



Natural
Resources
Commission

Annual progress report

Koala Research Program
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List of acronyms

ANU – Australian National University
DPI Forest Science – Department of Primary Industries - Forest Science
EES - Energy, Environment and Science
EPA - Environment Protection Authority
FCNSW - Forestry Corporation of NSW
WSU – Western Sydney University

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Acknowledgment of Country

The Natural Resource Commission acknowledges and pays respect to all the Traditional Owners and their Nations. The Commission recognises and acknowledges that the Traditional Owners have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge of natural resource management and their contributions of earlier generations, including the Elders.

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1 Introduction

The Natural Resources Commission (the Commission) is overseeing an independent research program to better understand how koalas are responding to regeneration harvesting in state forests on the NSW North Coast. This program is being delivered and funded under the NSW Government's Koala Strategy.¹

The Commission has selected three research projects to address the research question. In addition, the Commission will oversee the ongoing implementation of a research project currently being undertaken by the Department of Primary Industries' (DPI) Forest Science Unit, which is tracking koalas with telemetry technology in state forests.

The research projects are described in the Commission's koala research program plan.²

The Commission has committed to annual forums with researchers and annual reporting on progress.

1.1 Summary

The research projects funded by the Commission have achieved their set milestones as planned. Researchers have collected data across all projects, and analysis has begun. However, it is too early to report reliable results.

Preliminary analysis from DPI's other telemetry study suggests koalas are using a variety of tree sizes, including small diameter trees, in regenerating forests after harvesting. Koalas appear to prefer tallwood trees at night, and shelter in turpentine trees during the day.

The Commission-funded research commenced in drought conditions. Some areas experienced noticeable tree dieback, potentially impacting local tree species composition. Researchers will need to consider this in their final results.

Since August 2019, wildfires have impacted significant areas of the north coast, including state forests. Wildfire has not directly impacted DPI's acoustic array treatment and control sites, nor their telemetry study sites. However, wildfire has impacted many of the sites sampled for the habitat nutritional modelling project. This provides an opportunity to investigate post-fire impacts, for example nutritional content and moisture content of regenerating trees.

As a result of the wildfires, FCNSW are considering postponing planned harvesting operations at two research treatment sites. This may impact overall timing and design of the research program.

The Commission will explore options with the Department of Planning, Industry and Environment and the NSW koala advisory expert panel to build in additional post-fire research opportunities and any timing adjustments.

¹ The NSW Government released the NSW Koala Strategy on 6 May 2018. The Strategy sets out the first phase of actions aiming to stabilise and increase koala populations across NSW, ensuring genetically diverse and viable populations. It provides a starting point to achieve the longer-term goal of increasing koala numbers across the state. The Strategy will be reviewed at the end of three years and revised as required. The Strategy can be found at: <http://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-koala-strategy>

² Available at <https://www.nrc.nsw.gov.au/koala-research>

2 The program and progress

The Commission hosted an annual forum to bring together program researchers, the expert panel and other agency scientists.

The Commission's program researchers:

- Dr Karen Ford, Australian National University (ANU)
- Dr Ben Moore, Western Sydney University (WSU)
- Dr Brad Law, Department of Primary Industries Forest Science (DPI Forest Science)

The Commission's expert panel:

- Dr Desley Whisson (Deakin University)
- Dr Alistair Melzer (Central Queensland University)
- Professor Patrick Baker (University of Melbourne)

Project progress and insights were shared. Synergies with other work and opportunities were also identified.

2.1 Research projects

The Commission's research program plan³ outlines:

- three projects selected by the Commission:
 - ANU habitat nutritional quality modelling
 - WSU diet composition and quality analysis
 - DPI acoustic array and DNA survey
- two other relevant projects:
 - DPI telemetry study
 - DPI acoustic occupancy monitoring

Attachment 1 provides a brief summary for each project. The projects study a range of koala responses to regeneration harvesting, including:

- direct koala responses (occupancy/movement, population density and diet)
- changes to koala habitat, from which potential koala response can be reliably inferred (nutritional quality and composition of habitat)

Overall, the research projects will determine:

- where koalas move⁴
- how their numbers change
- what they eat in response to regeneration harvesting associated coastal IFOA prescriptions and mapped exclusion areas.

