010)	New South Wales Natural Resources Monitoring, Evaluation and Reporting (MER) System. State scale, 5 years plan	Adaptive management framework. Collecting and report monitoring data	Planned to link monitoring, evaluation and reporting, no practical evidence or cases found yet.
	Queensland Parks and Wildlife Services (QPWS) (2017)	The Queensland National Parks key park values rating system, single park scale, updated every 5 years. First state scale report will come in 2018	Values-Based Management Framework (VBMF) developed by QPWS, contains value assessment to identify key values and levels of service (LoS) assessment. Monitoring and research data used.	Assessment showing condition and trend is involved in park's management plan, followed by management priority.
	Conservation Research Unit, ACT	Conservation Effectiveness Monitoring Program(CEMP). State scale, started in 2017, first stage until 2019,	Adaptive management framework, with all ecological indicators and methods. Mainly used monitoring data from governmental units, also	Recommendation generated from evaluation will feedback to relevant business units to improve management plans through a priority

		and plan to update every 4 years. (Brawata 2017b, Brawata et al. 2017a)	use citizen science data,	procedure. At the planning stage, no practical evidence yet.

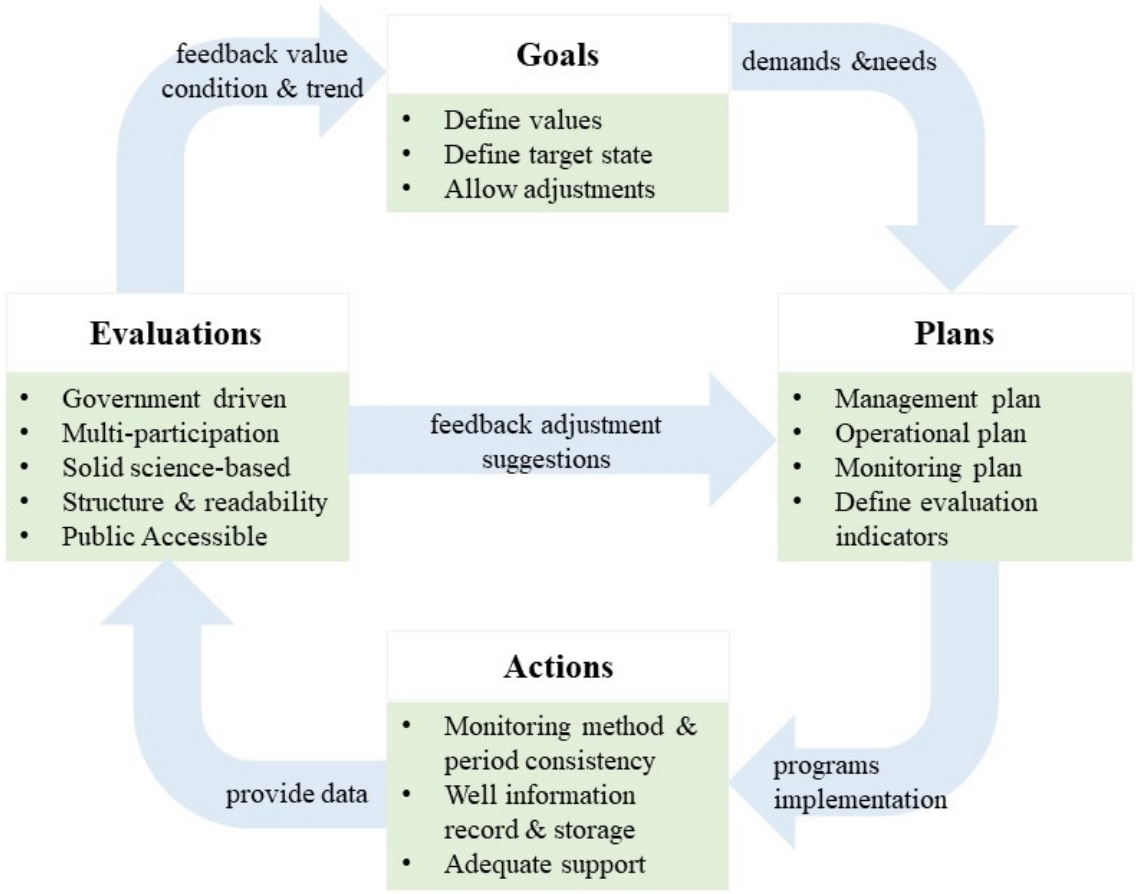


Fig. 2 Summarized adaptive management framework and success factors

Case Box 1: State of Parks Reports in Canada

Canada is one of the earliest countries in the world to develop state of parks report (1990s), the first few reports were at national scale (Parks Canada 1998). After the National Ecological Integrity Panel (2000) Parks Canada requires each national park to prepare a five-year state of the park report (SOPR) before launching a management planning process (Henry et al. 2008). The SOPR fits within a 5-year cycle of parks management (Fig.1), aim to link key issues identified with management plans. The reporting framework mainly contain the condition and trends from three aspects: Ecosystem Integrity (EI), Cultural Resources, Visitor Experiences, and some parks might extend two more aspects—Public Appreciation and Understanding, Cooperative Management, indicators were chosen according to the parks bioregion and cultural characteristics. EI is the most advanced in the assessment, Parks Canada made a national commitment to develop fully functioning EI monitoring and reporting systems for all national parks by 2008 (Parks Canada Agency 2006). Two levels of symbols are used to evaluate indicators (Table 3).

