INQUIRY INTO KOALA POPULATIONS AND HABITAT IN NEW SOUTH WALES

Organisation: Forestry Corporation of NSW

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Inquiry into koala populations and habitat in New South Wales

Submission by Forestry Corporation of NSW to the NSW Legislative Council Portfolio Committee No 7 inquiry into koala populations and habitat in New South Wales

2 August 2019

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Executive Summary

NSW has a world-class reserve network that encompasses more than a quarter of the 22 million hectares of native forest found state-wide and includes the forests with the highest conservation value and best koala habitat.

The Chief Scientist has acknowledged a lack of baseline data about koala populations in NSW at a landscape scale (NSW Chief Scientist & Engineer, 2016). Current research is addressing this and offering a clearer picture of koala populations across the landscape.

New research carried out in partnership by multiple government agencies suggests that koala occupancy in NSW's north-east forests is up to 10 times the rate previously estimated (Law et al 2018).

As studies have found a decline in some koala populations and long-term stability in others, it is important to address the threats to specific populations. Known threats to koala populations are permanent land clearing, activities associated with urban development, fire and drought (McAlpine 2015). These threats occur across tenures, including in areas set aside for conservation.

Timber harvesting, or logging, is very different from land clearing and multiple studies have demonstrated that sustainable timber harvesting is not a significant threat to koalas (Kavanagh et al 1995, Kavanagh et al 2007, Law et al 2018). Research has also demonstrated that koalas occupy harvested forests at the same rate as unharvested forests (Law et al 2018). Key reasons for this are the small scale of timber harvesting in the landscape context, the regulations around forestry activities that ensure trees are retained in each operation and the fact that forests are continually regrown after each operation, with new trees growing for every tree that was removed.

State forests make up 9.1 per cent of NSW's native forest and the area subject to timber harvesting comprises less than a quarter of one per cent of the native forest in NSW. Forestry operations in State forests are carried out in line with regulations designed to protect soil and water, ensure quality regeneration of forests and protect, at a landscape level, the habitat of koalas and other species.

Recent changes to the regulations governing native forestry in coastal State forests, the Coastal Integrated Forestry Operations Approval (IFOA) more than triple the number of koala browse trees retained compared to the previous settings. This is important, given research has found that the availability of preferred koala tree species is a fundamental component of koala habitat regardless of landscape context (McAlpine et al 2008).

Effective land management must be driven by robust data and underpinned by ongoing research. Tenure change will not address the known threats to koalas. Ongoing investment in long-term monitoring across the landscape is essential to ensure future land management decisions are informed by the best available data.

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About Forestry Corporation of NSW

Forestry Corporation of NSW (Forestry Corporation) is responsible for the sustainable management of two million hectares of commercial native and plantation forests in NSW.

The State forest estate is made up of approximately 1.9 million hectares of native forest and 256,000 hectares of native and exotic timber plantations and accounts for 9.1 per cent of the native forest in NSW. Around a million hectares of State forest is managed for conservation, through a network of permanently protected formal and informal reserves, with around a million hectares of native forest available to be harvested and regrown for renewable timber production in line with strict regulations in perpetuity. The same forests have been managed for timber production for more than 100 years on a long-term cycle that ensures less than one per cent of the State forest estate is harvested each year, trees with habitat and conservation value are protected throughout harvest areas and new trees are regrown to replace each harvested tree.

Forestry Corporation is also the appointed land manager for State forests. In this capacity, Forestry Corporation manages conservation, monitoring and research in State forests, facilitates community access to forests, provides community recreation facilities, is responsible for fire management and firefighting, maintains a public road network and carries out a range of other land management responsibilities.

Forestry Corporation manages State forests in line with best practice sustainable forest management and is certified to the Australian Standard for Sustainable Forest Management and has an ongoing role in managing koala habitat in collaboration with other land managers across the landscape.

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1. Term of reference (a) koala populations and koala habitat

There are studies that show local koala populations that have experienced a decline and others that show long term stability. Examining the factors that affect the ongoing functioning of these populations allows for better understanding of the options for managing threats and improving koala conservation outcomes in NSW.

1.1 Forests, habitat and conservation across NSW

NSW has a word class conservation reserve network and sound legislative protections for biodiversity management across all tenures. There are more than 22 million hectares of native forest in NSW. Around a quarter of this land, 5.6 million hectares, is set aside in the formal reserve network, close to two thirds (14.6 million hectares) is private land or leasehold forest and 9.1 per cent (two million hectares) is multiple-use native forest, meaning State forest managed by Forestry Corporation.

Native Forest area by tenure, New South Wales		
Tenure type	Area ('000 hectares)	Area (%)
Private land (incl. Indigenous)	8,852	39.7
Leasehold forest	5,745	25.8
Nature conservation reserve	5,581	25.0
Multiple-use public forest	2,022	9.1
Other Crown land	79	0.4
Unresolved tenure	2	0.0
Total native forest	22,281	100

Table 1: Native forest area by tenure (Australia's Forests at a Glance 2017)

Along the NSW coast, more than 68 per cent of the 10.3 million hectares of land area retains native vegetation cover, meaning the coastal regions are much less cleared than western NSW landscapes as shown in Figure 1 overleaf. More than 30 per cent of the total land area along the coast is reserved and managed in formal reserves, equating to more than 3.1 million hectares. These reserves are comprehensive in their coverage of environmental values, including koala habitat as detailed in Table 2 below. In addition, the one million hectares of State forest that is permanently reserved is afforded a similar level of protection as national parks (Slade and Law 2017).

