

## Northern Australia Environmental Resources Hub 2021 Final Hub Report – Attachment A

Project number /ID	Project name/title	Project summary	Project leader	Lead organisation	Approved Funding Research Plan Versions 1-6					Start date	Completion date	Status	Outputs
					NESP funding* \$	Other cash contributions* \$	Other in-kind contributions* \$	Total other contributions* \$	Total budget* \$				
1.1	Identifying critical knowledge gaps in the understanding of environmental resources in northern Australia to better prioritise government investment	This project will identify knowledge gaps that are critical to addressing the Hub's research priorities and which align with the research needs of other research users across northern Australia. Using a highly collaborative process involving researchers and research users from the Department of the Environment, Department of Prime Minister and Cabinet and key stakeholders from northern Australia, research needs will be identified based on desktop reviews and through a series of regional meetings and workshops. This will lead to the development of joint research projects that address key Departmental, regional and local priorities. The collaborative approach adopted in this process is designed to foster a higher level of research adoption into policy and on ground action.	Professor Michael Douglas	University of Western Australia	450,000.00	-	488,589.00	488,589.00	938,589.00	1/7/15	30/9/21	Completed	Database of northern Australian environmental resources
1.2	Review of integrated models, frameworks and decision support tools to guide management and planning in northern Australia	There is an identified research need to develop and trial spatially explicit tools that can be used to guide planning and management decisions that support a mix of multiple uses and protected areas while maintaining environmental values (hereafter 'modelling tools'). An important first step is to ensure that tools which are selected for development/trial suit end-user needs and can be feasibly developed with available resources. This project collated examples of modelling tools that have been used in northern Australia and elsewhere. It used insights from the literature, and from interviews with key stakeholders across Australia's north to create a document that summarises key characteristics of (broad categories of) different tools. Characteristics that were considered in the evaluation include: purpose/intended application of the tool and 'realms' considered (e.g. freshwater realms only, or including marine, social and economic realms), data requirements, types of output generated, research-user engagement, IT requirements and legacy, ease of use, transferability and adaptability. The project critically evaluated the characteristics of the different modelling tools to identify key strengths (so they can be enhanced) and weaknesses (so they can be improved). It also provided advice on how to choose which modelling tool is best suited to which purpose. In so doing, this project created a critical resource for those trying to identify and assess the suitability of particular tools in different contexts and/or trying to assess the feasibility of using, developing, and maintaining different types of tools to support decision makers into the future.	Professor Natalie Stoeckl	James Cook University	90,000.00	22,500.00	90,327.00	112,827.00	202,827.00	1/7/15	30/6/17	Completed	Integrated models, frameworks and decision support tools to guide management and planning in Northern Australia (stand-alone summary)
													Integrated models, frameworks and decision support tools to guide management and planning in Northern Australia (final report)
													Tools and models to support sustainable development decisions in northern Australia (wrap-up factsheet)
1.3.1	Critical water needs to sustain freshwater ecosystems and aquatic biodiversity in the Mitchell River	This project aims to improve our understanding of the critical flow needs to sustain freshwater ecosystems in the Mitchell River catchment and the implications of future land and water resource development. In particular, the project aims to predict the consequences of future development on important ecosystem linkages between the river and its flood-plain wetlands associated with flood flows, and to better understand other potential risks associated with likely changes to in-stream flow regimes.	Professor Stuart Bunn	Griffith University	905,600.00	183,800.00	2,061,762.00	2,245,562.00	3,151,162.00	1/6/16	30/9/21	Completed	Environmental water needs for the Mitchell River (start-up factsheet)
													Critical water needs to sustain freshwater ecosystems and aquatic biodiversity in the Mitchell River (presentation PDF)
													Spatial and temporal variation of fish community biomass and energy flow throughout a tropical river network (scientific paper)
													Working with government staff to help maximise research impact (impact story)
													Community-level migration patterns of fish throughout the Mitchell River, Queensland, Australia (presentation PDF)
													Environmental water needs for the Mitchell River (project update Oct 2018)
													Environmental water requirements for the Mitchell River (video)
Community-level migration patterns of fish throughout the Mitchell River, Queensland, Aus (video)													

													<p>Environmental water needs for the Mitchell River (project update Nov 2019)</p> <p>Upstream flows drive the productivity of floodplain ecosystems in tropical Queensland (scientific paper)</p> <p>Relationships between algal primary productivity and environmental variables in tropical floodplain wetlands (scientific paper)</p> <p>Assessing spatial variation in algal productivity in a tropical river floodplain using satellite remote sensing (scientific paper)</p> <p>Connectivity of fish communities in a tropical floodplain river system and predicted impacts of potential new dams (scientific paper)</p> <p>Environmental water needs for the Mitchell River (wrap-up summary)</p> <p>Impact of water resources development on connectivity and primary productivity across a tropical river floodplain (scientific paper)</p> <p>Trophic transfer of lipids and fatty acids across habitats in tropical river food webs (scientific paper)</p> <p>Critical water needs to sustain freshwater ecosystems and aquatic biodiversity in the Mitchell River (final report)</p>
1.3.2	<p>Environmental water requirements for the Daly River, Northern Territory</p>	<p>The Daly River is a distinctive perennial system, supporting diverse turtle and fish assemblages, important recreational fisheries and is of great cultural significance to its Indigenous people. Increasing agricultural development in the Basin has been concomitant with increasing demand for its water resources. To enable sound decision making on sustainable development, this project will collate existing, and develop new critical flow-ecology relationships and water requirements for key environmental assets of the Daly River.</p>	<p>Associate Professor Alison King</p>	<p>Charles Darwin University</p>	680,900.00	167,700.00	2,377,078.00	2,544,778.00	<b>3,225,678.00</b>	1/7/16	30/9/21	Completed	<p>Environmental water needs for the Daly River (start-up factsheet)</p> <p>Establishing environmental water requirements for the Daly River, NT (presentation PDF)</p> <p>Wiltma Nargun Lahan: Walking on Wagiman Land (impact story)</p> <p>Dry season habitat use of fishes in an Australian tropical river (scientific paper)</p> <p>Unravelling the taxonomy and identification of a problematic group of benthic fishes from tropical rivers (<i>Gobiidae: Glossogobius</i>) (scientific paper)</p> <p>Faster juvenile growth promotes earlier sex change in a protandrous hermaphrodite (barramundi <i>Lates calcarifer</i>) (paper)</p> <p>Use of radiotelemetry to quantify diel habitat preferences and minimum environmental flow requirements of a tropical riverine fish (Sooty grunter <i>Hephaestus fuliginosus</i>) (scientific paper)</p> <p>Preliminary evidence of spawning phenologies of freshwater fish in a wet-dry tropical river: the importance wet &amp; dry seasons (scientific paper)</p> <p>Flow-mediated predator-prey dynamics influence fish populations in a tropical river (scientific paper)</p> <p>Migration to freshwater increases growth rates in a facultatively catadromous tropical fish (scientific paper)</p> <p>Hydrology drives variation in spawning phenologies and diversity of larval assemblages of Australian wet-dry tropical fish (scientific paper)</p> <p>Environmental water needs for the Daly River (wrap-up summary)</p> <p>Environmental water needs of the Daly River (final report including conceptual models)</p> <p>Daly River fish monitoring data (dataset)</p>

1.3.3	Environmental water requirements for the Fitzroy River, Western Australia	This project will determine the water requirements of key environmental assets of the Fitzroy River. This information will support water resource assessments and water planning processes including a future Water Allocation Plan for the Fitzroy River.	Professor Michael Douglas	University of Western Australia	1,080,200.00	153,000.00	1,327,608.00	1,480,608.00	2,560,808.00	1/6/16	30/9/21	Completed	Environmental water requirements for the Fitzroy River (updated start-up factsheet)
													Environmental water requirements for the Fitzroy River (project update Feb 2019)
													Finding out about fish in the Fitzroy (science story)
													A transdisciplinary approach to WA's Fitzroy River water planning (impact story)
													Conceptualizing Hydro-socio-ecological Relationships to Enable More Integrated and Inclusive Water Allocation Planning (scientific paper)
													Hydro-socio-ecological (HSE) conceptual model enables inclusive and integrated water allocation planning for WA's Fitzroy River (poster)
													When and where are catfish fat fish? Hydro-ecological determinants of energy reserves in the fork-tailed catfish, <i>Neoarius graeffei</i> , in an intermittent tropical river (scientific paper)
													The use of regional and alluvial groundwater by riparian trees in the wet-dry tropics of northern Australia (scientific paper)
													Water velocity and groundwater upwelling influence benthic algal biomass in a sandy tropical river: implications for water-resource development (scientific paper)
													Characterising vegetation zones along lower Fitzroy River, WA (report)
													Characterising vegetation zones along lower Fitzroy River, WA (project update)
													Environmental water requirements for the Fitzroy River (wrap-up summary)
													Predicting the occurrence of riparian woody species to inform environmental water policies in an Australian tropical river (scientific paper)
													Environmental water requirements for the Fitzroy River (final report including conceptual models)
New insights into the food web of an Australian tropical river to inform water resource management (scientific paper)													
1.4	Contribution of rivers to the productivity of floodplains and coastal areas of the southern Gulf of Carpentaria	<p>This project will:</p> <ol style="list-style-type: none"> <li>examine the relative contribution of major southern Gulf of Carpentaria rivers to floodplain and coastal productivity, and key species that depends on the flow, and</li> <li>predict the consequences of changes in flow regimes on flood-driven subsidies in specific rivers, and better understand other potential risks associated with these changes.</li> </ol> <p>This will provide key information needed for prioritising rivers for development as part of future water planning.</p>	Professor Michele Burford	Griffith University	851,600.00	184,000.00	2,050,693.00	2,234,693.00	3,086,293.00	1/7/16	30/9/21	Completed	Gulf rivers and productivity (project update May 2017)
													Effect of flow alteration on estuaries in the Gulf of Carpentaria (presentation PDF)
													Gulf of Carpentaria river research (video)
													Links between Gulf rivers and coastal productivity (project update)
													Links between Gulf rivers, coastal productivity & migratory shorebirds (project update Sep 2019)
													Links between Gulf rivers and coastal productivity (start-up factsheet)
													Predicting hot spots of aquatic plant biomass in a large floodplain river catchment in the Australian wet-dry tropics (scientific paper)
													Floodplain productivity of the Gilbert and Flinders Rivers catchments (Final report component 3)
													Links between Gulf rivers and fisheries (Science week video 2020)
													What a catch! Understanding links between Gulf river flows and fisheries (impact story)
How important are freshwater flows for Gulf estuaries? A study of the effect on food supply for migratory shorebirds (presentation)													