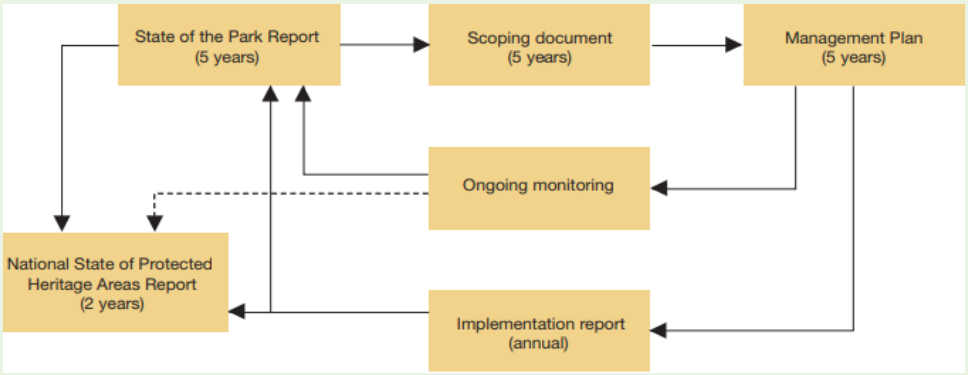


Fig.1 Planning, monitoring and reporting progress of parks in Canada (Henry et al. 2008)

Case Box 2: The Monitoring and Reporting System (MRS) in Tasmania

The MRS in Tasmania was embarked in 2007, the overall objective is 'to develop a practical performance monitoring and reporting system that generates measured evidence of management progress, achievements and challenges across Tasmania's national parks and reserve'（Jones 2015, p78）,the first official report came out in 2013. The system is outcomes-focused, evidence-based, operationally practical, and available to the public online, it delivers four types of reporting outputs: (i) Status and Trends Reports; (ii) Reference Information; (iii) Periodic Evaluation Reports (templates developed); (iv) Evaluated Case Study Reports, evaluate performance from management context to condition/trends of natural values.

One of the advantages of MRS is that the evaluation framework listed items from Key Priority Areas, what to monitor & evaluate, to whom and when to monitor, as well as the resource needed, prioritizing monitoring activities such as significant initiatives and major budget projects, instead of comprehensive evaluation of single parks. Such design is more suitable to relatively small or simple management areas or those with low management budgets.

2.3 Discussions

Above cases can be regarded as world-leading programs in conservation evaluation, however, even these countries or states have just started or finished their first round of evaluation, many other countries like China, still haven't established their own 'SOPR' system (Ren et al. 2015, Sutherland et al. 2004, Watson et al. 2016). At the current stage, there are still lack of evidence to show whether these adaptive models are sound, practical and useful, and lack of practical experiences to show the best way to feedback evaluation results to management planning & actions, to make a real change. Although, the newly developed CEMP in ACT has made some progress in reporting evaluation results through a priority procedure back to management practice, and this will be discussed in the next chapter.

3. A case study of ACT reserves and CEMP

3.1 Overview of current reserve system management framework in ACT

Canberra is well known as 'bush capital', with 55.22% of the ACT's total area designated as either nature reserve or national park to protect biodiversity of the region(Fig.3), higher than the national average and any other Australian jurisdiction. As a small city, Canberra has enriched biodiversity, with 18 species listed as endangered, and 16 species listed as vulnerable under the Nature Conservation Threatened Native Species List 2016 (No 1) (ACT Government 2016) .

The State of Environment Report 2015 pointed out that 'pressures leading to habitat loss and modification continue to present a serious threat to the ACT's biodiversity' (OCSE 2015, p220). It is expected that the population in Canberra will reach 500,000 by 2030 (ACT Chief Minister and Treasury Directorate, 2013), this places more pressure on the balance between urban development and natural environment including biodiversity. Thus calls for urgent needs to establish timely monitoring and response procedures for environmental changes and biodiversity dynamics, ideally an adaptive management system.