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Figure 1. Satellite image showing vegetation cover across the key coastal bioregions in New South Wales. Dark green areas are retained forests and the image shows the relatively high levels of intact forest along the coast which are described in Table 2. SEQ = South East Queensland Bioregion which extends into the NSW North Coast. **Source Google Earth**

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IBRA Bioregion	Area (ha)	Formal reserve area	% in formal reserve	% Native vegetation
South Eastern Queensland	1,647,040	227,633	13.8	53
NSW North Coast	3,962,537	980,148	24.7	69
Sydney Basin	3,573,565	1,439,968	40.3	68
South East Corner	1,153,600	496,561	43	85
Total	10,336,742	3,144,310	30.4	68

Table 2. Areas of native vegetation cover and formal reserve in key coastal bioregions in NSW for koala habitat (State of the Environment Report 2015). *Note: The national and regional planning framework for the comprehensive, adequate and representative 'CAR' National Reserve System is provided by the Interim Biogeographic Regionalisation for Australia (IBRA). The South East Queensland IBRA Bioregion Bioregions extends into the far north-east corner of NSW and the South East Corner Bioregion extends into Victoria. The values in Table 2 represent the NSW component only.*

On the NSW north coast, recent habitat mapping model developed by the Department of Primary Industries' Forest Science Centre indicates that there are 1.6 million hectares of high suitability koala habitat. More than half of this (53 per cent) is on private lands, with 25 per cent on national park and 22 per cent (375,440 hectares) on State forest. Of the habitat on State forest, nearly 40 per cent is in forest zoned for conservation and 14 per cent is available for harvesting, with strict prescriptions in place to protect koala populations in these areas.

At a landscape level, the reserve estate covers the whole range of koala habitat and includes previously identified koala hotspots such as Bongil Bongil National Park. The overall division of koala habitat and public forest tenure are shown in the figures below.
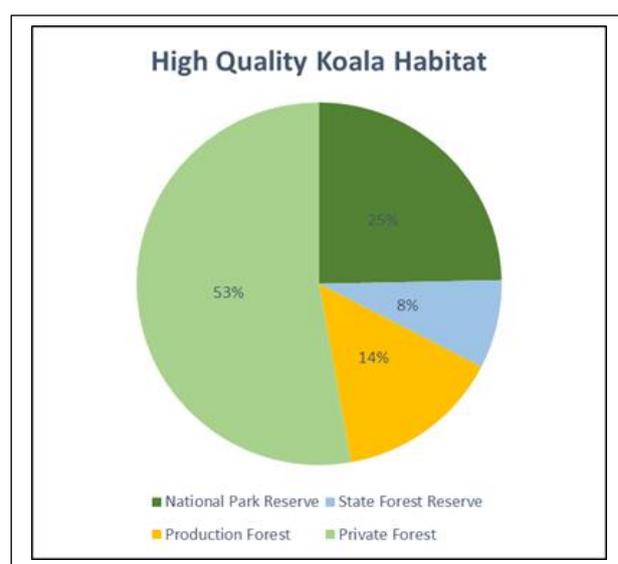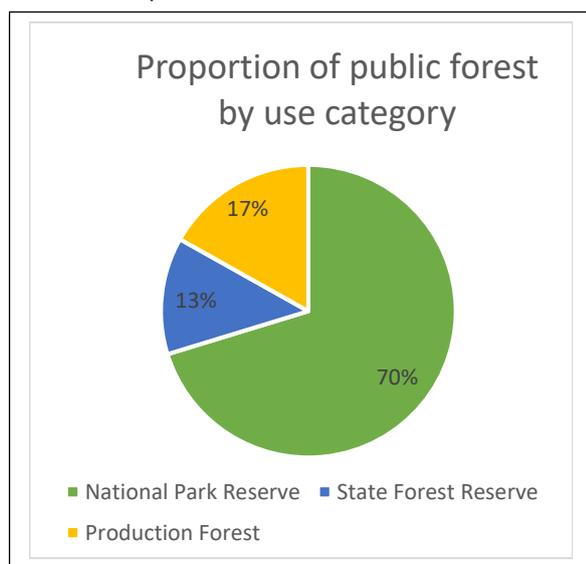
**Figures 2 and 3**: Proportion of public forest and koala habitat by use category

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It is clear from this data that koala habitat is very well represented in reserves along the coast in those areas of remnant forest in the north western parts of NSW. There are further large areas of suitable habitat on private land. Much of this is outside of urban development areas and is likely to support a significant koala population as well subject to threat management across the landscape.

1.2 Recent research in north coast forests

New research has produced evidence that koala occupancy in forested land in NSW's north-east is up to 10 times the rate previously estimated (Law et al 2018). This research included several data-driven studies carried out by the Department of Primary Industries' Forest Science Centre, which involved the development of a new habitat modelling methodology and new field survey techniques using song-meters.

