

# Research Program Plan

Koala and habitat response to harvesting in  
North Coast state forests

January 2024



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## Acknowledgement of Country

The Natural Resources Commission acknowledges and pays respect to traditional owners and Aboriginal peoples. The Commission recognises and acknowledges that traditional owners have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge in natural resource management and the contributions of many generations, including Elders, to this understanding and connection.

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## Version control

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# 1 Introduction

The NSW Government's [NSW Koala Strategy \(2021-26\)](#)<sup>1</sup> aims to deliver investment and action to secure important koala habitat, reduce threats, and engage communities and local expertise to deliver koala conservation works across NSW.

Under the strategy, the Government has requested that the Natural Resources Commission (the Commission) deliver independent research into koala responses to selective harvesting in north coast state forests.

This research will build on previous research overseen by the Commission under the *NSW Koala Strategy (2018-21)*, which surveyed nine north coast sites where selective harvesting operations took place. The new research program will resample previous sites to establish trends, and also extend to new sites in different forest types within the north coast region.

The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) has provided the Commission with \$265,000 over three years to undertake the research. The Commission has established an expert panel (**Section 1.2**) to provide advice on the design and delivery of the program.

## 1.1 Program objectives

The Commission will:

- deliver a research program that is based on rigorous, sound and impartial science
- provide an independent evidence base to inform future decision making on forest management practices for both koala habitat and timber production.

## 1.2 Expert panel

The Commission has engaged the following experts in koala and forest management to provide advice to support the design and delivery of the research program and review findings:

**Dr Desley Whisson** (Senior Lecturer in Wildlife and Conservation, Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University)

Dr Whisson is a terrestrial ecologist with 15 years' experience in conducting applied research on koala ecology and management. She is particularly interested in the spatial ecology of koalas including their habitat use and movements in modified landscapes. Prior to joining Deakin University in 2007, Dr Whisson held positions with the South Australian government (managing the Koala program on Kangaroo Island), the University of California (UC Davis), and the National Autonomous University of Mexico (UNAM).

**Dr Alistair Melzer** (Adjunct Research Fellow, Koala Research CQ, School of Medical and Applied Sciences and research program leader for koala research, Central Queensland University)

Dr Melzer, a field ecologist, has worked on koalas and their habitat for over 20 years. He has provided expert and independent advice to three state governments and the Australian Government. He managed a multidisciplinary research team as Director of the Centre for Environmental Management from 2001 to 2006. He was recently a member of the Queensland Government Koala Expert Panel, advising on the most appropriate actions to reverse population decline and ensure long-term persistence of south east Queensland's koalas. He was recently involved in developing rapid assessment tools for local- and landscape-scale koala habitat health.

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<sup>1</sup> ..... This strategy updates the previous Koala Strategy (2018-21)

**Prof Patrick Baker** (Professor of Silviculture and Forest Ecology, School of Ecosystem and Forest Sciences, University of Melbourne)

Professor Baker studies forest dynamics and has 25 years of experience working in temperate and tropical forests studying the impacts of past disturbances and climate variability on current structure and composition. He has previously worked at the Harvard Institute of International Development, The Nature Conservancy of Hawaii, the US Forest Service, and Monash University. Professor Baker was an Australian Research Council Future Fellow from 2012 to 2017 focussing on developing silvicultural systems to make south-eastern Australian forests more resilient to climate change.

**Dr Graeme Gillespie** (Senior Team Leader, Koala Science, NSW Department of Environment and Planning)

Dr Graeme Gillespie has 37 years of experience undertaking and leading diverse threatened species research and recovery projects and broad-based biodiversity conservation and management programs in Australia and Southeast Asia. He has published over 120 articles in refereed scientific journals and numerous technical reports in the fields of conservation biology and applied ecology. Through his research, influencing management and policy, and industry and community engagement, he has contributed significantly to improved threatened species conservation and ecosystem management in south-eastern Australia and the Northern Territory.

**Dr Louise Pastro** (Principal Policy Officer, NSW Koala Program, NSW Department of Environment and Planning)

Dr Pastro has contributed to strategic conservation policy in the NSW government for nearly a decade, building on previous roles in leading sustainability and engagement strategies. She has researched and published peer-reviewed papers on the impacts of fire on ecosystems and fauna, including arid areas in Australia. She is a former teaching fellow at the University of Sydney, and has been a previous board member at the NSW Environmental Trust Urban Sustainability Program and Green Capital.