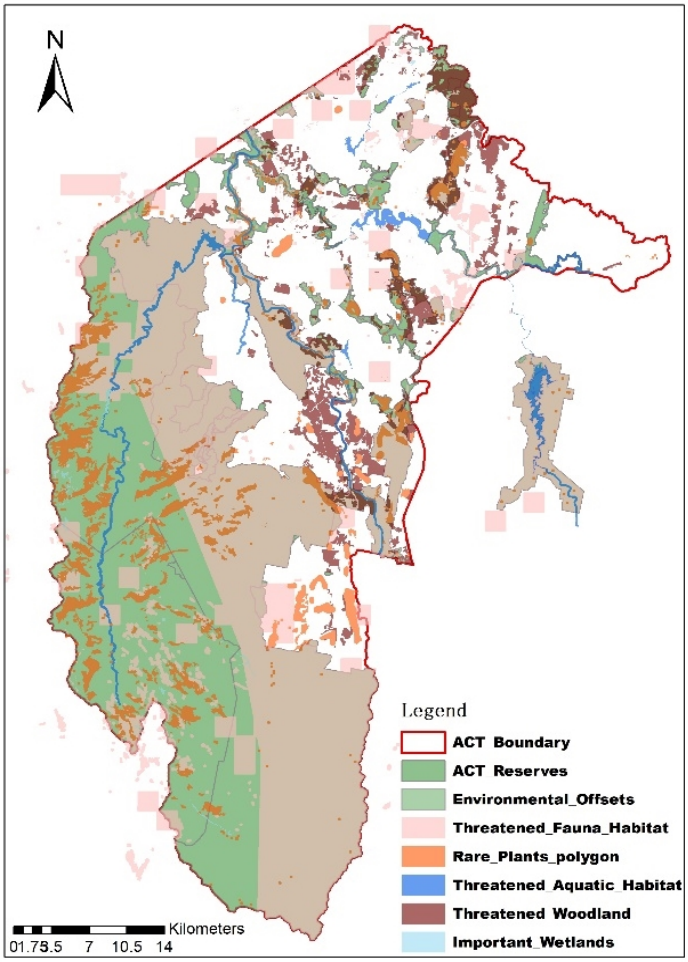


Fig. 3 The distribution of Canberra nature parks and national parks, as well as ecological important areas (such as Threatened Fauna Habitat)

3.2 Assessment of extent and location of ACT reserves, including their coverage of biological and landscape diversity

Assessment of the location and extent would help us to understand natural value representatives of ACT reserves at a landscape scale. Gap analysis were regarded as a powerful tool for conservation spatial planning (Scott et al. 1993), as reserves normally have legislation support and greater conservation efforts, the inclusion of threatened species habitats into nature reserve system is one of the priority approaches of in-situ conservation (Rodrigues et al. 2004).

3.2.1 Methods and data used

Methods including mapping, coverage and gap analysis using GIS. Datasets were collected from ACTMapi, environmental data including Threatened Fauna habitat, Aquatic Animal habitat, Rare Plants, Threatened Woodlands, Important Wetlands, boundary shape files including nature reserves & parks, offsets and the ACT border (Fig.3, Appendix 1).

Data processing procedures: import all the dataset (in shapefile format) into ArcMap10.2.1, overlap environmental layers with the boundaries of ACT reserves and environmental offsets, using 'extract' and 'spatial join' tools to extract and calculate areas fell into reveres/offsets and areas uncovered.

Five types of ecological important areas were analysed. Within these areas, distributing 19 threatened Fauna species including Grassland Earless Dragon (ACT Status-Endangered), Pink-Tailed Worm Lizard (ACT Status-Vulnerable), Northern Corroboree Frog(ACT Status-Endangered), Trout Cod (ACT Status-Endangered), 15 rare plants including Black Gum, Alpine Ash, River Red Gum, as well as ACT and EPBC listed Box Gum Grassy Woodland (with largest remaining patches in Australia). These threatened species and communities are the key natural values we are trying to conserve.

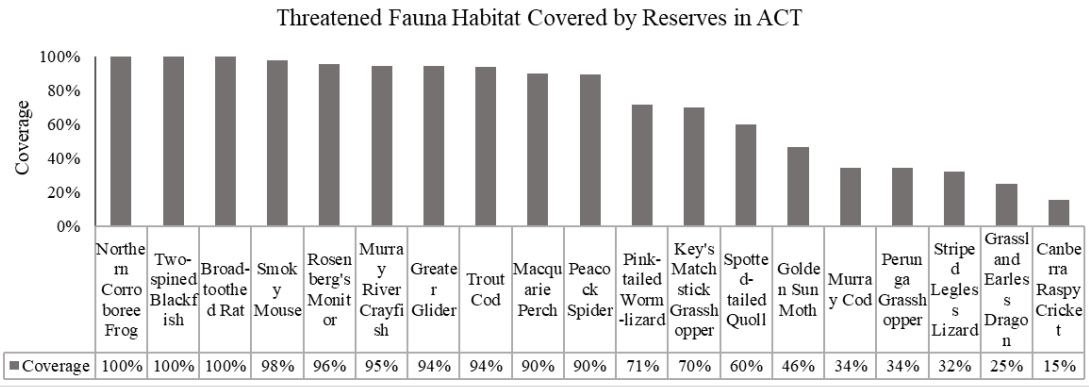
3.2.2 Main Findings

Results showed that among the 5 types of area, the recognised important wetland was covered most (more than 95%) by current reserve system in ACT, while the Threatened Yellow Box Red Gum Grassy Woodland was of the least coverage (less than 40%). The uncovered woodland distribute largely in central east Canberra, between Urambi Hills Nature Reserve and Rob Roy Range Nature Reserve, and partly in north-eastern Canberra (Fig. 3, Appendix 2). More than half of the threatened Fauna species known habitats were covered up to 60% by reserves & offsets, except Golden Sun Moth, Murray Cod, Perunga Grasshopper, Striped Legless Lizard,

Canberra Raspy Cricket (lowest coverage, 15%) (Fig. 4, Appendix 3). What's more, some of the rare plants and group of plants were not protected under the nature reserve system, including River Red Gum (6%), Lowland Snow Gum Woodland (6%), and Black Gum (0%) (Fig.4, Appendix 3).