³ Available at <https://www.nrc.nsw.gov.au/koala-research>

⁴ Note: this is not Commission-funded research

2.2 Progress to date

2.2.1 ANU habitat nutritional quality modelling

This project is assessing nutritional quality of trees in the landscape and modelling how it changes under different harvesting and regeneration scenarios, which can then be used to predict changes in koala population density.

Eucalypt leaf samples collected from control sites (old growth) and from harvest sites with different species compositions, age/size of trees, and time since harvest will be analysed for chemical compounds known to influence koala feeding behaviour.

The effects of habitat composition on nutritional quality will be considered using nutritional data collected from sampled trees and species composition information from treatment and control sites.

Researchers:

- have collected over 900 leaf samples from over 50 sites between Lansdowne and Grafton to analyse nutritional composition (collection included sites from the DPI acoustic array and DNA survey project)
- have surveyed species composition and forest structure at the same sites
- have identified 23 eucalypt species from the samples collected
- will collect further leaf samples at sites planned for harvest, both directly before harvesting operations, and post-harvest – this is subject to harvest timing in relation to the overall project timeline
- will undertake statistical modelling to predict the impacts of different management scenarios on the composition of regrowing forest and habitat nutritional quality (and associated changes in koala density).

The planned project milestones and timing are summarised in Figure 1.