**Mr Peter Cochrane – Panel Chair** (Assistant Commissioner, Natural Resources Commission)

Mr Cochrane is the Chair of the Sydney Institute of Marine Science and the Australian Tropical Herbarium Board. Since 2016, he has been a Council Member of the International Union for Conservation of Nature. Peter was formerly CEO of Parks Australia, a member of the Commonwealth Environmental Water Holder Review Panel, and Chair and Director of the Commonwealth Marine Reserves Review that re-examined the science and zoning for 40 marine reserves. At the Commission, he chairs the NSW Forest Monitoring Steering Committee.

## 2 The research program

The program will investigate two key research questions:

- 1 How does koala habitat, including feed tree abundance, foliage biomass, canopy tree species composition and forest structure, respond to varying levels of selective harvesting intensity?
- 2 How do koala populations respond following selective harvesting at varying levels of intensity?

This plan provides an overview of the research projects and how they will contribute to the research question. **Section 2.1** provides more detail on each project. Research projects were selected by the Commission via an open call for proposals and in consultation with the expert panel.

## 2.1 Research projects

The Commission will oversee two projects addressing the program's research questions:

### 1 Harvesting impacts on leaf nutrition and canopy biomass

This project will study the impact of selective harvesting on koala habitat, specifically the availability and spatial distribution of nutritional resources as indicated by leaf nutritional quality and canopy biomass. It will also explore koala movement patterns in relation to spatial distribution and availability of nutritional resources.

The work will be led by Western Sydney University (WSU) in collaboration with University of Melbourne (UoM) and Department of Primary Industries (DPI) – Forest Science Unit.

### 2 Koala density response to selective harvesting measured with acoustic sensors and drones with thermal cameras

This project will assess koala population density responses at the site scale both in the short- (around six months) and medium-term (about four-five years) post-harvest using different survey methods (acoustic sensors and drones with thermal cameras).

Assurance on acoustic survey design, analysis and results will be overseen by CSIRO. Data analysis will be undertaken by the Forest Science Unit at the NSW Department of Primary Industries with song meter deployment by Forestry Corporation of NSW (FCNSW) ecologists.

Assurance, data collection and analysis on drones will be led by the University of Newcastle. Drone piloting will be by FCNSW ecologists with oversight by researchers at the University of Newcastle.

Study sites for both projects will be selected collaboratively among the researchers, FCNSW and the Commission in NSW North Coast state forests. Where possible, the program will seek opportunities to collect data from the same study sites across different projects, creating overlaps that allow for data and results to be integrated and analysed in combination.

Acoustic surveys will also be undertaken at three sites that were selectively harvested in 2019-20 (and their paired control sites), and which have been surveyed under the Commission's previous koala research program. This will provide insights into longitudinal trends in koala density response to harvesting.

**Tables 1 and 2** provide a snapshot of the projects. The Commission will also consider and synthesise the findings of any other scientifically valid research that contributes to the understanding of a broader range of koala responses to forest harvesting.

**Table 1: Harvesting impacts on leaf nutrition and canopy biomass**

**What is the aim of the research?**

This project will develop models to predict leaf nitrogen content (a measure of nutritional value) and canopy biomass from multispectral imagery. These will be used to map nutritional quality, availability and spatial distribution of food resources for koalas at selectively harvested and unharvested sites to understand how selective harvesting impacts koala habitat quality.

**What will the research involve?**

**Site selection:** Survey sites will be selected over a broad geographic area in north coast forests of NSW. They will be split into three categories – unharvested (control) sites, sites selectively harvested up to five years ago, and sites harvested five-ten years ago. Detailed site selection will be undertaken after further discussion and consultation with FCNSW staff and other program participants in order to align and/or combine study sites with other projects where appropriate and to leverage existing data and research if possible.

**Development of predictive model:** The survey sites will be categorised as ‘training’ and ‘prediction’ sites. Multispectral imagery and photogrammetry data will be collected at the tree canopy level with remotely piloted aircraft systems (drones) at each site. Drone surveys will cover approximately 40-50 hectares of forest area per survey site. Additionally at the training sites, ground measures of canopy and foliar nitrogen measured from leaf samples will be used to develop models to predict foliar nitrogen and canopy biomass from the multispectral imagery data. The models will then be tested on the prediction sites.