													<p>River flows affect the growth of a tropical finfish in the wet-dry rivers of northern Australia, with implications for water resource development (scientific paper)</p> <p>Engagement is a two-way street: Creating symbols for science communication (impact story)</p> <p>Contribution of three rivers to floodplain and coastal productivity in the Gulf of Carpentaria (final report)</p> <p>Freshwater flows in the Gulf are essential for fisheries and estuarine ecosystems (wrap-up summary)</p> <p>Estimating the economic impact of potential extractions from Gulf rivers on the banana prawn fishery (final report)</p> <p>Finfish catch and growth in the Gulf of Carpentaria (Component 2 report)</p> <p>Responses of a macrobenthic community to seasonal freshwater flow in a wet-dry tropical estuary (scientific paper)</p> <p>Benthic-pelagic mixing of trace elements in estuarine food webs (scientific paper)</p> <p>Impact of water development on river flows and the catch of a commercial marine fishery (scientific paper)</p>
1.5	<p>Indigenous water requirements: methods for the determination of Indigenous water requirements and incorporation into water planning in the Fitzroy catchment, Kimberley</p>	<p>This research proposal will investigate the significance of water and waterbodies to Indigenous people of the Fitzroy River catchment where water use for agriculture is likely to increase. It will work closely with Indigenous communities to identify customary uses of water and waterways, reveal links between Indigenous values, practices and water regimes, and elicit knowledge as well as objectives for the future management of land and water resources. It will develop methods for the determination of Indigenous water requirements in ways that integrate with regional water and catchment management plans. Results will contribute to environmental management, improve water planning processes and enhance Indigenous capacity to influence allocation decisions, water policy and regional development solutions.</p>	<p>Associate Professor Sue Jackson</p>	Griffith University	498,400.00	125,200.00	488,886.00	614,086.00	<b>1,112,486.00</b>	1/6/16	30/9/21	Completed	<p>Building trust and establishing legitimacy across scientific, water management and Indigenous cultures (scientific paper)</p> <p>Water and Indigenous rights: Mechanisms and pathways of recognition, representation, and redistribution (scientific paper)</p> <p>Indigenous water needs for the Fitzroy River (updated start-up factsheet)</p> <p>Building trust and establishing legitimacy across scientific, water management and Indigenous cultures (science summary)</p> <p>Water and Indigenous rights: Mechanisms and pathways of recognition, representation, and redistribution (science summary)</p> <p>Indigenous water needs of the Fitzroy River (project update)</p> <p>Conceptualizing Hydro-socio-ecological Relationships to Enable More Integrated and Inclusive Water Allocation Planning (scientific paper)</p> <p>Hydro-socio-ecological (HSE) conceptual model enables inclusive &amp; integrated water allocation planning for the Fitzroy River (poster)</p> <p>A transdisciplinary approach to WA's Fitzroy River water planning (impact story)</p> <p>Nyikina seasonal calendar (poster)</p> <p>Nyikina seasonal connections poster</p> <p>Veins of the Country (video)</p> <p>Sustainability crises are crises of relationship: lessons from a Nyikina ecological ethics (science summary Oct 2020)</p> <p>Sustainability crises are crises of relationship: lessons from a Nyikina ecological ethics (scientific paper)</p> <p>Indigenous water needs of the Fitzroy River (final report)</p> <p>Living waters of the Martuwarra/Fitzroy River (StoryMap)</p> <p>Indigenous water needs of the Fitzroy River (wrap-up summary)</p> <p>Living Waters or Resource? Ontological differences and the governance of waters and rivers (scientific paper)</p> <p>Communicating an Indigenous understanding of WA's Fitzroy River through art and film (impact story)</p>

1.6	Multi-objective planning in northern Australia: co-benefits and trade-offs between environmental, economic, and cultural outcomes	This project will demonstrate how to operationalise participatory, multi-objective catchment planning, by which stakeholders can collaboratively construct and assess the outcomes of alternative development and management scenarios (including identifying co-benefits and trade-offs between objectives). The project will produce a toolkit that can be used by stakeholders to guide multi-objective planning, including selecting, parameterising, and integrating spatially explicit tools and models. The project will develop the toolkit using the Fitzroy River catchment as a case study, but with the intention that it can be transferable to other areas in northern Australia and beyond.	Professor Bob Pressey	James Cook University	1,092,100.00	237,300.00	1,938,405.00	2,175,705.00	3,267,805.00	1/7/16	30/9/21	Completed	Scenario planning (info sheet)
													Multi-objective planning in northern Australia: co-benefits and trade-offs between environmental, economic, and cultural outcomes (start-up factsheet)
													Exploring possible development futures for the Fitzroy catchment through participatory scenario planning (presentation PDF)
													Looking back to look forward: A timeline of Western Australia's Fitzroy River catchment (StoryMap)
													Looking back to look forward: A timeline of Western Australia's Fitzroy River catchment (report)
													Learning together with the Martuwarra (Fitzroy River) (scientific paper)
													Traditional Owners' response to stories about the future of the Fitzroy River Basin (poster)
													Scenario planning for the Fitzroy River catchment (wrap-up factsheet)
													Multi-objective planning in northern Australia: co-benefits and trade-offs between environmental, economic, and cultural outcomes (start-up factsheet)
													Participatory multi-stakeholder assessment of alternative development scenarios in contested landscapes (scientific paper)
													Assessing how changes in cultural services associated with future scenarios affect the wellbeing of different cultural groups (presentation)
													Assessment of the potential changes in wellbeing of key interest groups in the Fitzroy River catchment under alternative development scenarios: Scenario team's workshop 3 (report)
													Assessment of the potential changes in wellbeing of key interest groups in the Fitzroy River catchment under alternative development scenarios: Traditional Owners' workshop (report)
													Multi-objective planning in northern Australia: co-benefits and trade-offs between environmental, economic, and cultural outcomes (final report)
													Future scenarios for the Fitzroy River catchment: summary of key findings relevant to the Western Australian Government (discussion paper response)
ValueMapper: an interactive web-based tool to map and visualise spatial data (software manual)													
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Fitzroy scenarios project (Video in Kriol)													
Fitzroy scenarios project (Video in English)													
2.1	Addressing management of waste and marine debris in remote Northern Australian communities including Cape York	The communities of remote Northern Australia face significant challenges in waste management. Conventional challenges include limited connectivity to regional centres, low public or private investment in waste management, high transport costs, intermittent seasonal access, a wet-dry climate that makes infrastructure maintenance particularly challenging and scaling-up waste and debris management to cover vast areas of un-serviced land and coastlines. It has been well documented that many coastal communities, particularly those in the Gulf of Carpentaria also have the additional burden of a large volume of rubbish from external sources such as shipping and foreign fishing washing up on remote beaches. This project took stock of existing work and where it has	Ms Gigari George	North Australian Indigenous Land and Sea Management Alliance Limited (NAILSMA)	100,000.00	10,000.00	55,288.00	65,288.00	165,288.00	1/7/15	31/12/16	Completed	Remote recycling, rubbish and marine debris management in north Australia needs strong helping hands (final report)
													Addressing management of waste and marine debris in remote Northern Australian communities including Cape York (wrap-up factsheet)

