Australian Capital Territory

Nature Conservation (July 2022 – June 2024) Biodiversity Research and Monitoring Program 2023

Notifiable instrument NI2023–45

made under the

Nature Conservation Act 2014, s 25 (Biodiversity research and monitoring program—conservator to prepare)

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1   Name of instrument

This instrument is the *Nature Conservation (July 2022 – June 2024) Biodiversity Research and Monitoring Program 2023*.

2   Commencement

This instrument commences on the day after notification.

3   Biodiversity research and monitoring program

I have prepared the biodiversity research and monitoring program for the period 1 July 2022 to 30 June 2024 as set out in schedule 1 to this instrument.

4   Application

This program is in effect for the period 1 July 2022 to 30 June 2024.

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Bren Burkevics
Conservator of Flora and Fauna

30 January 2023

Biodiversity Research and Monitoring Program (BRAMP)
July 2022-June 2024

Overview

The Biodiversity Research and Monitoring Program (BRAMP) primarily supports the role of the ACT Conservator of Flora and Fauna (Conservator) by setting out biodiversity research and monitoring priority activities for a specified two year period. The BRAMP is a notifiable instrument under section 25 of the Nature Conservation Act 2014 (the Act) and relates to those aspects of the Conservator's role that are specific to monitoring and research.

The BRAMP sets out a two year program of biodiversity research and monitoring activities. A specific feature of the July 2022-June 2024 plan is that it goes beyond the requirements of s.25 of the Act to include research and monitoring not directly related to biodiversity, and in particular bring effect to activities under the EPSDD Science Plan 2020-2025.

The monitoring program primarily supports the role of the ACT Conservator of Flora and Fauna and contributes to:

- a long-term strategic approach to biodiversity monitoring and research;
- better understanding and tracking of ecosystem condition in the ACT; and
- an evidence base for environmental policy, program and resource allocation decisions, and reporting.

List of Acronyms

CPP	Conservation Planning and Policy branch
CR	Conservation Research branch
DA	Development application
EIS	Environmental impact statement
ESO	Environmental significance opinion
FFR	PCS Fire, Forests and Roads branch
GED	Canberra Grassland Earless Dragon *Typanocryptis lineata*
GSM	Golden Sun Moth *Synemon plana*
NRM	Natural Resource Management team
PCS	Parks and Conservation Service
PTWL	Pink-tailed Worm Lizard *Aprasia parapulchella*
SLL	Striped Legless Lizard *Delma impar*

PART ONE: Action Areas

1. AUTHORITATIVE SCIENCE ADVICE

Goals

1.1 Scientific staff are contemporary experts and provide reliable and timely advice

Actions

- Further development of sensitive ecological values mapping for guiding recreational impacts (PCS Continue provision of ecological advice into DAs/EISs/ESOs (PCS/Conservator Liaison /CR)
- Further development of corridors mapping for guiding land use decision making, including infrastructure development and priority habitat restoration activities (CR)
- Trial of a prioritisation map to guide management, based on risk assessment (CR/PCS)
- Develop and publish improved ecological connectivity models for grassland, woodland and aquatic/riparian ecosystems (CR)
- Develop and publish ecologically sensitive urban design technical guidelines to inform revised urban planning policies, and consistent and strategic delivery of on-ground programs
- Maintain and support work of Wombat Management Working Group (CR/PCS)
- Develop checklist of conditions for DA/EIS/ESOs (Conservator Liaison/Molonglo)
- Developing the 'Values Officer' role in fire operations (CR/FFR/NRM)
- Continue provision of high-quality kangaroo management advice: fertility control, culling, road design, carcass use, captive populations, connectivity, rural lands (CR)
- Mapping of swampy meadows as an important lowland ecological community worthy of conservation due to their critical role in maintaining hydrological processes and landscape function

1.2 Scientific staff are supported to maintain professional expertise and continue professional development, through e.g. enabling their access to scientific literature, linkages with scientific institutions, participation in relevant scientific conferences, and receipt of relevant training

Actions

- Support staff to attend relevant conferences and access appropriate training (PCS, CR)
- Explore options to get access to scientific literature in more systematised way. Currently scientific staff require access to the literature, but are not provided it through ACT Government, so access it in a variety of ad hoc ways such as via university affiliations
- Hold events to enable development of relationships with research partners, including e.g. further symposia, workshops, and collaboration events such as the "Ideas Mingle" with the ANU/UC/CSIRO Centre for Biodiversity Analysis.

2. TARGETED, WELL-DESIGNED RESEARCH AND MONITORING

Note: specific research and monitoring projects and programs are set out in Part Two.

Goals

2

2.1   All monitoring programs are scientifically robust, targeted and efficient; and collect the most appropriate data to evaluate and guide management actions

Actions:

- Identifying trigger points for management actions on offsets using quantitative baselines (PCS)
- Greater tracking/recording of management interventions is carried out to better enable evaluation of effectiveness (PCS/Resilient Landscapes/CR)

2.2   Monitoring efforts are designed in ways that enable relevant research questions to be addressed, and existing monitoring datasets are used to address relevant research questions

Actions:

- Provision of data for Threatened Species Index (PCS/CR)
- CEMP Priority Management Evaluations will complete question-driven quantitative case-studies in collaboration with primary data custodians to evaluate the ecosystem outcome(s) of management actions
- CEMP Recommendation Forums will be held to enable review of research recommendations from completed Ecosystem Condition Assessments with internal stakeholders to collectively progress action on priority recommendations where resources and feasibility allow.
- Development of a new urban habitat and connectivity monitoring program, based on citizen science and Canberra Nature Map, to identify biodiversity hotspots, key connectivity corridors, and evaluate the effectiveness of corridor restoration efforts, as part of the Connecting Nature Connecting People initiative.
- Review of monitoring program to consider whether and how we can collect data appropriate to track impact of climate change will be undertaken

2.3   Research is relevant, robust, subject to independent critical scrutiny, co-developed with user groups, and results wherever possible in peer-reviewed publication of research findings

Actions:

- Results and products of Superb Parrot, Grassland Earless Dragon, Striped Legless Lizard, and Gang-Gang research are prepared for end users and publication (PCS)
- Publication of urban biodiversity habitat and connectivity requirements, based on expert elicitation (CR)
- Publication of Little Eagle research with the Little Eagle Research Group (includes ACT Government, CSIRO, ANU and Ginninderry)
- ACT Habitat and Connectivity Project outputs (spatial models) are evaluated based on field-based biodiversity survey data and using genetic indicators (CR)
- Publication in scientific journal of long-term study monitoring the ecological effects of prescribed burning on dry forest communities in Canberra Nature Park. Insights are shared with stakeholders and incorporated in future fire management planning and operations. (CR)
- Publication of externally reviewed technical report detailing impacts and post-fire recovery of fire-sensitive vegetation communities in Namadgi after the 2020 Orroral Valley Bushfire. (CR)

3

- Further refinement of the Science Directory and associated Science Planning Good Practice Guidance to promote these objectives (CR)
- Publication of outcomes of study on implications of application of fire for conserving grassland communities and associated fauna (CR)
- Publication of genetic rescue of Macquarie Perch, montane crayfish genetics, Murray Darling Basin baseline fish assessment, Western ACT Macrophyte project.

2.4   Citizen science collaborations are enhanced and strengthened

Actions:
- Identify opportunities for knowledge sharing between EPSDD and rural landholders
- Use of Superb Parrot DigiVOL project to harness citizen sourced data (PCS)
- Volunteer engagement in SLL and GED research programs (PCS)
- PCS engagement with Red Hill Regenerators for Gang Gang monitoring (PCS)
- Enhance Canberra Nature Map to increase opportunities for citizen science input to government datasets, particularly around urban biodiversity mapping and monitoring
- Continuation of ongoing projects engaging citizen science (including the Little Eagle project, FrogWatch, the CHiP program, Montane Galaxias project, etc).
- Working with the Canberra Orchid Society to monitor key orchid populations and rare orchids, such as the Canberra Spider orchid (CR, NRM)
- Work with community organisations to develop and conduct a wombat monitoring program (CR).

2.5   The social science and economics expertise within the Division is increased

Actions:
- Recruit decision scientists to optimise offset management (PCS)
- Recruit fisheries conservation expertise (CR)

2.6   Ngunnawal people are widely consulted with and engaged in research and monitoring efforts, and understanding is increased of how Ngunnawal cultural knowledge and practices can contribute to achieving EPSDD's conservation and management priorities, and how integrating Ngunnawal cultural knowledge and practices with formal scientific knowledge and practices can generate fresh understanding to advise and guide management

- *Actions:* Include Ngunnawal language names where appropriate in presentations, maps and documentation on species and community ecology projects (CR)
- Traditional owner-centred development of climate adaptation strategies (PCS/CR)
- Exploration and co-development of a monitoring app to be used by Ngunnawal community, to enable potential integrated cultural/ecological assessment and reporting (CR/CPP
- Increasing frequency and level of collaboration, consultation and engagement between divisional scientists and the Ngunnawal community (CR/PCS)

2.7   Research and monitoring priorities and outcomes have high visibility, in a variety of appropriate forms, within and beyond Government to maximise opportunities for collaboration and the impact of our work on biodiversity conservation, sustainability and liveability

Actions:

4

- Provide regular high-quality content to Communications team to highlight PCS estate values and other ecological values and research efforts (PCS/CR)
- Establish and disseminate the new CEMP Online Hub (see below)
- Build the role of the EPSDD Science Platform in providing a single entry point for EPSDD research and monitoring news and updates
- Provide and update ArcGIS online dashboards to inform key monitoring outcomes around threatened species and weeds
- Fully implement CR communications strategy (CR)
- Appropriate content is provided to forthcoming State of the Environment report (several)
- Build urban fisheries online dashboard that may include an angler portal to record catch (CR)
- In collaboration with research partners, develop communication plans for innovative or high profile threatened species projects to enable strategic media and stakeholder engagement. Example species include the Koala, Grassland Earless Dragon, Northern Corroboree Frog and Smoky Mouse (CR/PCS).