**Application of model:** Spatial mapping of foliar nitrogen and canopy biomass will be predicted for the remaining canopy at all sites to quantify the effects of different harvesting intensities on koala foodscapes. From the spatial mapping, generalised linear models and landscape metric analyses will be used to compare metrics of site nutrition between harvested and unharvested sites and to assess spatial aggregation and potential fragmentation of canopy nitrogen and biomass as a result of harvest operations. There may also be scope for within-site comparisons where sites incorporate mosaics of forest harvesting exclusions and harvested areas. The spatial structure of koala feeding resources in the landscape will be interpreted in the context of koala movement patterns by leveraging previous koala GPS data from DPI.<sup>2</sup>

**How does the project contribute to the NSW Koala Strategy research question?**

Habitat quality for koalas is determined by the nutritional quality and availability of feed trees. To understand the impact of selective harvesting on koala habitat, it is necessary to investigate how it changes canopy species composition and nutrient content, available canopy biomass and spatial distribution of foliar resources.

**How will the project contribute to on-going forest management?**

The models to predict leaf nutrition and canopy biomass may be used to complement harvest planning in pre-harvest surveys to determine which are the most important trees to retain for koalas. They can also be applied to testing the effectiveness of Coastal Integrated Forestry Operations Approval (IFOA) conditions in maintaining post-harvest nutritional quality of koala habitat. More broadly, the models can be used to assess habitat quality predictions from other mapping, as well as time to recovery of koala habitat quality after harvest and after fire.

**Who will undertake the research?**

This study will be led by Associate Professor Benjamin Moore from Western Sydney University (WSU) with over 25 years of field and laboratory experience with koala feeding and nutritional ecology, digestion, microbiome, physiology, ecology and conservation. The project team, including Dr Benjamin Wagner (University of Melbourne), Professors Justin Welbergen and Matthias Boer (WSU) and Dr Leroy Gonsalves (DPI – Forest Science) have collective expertise in remote sensing and habitat suitability modelling for arboreal fauna, modelling to predict and map foliar nitrogen, and assessing response of fauna groups to timber harvesting.

<sup>2</sup> Law, B., Slade, C., Gonsalves, L., Brassil, T., Flanagan, C., Kerr, I. (2022). Tree use by koalas after timber harvesting in a mosaic landscape. [Wildlife Research 50: 589-592](#).

**Table 2: Koala density response to selective harvesting**

**What is the aim of the research?**

This project will investigate how selective harvesting impacts koala density both in the short- (around six months) and medium-term (about four-five years) post selective harvest. This work will build onto research overseen by the Commission under the previous NSW Koala Strategy (2018).<sup>3</sup>

**What will the research involve?**

**Survey sites:** The research will use a hybrid approach to surveying koalas using both acoustic sensors and drones fitted with thermal cameras. Acoustic sensors will be used to sample three sites (and their paired control sites) that were selectively harvested in 2019-20 and surveyed with acoustic sensors pre- and immediately post-harvest<sup>4</sup> to obtain longitudinal data on koala density at those sites and understand the medium-term (four to five years post-harvest) impact.

New treatment sites will also be selected at which both acoustic and drone surveys will be carried out pre- and post-selective harvesting operations. A paired control site will be selected for each new treatment site and will be surveyed at the same time as the treatment site. The number and location of these sites will be determined in consultation with FCNSW based on harvest plans, budget and resourcing constraints. Other factors such as the Great Koala National Park assessment area may also impact on site selection.

**Acoustic survey methods:** Arrays of 25 acoustic sensors will be set up in spring (when male koalas are most vocal) over 14 days at each of the previously sampled sites and each new treatment/control site pair selected to record male koala bellows. Grid-based maps of estimated male koala density across each array will be produced from the data and overlaid with harvesting maps to assess use of habitat within harvest and environmental protection areas. Spatial count modelling<sup>5</sup> is used to estimate male koala density. This involves using the acoustic data and other known information about koala behaviour (such as expected home range) to estimate the number and location of koala activity centres from which koala density is modelled.

**Drone survey method:** Drones fitted with thermal cameras to detect koala thermal signatures will be flown over 10 plots of 25 hectares at each of the new sites over three consecutive nights, both pre- and post-harvesting operations.