		been applied in the North, assessed the effectiveness of waste management in a remote community where substantial work is being undertaken and reviewed the 'gaps' and next steps to value add to the local model. It also addressed the dual issues of transferability of waste management modelling and scaling-up by sharing the experiences and lessons learned in that site with a community in another part of the North in a participatory process to adapt the model to the second location. This 12 month phase included a desktop study and a case study examining two communities with contrasting experience in active waste management that will value add to current success in one place, create a plan for another and identify issues and potential solutions in scaling up the activities over the sparsely populated and poorly serviced northern coastal area.											Managing marine debris & waste in remote Cape York communities (Science week video 2020)
													Remote recycling & marine debris management needs strong helping hands (impact story)
2.2	Mapping to underpin management of littoral rainforests	This project produced fine-resolution mapping of the location of the critically endangered Littoral Rainforest & Coastal Vine Thickets of Eastern Australia community between Townsville and Cooktown (Wet Tropics bioregion) and the current and projected future threats to its persistence and condition from the impacts of sea-level rise, storm surge and extreme weather events. The project then used an adaptation pathway framework to assess and prioritise management options that explicitly consider the dynamic nature of the community and future change regimes. The research addressed key gaps in our understanding of where, when and what management action is required to ensure the continued provision of ecosystem services and functions from Littoral rainforest and provided a robust scientific underpinning to support EPBC recovery planning regionally and nationally.	Dr Helen Murphy	CSIRO	100,000.00	-	128,602.00	128,602.00	228,602.00	1/7/15	30/6/16	Completed	Mapping to manage littoral rainforest (presentation PDF)
													Mapping to manage littoral rainforest (wrap-up factsheet)
													Mapping to manage littoral rainforest (final report)
													Mapping to manage littoral rainforest (appendices for final report)
													Managing North Queensland's endangered tropical littoral rainforest (impact story)
													Mapping of current and projected storm surge and inundation associated with extreme events, and projected sea-level rise across the study area (dataset)
2.3	Weed invasion, fire and ecosystem failure: catchment scale scenario modelling to improve planning and management	This project will: 1. collate existing information on impacts of land transformation and model the likely scenarios of changes in ecosystem function over the next 30 years in the Darwin and Daly regions. We will use this information to model future fire behaviour and impacts on ecosystem function and predict potential ecosystem failure to support improved planning and management practices; 2. develop and test remote sensing methods to detect areas of high biomass grass invasions across the northern Australian savannas. The methods will be developed and tested in consultation with the Department of the Environment and Energy with the aim of developing a mapping approach at a scale, reliability and cost suitable for monitoring in the Department's ERF draft savanna fire management determinations.	Dr Natalie Rossiter-Rachor Professor Samantha Setterfield	Charles Darwin University University of Western Australia	789,214.00	174,959.00	1,553,023.00	1,727,982.00	2,517,196.00	1/6/16	30/9/21	Completed	Exotic grass invasion alters microsite conditions limiting woody recruitment potential in an Australian savanna (scientific paper)
													Navigating the fiery debate: the role of scientific evidence in eliciting policy and management responses for contentious plants in northern Australia (scientific paper)
													Evaluation of satellite remote sensing pathways for mapping and monitoring of gamba grass for the Savanna Fire Management Methodology (report)
													Leveraging High-Resolution Satellite Imagery and Gradient Boosting for Invasive Weed Mapping (scientific paper)
													Scientists using technology to fight weeds (radio interview)
													Shaun Levick ABC Darwin interview (radio interview)
													Machine learning helps to map gamba grass from space (poster)
													Fire and Weeds in the Top End (start-up fact sheet (updated))
													Fire and weeds in the Top End (impact video)
													Remote sensing of gamba grass in northern Australia: An assessment of methods and guidelines for use (report)
													Fire and Weeds in the Top End (wrap-up summary)
													New ways to manage gamba grass and fire (impact story)

2.4	Support for an Emissions Reduction Fund carbon sequestration methodology: dead organic matter dynamics in semi-arid savannas	This project will provide data to support parameterisation of a carbon sequestration methodology for regions prioritised by NESP. This work will be conducted in consultation with staff of the Land Sector Abatement Branch of the Department of the Environment. The Savanna Burning Emissions Abatement methodology under the carbon farming initiative has been adopted across 140 000 km2 of northern Australia. Taking account of the carbon sequestered in dead organic matter under the same activity could significantly increase the accountable greenhouse gas benefit of these activities. Currently there is insufficient data to develop a robust, defensible methodology in the semi-arid savannas.	Dr Garry Cook	CSIRO	187,000.00	35,153.00	151,767.00	186,920.00	373,920.00	1/7/16	30/6/19	Completed	Savanna carbon sequestration method (start-up factsheet)
													Supporting savanna fire management through carbon farming (wrap-up factsheet)
													Supporting savanna fire management through carbon farming (final report)
													Rapid response of habitat structure and above-ground carbon storage to altered fire regimes in tropical savanna (scientific paper)
													Supporting savanna fire management via carbon farming (video)
													Standing dead trees contribute significantly to carbon budgets in Australian savannas (scientific paper)
													Supporting savanna fire management via carbon farming (impact story)
													Supporting savanna fire management via carbon farming (presentation PDF)
2.5	Defining metrics of success for feral animal management in northern Australia	This project will determine the impact of feral pigs, horses and cattle across aquatic systems in the context of regional and local feral animal control, local aspirations and government priorities. The project will also evaluate metrics used to assess how well control measures work in mitigating threats to aquatic ecosystems. These outcomes will be communicated using a reporting system, here for the Archer River Basin, which compares investment in control with consequent impacts on environmental values	Dr Justin Perry	CSIRO	844,200.00	146,330.00	986,370.00	1,132,700.00	1,976,900.00	1/6/16	30/9/21	Completed	Defining metrics of success for feral animal management in northern Australia (start-up factsheet)
													Defining metrics of success for feral animal management in northern Australia (presentation PDF)
													Thermal and asphyxia exposure risk to freshwater fish in feral-pig-damaged tropical wetlands (scientific paper)
													Defining metrics of success for feral animal management in northern Australia (project update Oct 2018)
													CSIRO engagement with APN (video)
													Science and community collaboration achieving results in feral animal management (impact story)
													Managing feral pigs on Cape York (impact story)
													No sitting on the fence: protecting wetlands from feral pig damage by exclusion fences requires effective fence maintenance (scientific paper)
													Reconnecting with Country through collaborative research (impact story)
													Protecting marine turtles from feral pigs on Cape York (science week video)
													A.I Technology boosting fledgling turtle survival on Cape York (video)
													Epigeic invertebrates of pig-damaged, exposed wetland sediments are rooted: An ecological response to feral pigs ( <i>Sus scrofa</i> ) (scientific paper)
													Healthy Country AI: an adaptable framework using AI to monitor ecosystem healthy (GitHub database)
													Queensland Waterhole Classification scheme (Department of Environment and Science (Queensland))
Simple conservation fence modification increases freshwater turtle land movement on floodplains (scientific paper)													
Healthy Country AI: an adaptable framework using AI to monitor ecosystem health (GitHub database)													
Kakadu & Cape York NESP teams iAwards (video)													

													<p>Teaming up for turtles (video)</p> <p>Using AI to protect baby turtles from feral pigs (impact story)</p> <p>Defining metrics of success for feral pig management (Power BI dashboard)</p> <p>Will fencing floodplain and riverine wetlands from feral pig damage conserve fish community values? (scientific paper)</p> <p>Defining metrics of success for feral animal management in northern Australia (wrap-up summary)</p> <p>Defining metrics of success for feral animal management in northern Australia (final report)</p> <p>Managing effects of feral pigs on wetlands (impact video)</p> <p>Managing feral pig threats on a tropical floodplain for fisheries values (Scientific paper)</p> <p>An evaluation of nest predator impacts and the efficacy of plastic meshing on marine turtle nests on the western Cape York Peninsula, Australia (scientific paper)</p>
2.6	<p>Guidelines for the management of threats to savanna riparian zones</p>	<p>This project uses four complementary case studies to develop practical guidelines for the management of savanna riparian zones. Riverbank (or riparian) zones are vital elements of the savanna landscape. Their contribution to biodiversity, cultural values and the economy is disproportionate to the small area they occupy. However, they are highly vulnerable to the effects of disturbances such as weed invasion, fire and the change in land use such as irrigated agriculture. As these threats increase, there is a growing need for guidelines for the management of savanna riparian zones.</p>	<p>Associate Professor Samantha Setterfield</p>	<p>University of Western Australia</p>	1,046,200.00	329,450.00	1,033,806.00	1,363,256.00	<b>2,409,456.00</b>	1/6/16	30/9/21	Completed	<p>Managing savanna riparian zones (start-up fact sheet)</p> <p>Direct and indirect interactions with vegetation shape crocodylian ecology at multiple scales (scientific paper)</p> <p>Distribution maps of freshwater crocodiles and their nest at Danggu (Geikie Gorge) National Park (report)</p> <p>Managing stinking passionflower in Geikie Gorge (radio interview)</p> <p>Absence of evidence is not evidence of absence: Knowledge shortfalls threaten the effective conservation of freshwater crocodiles (scientific paper)</p> <p>Guiding stinking passionflower management at Danggu (Geikie Gorge) National Park for conservation of freshwater crocodiles (final component report)</p> <p>An eco-hydrological model for assessing riparian habitat: Application to <i>Passiflora foetida</i>-crocodile nest interactions at Danggu (Geikie Gorge) National Park (report)</p> <p>Distribution maps of stinking passionflower (<i>Passiflora foetida</i>) at Danggu (Geikie Gorge) National Park (report)</p> <p>Managing savanna riparian zones (wrap-up summary)</p> <p>Assessment of tools for monitoring savanna riparian vegetation (report)</p> <p>The ecological importance of crocodylians: towards evidence-based justification for their conservation (scientific paper)</p>
2.7	<p>Ecohydrology and sensitivity of riparian vegetation</p>	<p>Current understanding of ecohydrological properties of Top End vegetation suggests spring-feed monsoon vine forests and riparian vegetation have a high groundwater dependence. Contamination of surface groundwater post-rehabilitation of the Ranger site could therefore have significant impact on riparian vegetation and thus impact stream health. Environmental isotopes and tritium analysis will be used to quantify groundwater dependence of riparian vegetation in the Magela Creek catchment, Kakadu NP / Ranger Project Area. This knowledge will be coupled with sensitivity testing of common riparian woody species to MgSO<sub>4</sub> to provide a risk assessment of impact from surface and/or groundwater egress of mine-related contaminants.</p>	<p>Professor Lindsay Hutley</p>	<p>Charles Darwin University</p>	360,000.00	90,000.00	300,475.00	390,475.00	<b>750,475.00</b>	1/3/18	30/9/21	Completed	<p>Tree water use and sensitivity to contaminated mine water (start-up factsheet)</p> <p>Filling knowledge gaps for the rehabilitation of Ranger uranium mine (impact story)</p> <p>Tree water use and sensitivity to contaminated mine water (project overview presentation PDF)</p> <p>Effect of elevated magnesium sulfate on two riparian tree species potentially impacted by mine site contamination (scientific paper)</p> <p>Tree water use and sensitivity to contaminated mine water (project update Apr 2020)</p> <p>Ecohydrology and sensitivity of riparian flora, Magela Creek, Ranger uranium mine (wrap-up summary)</p>