3. EMBED ADAPTIVE MANAGEMENT ACROSS EPSDD

Goals

3.1 The science, policy and implementation teams across the Environment Division are "interoperable", delivering joined-up strategic, evidence-based and adaptive management

Actions:
- Deliver a coordinated, cross-Directorate approach to evidence-based conservation of urban ecology and green/blue spaces through the Connecting Nature Connecting People initiative
- Promoting the role of the Fire Ecology Working Group as a community of practice for ecological fire management within the ACT, establishing the working groups as a collaborative forum for sharing ideas and learnings related to ecological aspects of bushfires and fire management (PCS/CR)
- Work with PCS districts and the Fire Management Unit to explore appropriate governance arrangements for planning and approval of ecological burns that consistently and transparently incorporates considerations including ecological merit and operational feasibility (CR)
- Continue to provide technical advice to update fisheries regulations, based on results of scientific monitoring and social expectations (CR)
- Environmental flow guidelines are updated to include reflect monitoring results and best practice improvements for eflow delivery (CR)

3.2 CEMP provides a coordinated, systematic, and robust biodiversity monitoring program across all ecosystem types in the ACT, which can detect changes in ecosystem condition within the ACT, evaluate the effectiveness of management actions in achieving conservation outcomes, and provide evidence to support decision making

Actions:
- Undertake the statistical analysis and reporting work on question-driven case-studies that address the priority management evaluation needs of land managers

5

- Completion of ecosystem condition assessments for Aquatic and Riparian, Bogs and Fens, and Woodlands ecosystems, and update of the Grasslands ecosystem condition assessment, and release online
- Develop online applications that enable standardised monitoring of basic ecosystem condition variables for riparian, woodland and grassland ecosystems

3.3 CEMP is mainstreamed across the Division, and its outputs are translated into strategic, statutory and operational planning

Actions:
- Establishing the CEMP Online Hub as a central location of Ecosystem Condition Assessments, Priority Management Evaluation case-studies, and Adaptive Management Support tools and resources.
- Following the completion of relevant Ecosystem Condition Assessments, facilitation of Forums with internal stakeholders to review, assess and prioritise for action the recommendations of the assessments

3.4 Systems and tools that enable and support adaptive management are widely adopted, including online databases, apps and dashboards that facilitate data visualisation and use

Actions:
- Develop a front-facing tool for managers to view baselines and triggers (PCS).
- Refine the environmental offsets Restoration and Project Information Dashboard (RAPID) to guide adaptive management from captured restoration and planning activities (PCS).
- Enhance capability of Canberra Nature Map to enable site specific monitoring of biodiversity values over time
- Options for enhancing integration between CEMP and the PCS spatialising operations dashboard are explored (PCS/CR)
- Integrate spatial prioritisation into herbage mass management decisions (CR/PCS)
- Publish Herbage Mass Decision Support Tools (CR/PCS)
- Evaluating effectiveness of adaptive kangaroo management in the ACT (CR/RL)

4. THOUGHT LEADERSHIP

Goals

4.1 Processes and events held across ACT Government and beyond stimulate scientifically informed debate, creative exploration and the generation of management responses to high-impact emerging issues, including climate change adaptation.

Actions:
- The Climate Adaptation for Nature initiative is established in collaboration with CSIRO, with at least three case studies underway or finished, each exploring and promoting adaptation responses in particular areas/issues, including identifying barriers and pathways to change (CR/PCS-led, involving various other areas)
- Research and monitoring projects address impacts of climate change on specific ecosystems or species (CR/PCS)
- Carrying out/contribute to a fire science review embedding climate adaptation as a core consideration, in a collaboration with CR, the PCS fire team, Office of the Commissioner for Sustainability and the Environment, and the Emergencies Services Agency to lay a robust and

6

agreed scientific foundation for the Strategic Bushfire Management Plan (SBMPv5) and the 2024-2029 Regional Fire Management Plan.

- Continue the EHW webinar series, focusing on significant issues of broad relevance and significance (CR).
- Collaborative events held with research partners on issues of joint significance, to promote insight, collective learning, exploration of solutions and pathways forward, and articulate research agenda (CR).

5. DATA CUSTODIANSHIP AND CURATION

Goals

5.1 Data governance processes and culture that foster the importance of data curation, accessibility and transparency established in the Division

Actions:

- Improve data consistency, accessibility, usability, open access, and data management protocols.
- Develop and implement sound data governance for science and ecological data types, including custodianship and curator guidance.
- Develop data Standard Operating Procedures (or similar), metadata and accessibility guidelines to guide data management and data sharing.
- Explore establishment of appropriate governance arrangement in EHW focused on data, with representation from senior leadership and data managers to lead improvements in key areas – Governance, Culture and Data Technology.
- Collaborate with state, territory and commonwealth partners on data sharing and sensitive species lists.

5.2 Innovation and best practice technology for capture, processing and storage of data, collaboration, and interactive visualisation and investigation of results are widely adopted

Actions:
- Develop applications standardising data collection for key condition metrics of riparian, woodlands and grassland ecosystems (CR/PCS)
- Developing a LMA app to capture rapid condition assessments of rural areas (CR)
- Developing a CNP app to capture rapid condition assessments of reserves (CR)
- Invest in data infrastructure, analysis platforms/software, AI/deep-learning and large data storage.
- Migrate workflows and datasets into the new centrally managed EPSDD Geospatial Ecosystem (GE) in accordance with developed EPSDD/TCCS GE Governance Framework[1].
- Use LiDAR and other remote sensing technologies and data to inform structural and vegetation metrics across the landscape
- Upskill staff in data management, dashboards, field applications and web apps.
- Explore options for AI/machine learning processing of image and songmeter data (CR/PCS)
- Update ACT wetland mapping (CR)

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[1] The Geospatial Ecosystem is the new secure spatial data management platform for managing all spatial data centrally, under strict governance protocols for EPSDD and TCCS

- Identification and mapping of swampy meadow wetland ecosystems (CR)

5.3   Workflows that address full adaptive management cycles and strategic objectives beyond data capture and storage are adopted; such as streamlined analysis and data-driven visualisation portals to inform decision-making, policy, and review of management actions

Actions:

- Incorporation of qualitative data (e.g. multi-media, social and cultural values) into analysis and evaluation to inform decision making (PCS)
- Encourage all projects to consider data management and storage that supports near-real time interactive dashboards to be used for decision making (CR)
- Roll out interactive CEMP Online Hub pages for all ecosystems (CR)

5.4   Data generated by the Division is accessible and catalogued, for government, research institutions and the public, in line with the ACT's Open Data Policy

Actions:
- Ensure environment and ecological data is properly catalogued, including public access catalogues where appropriate, meeting metadata and accessibility standards within WoG data catalogues (PowerBi and Geospatial Ecosystem) and Environment specific data catalogues.
- Ongoing use of the Science Directory, including establishing a public access portal to project titles, summaries and themes.
- Data created and shared under appropriate sharing agreements with research organisations and other partners, and/or made available in open data catalogues as appropriate (CR)
- Publish outcomes from ACT Habitat and Connectivity Project as habitat connectivity spatial layers and biodiversity sensitive urban design (technical) guidelines and policy (CR)
- Establish ecological connectivity development impact calculator tool (CR)
- Collaborate with commonwealth on Biodiversity Data Repository project (CPP/CR/PCS)

5.5   The use of knowledge-bases to capture and reuse research findings is actively explored.

5.6   Management knowledge is imported into models that are used to support decision-making by EPSDD/others.

Not being currently pursued.

PART TWO: Research and Monitoring Themes

1. Climate change

Strategic Objective: Updated climate change projections are available for the ACT, through the NSW and ACT Regional Climate Modelling (NARCliM) Project partnership, with clearly understood implications; frameworks available to assess and manage risks; and government, industry and the community are supported in assessing policy and management options to mitigate and adapt.

Knowledge needs and gaps:

- Revised climate projections for the Territory
- Understanding of impacts on natural and built environments at a management scale

- Climate adaptation pathways for urban and rural societal sectors
- Identification and prediction of changes in:
  - ecosystem function, resilience, and ecosystem service provision
  - fire regimes
  - distribution and threat status of species and communities
  - the invasiveness of plant and animals
  - ecosystem processor species (e.g. pollinators, soil disturbers and decomposers)
  - soils, including soil carbon
  - the resilience of species and communities to climate change
- Identification of climate refugia and climate connectivity
- Re-conceptualised conservation goals and prioritised conservation actions in a rapidly changing climate

Project list:

- Climate Adaptation for Nature initiative – exploring adaptation responses and identifying barriers and pathways to change (CR/PCS/CSIRO)
- Climate change adaptation for two threatened cockatoo species - pilot project with University of Queensland (CR) – development of management implications summary.

Key gaps – to be pursued as resources allow:

- Modeling of species movements and assessment of species vulnerability under climate change (CR/PCS)
- Updated climate refugia modelling (CR)
- Modeling of fire patterns and frequency under climate change scenarios (CR/PCS)
- Water vulnerability assessment project (Office of Water)

2. Ecosystem processes and resilience

Strategic objective: Improved understanding of ecosystem processes that drive ecological change and identification of opportunities to build and maintain resilience.

Knowledge needs and gaps:

- Characterisation of appropriate fire and water flow regimes to meet terrestrial and aquatic management goals
- Effective approaches for restoring connectivity in rural and urban environments for improving resilience
- Effective approaches for catchment and local-scale restoration for improvement in water quality and quantity and aquatic ecosystem condition
- Understanding of soil processes and the impacts of their disruption.

Project list:

- Effectiveness of leaky weirs to promote post-fire recovery in upland bogs (CR)
- Effectiveness of shade cloth at increasing survival and growth of Sphagnum moss in bogs post-fire (CR)
- Herbage mass assessments- to inform and evaluate effective land management as it relates to grasslands and grassy woodlands ground layer vegetation (PCS/CR)

9

- Herbage Mass Decision Support Tool for assisting land managers to make consistent, scientifically based, on-ground decisions for managing herbage mass (PCS/CR)
- Biodiversity responses to reinstating rock back into ACT grasslands - invertebrate, floristic and reptile response to habitat rock supplementation (PCS Offsets)
- Rehabilitation of Pink-tailed Worm-lizard habitat in the Molongolo Valley (PCS Offsets)
- Urban habitat and connectivity: Using expert elicitation to inform ecological requirements in the ACT – address gaps in the description of habitat structure and function requirements(CR and partners)
- Waterwatch Catchment Health Indicators Program – develop numerical scores of catchment health using data collected by Waterwatch volunteers (HW)
- Cotter River environmental flows monitoring – monitorIcon Waters delivery of environmental flow in the Cotter River on Threatened Two-spine Blackfish (CR)
- Lakes and Rivers Water Quality Program – monitor water quality in rivers and urban lakes of the ACT to track waterway condition and inform management decision(HW)
- Protecting and connecting endangered woodlands in the ACT – improve the status of Box Gum Woodland areas through targeted management activities (NRM)
- Asset Evaluation and Land-Use Monitoring Program – address critical knowledge gaps on pollutant load generation by land use types across the ACT and performance of Water Sensitive Urban Design infrastructure (ACT Healthy Waterways)
- Conservation Effectiveness Monitoring Program – evaluate the current condition of ecosystems to inform adaptive management and track trends in ecosystem conditions over time (CR)
- Understanding how development affects groundwater and surface water and the flow on effects to conservation values in the Nadjung Mada Nature Reserve (PCS)

Key gaps - to be prioritised as resources enable:

- Landscape scale connectivity in the ACT including all grassland, woodland and aquatic-riparian habitat connections within the ACT and between the ACT and NSW.
- Understanding impact/effectiveness of corridors
- Characteristics of appropriate fire regimes to promote biodiversity
- Understanding development impacts on water table and groundwater flows

3. Species and community ecology

Strategic objective: Innovative research to improve the understanding of the genetics and ecology of high-priority species and ecological communities, as a basis for informing and evaluating management and policy.