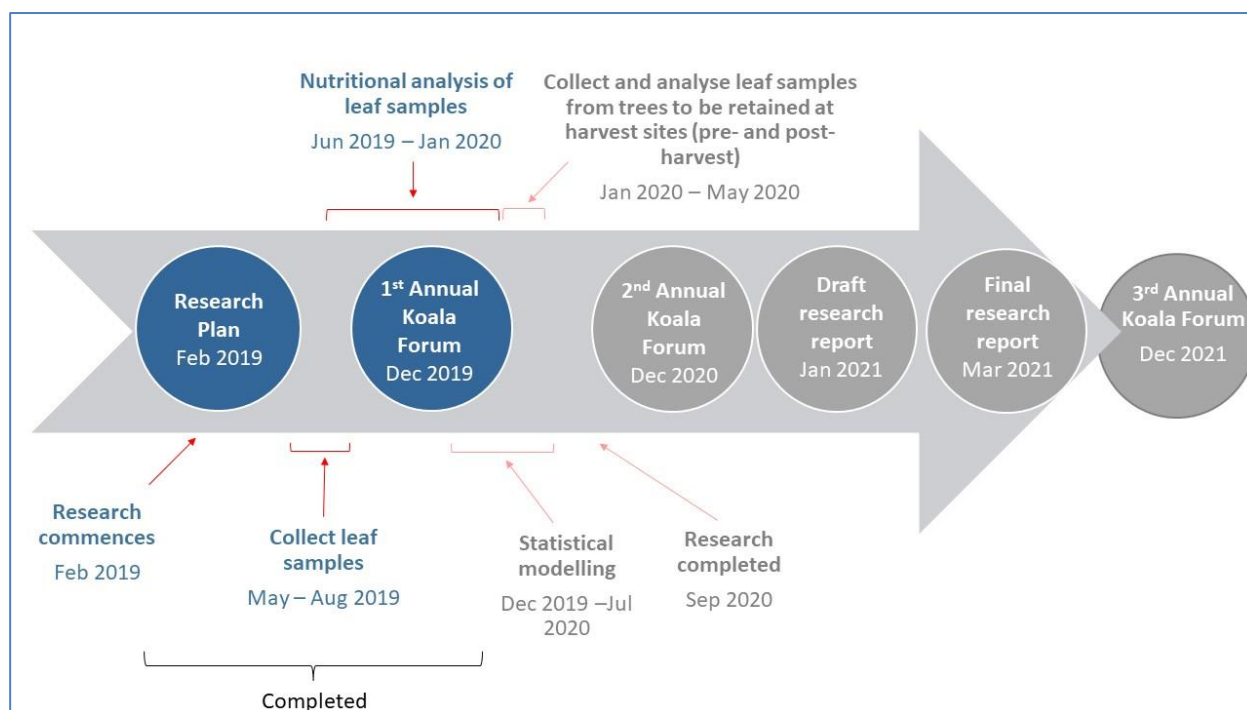


Figure 1. Project milestones and timing for ANU habitat nutritional quality modelling

2.2.2 WSU diet composition and quality analysis

This project aims to determine if, and how, koala diet is affected by harvesting history and assess whether regeneration harvesting is likely to change the nutritional quality of koala diets. It will also determine if changes in diet affect likelihood of koala populations persisting in harvested areas.

Koala scats will be collected from sites with different harvest histories (including the treatment sites selected for the DPI acoustic array and DNA survey and sites occupied by the GPS-tracked koalas from the DPI telemetry study) and DNA samples from these will be analysed to understand:

- which tree species koalas eat
- the nutritional value of the trees eaten
- whether harvesting has impacted the nutritional value of trees.

Researchers:

- have collected koala scat samples from multiple sites
- have collected leaf samples from all the sites to identify tree species used by koalas on the north coast, and extracted DNA
- are identifying genetic markers from the leaf samples to create a tree DNA reference library which will help identify tree species eaten by koalas from plant DNA in scats
- are implementing an additional molecular approach to improve the reliability of tree species identification – this step tests genetic markers before applying to faecal DNA in order to avoid false positives
- are continuing to work towards analysing koala scats to:
 - identify tree species DNA
 - find tannin-bound and unbound proteins that indicate the digestibility of protein in the tree species and their relative nutritional quality

The planned project milestones and timing are summarised in Figure 2.