													Deuterium depletion in xylem water and soil isotopic effects complicate the assessment of riparian tree water sources in the season tropics (scientific paper)
													Ecohydrology and sensitivity of riparian flora, Magela Creek, Ranger uranium mine (final report)
													Effect of elevated magnesium sulfate on two riparian tree species potentially impacted by mine site contamination (dataset)
2.8	Rehabilitation of faunal assemblages at Ranger uranium mine	<p>This project aims to:</p> <ol style="list-style-type: none"> <li>1. develop faunal closure criteria for successful ecosystem rehabilitation of Ranger uranium mine, and</li> <li>2. assess faunal colonisation of trial revegetation sites at Ranger.</li> </ol> <p>The faunal assessments will inform the development of completion criteria, which will be directly used by the Federal government to assess ultimate restoration success at Ranger. The faunal assessments will also provide valuable information on the performance of different revegetation practices, and thus help inform future rehabilitation management at Ranger. These outcomes will have broad relevance to minesite rehabilitation across northern Australia.</p>	Professor Alan Andersen	Charles Darwin University	80,000.00	20,000.00	180,325.00	200,325.00	<b>280,325.00</b>	1/3/18	31/12/18	Completed	Rehabilitated mine sites and Top End animals (start-up factsheet) Filling knowledge gaps for the rehabilitation of Ranger uranium mine (impact story) Recommended faunal standards for the rehabilitation of Ranger Uranium Mine (final report) Invertebrate assemblages at Ranger Uranium Mine's trial revegetation sites compared with natural reference sites (report) Rehabilitation of vertebrate assemblages at Ranger Uranium Mine: Assessment standards and monitoring methodology (report) Recommended standards for fauna recovery at rehabilitated mine sites (wrap-up factsheet) Rehabilitated mine sites and Top End animals (impact video) The importance of sampling intensity when assessing ecosystem restoration: ants as bioindicators in northern Australia (scientific paper)
2.9	Effects of surface and ground water egress of mining-related solutes on aquatic ecological connectivity in Magela Creek	<p>Egress of both saline surface water runoff and groundwater into Magela Creek, mainly from waste rock associated with the rehabilitated Ranger uranium mine final landform, has been identified by the Supervising Scientist Branch (SSB) as a potentially important threat to the ecological values of the region. This project will combine fish tracking and imaging technologies to enumerate and characterise fish migration and residence in Magela Creek both upstream and downstream of the mine. Where possible, the results will be linked to surface and groundwater solute modelling and additional risk assessments to assess the likely effects of surface and ground water egress on fish migration and to develop future monitoring strategies.</p>	Associate Professor David Crook	Charles Darwin University	359,500.00	90,000.00	477,300.00	567,300.00	<b>926,800.00</b>	1/3/18	30/9/21	Completed	Fish migration in Magela Creek (presentation PDF) Filling knowledge gaps for the rehabilitation of Ranger uranium mine (impact story) Fish movement and sensitivity to contaminated mine water (start-up factsheet) Fish movement and sensitivity to contaminated mine water (project update Aug 2019) Fish movement and sensitivity to contaminated mine water (impact video) Fish migration in Magela Creek and potential impacts of mining-related solutes (Final report) Fish migration in Magela Creek and potential impacts of mining-related solutes (wrap-up summary) Fish movement and sensitivity (update video Aug 2019)
2.10	Management options for high biomass grassy weed management in Cape York conservation areas	<p>High biomass grassy (HBG) weeds pose an increasing threat to savanna ecosystems across northern Australia. These weed invasions can result in the alteration of habitat, a loss of biodiversity, and transformation of a range of ecosystem processes. However, management options are currently limited for the management of these HBG weed species. This project will collate existing weed management approaches and knowledge on HBG weed management. We will use this information to identify successful weed management strategies, and research gaps. These results will inform a range of trials on additional options for on-ground management of HBG weeds on Cape York, including additional residual herbicides and biomass reduction treatments. This information will support improved management strategies and decision support tools for the strategic management of HBG weeds in conservation areas.</p>	Dr Helen Murphy	CSIRO	268,000.00	42,000.00	226,000.00	268,000.00	<b>536,000.00</b>	1/3/18	30/9/21	Completed	Improving gamba grass control on Cape York (start-up factsheet) Gamba grass on Cape York Peninsula (wrap-up summary) Management options for gamba grass ( <i>Andropogon gayanus</i> ) in conservation areas of Cape York (final report) Management options for high biomass grassy weeds in Cape York (presentation PDF)

3.1	A method for identifying high-priority areas in northern Australia for threat abatement and species recovery investments	To help address the decline in northern Australia's biodiversity, this project, in collaboration with research-users, brought together key stakeholders with interest and expertise in threatened ecosystems and species in northern Australia to develop a detailed design for a multi-year, cutting-edge research project. The larger project will produce comprehensive data, models, and guidelines for threat abatement and restoration of the North's biodiversity. This short-term project involved two workshops: an inception workshop with end-users and other stakeholders; and a technical design workshop to identify detailed methods for compilation of data, modelling, and prioritisation.	Professor Bob Pressey	James Cook University	50,000.00	-	185,321.00	185,321.00	235,321.00	1/7/15	30/6/16	Completed	Identifying high-priority areas in northern Australia for threat abatement and species recovery (wrap-up factsheet)
3.2	Investigating the role of feral cats in small mammal declines in Kakadu National Park	This project aimed to improve understanding of the role of predators, specifically feral cats, in small mammal declines across northern Australia. Building on a project commenced under NERP in 2013, the responses of small mammal populations to predator (cat and dingo/dog) exclusion were experimentally evaluated at sets of paired fenced and unfenced sites in Kakadu National Park. The densities of cats and dingoes were estimated in the surrounding landscape using camera traps, and their prey evaluated through scat analysis. The findings informed management responses to address mammal declines in Kakadu National Park specifically and northern Australia more generally.	Dr Graeme Gillespie	NT Dept of Environment, Parks & Water Security	130,000.00	-	318,715.	318,715.00	448,715.00	1/7/15	30/6/16	Completed	Feral cats and small mammal decline in Kakadu National Park (wrap-up factsheet)
													Experimental evaluation of the role of feral cat predation in the decline of small mammals in Kakadu National Park (final report)
													What do predator diets tell us about mammal declines in Kakadu National Park? (scientific paper)
													Multiple cameras required to reliably detect feral cats in northern Australian tropical savanna: an evaluation of sampling design when using camera traps (scientific paper)
3.3	Prioritising threatened species and threatening processes across northern Australia	To help address the decline in northern Australia's biodiversity, this project will produce a best-practice approach to guiding management actions across northern Australia that abate threats to, and promote recovery of, threatened species. It will involve working closely with key stakeholders to bring together diverse sources of data and expertise, and to synthesise and develop best available mapping of threatened species and threatening processes, and provide practical approaches to interpreting project outputs for prioritisation, policy, and day-to-day decision-making.	Dr Anna Pintor	James Cook University	467,800.00	129,226.00	1,214,830.00	1,344,056.00	1,811,856.00	1/7/16	31/12/19	Completed	Prioritising threatened species in northern Australia (start-up factsheet)
													Prioritising threatened species in northern Australia (project update Oct 2018)
													Prioritising threatened species in northern Australia (presentation PDF)
													Modelling and mapping for conservation outcomes across the north (impact story)
													Prioritising threatened species and threatening processes across Northern Australia (user guide for data)
													Big trouble for little fish: identifying Australian freshwater fishes in imminent risk of extinction (scientific paper)
													Prioritising threatened species in northern Australia (wrap-up factsheet)
													Vulnerability maps identifying the response of threatened species in Northern Australia to specific threatening processes. James Cook University (dataset)
3.5	Securing the future for the bilby in the Fitzroy catchment/west Kimberley	The greater bilby (Macrotis lagotis) is an iconic threatened Australian mammal of high cultural importance to Traditional Owners. The greater bilby is suffering an ongoing decline in range and abundance attributed to several threats which may act in concert to reduce the viability of populations. This project aims to attain an accurate appreciation of the distribution, habitat preferences and patterns of site fidelity/occupancy for the Fitzroy Catchment's bilby population, while identifying and initiating the implementation of on-ground actions that abate the impacts from key threats.	Dr Lesley Gibson	WA Dept of Biodiversity, Conservation & Attractions	720,000.00	85,000.00	540,000.00	625,000.00	1,345,000.00	1/1/18	30/9/21	Ongoing	Monitoring, mapping & safeguarding Kimberley bilbies (start-up factsheet)
													Monitoring, mapping & safeguarding Kimberley bilbies (wrap-up summary)
													Monitoring, mapping & safeguarding Kimberley bilbies (wrap-up factsheet)
3.6	The vulnerability of food supplies for migratory shorebirds to altered flow in the	River catchments of the Gulf of Carpentaria support threatened species which are likely to be adversely impacted by intensive water resource development and climate change. This project aims to quantify the importance of a range of river flows to threatened migratory shorebirds by	Professor Michele Burford	Griffith University	210,000.00	50,000.00	566,105.00	616,105.00	826,105.00	1/3/18	30/9/21	Completed	Links between Gulf rivers and food for migratory shorebirds (start-up factsheet)
													Understanding risks to shorebirds & fisheries from reduced Gulf river flows (video)