Knowledge needs and gaps:

- Distribution, abundance and conservation status of ecological communities and species (including invertebrates)
- Fundamental ecological dynamics and processes of high-priority species and communities to inform adaptive management
- Understanding of how current management practices affect priority species and communities
- Identification of interventions that promote ecosystem resilience and generate broad biodiversity benefits

10

- Identification and exploration of captive breeding, genetic management, and reintroduction techniques to safeguard genetic diversity, promote threatened species conservation, and restore lost species from the landscape
- Identification of effective land, aquatic, and ecological community restoration techniques.

Projects:

- ACT Superb Parrot Monitoring Program – assess the number of Superb Parrot pairs and monitor competitive interactions between these birds and other hollow nesting species within the Gunghalin and Molonglo Strategic Assessment Areas (PCS)
- Platypus ecology PhD project (NRM/CR/UCan)
- Provision of advice as required to Mulligans Flat/Goorooyaroo – management, woodland restoration and reintroductions (ANU-led/CR)
- Mulligans Flat Woodland Sanctuary Monitoring Framework and Implementation Plan to support adaptive management (CR)
- Monitoring golden sun moth male and female spatial and temporal relationships in the ACT to identify fine-scale and landscape-scale factors affecting local habitat suitability (PCS)
- Herbage mass, floristic composition and weed density monitoring across Offset and CNP reserves to inform on ground management and planning (PCS/CR)
- Developing an eDNA library for orchid and lilies to guide future herbivore diet studies (CR/ANU)
- Refining vegetation mapping across key reserves to better understand condition, management requirements and restoration opportunities (CR??)
- Monitoring the understorey plant community at Mulligans Flat and Goorooyarroo nature reserves across 96 ANU experimental plots established in 2008 (CR/ANU)
- Offsets woodland bird monitoring (10 min fixed point) – monitor bird species richness, number of individuals, exotic species and overabundant native birds in offset areas to inform management and planning (PCS)
- Golden Sun Moth habitat and population monitoring across key grassland and woodland reserves – to inform management and planning (PCS/CR)
- Offsets Grassland Earless Dragon habitat monitoring (1x1m vegetation structure) (PCS) – monitoring of habitat extent and quality in urban grassland reserves and offset areas to inform management and planning
- Offsets Grassland Earless Dragon population monitoring (20x20m plot active searches) – surveys for presence of Grassland Earless Dragons in urban grassland reserves and offset areas (PCS)
- Grassland Earless Dragon population monitoring (artificial tubes) (PCS/CR)
- Offsets natural burrow addition monitoring (habitat creation) (PCS/CR)
- Offsets natural burrow monitoring (permanent transects) (PCS)
- Striped Legless Lizard habitat and population monitoring across key grassland reserves (PCS/CR)
- Molonglo vegetation condition monitoring program – monitor the ecological condition for the Molonglo River Reserve and associated offset sites (PCS Projects)
- Monitor movement of Little Eagles in the ACT to inform strategic planning and land management (Little Eagle Research Group (CR))
- Monitoring Montane crayfish after fire in bog and creek habitats - Investigating genetic diversity to determine connectivity between locations. (CR)
- Impact of prescribed burns on glider populations in Namadgi National Park (CR/ANU)

- Impacts of and post-fire recovery of fire-sensitive vegetation communities in Namadgi after the 2020 Orroral Valley Bushfire (CR)
- Understanding the role of Dingo management in enabling critical weight range species persistence and reintroduction to Namadgi National Park (CR)
- Murrumbidgee Fisheries Monitoring Program (CR)
- A soft-release trial for translocation of the Smoky Mouse to Tidbinbilla Nature Reserve (CR)
- Trialling new approaches to mitigating threats and re-establishing self-sustaining populations of Northern Corroboree Frogs (CR/Tid/ANU)
- Undertake surveys to obtain baseline data on small native mammal, arboreal mammal and bat population distributions across CNP. Conduct research to better understand habitat needs for the persistence of small native mammal populations and explore options for restoration of small mammal populations in CNP where they no longer persist (CR/PCS)
- Genetic rescue of Macquarie Perch in the Cotter River through translocation of fish from NSW (CR)
- Incorporating genetics in threatened fish management (CR)
- PTWL translocation trial (Molonglo)
- Genetic health analysis of Two-Spined Blackfish population in the Cotter River and ACT region - post fire habitat survey and monitoring (CR)
- Canberra Spider Orchid Conservation Project – research into germination, pollination and habitat ecology to (CR)
- The ACT Native Species Conservation Plan for the Gula (Koala): Baseline monitoring for Koalas in the ACT (CR)
- Assessment of potential sites for the reintroduction of the endangered Brush-tailed Rock Wallaby into Namadgi National Park and Tidbinbilla Nature Reserve (CR)
- Woodland thinning trial monitoring to identify effects of thinning on habitat structure and growth (CR)
- Threatened flora species monitoring – field checks and seed collection (CR)
- Targeted orchid baseline monitoring in Goorooyarroo nature reserve (CR)
- Development of distribution models for over 100 local plant species to guide restoration and management actions (CR/PCS)
- Translocation trails of Small Purple Pea plants grown at the Australian National Botanical Gardens into select reserves (CR/PCS)
- Monitoring of the Purple Copper Butterfly (Paralucia spiniferia) in Namadgi National Park
- Monitoring and habitat use of the Scarlet Robin (Petroica boodang) in the ACT (CR)
- PTWL monitoring in offsets using low impact survey techniques (PCS)
- GED reintroduction and research (PCS/UC)
- Gang gang bushfire recovery project (PCS/Policy/NRM)
- SLL, GSM and GED species distribution modelling (PCS)
- GSM Light Rail habitat and soil microbiome restoration project (TCCS/PCS)
- Evaluating the role of infrastructure development on ecological connectivity for species and ecosystems (CR/UC)
- Understanding macrophytes of the ACT (CR)