The first project used new modelling techniques to predict habitat quality across the north coast (Law et al 2017). This identified nearly two million hectares of high-suitability habitat across northern NSW and a further two million hectares of lower quality habitat containing low-density koala populations, as shown in Figure 4 below.

Figure 4: Map layer produced by the DPI Forest Science habitat model, which is used to predict habitat quality across the landscape based on input variables, such as aspect, infrared vegetative reflectance values, fire history, and historical koala records.

The data layer is categorised to reflect habitat suitability classes.

Data provided by DPI Forest Science.

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The habitat models were validated using sound recording devices known as song meters, which were installed throughout the forest for more than seven days to record animal calls. The recordings were then analysed to determine koala presence within a range of approximately 500 metres. This survey provided a dramatically extended survey duration and area coverage when compared with other available techniques for surveying koalas.

Using the new habitat model and occupancy survey results, Law et al (2018) identified that the north coast had a substantially higher koala population than previously estimated from expert elicitation and in the Chief Scientist report (2016). Using a very conservative approach, it was estimated that there is a minimum of 14,000 Koalas in high quality habitat on public lands alone, (Law et al 2018).

Taking a less conservative approach and applying published koala densities for different habitat qualities, the koala habitat model has been used to estimate a koala population in the entire northern NSW koala habitat model area, as shown in Table 3 below.

Table 3: Koala population for north coast NSW based on DPI habitat model and published koala densities in different quality habitat.

Habitat Quality	Area of modelled habitat (hectares)	Range of Published Average Home range size (hectares)	Range of published Koala densities (Koalas/ha)	Feasible koala population (assuming 80% occupancy)
Very High	385K	7 - 13	0.15 - 0.08	20,400
High	1.28M	50	0.02	20,400
Low-Moderate	2.96M	100 - 200	0.005 - 0.01	25,450
Total	4.6M			66,250

Field surveys conducted across the north coast since 2015 using this methodology have shown occupancy at higher than expected levels and a stable trend (Law et al 2018). The methodology has been tested on the south coast of NSW in the Murrah Flora Reserves (Law et al 2019) and trials are underway or planned in areas on the southern tablelands and north west slopes.

Through the koala strategy, the NSW Government is developing predictive habitat models for a range of regions in NSW. These models, combined with occupancy data at a regional scale from song meters, could quickly provide a reliable picture of koala habitat and population size across the State. Ongoing monitoring using song meters can affordably provide an evidence base for regional trends.

Key points to consider from the new research are:

- new techniques have been developed to establish a more complete picture of koala populations than previously available
- north coast forests have up to ten times more koalas than previously estimated
- research, modelling and monitoring are required to provide an ongoing understanding of local koala populations and trends.

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1.3 Research into koalas and forestry

A number of research projects in NSW have identified that timber harvesting is not a significant threat to koala populations (Kavanagh et al 1995, Kavanagh et al 2007, Law et al 2018).

In 2018, following the Chief Scientist's report and strategy, Forestry Corporation partnered with DPI Forest Research to examine koala occupation of high-quality habitat in areas of forest that had been harvested for timber. The study compared occupancy in areas that were harvested recently, less recently and areas that had not been harvested for decades. The areas had been harvested using different techniques, with fewer trees harvested in selective harvesting operations and more trees harvested in intensive harvesting operations. The results found no difference in koala occupancy between sites, regardless of time since harvest, harvest intensity or amount of harvesting in the local landscape (Law et al 2018) as shown in Figure 5 below.
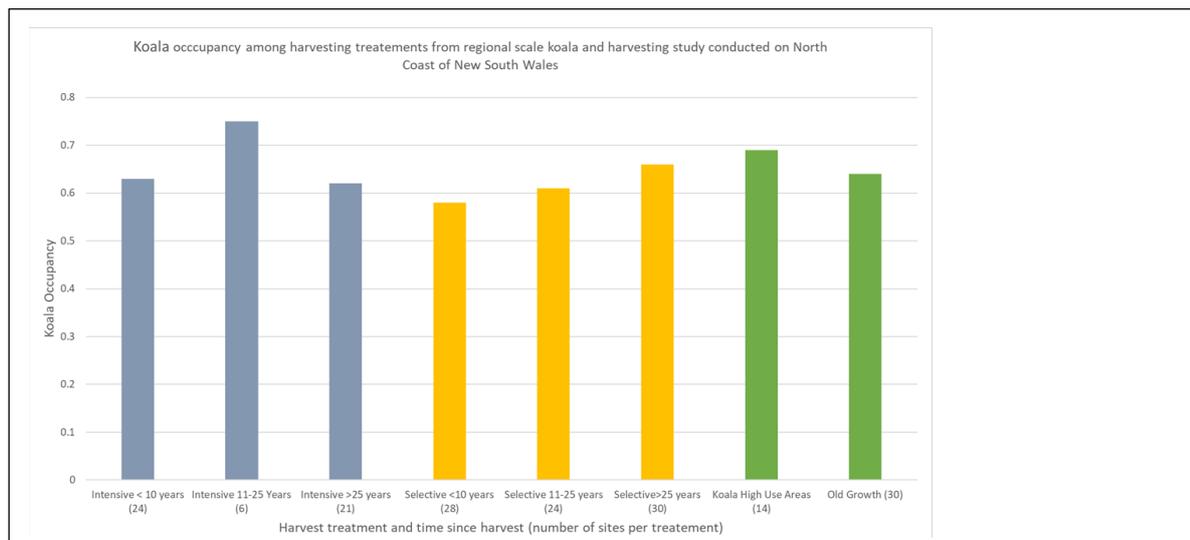

Figure 5: Koala occupancy among harvesting treatments from regional scale koala and harvesting study conducted on north coast of NSW (modified from Law et al 2018).