Table 3. Spatial analysis of reserves' coverage on 5 types of ecological important areas

Type	Total area in ACT(ha)	Area covered by reserves (ha)	Area covered by offsets (ha)	Conservation gap area (ha)	Gap proportion (%)	Type/Species being covered most	Coverage (%)	Type/Species being covered least	Coverage (%)	Reserves with largest coverage
Important Wetland	348.18	332.76	0.00	15.42	4.43	All except Horse Park Wetlands	100	Horse Park Wetlands	0.00	• Jerrabomeberra Wetland Nature Reserve • Namadgi National Park
Rare Plants	17292.06	14248.09	14.67	3029.29	17.52	Alpine Ash	99.69	Black Gum	0.00	• Namadgi National Park
Threatened Aquatic Habitat	25107.53	21092.74	0.00	4014.02	15.99	Two-Spined Blackfish	100	Murray Cod	34.40	• Lower Molonglo Nature Reserve • Namadgi National Park • Lower Cotter Catchment
Threatened Fauna Habitat	101384.94	89464.42	203.16	11717.41	11.56	Broad-Toothed Rat, Northern Corroboree Frog	100	Canberra Raspy Cricket	15.21	• Stony Creek Nature Reserve • Namadgi National Park
Threatened Yellow Box Red Gum Grassy Woodland	13956.13	5001.34	323.50	8667.09	62.10	Yellow Box Red Gum Grassy Woodland	35.84	Yellow Box Red Gum Grassy Woodland	35.84	• Goorooyarroo Nature Reserve • Majura Special Purpose Reserve



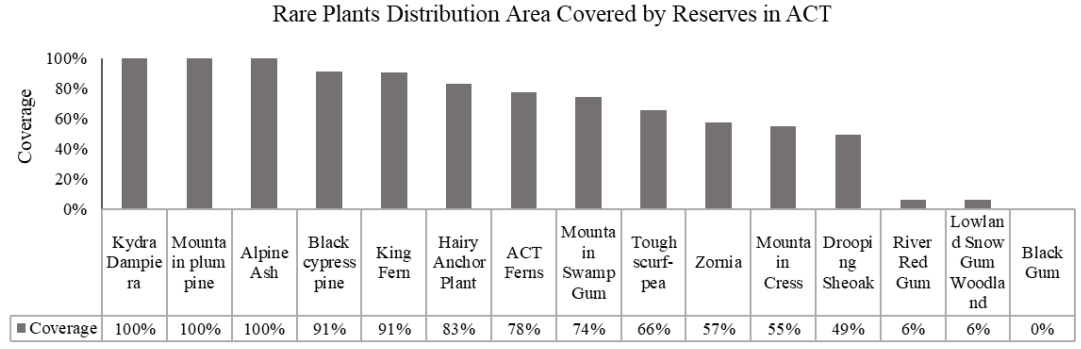


Fig.4 Threatened Fauna habitat and rare plants distribution area covered by reserves in ACT.

3.3 CEMP—plans, progress and problems found

3.3.1 Introduction of CEMP

The Conservation Effectiveness Monitoring Program (CEMP) supported the role of Conservation Research Unit, Environment, Planning and Sustainable Development in the ACT government since 2016. The first technical report 'Conservation Effectiveness Monitoring Program-An Overview' in May 2017, states that the program 'aims to create a coordinated, systematic, and robust biodiversity monitoring program' to 'detect changes in ecosystem condition within reserves, evaluate the effectiveness of management actions in achieving conservation outcomes and provide evidence to support land management decisions.' (Brawata et al. 2017a, p4). Different from other states, though mainly focussing on nature reserves where they have the management abilities to make some changes, the CEMP is hoping to cover broadly in ACT through 8 ecosystem units, including the lease hold private lands. 8 ecosystem units were based on vegetation types defined by Keith (2004), namely lowland native grasslands; lowland woodlands; lowland forests; aquatic and riparian ecosystems; upland native grasslands; upland woodlands; upland forests; upland bogs and fens.

An adaptive management framework was developed to link all parts of conservation units and improve positive feedback (Fig.5), involving all business units and contributors from Goals (strategies, what to protect), Action (planning, what to monitor), Do (implementation, data collection), Evaluate (assess evidence and data analysis, supported by CEMP) to Report (evaluation feedback and provide recommendations, supported by CEMP). This process is expected to provide timely feedback on problems found, help adjust the Goals in a more effective way and move into the next round (Allan 2007).

The design of CEMP has combined a blend of systems mentioned in 2.2, for

example, Tasmania State of Parks (trigger zone)(Jones 2009), Queensland National Parks (Values-Based Management Framework) (Queensland Parks and Wildlife Service 2017), and US State of Parks ('traffic-lights' system) (National Park Service 2014). Indicators for evaluation were suggested by expert referencing group (Fig. 6), monitoring data were collected from multiple contributors, ranging from Government Business Units (Conservation Research-main data source, Parks and Conservation Services, Natural Resource Management) to Community Groups (such as Frogwatch, Canberra Ornithologists Group).