Key gaps – to be pursued as resources allow:

- Additional monitoring of aquatic and terrestrial invertebrates
- Developing a project to guide the mapping of future plant distributions (local and non-local) under different climate change scenarios.

- Higher emphasis on woodland and forest vegetation monitoring
- Understanding of key soil microbiomes and their ecological functions including interactions between microbiota and soil chemistry.
- Ngunnawal culturally significant species (e.g. wedge tailed eagle, bogong moth)
- Monitoring of threatened invertebrate populations

4. Threats

Strategic objective: Improved understanding of key current and future threats (beyond climate change) to the ACT's environment, agriculture and liveability, in order to inform effective management responses.

Knowledge needs and gaps:

- Increased understanding of bushfire impacts and the effectiveness of interventions for post-fire recovery
- Increased understanding of impacts of climate change-related changes in bushfire on ecological values, including identification of key fire refugia under likely climate scenarios
- Improved capability to predict and respond to plant invasion pathways
- Effective invasive plant management practices to improve environmental, economic and social values
- Innovative and cost-effective native and introduced herbivore management techniques to protect environmental, economic and social values
  Improved understanding of the ecosystem impacts of invasive predators and other animals, to inform appropriate management actions
- Improved awareness of development-related threatening processes (e.g. environmental contamination, habitat loss and fragmentation)
- Improved understanding of the impacts of specific human behaviours on ecological systems
- Assessment of economic impost of 'on farm' environmental threat management and implications for broader biodiversity values.

Project list:

- Looking at the influence of Blakely's Red Gum Provenance on dieback resistance (NRM/CSIRO/CR/ANU)
- Trialling the use of carbon supplementation (sugar and mulch) to reduce soil nutrients and improve health of Blakely's Red Gum trees (CR)
- Snowgum Dieback project (ANU-led/CR)
- Setting management targets for weed management (RL/CR/UC)
- Effects of wildfire and planned burning on subalpine woodland structure, habitat, and fauna diversity in Namadgi National Park (CR)
- Using LiDAR to investigate the relationship between elevated fuel density and time since fire and fire severity in Namadgi (P&P)
- Ecological effects of planned burning on dry forest communities in Canberra Nature Park (CR)
- Effectiveness of shade cloth at increasing survival and growth of Sphagnum moss in bogs post-fire (CR)

13

- Effectiveness of leaky weirs at increasing survival and growth of Sphagnum moss in bogs post-fire (CR)
- Factors influencing kangaroo-vehicle collisions in the ACT (CR/USYD)
- Effectiveness of hand and dart delivered GonaCon immunocontraceptive vaccine in three species of macropods (CR/CSIRO)Annual Canberra Nature Park kangaroo and wallaby population surveys (CR)
- Assessing the impacts of Sambar Deer in upland woodlands (CR/PCS)
- Using eDNA to understand diet composition in fallow deer in ACT (CR)
- Determining population connectivity and dynamics in fallow deer, using genetic techniques (CR)
- Engineered Log Jam construction and effect on aquatic habitat quality for threatened and other fish (CR)
- Off-target impacts of anticoagulant poisons on native wildlife (CR)
- Post-fire deployment of nest boxes and bat boxes and utilisation by target species (NRM/CR/ANU)
- Trialling remote delivery of Bravecto for the treatment of mange in wombats (CR)
- Dieback Assessment and Remediation Project (CR)
- Trialling supplementary habitat to promote postfire recovery of reptiles and small mammals in Namadgi National Park
- Fuel dynamics projects (FFR)
- Herbivory impacts on shrubs at Mulligans Flat (CR)
- Noisy miner colonisation study (PCS)
- Evaluation of GonaCon as a management tool for kangaroos in ACT nature reserves (CR/CSIRO/RL/PCS)
- Transfer reach survey of Blackfish in the Cotter River, to understand impact of water supply transfer flows from Corin Dam (CR)

5. Urban sustainability and wellbeing

Strategic objective: Knowledge established to maintain or enhance biodiversity values across the urban setting and the interface with reserves, and clarify the contributions of nature/biodiversity to the wellbeing of Canberra's citizens.