Research has found that the availability of preferred koala tree species is a fundamental component of koala habitat regardless of landscape context (McAlpine et al 2008). In studies from the former Pine Creek State Forest, now Bongil Bongil National Park, multi-age regrowth forests with more than six feed trees per hectare of primary koala browse trees was found to be the best habitat, although all habitat classes were used by koalas (Miller 2012, Smith 2004).

Occupancy of plantations by koalas on the Liverpool Plains showed substantial koala populations in very young forests with remnant vegetated areas in proximity (Kavanagh and Stanton 2012), showing young regrowth forests in a well-managed landscape support substantial koala populations.

Another research project underway between DPI Forest Science, Port Macquarie Koala Hospital and Forestry Corporation ecologists is using GPS radio-tracking to look at how koalas use harvested areas. By observing koala movements and browsing in exclusion corridors, which are areas of habitat that are not harvested, retained browses trees in the harvest areas and regrowth from recent harvesting, the research aims to determine the most important elements to koalas continued occupancy in harvested forests. Data to date shows koalas using both exclusion zones and harvested areas and feeding in both scattered retained trees and regrowth from recent harvesting, as demonstrated in Figure 6 overleaf.

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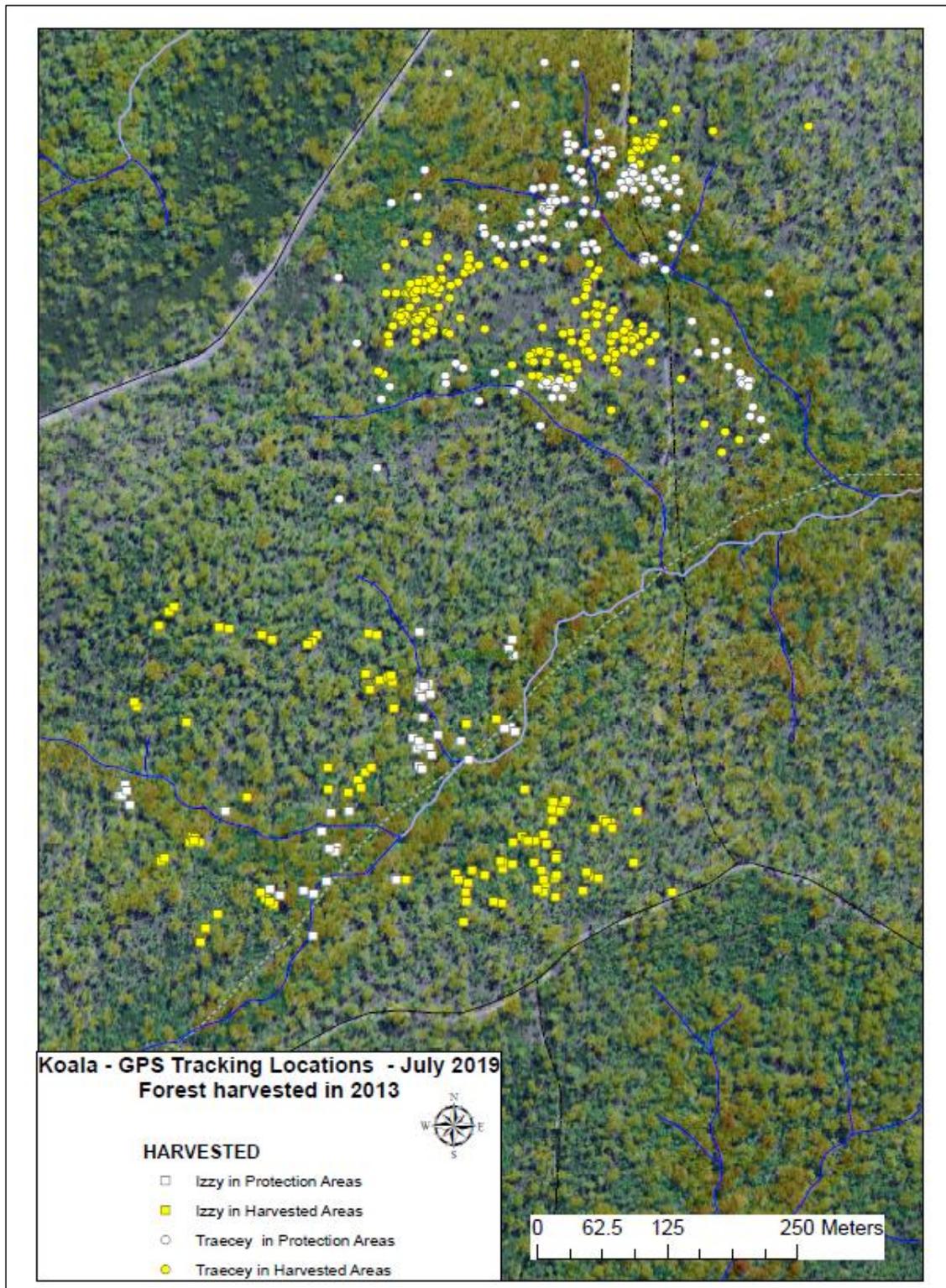
Figure 6: Satellite image showing GPS tracking locations of two female koalas in Maria River State Forest, south of Kempsey. This area was subject to intensive harvesting six years prior to the radio tracking study and the koalas home range and habitat use clearly includes the retained trees and regenerating trees in the harvested areas.