Fig. 5 The stage of adaptive management cycle as applicable to CEMP (Brawata et al. 2017)

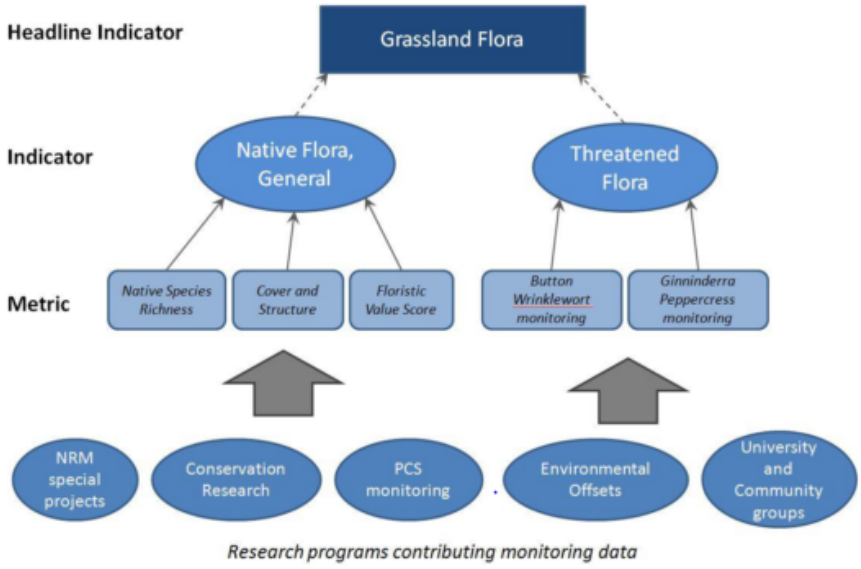


Fig. 6 Indicator structure diagram, an example of Grassland Flora in the Lowland Native Grassland Ecosystem unit.

3.3.2 Related legislation, planning and documents

There are increasing requirements for governmental-driven robust conservation effectiveness monitoring, evaluation and reporting programs, a wide range of legislations, planning, and documents at all levels have helped or influenced programs like CEMP. For example:

Table 4. Legislation and planning context

Scale	Legislation, planning and documents related
International	**IUCN world commission on Protected Areas**
	IUCN world parks congress Durban,2003
	CBD programs of works on PAs COP7 Decision VII/28
	IUCN world conservation congress Barcelona 2008
Commonwealth	**Environmental Protection and Biodiversity Conservation Act 1999**
	Nature Conservation Act 2014 *'promoting and supporting the management, maintenance and enhancement of biodiversity of local, regional and national significance'* **Australia strategy for the national reserve system 2009-2030** *'use management effectiveness framework to robustly and routinely evaluate and report on the state of biodiversity assets and responses to management action'* ***Australia's Direction for the National Reserves System*** (Natural Resource Management Ministerial Council 2005), ***National Reserve System Program 2006 Evaluation*** (Gilligan 2006) Identified the strategic priority for effectives evaluation, 'protected area agencies should establish programs, such as State of the Parks (SoP) to assess and report on the management of protected areas within their jurisdiction' **Australian Government MERI strategy 2011** *'Evaluation is an important part of the delivery of government programs or policies'*

	Australia's biodiversity conservation strategy 2010-2030 (Natural Resource Management Ministerial Council 2010) states '*by 2015, establish a national long-term biodiversity monitoring and reporting system*'.
ACT	**Nature Conservation Act 2014** Legislation for the protection of native plants and animals in the ACT. Suggested Biodiversity Research and Monitoring Program designed to monitor the state of nature conservation, planed every two years, and report at the end of the program
	ACT Nature Conservation Strategy 2013-2023 (ESPDD,2013) 'Declared species, research and monitoring obligations under current funding arrangements, availability of resources, and consultation with the scientific committee.'
	ACT State of Environment Report 2015 (OECD,2015) revealed concerns about *'the poor condition of the ACT's biodiversity values in our protected areas', 'the fact that the capacity of the reserve system to protect biodiversity in the face of climate change is unclear', 'the fact that the conservation outcomes for biodiversity resulting from land added to the reserve system for offset purposes are unknown'.*
	Biodiversity Research and Monitoring Program(BRAMP) supports the role of the ACT Conservator of Flora and Fauna (Conservator),designed to monitor the state and effective management of nature conservation in ACT
	Conservation Effectiveness Monitoring Program (2017) Supported by Conservation Research, EPSDD, Lowland Native Grassland Ecosystem Condition Monitoring Plan completed

3.3.3 Research Methods

Methods used in this section include a review of CEMP technical reports and open interview with key informants of the program. An open interview was did with Dr. Renee Brawata, the project officer of CEMP, to acquire more details of the program design, progress, outputs and application. Additionally, I went to several national parks and nature reserves in ACT and did informal interviews with the park rangers, staffs in Conservation Research (CR), Parks and Conservation Services (PCS), and NGOs representatives, about conservation management status and problems met. Based on above information, I then analysed CEMP under the SWOT

framework, and presented my opinions and suggestions on the problems found.

3.3.4 Main Findings

The first stage of CEMP is funded until 2019, the current progress is: among the 8 units, the monitoring plan of Lowland Native Grasslands was completed, Upland Native Grassland is close to finish, Aquatic and Riparian Ecosystems can be finished by the end of this year, and then start on Woodlands Ecosystem. If the first stage works well, the program will be expected to run in the long term.