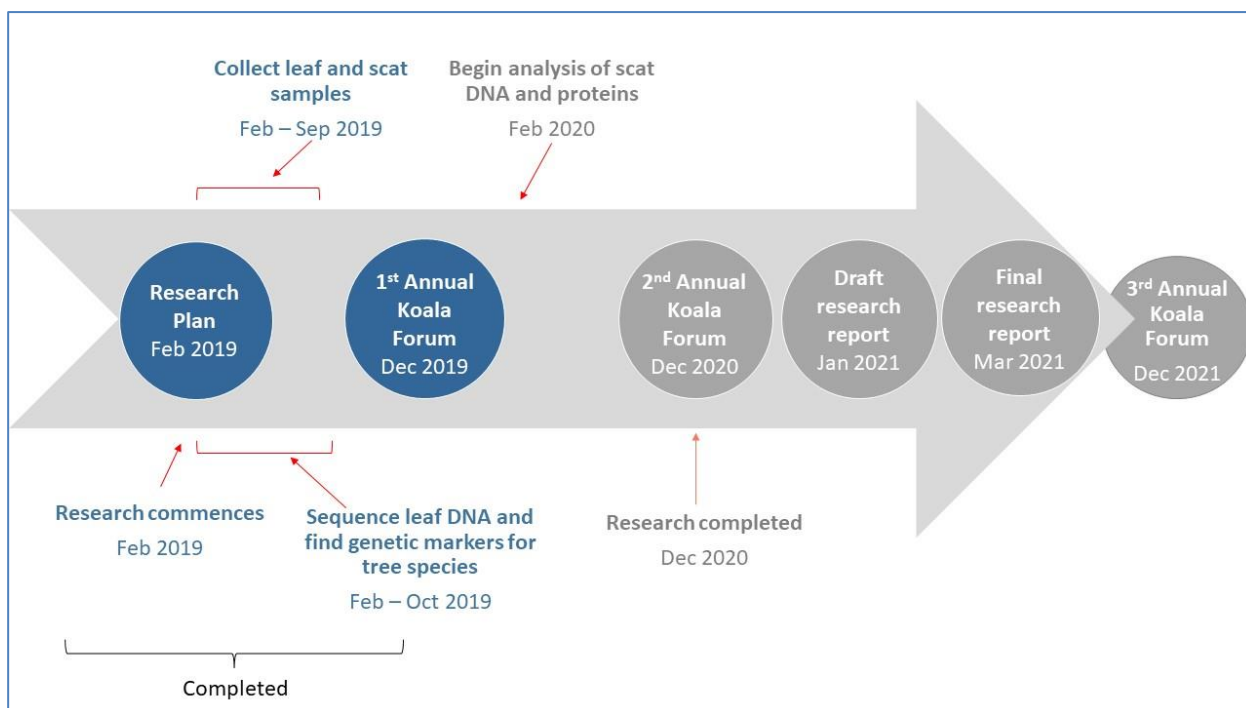


Figure 2. Project milestones and timing for WSU diet composition and quality analysis