	southern Gulf of Carpentaria	quantifying and comparing food availability across three rivers potentially subject to flow alteration, and assessing how flow affects food sources. The project will also identify areas of high productivity within the river estuaries and adjacent mudflats. This will provide key information needed for future water planning, assessment of impacts of proposals that may lead to altered flow, as well as shorebird habitat protection and management.											Shoring up food supplies for migratory birds (impact story)
													Links between Gulf rivers, coastal productivity & migratory shorebirds (impact video)
													How important are freshwater flows for Gulf estuaries? A study of the effect on food supply for migratory shorebirds (presentation)
													Links between gulf rivers and food for migratory shorebirds (science week video)
													Understanding risks to shorebirds & fisheries from reduced Gulf river flows (presentation PDF)
													How important are freshwater flows for Gulf estuaries? A study of the effect on food supply for migratory shorebirds (presentation)
													Comparing the importance of freshwater flows driving primary production in three tropical estuaries (scientific paper)
													Implications of water resource development on migratory shorebird habitat in the Gulf of Carpentaria region (policy brief)
													The vulnerability of food supplies for migratory shorebirds (wrap-up summary)
													The vulnerability of food supplies for migratory shorebirds (final report)
													Responses of a macrobenthic community to seasonal freshwater flow in a wet-dry tropical estuary (scientific paper)
													Links between Gulf rivers, coastal productivity & migratory shorebirds (project update 2019)
3.7	Terrestrial fauna monitoring in Kakadu National Park	Monitoring biodiversity is essential to report ecological condition, responses to management and environmental change, and to enable timely implementation of informed policy and management. Building upon previous monitoring, we will trial the implementation of a revised ecological monitoring framework in Kakadu National Park, and evaluate its effectiveness for detecting and reporting trends in a suite of terrestrial vertebrates, including some threatened species, habitat condition and key threatening processes. Findings will enable further optimisation of the monitoring framework to maximise cost-effectiveness, and alignment with the Park's priorities. The outcomes will also inform improved ecological monitoring methodology across northern Australia, including IPAs and other protected areas.	Dr Graeme Gillespie	NT Dept of Environment, Parks & Water Security	150,000.00	-	690,000.00	690,000.00	840,000.00	1/1/19	30/9/21	Completed	Monitoring terrestrial animals in Kakadu (start-up factsheet)
													Monitoring terrestrial animals in Kakadu (research booklet)
													Monitoring terrestrial animals in Kakadu (wrap-up factsheet)
													Monitoring terrestrial animals in Kakadu (final report)
Joint project with TSR Hub	Kakadu National Park's threatened species	Small mammal species in northern Australia have undergone catastrophic declines, including in key reserves such as Kakadu National Park. The project aims to guide management priorities to recover threatened mammals in monsoonal northern Australia, especially in relation to fire and feral cats. The team is compiling and analysing a large dataset (from Kakadu and comparable other sites in the Top End) on the occurrence of cats, native mammals and fire to evaluate landscape-scale relationships. It is also contributing to the analysis and documentation of responses of native reptiles and mammals to cat-exclusion at established fenced sites in Kakadu National Park.	Dr Graeme Gillespie	NT Dept of Environment, Parks & Water Security									Small mammal declines in the Top End: Feral cats, dingoes, feral herbivores and habitat complexity (science summary)
													The mystery of the Top End's vanishing wildlife, and the unexpected culprits (article)
													Cats, fire, buffaloes, dingoes and mammals in Northern Australia (video)
													Bottom-up and top-down processes influence contemporary patterns of mammal species richness in Australia's monsoonal tropics (scientific paper)
													Habitat structural complexity explains patterns of feral cat and dingo occurrence in monsoonal Australia (scientific paper)

4.1	Remote environmental monitoring in northern Australia: scoping key research needs	Environmental monitoring in northern Australia is challenged by significant logistical, financial and skills-based constraints. These issues can lead to constrained monitoring programs with poor power to track environmental change or to provide data in a useful format for end-users. Several new technologies including detection sensors, eDNA and airborne remote sensing, have recently emerged that may prove useful in overcoming some of these constraints.	Associate Professor Alison King	Charles Darwin University	100,000.00	12,000.00	159,796.00	171,796.00	271,796.00	1/7/15	30/6/16	Completed	Remote environmental monitoring in northern Australia: Scoping key research needs (start-up factsheet)
		RPAS for environmental monitoring in northern Australia (presentation PDF)											
		Camera traps for terrestrial biodiversity monitoring in northern Australia (presentation PDF)											
		Remote environmental monitoring in northern Australia: Scoping key research needs (wrap-up factsheet)											
		Remote environmental monitoring in northern Australia: Scoping key research needs (final report)											
4.2	Status of the methods and techniques used to estimate temporal changes in soil carbon	This research project reviewed the current state of knowledge on measurement and modelling methods and techniques for estimation of soil carbon and soil carbon stock change in northern Australia. We held meetings between key researchers and policy makers with interests in estimating soil carbon and soil carbon stock change. The result is an assessment of the applicability and cost of current and proposed methods and techniques in the context of soil carbon levels and the response of soil carbon to changes in management practices as they occur across north Australia. Recommendations are provided on future research directions to improve cost-effective methods for northern Australia to assist in informing the National Greenhouse Gas Inventory with regard to carbon stock changes and thereby enabling a potentially greater range of model based and potentially fully modelled carbon sequestration methodologies under the Emissions Reduction Fund.	Associate Professor Samantha Setterfield	Charles Darwin University	100,000.00	-	170,798.00	170,798.00	270,798.00	1/7/15	31/12/16	Completed	Paper in preparation
4.3	Northern Australia eDNA program – revolutionising aquatic monitoring and field surveys in tropical waters	All organisms constantly shed DNA into their environment. This DNA is termed environmental DNA (eDNA). Capture and analysis of eDNA (in soil or water samples) is proven as a highly efficient and sensitive method to detect the presence of a wide range of species without actually requiring physical capture, or sighting of the organisms themselves. eDNA field sampling can involve as little as collecting water samples and subsequent laboratory analyses. Consequently, the method offers the potential for research and monitoring programs to be conducted rapidly, at lower cost, across a large array of locations, and to involve the participation of non-specialists. This project will develop eDNA technology, and trial field programs, for an array of species of conservation and management significance.	Professor Damien Burrows	James Cook University	570,000.00	130,625.00	635,563.00	766,188.00	1,336,188.00	1/1/17	30/9/21	Completed	Developing eDNA methods for tropical waters (start-up factsheet)
													Development of eDNA assays for monitoring three endangered frog species ( <i>Litoria dayi</i> , <i>L. lorica</i> and <i>L. nannotis</i> ) in Australia's wet tropics (report)
													Development of revised tilapia eDNA assay (report)
													Development of Cabomba caroliniana eDNA assay (report)
													Development of cane toad eDNA assay (report)
													Can environmental DNA be used to detect first arrivals of the cane toad, <i>Rhinella marina</i> , into novel locations? (scientific paper)
													Monitoring for invasive <i>Cabomba caroliniana</i> eDNA in two Darwin River billabongs following eradication attempts (report)
													Environmental DNA survey of Eureka Creek, Upper Mitchell and Walsh River for two invasive tilapia species (report)
													A giant leap forward in detecting unwanted visitors (impact story)
													Got glycogen?: Development and multispecies validation of the novel preserve, precipitate, lyse, precipitate, purify (PPLPP) workflow for environmental DNA extraction from Longmire's preserved water samples (scientific paper)
													Improved detection sensitivity using an optimal eDNA preservation and extraction workflow and its application to threatened sawfishes (scientific paper)
Developing eDNA methods for tropical waters (project update Feb 2020)													