By combing information from the report and interviews, a SWOT analysis showed strengths like strong science, weakness, opportunities and threats (challenges) found (Table 5). One of the advantages of CEMP is the strong intension to feedback evaluation results to management operations, currently through a priority procedure. All related management business units-Parks and Conservation Services, Environment Offsets, Nature Resources Management, Conservation Research are involved in a workshop, where the CEMP can report evaluation results and recommendations, the other units can rank the priority of these recommendations and embed them into practice. This feedback procedure has improved the operation feasibility, and the communication efficiency of all sectors.

Some of the main problems are:

1) There are overlaps on the current monitoring programs in various business units and community groups, but methods used not standardized, and lack of continuity, increased difficulties in the robust analysis of some indicators.
2) the program mainly focus on ecological data and methods, lack of stress indicators on human influence, such as recreational use, construction programs (roads, houses) and their potential impacts on conservation targets. Such assessments need cross-sector cooperation and data collection, but are currently difficult to implement.
3) The success of this program depends largely on support from other business units

and higher-level recognition, though situations are getting better, there are still disconnections between sectors, plan makers and operators (rangers).

Table 5. SWOT analysis of CEMP

	Helpful to the objective	**Harmful to the objective**
Internal attributes	**Strengths**	**Weaknesses**
	• Strong evidence-based, using ecological data and research methods for evaluation. • Data rich, supported by long term monitoring programs using rigorous research methods (e.g. kangaroo & rabbits monitoring). • The special land ownership of ACT allows program to operate at state level and cover all ecological units rather than just reserves areas. • Common interests for all environmental departments & sectors. • Provide monitoring recommendations through priority workshop, with voluntary enforcement by other units, improved the operation feasibility.	• Business units have different priorities; there are some disconnections and gaps. • Scattered storage of monitoring data in different business units, lack of unified format and data sharing system. • Currently not considering social and recreational values, lack of data on tourism and recreational use, hard to measure this kind of stressor. • Feasible indicators & assessment metrics are not easy to choose. Technical difficulties (some indicators lack sufficient data and research, both targets and trigger zones are hard to set).
External attributes	**Opportunities**	**Threats**
	• Create opportunity for all units to communicate and work more efficiently. • Standardize monitoring activities and information sharing. • Conducive to achieve adaptive management. • Capacity building and	• Risk on program persistence (lack of funding, efforts, staff & rangers turnover, etc.). • The linkage from evaluation back to goals-plans-actions on the adaptive management cycle is not easy to build. • Uncertainty in implementation, business units (PCS, offsets,

	involvement for rangers (e.g. the 'health check-up' plan). • Strong community and citizen science involvement (Frogwatch, Friends of Grassland, Canberra Ornithologists Group, etc.), improve monitoring efficiency. • Provide information for other reporting programs, such as Environmental Accounting in ACT, State of Environment Report, etc.	NRM, etc.) have different priorities and disagreement on what should be done. • Too many indicators might create more monitoring needs in a long-term process. • Rangers may not cooperate enough in some operational plans (short-handed). • Rangers have high turnover rate, will affect monitoring consistency.

3.4 Other problems and suggestions

As an overview of the conservation management in ACT reserves, problems also found in:

1) Although nature reserves or parks are the main body for threatened species conservation, the gap analysis shows that there are still habitats not covered by reserve areas, calls for more attention in further management plans.
2) Whether the adaptive management cycle can be completed depend largely on what happened after the evaluation feedback. However, currently I found that there might be gap between management planning and on-the-ground operation. Taking management zones for example, though there were planned Zone1-3 that supposed to have different management strategies such as visitor access, utility infrastructures, but lack of evidence to support the implementation and effect. Besides, there are now different kinds of zoning (such as tourist management zones) on the same area, the overlap might cause further conflicts in management requirements.
3) The knowledge gap and disconnection between plan-makers and ground-operators (rangers). Through informal interviews, both park managers and research staff expressed their concerns about rangers 'lack of the big-

picture', some 'not actively cooperative on new monitoring items & methods', as well as the 'high turn-over rate' that increased communication costs. While from a ranger's perspective, one ranger I interviewed said it's 'hard to meet all the needs & values from different groups' with 'limited budget', especially when he is managing several sites at the same time. These exposed issues have highlighted the need for capacity building, continuity of tenure and potential additional posts.

4) Besides natural values, there are also cultural, recreational values on the same lands, managed or maintained by different business units, made full and timely communication necessary. For instance, the landscape classification system for visitor management conducted by PCS this year, aims to characterising the biophysical, social and management attributes of reserves as well as offsets from recreational use. Biodiversity and ecological baseline data from CEMP or other monitoring programs can provide reference for classification planning. Long-term cooperation is required to detect conditions and changes from both visitors and nature perspective.

4. Conclusions and discussions

4.1 Conclusions

This study has reviewed several world-leading cases in the conservation effectiveness monitoring of protected areas (mainly) with an in-depth understanding of CEMP in ACT, conclusions are summarized as following:

- By comparing effectiveness evaluation cases worldwide, an adaptive conservation management model with key success factors was developed, showing the role of evaluation and its linkage with other management process.
- At the current stage, there are still lack of evidence to show whether these adaptive models are sound, practical and useful, and lack of practical experiences

to show the best way to feedback evaluation results to management planning & actions.