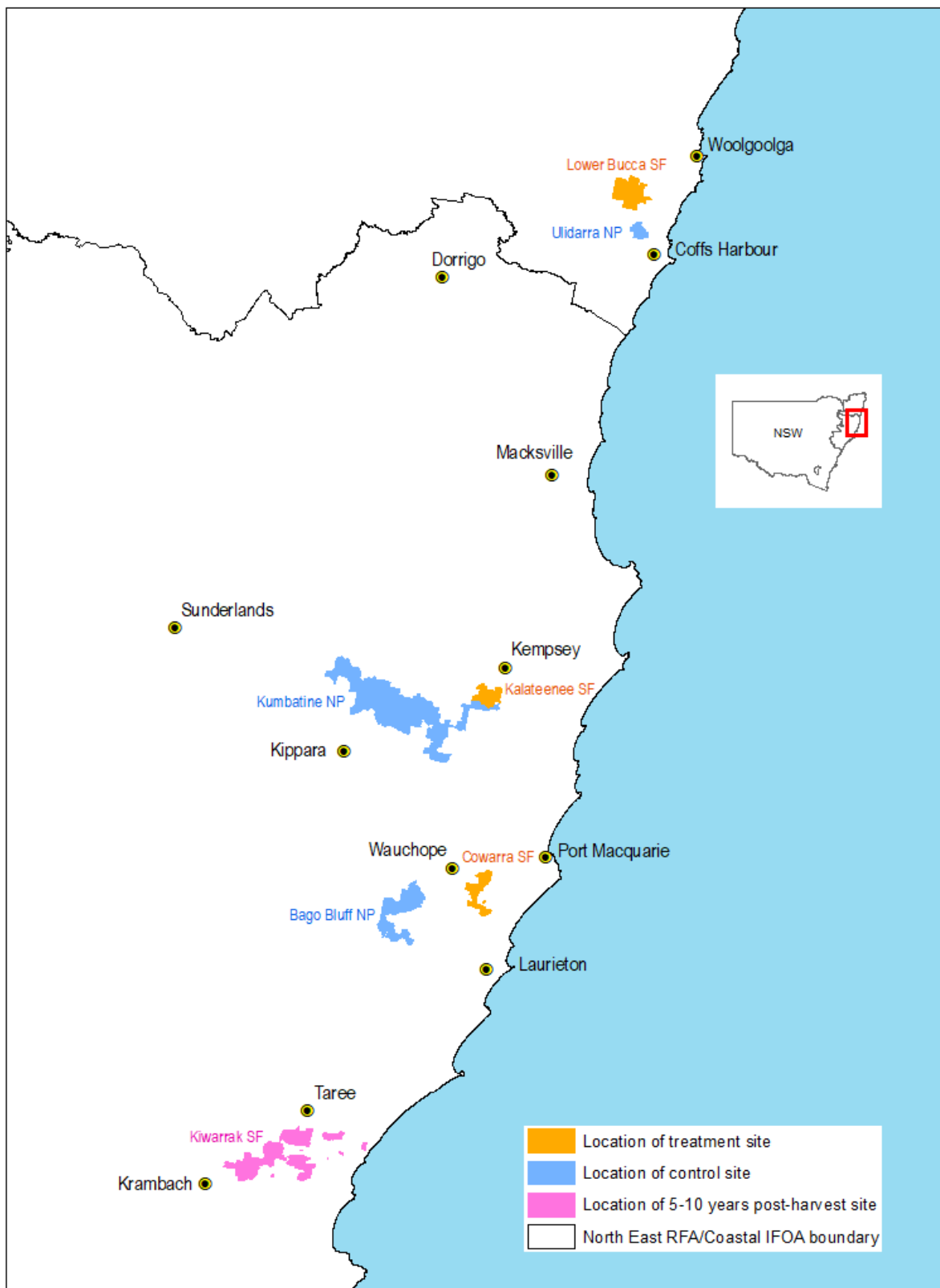
2.2.3 DPI acoustic array and DNA survey

This project will estimate koala population density before and immediately after regeneration harvesting, as well as at the early stages of forest regeneration.

Three treatment sites (sites planned to be harvested on state forests) and three corresponding control sites (within national parks) were selected for pre- and post-harvest surveys. Three additional sites subject to heavy harvests in the last five to ten years will be surveyed to assess koala population density at the early stages of regeneration.

Figure 3 shows the survey sites.⁵

⁵ Note that only one of three post-harvest (5-10 years) sites has been surveyed; the remaining two will be chosen and surveyed in the spring of 2020



Spatial data: Department of Primary Industries and Forestry Corporation of NSW

Document Path: U:\MXDS\Land and forests\Koala research\Draft maps\Draft Map 003E - Koala sites for acoustic survey.mxd

Figure 3. Map of sites selected for DPI acoustic array and DNA survey project

Researchers:

- have set up acoustic sensor grids at each of the treatment and control sites from August to November 2019 to record koala calls (recording for two weeks per site)
- are screening and analysing the recorded calls to estimate koala density at the control and treatment sites pre-harvest
- have completed habitat assessments and scat surveys at all sites surveyed with acoustic sensor grids
- are estimating koala density and sex ratio at Kalateenee state forest using scats and DNA
- have surveyed koala bellows at Kiwarrak state forest (previously harvested five to ten years ago) in addition to treatment and control sites - two additional previously harvested sites (yet to be selected) will be surveyed in 2020.

The planned project milestones and timing are summarised in Figure 4.