													<p>Enhancing tropical conservation and ecology research with aquatic environmental DNA methods: an introduction for non-environmental DNA specialists (scientific paper)</p> <p>Quantifying shedding and degradation rates of environmental DNA (eDNA) from Pacific crown-of-thorns seastar (<i>Acanthaster cf. solaris</i>) (scientific paper)</p> <p>Considerations for future environmental DNA accreditation and proficiency testing schemes (scientific paper)</p> <p>eDNA detection of snakehead in the Barron River (report)</p> <p>Long distance (&gt;20 km) downstream detection of endangered stream frogs suggests an important role for eDNA in surveying for remnant amphibian populations (scientific paper)</p> <p>Wrap-up summary and recommendations</p> <p>Adolphus Island cane toad eDNA detection (technical note)</p> <p>Practical eDNA sampling methods inferred from particle size distribution and comparison of capture techniques for a Critically Endangered elasmobranch (scientific paper)</p> <p>Standard operating procedures for environmental DNA field sample collection (report)</p>
4.4	Assessing the Gulf of Carpentaria mangrove dieback	<p>In early 2016, extensive dieback of mangrove forests was recorded along the southern and western Gulf of Carpentaria coastline. Landsat analysis suggests that 7,400 hectares of mangrove forest suffered dieback over a relatively short and synchronous period around November 2015, along a &gt;1,000km wide front from Karumba in the east to Limmen River in the west. Recent field visits to a limited range of affected sites suggest that a relatively low percentage of trees have recovered, and most are dying/dead. This is the largest event of natural dieback of mangroves ever recorded in the world. This project will provide a survey, description and analysis of the extent of the dieback across its range, as well as examining patterns of dieback. The assessment will include training and participation of local Indigenous ranger groups in mangrove assessment and monitoring methods, as well as providing recommendations for recovery, potential intervention, future monitoring and further studies. A synthesis workshop will also be held to present the findings of the assessment to a wide audience.</p>	Dr Norm Duke	James Cook University	200,000.00	46,500.00	186,513.00	233,013.00	<b>433,013.00</b>	30/9/17	31/12/19	Completed	<p>Large-scale dieback of mangroves in Australia's Gulf of Carpentaria: a severe ecosystem response, coincidental with an unusually extreme weather event (scientific paper)</p> <p>Assessing mangrove dieback in the Gulf of Carpentaria (start-up factsheet)</p> <p>Rainfall and its possible hysteresis effect on the proportional cover of tropical tidal-wetland mangroves and saltmarsh-saltpans (scientific paper)</p> <p>Mangrove harbingers of coastal degradation seen in their responses to global climate change coupled with ever-increasing human pressures (scientific paper)</p> <p>Assessing mangrove dieback in the Gulf (presentation PDF)</p> <p>Assessing mangrove dieback in the Gulf of Carpentaria (wrap-up factsheet)</p> <p>Assessing the Gulf of Carpentaria mangrove dieback 2017-2019 (summary report)</p> <p>Assessing the Gulf of Carpentaria mangrove dieback 2017-2019. Volume 1: Aerial surveys (final report)</p> <p>Assessing the Gulf of Carpentaria mangrove dieback 2017-2019. Volume 2: field studies (final report)</p> <p>Assessing mangrove dieback in the Gulf (project update Jun 2019)</p>

												<p>Indigenous Ranger field guide to the Shoreline Video Assessment Method</p> <p>Combating ecosystem collapse from the tropics to the Antarctic (scientific paper)</p> <p>Assessing mangrove dieback in the Gulf of Carpentaria (Science week video 2020)</p> <p>Assessing mangrove dieback (project update video June 2019)</p> <p>Abandoned, lost and discarded fishing gear 'ghost nets' are increasing through time in Northern Australia (scientific paper)</p> <p>Combating ecosystem collapse from the tropics to the Antarctic (scientific paper)</p> <p>Processes and factors driving change in mangrove forests – an evaluation based on the mass dieback event in Australia's Gulf of Carpentaria (book chapter)</p> <p>Climate drivers of the 2015 Gulf of Carpentaria mangrove dieback (report)</p> <p>Facilitating natural regeneration processes: Planting seedlings is not the best response to mass mangrove dieback in the Gulf of Carpentaria (case study synthesis)</p> <p>Influence of the 2015–2016 El Niño on the record-breaking mangrove dieback along northern Australia coast (scientific paper)</p> <p>Processes and factors driving change in mangrove forests – an evaluation based on the mass dieback event in Australia's Gulf of Carpentaria (book chapter)</p>	
4.5	<p>Trialling new techniques for assessing terrestrial biodiversity in data-poor environments</p>	<p>The project will investigate the use of environmental DNA (eDNA) to detect significant terrestrial animal species. This may provide a reliable and cost-effective method to sample some species that are difficult and/or expensive to detect using conventional survey techniques. The concept will be initially tested using Gouldian Finch, including field validation using water samples from waterholes where the abundance of the species is intensively monitored. The incorporation of eDNA methods will be subsequently tested during a major new program to assess key biodiversity values in remote, data-poor regions of the Northern Territory.</p>	<p>Dr Alaric Fisher</p> <p>Professor Karen Gibb</p>	<p>NT Dept of Environment, Parks &amp; Water Security</p> <p>Charles Darwin University</p>	190,000.00	20,000.00	167,000.00	187,000.00	<b>377,000.00</b>	1/1/18	30/9/21	Completed	<p>Developing eDNA methods to detect Top End animals (start-up factsheet)</p> <p>Developing eDNA methods for Top End animals (presentation video)</p> <p>Developing eDNA methods for Top End animals (project update Oct 2019)</p> <p>Development and validation of an environmental DNA test for the endangered Gouldian finch (scientific paper)</p> <p>Standard operating procedures for collecting and extracting Gouldian finch DNA (report)</p> <p>Developing eDNA methods for tropical animals (project update presentation video)</p> <p>eDNA game website</p> <p>Finding finches – using eDNA to track endangered birds (impact video)</p> <p>Finding finches – using eDNA to track endangered birds (impact story)</p> <p>Developing eDNA methods to detect Top End animals (final report)</p>