- Gap analysis showed that among the 5 types of areas with conservation value in ACT, less than 40% Threatened Yellow Box Red Gum Grassy Woodland was covered under the nature reserve system and offsets. The uncovered woodland distribute largely in central east Canberra, and partly in north-east. More than half of the threatened Fauna species known habitats were covered up to 60% by reserves & offsets, but several species such as Golden Sun Moth, Murray Cod, Perunga Grasshopper, Striped Legless Lizard were covered insufficiently.
- Through literature review and interviews, advantages and problems found were analyzed under the SWOT framework, the outstanding advantages of CEMP including strong science & data support, communities' participation, effective feedback to management plans through a priority procedure, while facing challenges in multi-sectors cooperation and indicators feasibility.

4.2 Discussions

Monitoring and periodic assessment of protection targets and actions are indispensable parts in the adaptive management of protected areas, and are gradually becoming necessary tools for conservation management. A program like CEMP has great potential to improve actions efficiency for conservation management in ACT, as comment by Dr. Brawata, 'CEMP focuses very much on how we are going with our management on the ground, whether our management is actually improving or maintaining our assets base (values) and how we can improve management to improve values. It's much more useful for adaptive management, directing on the ground actions, rather than just reporting on what we have' (quote from interview contents). However, the world is still in the early stages of exploration on how to improve the protection assessment process. Programs like CEMP are still facing challenges and need dynamic adjustments through practice.

Today, the nature conservation in Canberra is facing increasing pressures from population growth, urban development and constructions, thus all groups need to draw more attention to, and build support for, the nature values we are trying to preserve, and develop more adequate cross-sectoral cooperation and information sharing, and more transparent information disclosure mechanisms and accountability mechanisms.

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Appendix 1

Table 6. Dataset used in 3.2 (source: ACTMapi)

Data used	Type	Introduction (last updated)
Threatened Aquatic Habitat	Environment	The habitat map layers are based on data collected by the ACT Government in the field or based on known fish stocking locations. (last updated 2017)
Threatened Fauna Habitat	Environment	This dataset is from a series of layers showing habitat for terrestrial mammals, reptiles, birds and invertebrates listed as threatened in the ACT under the Nature Conservation Act 2014 (last updated 2016)
Rare Plants	Environment	select species or groups of species that are of conservation interest but are not listed as threatened under the ACT Nature Conservation Act or EPBC (last updated 2016)
Important Wetlands	Environment	Remote sensing data (Lidar), 1:10,000 scale (updated 2016)
Threatened Woodland	Environment	the distribution of ACT and EPBC listed Box Gum Grassy Woodland in the ACT (updated 2017)
Vegetation Communities	Environment	Sensor: Leica ADS40; Sensor Type: Push-Broom airborne; Ground Sample Distance (Pixel Size): 50 cm;(last updated 2013)
Environmental Offsets	Environment	Biodiversity compensate areas, to maintain or improve the likelihood of species, communities and habitat persisting into the future. (last updated 2016)
ACT Boundary	Land Administration	Aerial Imagery, Ground Sample Distance (GSD) of 0.1m and has been referenced to MGA Zone 55 Grid. (last updated 2016)
ACT Reserves	Land Administration	Reserves, Nature Reserves, Special Purpose Reserves, National Parks, Woodland and Forest. (last updated 2017)
ACT Water Features	Water	1:10,000 Plan Series, 1:2,500 Cadastre, 1:2,500 Detail, 1:1,000 Detail and traced from Topobase (last updated 1995)