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The Natural Resources Commission (NRC) is also overseeing the implementation of several research projects into koalas in areas subject to timber harvesting. These projects, operating under the NSW Government's Koala Strategy, aim to identify koala densities before and after harvesting, preferred koala browse species and map nutritional value of forests.

The key points from research in State forests are:
- while timber harvesting takes place in forests inhabited by koalas, it is not a key threat to koala populations
- measures in place to manage timber harvesting in State forests were developed from research and are important contributors to why koalas are still common in harvested forests
- research and monitoring are ongoing to ensure future land management decisions are informed by the best available data.

1.4 Research into non-State forest koala populations that are declining

Koalas are difficult to research as they have very large home ranges, do not move much during daylight hours and are frequently obscured by the trees in which they spend the majority of their days. An average population density in the order of one koala per 200 hectares makes koalas difficult to survey directly. Indirect surveys, such as by searches for scats, are also unreliable as the rate of scat production and decomposition are highly variable from site to site and throughout the year.

Most published studies of koala population status have focused on populations suffering from known and ongoing threatening processes. For example, studies have been carried out on populations affected by roads and permanent clearing for highway upgrades in Northern NSW (Kavanagh 2016, Lassau 2008) or populations in urban or peri-urban areas (Golidingay and Dobner 2014, Lunney et al 2002, Dique et al 2003). Studies have also been carried out drawing on results from koala hospital admissions (Gonzalez-Astudillo et al 2017).

The example in figure 7 overleaf of the koala populations in a conservation reserve adjoining the town of Iluka in northern NSW shows at a small scale how persistent threats lead to a population decline in a local area. First, habitat is directly lost as the town is developed with houses and roads. The constant movement of traffic on a mid-high-speed road through high quality habitat into town results in ongoing mortality at higher than the breeding capacity.

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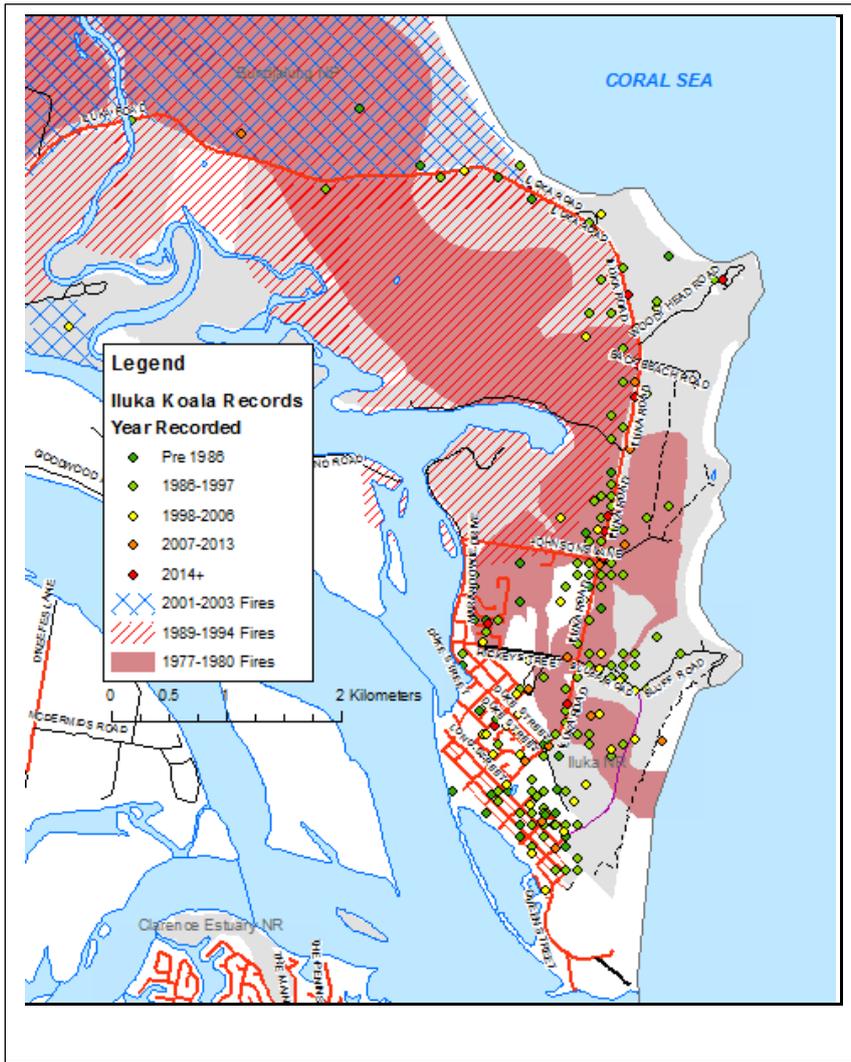
Figure 7: Koala records and major fires at Iluka NSW. Lunney at al (2002) researched koala declines in this area and modelled local population extinction and forecast koala recovery from recruitment from the wider koala population. The key threats to the population included:

- Disease – high rates of *Chlamydia* were identified in the population along with low fertility.

- Car collisions – Iluka Road is a high-speed sealed road running through koala habitat in Bundjalung National Park entering town.

- Dog attacks – these may be domestic dogs in town and wild dogs in reserves.

- Clearing for development – the number of records in the town streets is notable in recent years.

- Wildfires – the map shows large areas burnt by wildfires since 1977, with some areas burnt at least three times between 1977 and 2003.

In South-east Queensland the process described above has occurred at a larger scale as Brisbane, the Gold Coast and the Sunshine Coast have developed over the past 30 years. The urbanisation around Brisbane, where threatening processes have been rapidly expanding over the last 30 years is evident in Figure 8 overleaf. The small islands of retained forest in this landscape have known koala populations and mortality is frequently reported in the surrounding suburban areas.

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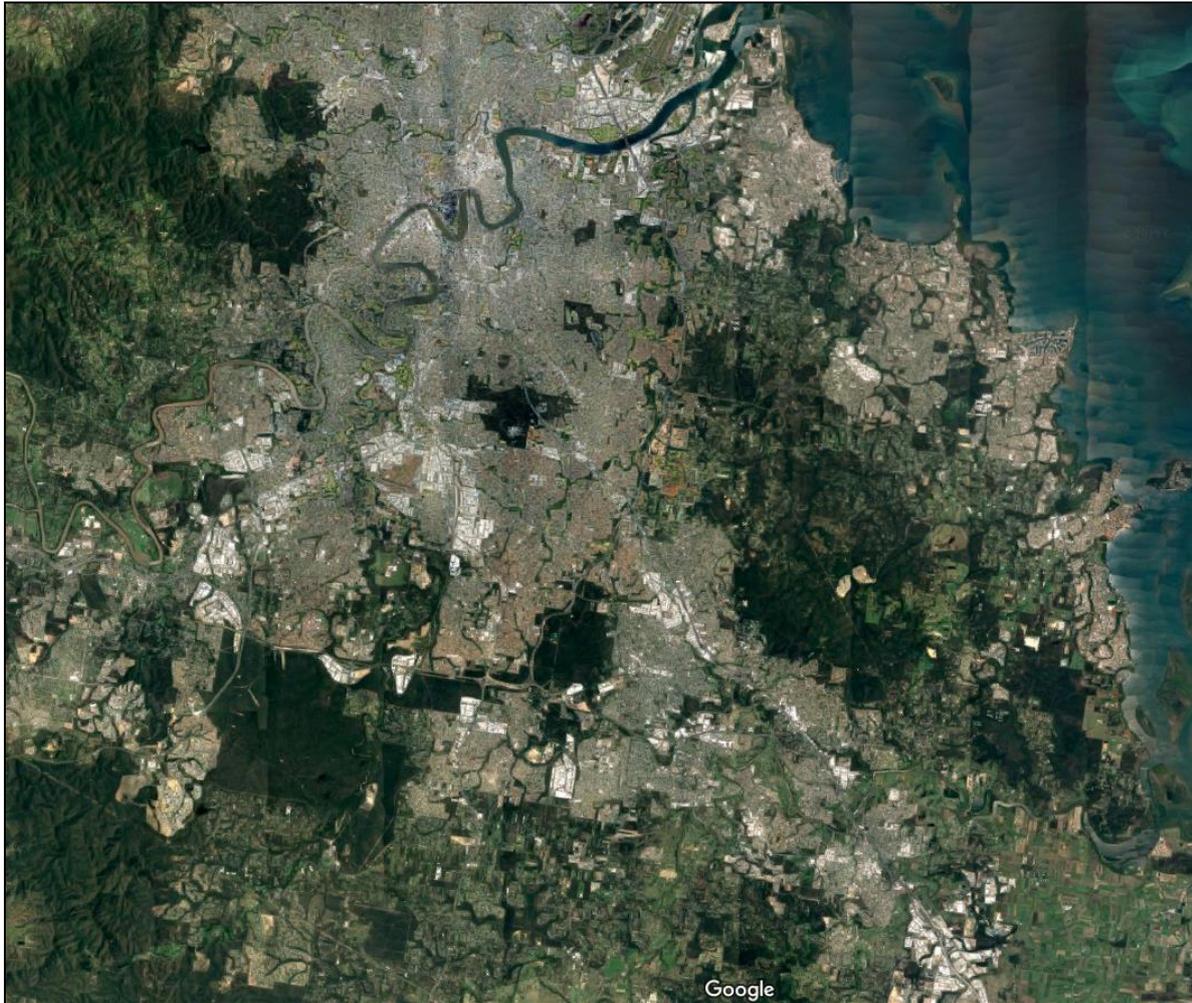
Figure 8: Satellite image showing urban expansion in koala habitat around Brisbane in south east Queensland. Source: Google earth