													Developing eDNA methods to detect Top End animals (wrap-up summary)
4.6	Environmental economic accounting for interconnected ecosystem assets and ecosystem services in the Mitchell catchment, QLD	It is extremely challenging to track the impacts of development and conservation decisions in Northern Australia where decision makers must consider trade-offs among ecological, environmental, socio-economic and cultural values within a relatively natural landscape. The multiple types of values involved can be overwhelming for decision makers who will not necessarily have expertise in all relevant areas. Using the Mitchell catchment as a case study, we will develop an approach to environmental-economic accounting for Northern Australia that will provide clear performance metrics to help inform development and conservation investments. In the light of on-going advances in environmental-economic accounting, we will synthesise existing ecological and economic research in the region and conduct socio-cultural fieldwork in the Mitchell to develop approaches that can account for the condition of interlinked ecosystem assets and the value of ecosystem services in ways which reflect northern ecological and socio-cultural contexts. We will also consider the extent to which environmental-economic accounting can represent the full suite of ecosystem-related values which are relevant to regional populations and where possible will recommend approaches to overcome identified limitations.	Dr Jim Smart	Griffith University	360,000.00	90,000.00	270,000.00	360,000.00	720,000.00	1/9/18	30/9/21	Ongoing	Environmental-economic accounting for the Mitchell River catchment (start-up factsheet)
													Environmental-economic accounting for interconnected ecosystem assets and ecosystem services in the Mitchell catchment (presentation PDF)
													Representing the sediment retention ecosystem service within an ecosystem account of the Mitchell catchment (scientific paper)
5.1	Research priorities for IPAs across northern Australia	Indigenous Protected Areas (IPAs) constitute >40% of Australian's National Reserve System, protecting biodiversity, ecosystem services, cultural and community values that are vital to Australian societies and of national significance. In collaboration with IPA managers, government, non-government and research stakeholders across the north, this project undertook desktop reviews, interviews and engaged in workshops to provide an assessment of the research priorities for northern Australia's IPAs. Particular attention was focused on research needs that underpin Indigenous peoples' goals and issues for participation in environmental management. The results of the project contributed to the development of a multi-year research plan to address these priorities. Reviews, interviews and workshops were also used to qualitatively identify core social/ economic/ cultural benefits associated with IPA's, and to identify ways in which IPA managers, government and non-government stakeholders could use information about those benefits in decision making contexts. This enabled researchers to identify appropriate methods for quantifying (or otherwise assessing) those benefits, so that a multi-year research project which focuses on the social cultural and economic benefits of IPAs can be developed.	Dr Ro Hill	CSIRO	150,000.00	-	172,068.00	172,068.00	322,068.00	1/7/15	30/6/16	Completed	Research priorities for Indigenous Protected Areas (IPAs) across northern Australia (project key findings factsheet)
													Research priorities for Indigenous Protected Areas (IPAs) across northern Australia (final report)
													Research priorities for Indigenous Protected Areas (IPAs) across northern Australia (wrap-up factsheet)
													Research priorities for Indigenous Protected Areas (IPAs) across northern Australia (project summary)
													Economic values and Indigenous Protected Areas across northern Australia (final report)
5.2	Identifying lessons learned from the incorporation of Top End Indigenous fire knowledge into fire management, to inform the incorporation of Indigenous knowledge in fire management and carbon abatement planning nationally	This project evaluated if and how Indigenous fire knowledge (IK) has been used in Top End (Kimberly, Arnhem Land and Cape York) fire projects. Interviews and workshops involving key Indigenous fire managers and partners (Traditional Owners, NGOs, scientists and government agencies) were combined with a literature review to: <ul style="list-style-type: none"> <li>Document the successes and challenges associated with the different approaches used to share IK with western science, and to translate IK and historical purposes of Indigenous fire into contemporary fire management activities</li> <li>Report on different perspectives, experiences and lessons learned from the incorporation and translation of IK into fire management</li> <li>Identify the institutional, social, cultural and other factors that enable or constrain the incorporation of IK into fire management goals and activities.</li> </ul> The resulting insights were synthesised into a report summarising key existing lessons, that informed protocols that can be used to guide the incorporation of IK in fire management and carbon abatement programs.	Dr Cathy Robinson	CSIRO	165,000.00	-	168,146.00	168,146.00	333,146.00	1/7/15	30/6/16	Completed	Protocols for Indigenous fire management partnerships (presentation PDF)
													Protocols for Indigenous fire management partnerships (wrap-up factsheet)
													Protocols for Indigenous fire management partnerships (final report)
													Protocols for Indigenous fire management partnerships (start-up factsheet)
													Reporting back to Traditional Owners on NT discussions (final report – Appendix 3)
													Reporting back to Traditional Owners on Kimberly discussions (final report – Appendix 2)
													Report back to Traditional Owners on the fire management forum (final report – Appendix 1)
Report back to Traditional Owners on Olkola fire management case study (final report – Appendix 4)													

5.3	Multiple benefits and knowledge systems of ILMPs – economic perspectives	<p>There are numerous environmental benefits associated with Indigenous land and sea management projects/programs (ILSMPs) which include, but are not limited to Indigenous Protected Areas and Country. More recently, numerous social and economic benefits of ILSMPs have also been recognised, but few of those benefits have been quantified. This could lead people to under invest in ILSMPs; it also makes it difficult to determine which types of ILSMPs are likely to generate greatest socioeconomic and environmental benefit. This project will provide quantified, comparable data about the social, cultural and economic benefits of different types of ILSMPs. In doing so, it will generate information that will:</p> <ul style="list-style-type: none"> <li>• support continued and improved funding to support Indigenous people working on country;</li> <li>• better guide investments towards ILMPs that effectively deliver most benefit in different contexts.</li> </ul>	Professor Natalie Stoeckl	James Cook University	490,800.00	126,300.00	415,050.00	541,350.00	<b>1,032,150.00</b>	1/2/16	30/6/20	Completed	Multiple benefits of Indigenous land & sea management programs (start-up fact sheet)
													The crowding out of complex social goods (scientific paper)
													Can Indigenous land & sea management programs promote regional development and help 'close the gap'? (policy note)
													Multiple benefits of Indigenous land & sea management programs (project update Jun 2017)
													Using measures of wellbeing for impact evaluation: Proof of concept developed with an Indigenous community undertaking land management programs in northern Australia (scientific paper)
													Improving our understanding of the multiple benefits of Indigenous land & sea management programs (science summary)
													Are Indigenous land & sea management programs a pathway to Indigenous economic independence (policy note)
													Using measures of wellbeing for evaluating the impact of Indigenous land & sea management programs (ILSMPs) (policy note)
													Multiple benefits of Indigenous land & sea management programs – economic perspectives (project update Jun 2018)
													Indigenous land & sea management programs: Can they promote regional development and help "close the (income) gap"? (scientific paper)
													Are Indigenous land & sea management programs a pathway to Indigenous economic independence? (scientific paper)
													Economic development across the north (book chapter)
													The learning generated through Indigenous natural resources management programs increases quality of life for Indigenous people – improving numerous contributors to wellbeing (scientific paper)
													Can ILSMPs contribute to development as it is perceived by Indigenous communities? (policy note)
													Multiple benefits of Indigenous land & sea management programs (presentation video)
													A holistic view to monitoring Indigenous land & sea management programs (policy note)
													Multiple benefits of Indigenous land & sea management programs (wrap-up factsheet)
													Multiple benefits of Indigenous land & sea management programs (user & co-researcher perspectives video)
													Multiple benefits of Indigenous land & sea management programs (presentation PDF)
													Multiple benefits of Indigenous land & sea management programs (presentation video)
Caring for Country and improving Indigenous lives through Indigenous land & sea management programs (impact story)													
The ability of community based natural resource management to contribute to development as freedom and the role of access (scientific paper)													
The importance of social learning for non-market valuation (scientific paper)													
Indigenous land & sea management programs (ILSMPs) enhance the wellbeing of Indigenous Australians (scientific paper)													
Multiple benefits of Indigenous Land and Sea Management Programs (final report)													



5.4	Knowledge brokering for Indigenous land management	To support improved Indigenous land management knowledge adoption and land-use decision-making, this project will undertake active co-research, partnering with Indigenous people in the Fitzroy catchment (WA) and in the Northern Territory, to design and test culturally tailored knowledge brokering methods and tools, and the sharing of these through a pan-northern Indigenous knowledge network. The project will deliver three broad outputs: the tailored knowledge brokering tools, the knowledge network, and the diagnosis of the conditions under which knowledge brokering can improve Indigenous adaptive management of environmental assets.	Mr Ricky Archer	North Australian Indigenous Land and Sea Management Alliance Limited (NAILSMA)	985,000.00	123,815.00	789,520.00	913,335.00	<b>1,898,335.00</b>	1/7/16	31/3/20	Completed	Weaving knowledge systems in IPBES, CBD and beyond – lessons learned for sustainability (scientific paper)
													Knowledge brokering with Indigenous land managers to support informed decisions (presentation PDF)
													Biosphere stewardship – reflections from Indigenous governance systems and ethics of care and reciprocity (presentation PDF)
													The role of communities and Indigenous knowledge for stewardship across scales (presentation PDF)
													Knowledge brokering activities & outcomes: A report to the Kimberly Land Council (report)
													Knowledge brokering at the Kimberley Ranger Forum (report summary)
													Knowledge brokering for Indigenous land management (Wanyyi Garawa case study update Apr 2018)
													Weaving knowledge systems for sustainable environments and societies: Five tasks (science summary)
													Knowledge brokering for Indigenous land management (Fitzroy catchment case study update Jun 2018)
													Showing and sharing knowledge in WA's Fitzroy River catchment (video June 2018)
													Showing and sharing knowledge in the Fitzroy River catchment (video Sept 2018)
													Our Knowledge Our Way guidelines (call for case studies)
													Walking in Country: A medium for protecting and transmitting culture and managing the land (research essay)
													Knowledge brokering for Indigenous land management (Wanyyi Garawa case study update)
													Getting back to Jilundarina (video)
													Knowledge brokering for Indigenous land & water management (presentation video)
													Children working with the map (video)
													3D map road trip (video)
													Showing and sharing knowledge through a hands-on map (impact story)
													Working with Indigenous, local and scientific knowledge in assessments of nature and nature's linkages with people (scientific paper)
Strengthening and sharing knowledge for land and sea management (impact story)													
Knowledge brokering for Indigenous land management (start-up factsheet)													
Our Knowledge, Our Way: Indigenous-led best practice guidelines (launch video)													
The launch of Our Knowledge, Our Way: Indigenous-led best practice guidelines (presentation video)													
Showing and sharing knowledge in WA's Fitzroy River catchment (project summary video)													