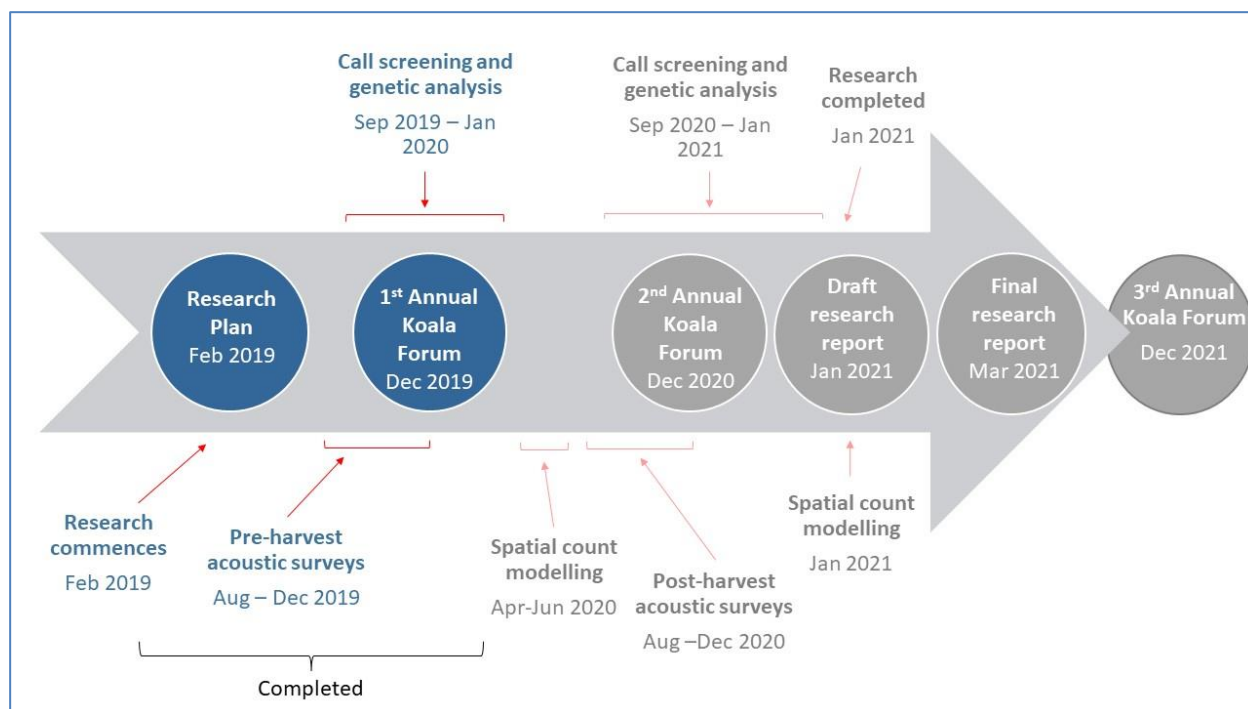


Figure 4. Project milestones and timing for DPI acoustic array and DNA survey

2.2.4 DPI telemetry study

DPI is tracking koala movements within sites harvested around 10 years ago to assess their use of the post-harvest landscape. DPI have collared eight koalas with GPS devices at Maria River, Kalateenee and Cowarra state forests.

Preliminary analysis indicates that koalas are using both mature and young regeneration forest, including small-diameter trees. Tallowood trees are most commonly used for browsing at night, and turpentine trees are commonly used in the day for shelter.

2.3 Implications of drought and wildfire

The major issues that have emerged since this research program commenced are drought and wildfire.

Some forest areas in northern NSW are experiencing noticeable dieback due to the 2019 drought. This may impact tree species composition locally and will be factored into the interpretation of results for the research projects for any sampling sites that may have been affected.

In addition to the drought, wildfire has burnt through over 2 million hectares of the NSW north coast since August 2019. The area is a mosaic of burnt and unburnt patches with varying levels of fire severity. Treatment and control sites for DPI's acoustic array and DNA survey, and DPI's telemetry study have not been directly impacted by the wildfires. Koalas continued to breed at DPI's unburnt, but drought affected, telemetry sites.

However, wildfire has impacted some of the sites sampled for the ANU habitat nutritional modelling project. This provides an ideal opportunity to investigate post-fire impacts on nutritional content of trees, discussed further below in Section 3. Leaf material required by the WSU diet composition project for the identification of appropriate plant DNA markers was collected from all regions and sites prior to the fires.

At the time of publishing this report, FCNSW have postponed planned harvesting operations at two (of three) treatment sites for DPI's acoustic array and DNA survey. This may impact overall timing and design of the research program.

3 Post-fire research opportunities

Opportunities for further research were identified at the forum, particularly with respect to the impacts of wildfire and post-fire recovery.

A range of broad opportunities were identified:

- using drones to locate koalas, including emerging opportunities to use new technology to identify species from thermal images
- understanding which tree species koalas are eating at particular sites, and the differences in leaf quality and digestibility between sites to inform translocations
- comparing scat and acoustic surveys for south coast koalas
- overlaying habitat suitability and new occupancy mapping and fire severity mapping to assess fire impacts on koala habitat
- investigating variability in fire impacts on different vegetation, and linkages to refugia
- investigating post-fire vegetation recovery in drought conditions
- assessing impact of epicormic growth and post-fire leaf regeneration on landscape nutritional quality, and koala feeding and site occupancy post-fire
- identifying critical data to collect for predictive modelling and future change scenarios for koala conservation.