There are two key points that can be taken from these examples of koala populations:

- These threats do not occur evenly across all koala habitat and populations, so the declines associated with them can't be assumed to occur everywhere.
- The reserve network did not take these threats away – the Iluka population was within a national park. The threats are not tenure specific but arise from land management paradigms that lead to the threats arising.

1.5 Research into non-State forest koala populations that are stable

Studies in south west Sydney and on the Southern Tablelands have found evidence of stable low-density koala populations in areas not impacted by permanent land clearing and shown larger and more stable populations than previously known.

A range of projects that have identified stable populations, include:
- Close et al (2017) found that a study population in Campbelltown, though at low density, was approaching maximal population dynamics in terms of longevity and reproductive success

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- surveys conducted in Western Sydney by the Science for Wildlife Group in conjunction with University of Sydney, are mapping large areas of koala habitat from the Hawkesbury and Wollomi to Kanangra-Boyd and the Newnes Plateau
- Wollondilly, Wingecarribee and Campbelltown Council in conjunction with the Office of Environment and Heritage (OEH), identified healthy koala populations in southern Sydney
- survey work in the Southern Tablelands between Snowy-Monaro Council, local groups and OEH identified a large koala population on the southern tablelands.

The common themes from these research projects are:
- despite there being large areas of reserves, limited surveys and the cryptic nature of koalas meant little was known about the koala populations
- systematic surveys and research have shown healthy koala populations and many more koalas than previously thought in these locations.

1.6 Conclusions from research and areas for further research

Conclusions that can be drawn from the range of research are:

- koala habitat is very well represented in reserves along the coast of NSW
- the reserve network does not in itself remove threats to koalas as they are not tenure specific and often arise from adjoining land use
- threats do not occur evenly across all koala habitat and populations, so the status of koala populations across the State cannot be extrapolated from studies in a single location
- new research provides evidence of koala occupancy in NSW's north-east forests up to 10 times previously estimated levels and there is evidence of stable koala populations in other locations
- if managed under evidence-based measures, timber harvesting does not impact koala occupancy
- further monitoring is needed to develop a clearer picture of koala populations across NSW.

Priorities for further research and monitoring on koalas should focus on four main areas:

1. Initiatives to improve the quality and quantity of data on koala populations across NSW:
- monitoring koala population trends at a regional scale across multiple land tenures to clearly identify regions areas where koalas are stable, increasing and declining
- better mapping and understanding threats in areas where koalas are declining.

2. Initiatives to address the known threats to and declines of some koala populations:
- disease prevention and management strategies
- road design, fencing, crossings
- effective fuel reduction and fire management strategies for koala habitat
- effective wild dog management strategies in peri-urban areas.

3. Initiatives for returning koalas to degraded landscapes:
- Identifying priority areas to re-establish corridors and connections between fragmented habitat
- tree plantings to increase koala habitat where it has historically declined such as the Bega Valley
- potential for translocation of koalas to areas where they no longer occupy suitable habitat.

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4. Ongoing research into koalas in forests subject to timber harvesting. The following work is already underway and will be reporting in coming years:
- Forestry Corporation and various research partners are committed to research projects looking into koala habitat usage in various harvesting contexts
- Forestry Corporation and research partners are committed to monitoring koalas across their range in State forests.