**How does the project contribute to the NSW Koala Strategy research question?**

Estimates of changes in koala density will deliver a direct measure of koala response to selective harvesting. This will contribute greatly to the interpretation of how selective harvesting affects koalas and how various forms of logging exclusion mitigate impacts.

**How will the project contribute to on-going forest management?**

Once sensor arrays have been established, continued monitoring of koala movement and density can occur as part of ongoing forest monitoring to track changes in koala response over the longer term as the forest continues to regenerate. Long term data can contribute to adaptive management and continuous improvement of harvest prescriptions under the Coastal IFOA by enabling assessment of the collective effectiveness of the rule set, including basal retention harvesting limits, koala browse tree retention limits and harvest exclusion zones.

**Who will undertake the research?**

Assurance on acoustic survey design, analysis and results will be overseen by Dr Andrew Hoskins at CSIRO. Data analysis will be led by Dr. Brad Law at the Forest Science Unit at the NSW Department of Primary Industries. Song meter deployment will be led by FCNSW ecologists trained in drone piloting by the Department of Planning and Environment's Drone Hub.

Assurance, data collection and analysis on drones will be led by Dr Ryan Witt at the University of Newcastle. The University of Newcastle will oversee the drone piloting by ecologists from FCNSW.

<sup>3</sup> ..... NRC (2022). [Koala response to harvesting in NSW north coast state forests - Final report \(updated\)](#).

<sup>4</sup> ..... Law, B., Gonsalves, L., Burgar, J., Brassil, T., Kerr, I., O'Loughlin, C., Eichinski, P., Roe, P. (2022). Regulated timber harvesting does not reduce koala density in north-east forests of New South Wales. [Scientific Reports 12: 3968](#).

<sup>5</sup> ..... Law B., Gonsalves L., Burgar J, Brassil T, Kerr I, Wilmott L, Madden K, Smith M, Mella V, Crowther M, Krockenberger M, Rus A, Pietsch R, Truskinger A, Eichinski P, Roe P (2022). Estimating and validating koala *Phascolarctos cinereus* density estimates from acoustic arrays using spatial count modelling. [Wildlife Research 49, 438-448](#).



### 3 Timing and milestones

Research, including field work will be undertaken between December 2023 and October 2025, with reporting completed by January 2026 (**Table 3**). Timing and milestones may be subject to change, for example due to unforeseen changes in harvest plans, impacts from wildfires (including impacts to sites and survey resource re-allocation to fire-fighting), and potential site safety risks.

**Table 3: Timing of program activities**

Project 1: koala habitat response		Project 2: koala population density response	
Stage	Timing	Stage	Timing
<b>Field work</b> – site selection, drone flights, leaf sampling	December 2023 - June 2024	<b>Acoustic surveys</b> – longitudinal data at previous research sites	November - December 2023
<b>Data processing and chemical analyses</b>	July 2024 - December 2024	<b>Pre-harvest drone surveys</b> – new treatment/control sites	Winter 2024
<b>Statistical analysis</b>	January 2025 - June 2025	<b>Pre-harvest acoustic surveys</b> – new treatment/control sites	Spring 2024
		<b>Post-harvest drone surveys</b> – new treatment/control sites	Winter 2025
<b>Report preparation</b>	July 2025 - October 2025	<b>Post-harvest acoustic surveys</b> – new treatment/control sites	Spring 2025
		<b>Report preparation</b> <i>(Note: annual reporting will occur)</i>	January 2026

### 4 Engagement and communication

In addition to the final report, information on the program and findings will be shared via:

- updates to the Commission’s [koala research webpage](#)
- updates to the Commission’s koala research mailing list (you can [sign up here](#) to stay in touch, or join via the [webpage](#))
- annual reports on project progress and findings published on the [webpage](#)
- publishing of peer reviewed journal papers by researchers.

To assist in sharing knowledge and disseminating findings from research, the Commission will also convene forums at relevant milestones involving all researchers under the program and expert panel members. These forums will be used to share and discuss findings, address issues and identify any opportunities to improve the project delivery.

### 5 Reporting and evaluation

The Commission will provide a final report of findings to the NSW Government in early 2026. The Commission will also routinely report progress to DCCEE as the funding body. Research data and outputs will be published on the NSW Sharing and Enabling Environmental Data ([SEED](#)) portal.

An independent evaluation will be conducted following the completion of the program to assess the extent of achievement against program objectives.