Knowledge needs and gaps:

- Identification of biodiversity hotspots in urban environments
- Establishment of an integrated, comprehensive and scientifically informed vision for Canberra's development that maintains or enhances conservation outcomes
- Understanding of design and planning features for homes, gardens, parks, waterways and suburbs that increase wildlife benefit through the provision of habitat or connectivity
- Improved understanding of the extent and impacts of urban intensification, urban sprawl and urban infrastructure on biodiversity and human-wildlife conflicts, and the efficacy of approaches in reducing impacts
- Enhanced understanding of the relationship between nature conservation and community wellbeing, and how conservation contributes to achievement of the ACT's wellbeing targets
- Cost/benefit analyses of achieving biodiversity sensitive urban design

14

- Understanding patterns, trends, motivations for and experiences of park visitation; and identifying acceptable levels of ecosystem change due to visitor impact.
- Understanding the barriers to and benefits of changing specific human behaviours from the perspective of relevant social groups
- Understanding the efficacy and cost-effectiveness of specific behaviour-change interventions
- ACT Urban Habitat and Connectivity Project (CR andpartners)
- Monitoring of native fish stockings in the urban lakes fishery (CR)
- Monitoring of carp removal ponds in Tuggeranong (CR)
- Land management of urban space considered for its habitat connectivity value (TCCS/SLA/PCS)
- Kama long-term (20 years) monitoring program, measuring change as the urban edge gets closer (Molonglo)

Key gaps:

- Social science related to community well-being, perspectives and behaviours related to urban nature.

6. Rural lands

Strategic objective: Improved understanding of approaches to support ACT Rural Landholders to be productive and environmentally sustainable.

Knowledge gaps and needs:

- Improved knowledge on systems of sustainable agriculture, grazing and livestock management; niche/alternative industries and certification; and integrated pest management
- Approaches for maintenance and enhancement of on-farm biodiversity, soil health, water quality/ supply
- Social and economic research on factors affecting landholders' engagement in sustainable production activities
- Knowledge to support on-farm climate mitigation and adaptation.

Project list

- Establishing drought refuges on ACT farms through improved riparian management and farm dam restoration (NRM)

Key gaps – to be pursued as resources allow

- Effect of stock exclusion or grazing regime on the retention/loss of mature native paddock trees and on tree health
- Extent of landholder understanding of agricultural value impacts of loss of mature/paddock native trees and the steps required to maintain or improve existing tree cover
- Interaction of vertebrate pests between reserves and neighbours
- Exploration of efficacy and impact of stewardship payments for rural landholders on biodiversity and native vegetation management.
- Guidance on management of chain of ponds and the advantage or impacts this has on the health of streams.

7. Fire Management

Strategic objectives: Knowledge and evidence base generated to guide fire management practices that balance the need to protect human life and property with other land management objectives, particularly conservation of environmental and heritage values, in a changing climate.

Knowledge needs and gaps:

- Improved capability to predict fire behaviour to reduce risks to human life, property and ecological values
- Improved understanding of post-fire water quality risks
- Improved understanding of the effects of fire suppressant chemicals on biodiversity and how best to apply them during fire management actions to minimise risks
- Increased understanding of ecological impacts of prescribed burning regimes to inform fire management programs
- Spatial modelling capability for exploring strategic fuel management options that optimise bushfire risk and environmental outcomes
- Greater understanding of long-term fuel dynamics of ACT ecosystems in response to prescribed burning
- Greater understanding of aspirations of Ngunnawal peoples regarding burning as a management tool, including incorporation of cultural knowledge and techniques

Project list:

- Impact of fire regimes in subalpine woodlands on bushfire recovery (CR)
- Post-fire monitoring of birds in Namadgi wet sclerophyll forests (CR)
- Trialling the role of burning in grassland management and conservation (CR/PCS)
- Ecological impacts of, and recovery after, prescribed burn "escapes": Potters Hill and Cotter River (depending on initial review of sites)(CR)
- Research into artificial bird habitat (CR)

Key gaps - to be prioritised as resources enable:

- Impacts of road asset management (network, crossings) on biodiversity and erosion.
- Engagement with Ngunnawal people in order that fire management in the ACT can benefit from their knowledge.
- Efficacy and approaches to deploying prescribed burning to protect ecological assets.
- Impact of firefighting chemicals on terrestrial and aquatic biodiversity

8. Water

Strategic objectives: Knowledge and evidence developed to support the maintenance of water quality and quantity into a warmer and drier future.

Knowledge needs and gaps:

- Projected scenarios for water flows and impacts on water bodies in the ACT
- Water quality dynamics within the ACT waterways, including nutrient movements in urban ponds, wetlands and lakes

- Possible management interventions in these waterways (e.g. transformation of current water bodies to wetlands; restrictions on chemical fertilisers; mandatory pre-treatment zones for stormwater runoff as part of development applications) and their efficacy at achieving objectives
- Improved understanding of the impacts of specific human behaviours on water quality and the efficacy and cost effectiveness of possible behaviour-change interventions
- Understanding of the effectiveness of the ACT's environmental flow guidelines and potential improvements, including with respect to needs of aquatic species and communities
- Understanding interactions between terrestrial land management practices (e.g. total grazing pressure), soil processes, and water management
- Assessment of the requirements for environmental flows from upstream of the ACT e.g. Tantangara releases to the Upper Murrumbidgee River, including proposed changes under the Snowy licence and Snowy Hydro 2.0 → Emerging technologies to reduce pollutant load
- Regional approaches to catchment management/ research.