Opportunities specifically related to the Commission's funded projects include investigating post-fire regeneration and capacity of trees to support koalas through:

- sampling sites for nutritional content of regenerating trees in a post-fire and drought affected landscape – this would build onto data gathered prior to the wildfires for the ANU habitat nutritional quality modelling

- assessing changes in habitat composition in response to drought and wildfire, building onto data collected prior to the wildfires through the ANU habitat nutritional quality modelling
- resurveying Kiwarrak state forest to understand how koalas occupy sites in a post-fire landscape (this site was surveyed for koala bellows in 2019 for the current DPI acoustic array project, just prior to the wildfires).

Wildfire has impacted some of DPI's previous acoustic occupancy monitoring sites at Bellangary and Bril Bril state forests (surveyed in 2018). They could provide valuable insights on koala use and re-colonisation of the post-fire landscape through occupancy and density estimates. DPI and FCNSW plan to resample these sites in 2019 and 2020 in a project funded under the NSW Forest Monitoring and Improvement Program, oversights by the Commission.⁶

These additional post-fire research opportunities will be further explored with the NSW koala advisory expert panel and the Department of Planning, Industry and Environment.

⁶ The Commission is independently overseeing and advising on a state-wide monitoring, evaluation, reporting and improvement program for NSW forests. More information available at <https://www.nrc.nsw.gov.au/forest-monitoring>

Attachment 1: Overview of research projects

Research projects selected by the Commission

1 Assessing the contribution of regenerating forests to koala nutrition using molecular and chemical faecal analysis to understand koala diet composition and quality

- Dr Ben Moore, Western Sydney University (WSU).
- Uses DNA and chemical analysis of koala faecal pellets (scats) to understand what koalas are eating, its nutritional value and whether this is impacted by harvest history.
- Referred to as **WSU diet composition and quality analysis** throughout.

2 Determining the effects of regeneration harvesting on habitat nutritional quality for koalas

- Dr Karen Ford, Australian National University (ANU).
- Investigates nutritional quality of koala habitat before and after harvesting and uses known relationships between nutritional quality and koala density to predict the future potential of habitat to support koalas in harvest areas.
- Referred to as **ANU habitat nutritional quality modelling** throughout.

3 Assessing the effects of regeneration harvesting on koala density using acoustics and faecal DNA

- Dr Brad Law, DPI Forest Science Unit.
- Uses a grid of acoustic sensors to understand how koala density varies in the landscape in response to harvesting and with respect to specific IFOA prescriptions.
- Referred to as **DPI acoustic array and DNA survey** throughout.

Other relevant completed and existing projects delivered by DPI Forest Science Unit

4 Tracking koalas in a forestry landscape: Use of intensively harvested landscapes on the NSW North Coast

- Dr Brad Law, DPI Forest Science Unit.
- Current research which uses GPS tracking technology to describe koala use of the post-harvest landscape and assess use of young regeneration versus different kinds of harvest exclusion areas.
- Referred to as **DPI telemetry study** throughout.

5 Passive acoustics and sound recognition provide new insights on status and resilience of an iconic endangered marsupial (koala *Phascolarctos cinereus*) to timber harvesting⁷

- Dr Brad Law, DPI Forest Science Unit.
- Research published in 2018 that used habitat mapping and acoustic recorders to survey for male koalas, focusing on occupancy and bellow rate in different timber harvesting treatments.
- Referred to as **DPI acoustic occupancy monitoring** throughout.

⁷ Law BS, Brassil T, Gonsalves L, Roe P, Truskinger A, McConville A. 2018. Passive acoustics and sound recognition provide new insights on status and resilience of an iconic endangered marsupial (koala *Phascolarctos cinereus*) to timber harvesting. PLOS ONE 13:e0205075.