													Showing and sharing knowledge in WA's Fitzroy River catchment (shorter summary video)
													Our Knowledge Our Way guidelines (report)
													Our Knowledge Our Way guidelines (summary)
													Showing and sharing knowledge: Feedback on Western Australian Government discussion paper
													Learning together with the Martuwarra (Fitzroy River) (scientific paper)
													Our Knowledge Our Way in caring for Country (practice brief for scientists)
													Our Knowledge Our Way in caring for Country (policy brief)
5.5	Indigenous natural resource management in Kakadu National Park	This project will identify and undertake research projects involving Indigenous natural resource management in Kakadu National Park (KNP). Component 1 is a collaborative process to identify and develop action-research projects involving <i>Bininj/Mungguy</i> , Hub researchers and KNP staff. It will identify a number of targeted research projects that are a priority for <i>Bininj/Mungguy</i> , address NESP NAER Hub priorities, and support the Kakadu Plan of Management. In Component 2, priority research projects will be undertaken as part of Research Plans v2 and v3. Component 3 will review and apply collective lessons to broaden and deepen engagement of <i>Bininj/Mungguy</i> in core KNP work.	Professor Michael Douglas	University of Western Australia	740,000.00	185,100.00	478,324.00	663,424.00	<b>1,403,424.00</b>	1/6/16	30/9/21	Completed	Indigenous NRM in Kakadu National Park (start-up factsheet)
													<i>Bininj/Mungguy</i> healthy country indicators (start-up factsheet)
													<i>Bininj/Mungguy</i> healthy country indicators (video)
													Using technology to monitor country – <i>Bininj/Mungguy</i> healthy Country indicators for Kakadu National Park (video)
													Video produced with Microsoft about Microsoft AI component in Kakadu (video)
													Healthy Country AI: an adaptable framework using AI to monitor ecosystem health (GitHub database)
													Kakadu NESP team – Eureka STEM Inclusion Prize finalist video)
													Keeping Country healthy in Kakadu National Park (impact video)
													Keeping Country healthy in Kakadu National Park (impact story)
													Using <i>Bininj</i> knowledge to care for Nardab (video)
													Empowering Indigenous people to use AI to rapidly assess the health of their lands (video for i-Awards)
													Indigenous-led responsible innovation: lessons from co-developed protocols to guide the use of drones to monitor a biocultural landscape in Kakadu National Park, Australia (scientific paper)
													Healthy Country AI – Kakadu (dashboard)
													Understanding Indigenous values and priorities for wetlands to guide weed management actions: Lessons from the Nardab floodplain in northern Australia's Kakadu National Park (scientific paper)
													Using <i>Bininj/Mungguy</i> indicators to monitor the health of Country in Kakadu National Park (wrap-up summary)
													Using <i>Bininj/Mungguy</i> indicators to monitor the health of Country in Kakadu National Park (final report)
5.6	Guiding non-government investment in Indigenous cultural and natural resource management enterprises: performance and	This project focuses on the integrated performance and impact assessment needed by the Indigenous cultural and natural resource management (ICNRM) enterprises to showcase the multiple benefits from ICNRM and thereby guide new investment from non-government sources. It emphasises the current and future assessment needs and associated investment logics of two key investor categories (corporate, and Indigenous community investors) to identify if and how the assessment of ICNRM activities can be shared, aligned and/or	Dr Marcus Barber	CSIRO	200,000.00	50,000.00	150,000.00	200,000.00	<b>400,000.00</b>	1/1/19	30/9/21	Completed	Investing in Indigenous cultural & natural resource managers (start-up factsheet)
													Investing in Indigenous cultural & natural resource managers (wrap-up summary)

	impact assessment needs	combined. In doing so, it will inform strategies used to guide the expansion and diversification of new corporate investment and in better accounting for Indigenous community investor needs and objectives. The project responds to strategic priorities identified by both Indigenous and corporate stakeholders at the 2017 Kimberley Ranger Forum and will complement related DoEE and PMC research initiatives that address government investor assessment priorities. Assessment regimes are needed that can build stronger future investment in the environmental, social, cultural and other impacts delivered by ICNRM.											Diversifying investment in Indigenous cultural and natural resource management (wrap-up factsheet)
													Guiding non-government investment in Indigenous cultural and natural resource management enterprises (brief for Indigenous organisations)
													Pathways and opportunities to diversify investment (final report)
													Guiding non-government investment in Indigenous cultural and natural resource management enterprises (policy brief)
6.1	e-Flow synthesis project: enhancing uptake of environmental flow research for improved water planning in northern Australia	Synthesis project aimed at increasing transferability of environmental flow research from case study regions (the Fitzroy, Daly and Mitchell rivers and the southern Gulf of Carpentaria) covered under existing projects 1.3 and 1.4 to other northern catchments and regions. Project outputs will be targeted to underpin sustainable water resource management in northern Australia.	Associate Professor Mark Kennard	Griffith University	270,000.00	60,000.00	556,510.00	616,510.00	886,510.00	1/3/18	30/9/21	Ongoing	e-Flows synthesis project (presentation PDF)
													Connectivity, habitat, and flow regime influence fish assemblage structure: Implications for environmental water management in a perennial river of the wet-dry tropics of northern Australia (scientific paper)
													Carbon sources supporting Australia's most widely distributed freshwater fish, <i>Nematalosa erebi</i> (Günther) ( <i>Clupeidae: Dorosomatinae</i> ) (scientific paper)
													e-Flows synthesis project (final report available on request)
													Applying knowledge of river flow-ecology links (start-up factsheet)
6.2	Transdisciplinary environmental research	Transdisciplinary research is solution-oriented, multidisciplinary and includes participants from outside academia with the aim of increasing the uptake of research results by users. A group of NESP-NAERH projects in the Fitzroy catchment (WA) are adopting a transdisciplinary approach by having water resource management as a common theme, integrating their research processes and outputs and developing strong links with research users. Our project will: use lessons learned from other transdisciplinary projects to enhance the Fitzroy group via formative evaluation, assess the achievement of desired outcomes, contribute to the emerging literature on transdisciplinarity and inform future environmental research in the Department of Environment and Energy.	Professor Dave Pannell Professor Michael Douglas	University of Western Australia	195,000.00	48,750.00	200,000.00	248,750.00	443,750.00	1/3/18	30/9/21	Completed	Transdisciplinary research for water management (start-up factsheet)
													Transdisciplinary research for water management (wrap-up factsheet)
													Learning together with the Martuwarra (Fitzroy River) (scientific paper)
													Transdisciplinary research for water management (final report)
6.3	NESP output synthesis and transferability	The Hub is planning a range of knowledge synthesis and transfer activities to maximise project outputs that include a period of research synthesis, adoption and engagement at the conclusion of each major phase of research. Key features of the knowledge synthesis activity will be: <ul style="list-style-type: none"> <li>Synthesis of project findings across topics and focus regions</li> <li>Transferability of project outputs to other regions</li> <li>National, State, Territory and regional workshops and briefings</li> <li>Development of web-based products and tools for management</li> <li>Synthesis publications and key findings reports across regions and themes</li> </ul>	Professor Michael Douglas Mr Brendan Edgar Ms Jane Thomas	University of Western Australia  Charles Darwin University	772,779.00	150,000.00	625,000.00	775,000.00	1,547,779.00	1/7/18	30/9/21	Ongoing	Valuing Indigenous cultural connections (start-up factsheet)
													Australian Indigenous insights into ecosystem services: Beyond services towards connectedness – People, place and time (scientific paper)
													Savanna fire regimes and biodiversity impacts (final report)
													Savanna fire regimes and biodiversity impacts (wrap-up summary)
													Mitchell River story map (start-up factsheet)
	Hub-wide products										30/9/21	Completed	National Environmental Science Program (NESP) Northern Australian Hub presentation at Fitzroy Valley Futures (presentation PDF)

											West Kimberley research overview (brochure)
											Top End research overview (brochure)
											North Queensland research overview (brochure)
											Indigenous science partnerships (brochure)
											Environmental assessments support development and evaluation of Queensland Water Plans (presentation PDF)
											Stable isotopes, fatty acids and compound specific stable isotopes of fatty acids as biomarkers (presentation PDF)
											Palaeo-tracers: A brief overview of some chemical tracers used to reconstruct past aquatic environments (presentation PDF)
											Use of otolith chemistry to trace life history variability in barramundi (presentation PDF)
											Environmental assessments support development and evaluation of Queensland Water Plans (presentation video)
											Stable isotopes, fatty acids and compound specific stable isotopes of fatty acids as biomarkers video (presentation video)
											Palaeo-tracers: A brief overview of some chemical tracers used to reconstruct past aquatic environments (presentation video)
											Use of otolith chemistry to trace life history variability in barramundi (presentation video)
											Bringing northern Australia science to Canberra (impact story)
											Engagement is a two-way street: Creating symbols for science communication (impact story)
											Final findings on knowledge synthesis to inform a national approach to fighting extinction (video)
											Graphics library of publicly available symbols
											Supporting Indigenous natural resource management and alternative economies (thematic impact story)
											The importance of northern Australian rivers and flows (thematic impact story)
											Managing threatened species and threatening processes (thematic impact story)
											New approaches for monitoring and communicating about environmental resources (thematic impact story)
											NESP NAER Hub Gulf Research overview video
											NESP Northern Hub wrap-up video