Project list:

- ACT water vulnerability assessment (Office of Water)
- ACT Hydrometric Network - track and report condition of water resources across the ACT, operations of water management infrastructure, flood warning and research (Healthy Waterways)
- AUSRIVAS monitoring – using macroinvertebrates as indicators of health across rural and urban catchments (Healthy Waterways)
- Lakes and Rivers Water Quality Program - monitor water quality in rivers and urban lakes of the ACT to track waterway condition and inform management decision (Healthy Waterways)
- Mass balance of street tree leaves to inform water quality improvement activities (Healthy Waterways)
- The Waterwatch Catchment Health Indicator Program (CHIP) report provides an annual assessment of the health of the waterways of the upper Murrumbidgee catchment. 100 reach report cards are produced using approximately 2000 water quality surveys, 200 aquatic macroinvertebrate surveys and 230 riparian assessments.(NRM)
- Lake Tuggeranong research project – to determine the cause of blue-green algae blooms in Lake Tuggeranong and identification of potential sources of pollution (Healthy Waterways)
- Post fire sediment impacts (NRM/PCS/CR)
- Flow delivery to barriers in upper Murrumbidgee (Water Office)
- H2OK stormwater education and behaviour change program to reduce eutrophication and blue-green algae outbreaks in urban waterways (NRM)
- Leaf Collective behaviour change program (part of H2OK) (NRM) to reduce eutrophication and blue-green algae outbreaks by reducing leaf litter entering stormwater drains.
- ACT Fertiliser Use and Behaviour Research - to inform choice of target audience for a fertiliser run-off reduction program (NRM)
- Understanding how development affects groundwater and surface water and the flow on effects to conservation values in the Nadjung Mada Nature Reserve investigation (PCS)

Key gaps – to be pursued as resources allow:

17

- Increased understanding of impacts of proximate development/construction on water quality and biodiversity
- Further monitoring of wetlands
- Knowledge of levels and impacts of silver and other elements in waterways

9. Soils

Strategic objectives: Knowledge and evidence developed to maintain and improve soil quality into a warmer and drier future through management interventions.

Knowledge needs and gaps:

- Projections on soil quality, soil moisture, hydrology, erosion and nutrient cycling under a warming and drying climate, and implications for agricultural productivity and ecosystem functioning
- Better understanding of how soil condition on rural lands, and its response to drought, compares to soils on conservation estate
- Knowledge on soil biodiversity across the landscape
- Understanding of the areas and soil types that can benefit the most from conservation and management interventions
- Improved understanding of most effective management interventions to preserve and improve soil quality and productivity, including under hotter and drier conditions
- Improved understanding of management practices to prevent or restore areas of significant soil erosion, nutrification, or contamination.

Ongoing projects:

- ACT NRM's Better Land Management Project (2018-2023) – improving soil acidity and pasture health on farms (NRM/NSW DPI)
- Mapping soil chemistry within Canberra Nature Park and Offsets (CR/PCS)
- Investigating the role of soil chemistry in Eucalyptus dieback and implications for dieback management in the ACT (PCS)
- Understanding impacts of microbe addition from Natural Temperate Grassland on survival of Golden Sun Moth food plants (Light rail project) (PCS with Major Projects)
- Trialling seed pelletisation as a method of direct seeding for grassland restoration (PCS)

Key gaps:

- Understanding of importance of, and impacts of interventions on, soil microbiomes
- Carbon flux in soil systems under different management regimes.

10. Plantations, carbon and biodiversity management

Strategic objective: Knowledge base established for effective carbon capture in the landscape, particularly through plantations, and managing plantations to enhance biodiversity values.

Knowledge needs and gaps:

- Exploration of impact of management approaches, such as native vegetation corridors, on biodiversity in and around pine plantations
- Understanding of effective approaches for carbon capture in ACT context
- Identification of future planting requirements and determination of offset capacity
- Investigation of means to align reforestation for carbon offsets and biodiversity conservation objectives
- Development of new forms of carbon sequestration for submission to the Clean Energy Regulator for consideration for funding

Ongoing projects:

- Ecological restoration through carbon accreditation (PCS)
- Carbon trial on an ACT farm – baseline analysis of carbon stores (NRM/ NSW DPI)
- Improving forest soil health through addition of Carbon/Biochar – Kowen Forest (PCS, Forestry, ANU, CSIRO and Icon Water)

Priority gaps – to be pursued as resources allow

- Monitoring the long-term effectiveness of establishment of wide habitat corridors through pine plantations (e.g. Ingledene Forest)

11. Ecosystem services and environmental accounting

Strategic objectives: The economic contribution of ecosystem services to the ACT is better understood, including to guide investment in the protection and management of ecosystem services, and the utility and appropriate use of environmental accounting in the ACT context is assessed.

Knowledge needs and gaps:

- *Water*
    - o Understanding of what savings are made by ensuring water quality at source is high compared to the cost of treating water after extraction
- *Forests and woodlands* (including urban forests)
    - o Assessment of the contribution of forests and woodlands to the liveability of Canberra (e.g. air quality, moderation of temperature)
    - o Establishment of method to provide a monetary value (and cost benefit analysis) to benefits provided by trees across their lifetime
    - o Understanding of whether retention of mature trees and urban open space improves the value of adjacent blocks
    - o Understanding of how the economic and social benefits of ACT pine plantations balance with their impact on ecosystem services (e.g. water yield and quality)
- *Health, wellbeing and amenity* »
    - o Knowledge on the benefits provided by reserves to the community (health, wellbeing and/or amenity), and why
- *Environmental accounting*
    - o Appropriate valuation methods for biodiversity and conservation in the ACT, and understanding on how they can inform EPSDD decision making » Assessment of how much members of the ACT community are willing to pay for conservation.

Project list:

19

- Ecological restoration through carbon accreditation (PCS)
- Exploring carbon accounting (PCS)

Key gaps – to be pursued as resources allow

- Exploration of potential of market based instruments on farms.