Appendix 2

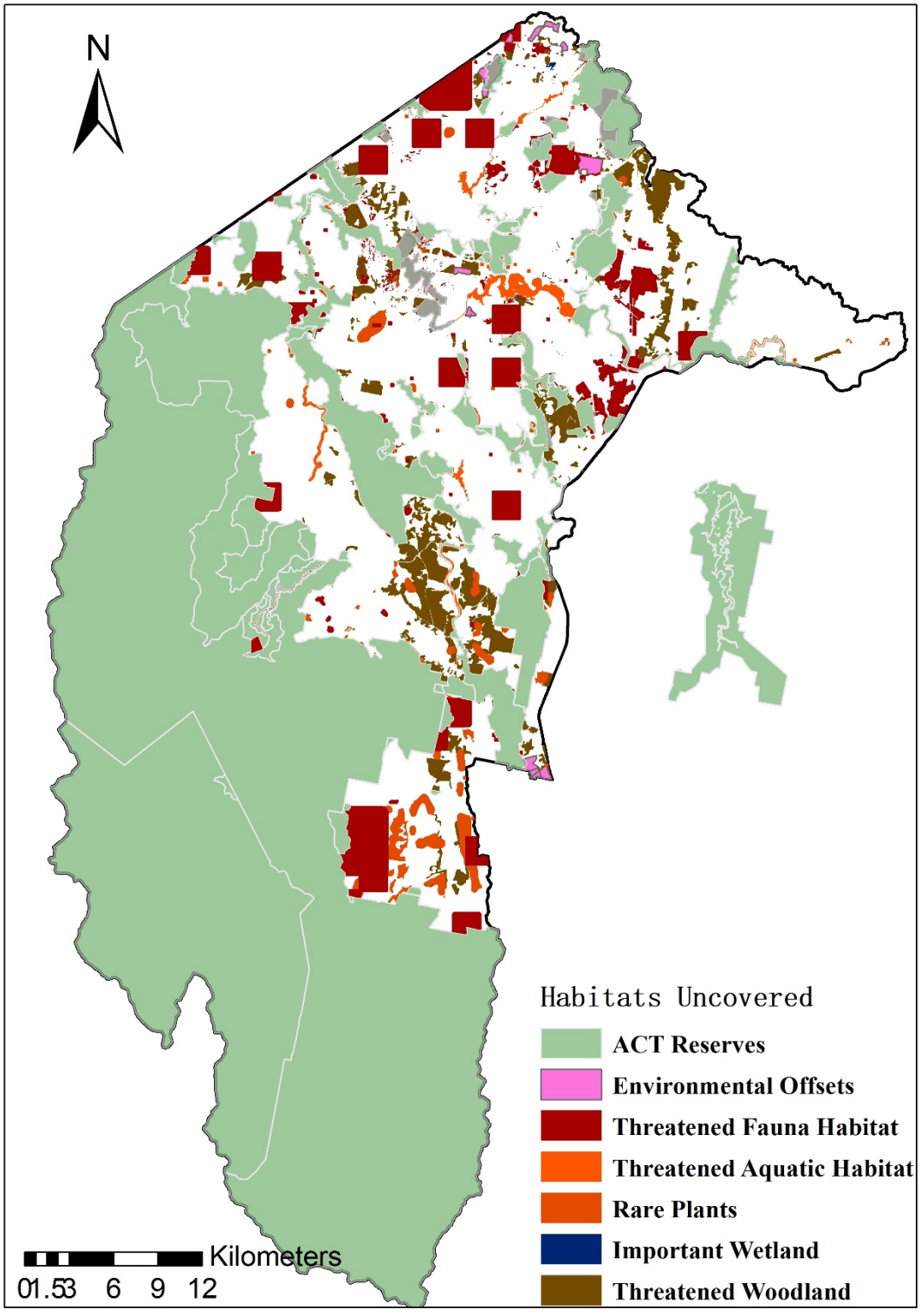

Fig. 7 Threatened species habitat and woodlands not covered by reserves or offsets areas

Appendix 3

Table 7. Details on each species known habitat and conservation coverage

Species	Category	ACT Conservation Status	Known Habitat (ha)	Covered by Reserves (ha)	Coverage Rate
Broad-toothed Rat	Mammal	Conservation significance	111.74	111.74	100%
Canberra Raspy Cricket	Invertebrate	Rare / Data Deficient	179.98	27.38	15%
Golden Sun Moth	Invertebrate	Endangered	1763.32	819.81	46%
Grassland Earless Dragon	Reptile	Endangered	1049.91	260.36	25%
Greater Glider	Mammal	Not listed	8325.98	7857.72	94%
Key's Matchstick Grasshopper	Invertebrate	Rare / Data Deficient	16.97	11.82	70%
Northern Corroboree Frog	Amphibian	Endangered	134.87	134.87	100%
Peacock Spider	Invertebrate	Rare / Data Deficient	59.83	53.64	90%
Perunga Grasshopper	Invertebrate	Vulnerable	314.40	107.32	34%
Pink-tailed Worm-lizard	Reptile	Vulnerable	1579.79	1129.10	71%
Rosenberg's Monitor	Reptile	NSW Vulnerable	69784.62	66786.72	96%
Smoky Mouse	Mammal	Endangered	5010.01	4885.25	98%
Spotted-tailed Quoll	Mammal	Vulnerable	11155.29	6664.91	60%
Striped Legless Lizard	Reptile	Vulnerable	1898.25	613.80	32%
Macquarie Perch	Aquatic	Endangered	8572.11	7703.00	90%
Murray Cod	Aquatic	Special Protection Status	4046.91	1392.09	34%
Murray River Crayfish	Aquatic	Vulnerable	4814.14	4549.39	95%
Trout Cod	Aquatic	Endangered	3760.85	3534.74	94%

Species	Category	ACT Conservation Status	Known Habitat (ha)	Covered by Reserves (ha)	Coverage Rate
Two-spined Blackfish	Aquatic	Vulnerable	3913.53	3913.53	100%
ACT Ferns	Plant	Important/Rare	390.16	302.92	78%
Alpine Ash	Plant	Important/Rare	10449.26	10417.06	100%
Black cypress pine	Plant	Important/Rare	758.39	689.24	91%
Black Gum	Plant	Important/Rare	12.07	0.00	0%
Drooping Sheoak	Plant	Important/Rare	3809.38	1877.86	49%
Hairy Anchor Plant	Plant	Important/Rare	545.74	453.96	83%
King Fern	Plant	Important/Rare	22.64	20.49	91%
Kydra Dampiera	Plant	Important/Rare	1.96	1.96	100%
Lowland Snow Gum Woodland	Plant	Important/Rare	694.66	40.03	6%
Mountain Cress	Plant	Important/Rare	10.17	5.58	55%
Mountain plum pine	Plant	Important/Rare	184.25	184.25	100%
Mountain Swamp Gum	Plant	Important/Rare	73.06	54.19	74%
River Red Gum	Plant	Important/Rare	6.03	0.37	6%
Tough scurf-pea	Plant	Important/Rare	99.28	65.32	66%
Zornia	Plant	Important/Rare	234.99	134.87	57%