2. Term of reference (b) the impacts on koalas and koala habitat:

2.1 Context for public native forestry in NSW

State forests make up a small proportion of the NSW landscape, equating to around two per cent of the total land area and 9.1 per cent of the total native forest estate. Half of the native State forest estate is in exclusion areas that are afforded the same protections as national parks (Slade and Law 2017). Each year, timber harvesting takes place in less than one per cent of the area set aside for timber production, equating to 0.24 per cent of the total area of public native forest in NSW as shown in the figures below.
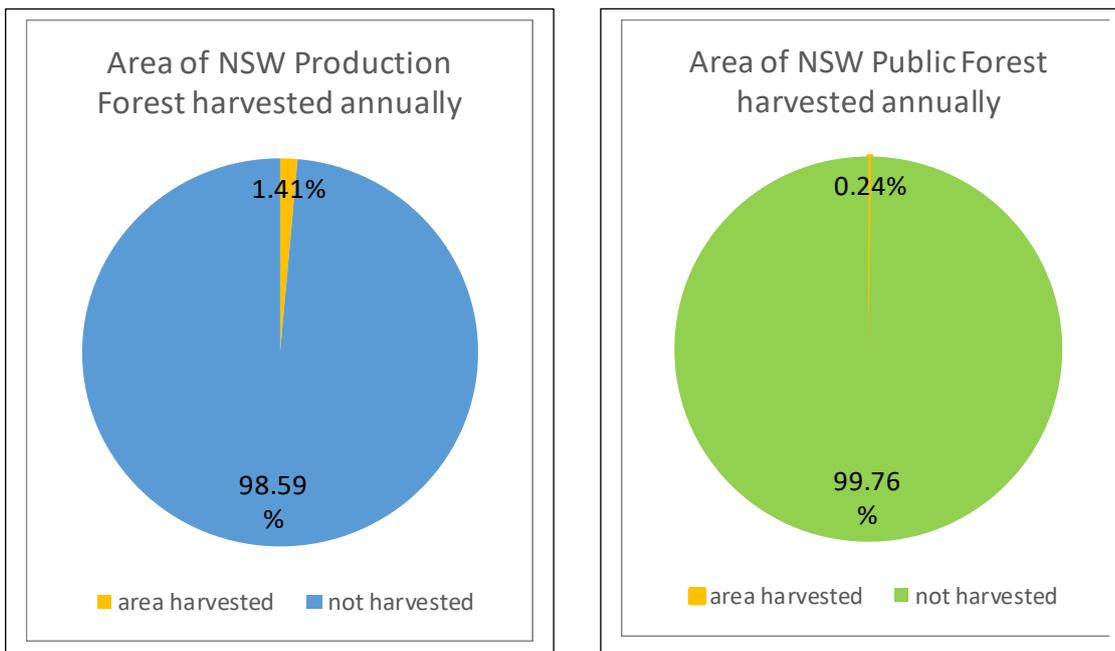
Figures 9 and 10: Charts showing the average area subject to harvest per year as a proportion of the total area of a) public state forest and b) all public forest in NSW.

The small footprint of timber harvesting in State forests and the continual regrowing of harvested forest provides ongoing habitat for flora and fauna populations, including koalas. Koalas are found throughout the NSW forest estate where harvesting has either historically and recently occurred (Law et al 2018).

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2.2 Timber harvesting and koalas under the RFA and IFOA

Forestry on public lands in NSW takes place in a framework set by the Regional Forest Agreement (RFA), which is a long-term agreement between the State and Commonwealth. The RFAs set up the comprehensive, adequate and representative (CAR) reserve system in the coastal areas of NSW that led to the transfer of the best quality habitat on State forest to the formal reserve system and helped ensure delivery of NSW's current world-class forest landscape reserve system.

The RFAs also set up requirements to implement Ecologically Sustainable Forest Management (ESFM), a key principle of which is to only harvest as much as is grown and to always grow back whatever trees are harvested. They prescribe that timber can only be harvested from regrowth forests, that is forests that have previously been harvested for timber and regrown and have ongoing monitoring and reporting requirements.

The requirements for ESFM set up in the RFAs are implemented through rules established under the Integrated Forestry Operations Approvals (IFOA). In November 2018, a new Coastal IFOA was introduced to improve upon and replace four existing IFOAs for the Upper North East, Lower North East, South Coast and Eden regions of NSW.

The key management practices that apply under both the previous and updated Coastal IFOA to manage koalas were developed by expert panels based on research. The principles are:

- maintaining patches of undisturbed habitat in the landscape
- identifying and retaining adequate feed trees
- setting appropriate limits on the size of harvest areas
- dispersing harvesting across the landscape over time
- ensuring forests are regrown after harvesting.

The Environment Protection Authority (EPA) and NRC were engaged in the process of developing the new Coastal IFOA to deliver better and more reliable outcomes for koalas. Key changes applied were:

- replacing ineffective surveys conditions with new, verified, habitat models to implement koala browse tree retention even where no koalas are detected, resolving the difficulty of finding koalas in field surveys
- implementing new wildlife habitat clump protections, which substantially increases the area of koala habitat strictly and permanently protected compared to previous IFOAs
- doubling tree retention rates in the highest quality habitat
- requiring ongoing assessment of koala trends and the effectiveness of the conditions in supporting koalas.

The combined results of these changes more than triple the number of koala browse trees retained compared to the previous settings. This is an important improvement given research has found that the availability of preferred koala tree species is a fundamental component of koala habitat regardless of landscape context (McAlpine et al 2008).

The IFOAs set out a range of detailed environmental protection measures that must be adhered to in timber harvesting operations in native State forests. Forestry Corporation spends many months before every operation carrying out detailed planning, including ecological surveys, and sets aside

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large areas for protection and conservation of native flora and fauna and forest biodiversity in line with these regulations. Additional exclusion zones are set aside for threatened species in line with prescriptions developed by expert scientific panels. These are all marked on electronic maps installed in equipment, which is then electronically tracked as part of ongoing compliance auditing. The entire area is then regrown after each operation.

The images on the following pages show harvest planning and regeneration in line with the requirements of the IFOA. Mapping underlays and overlays showing detailed topographic maps produced from LIDAR (remote sensing) data, electronically marked retained trees (including koala browse trees) and harvesting machinery GPS tracks. In this operation thousands of trees were identified for retention either as hollow-bearing trees, recruitment trees, which are trees that will become hollow-bearing trees in future, seed trees or koala feed trees.

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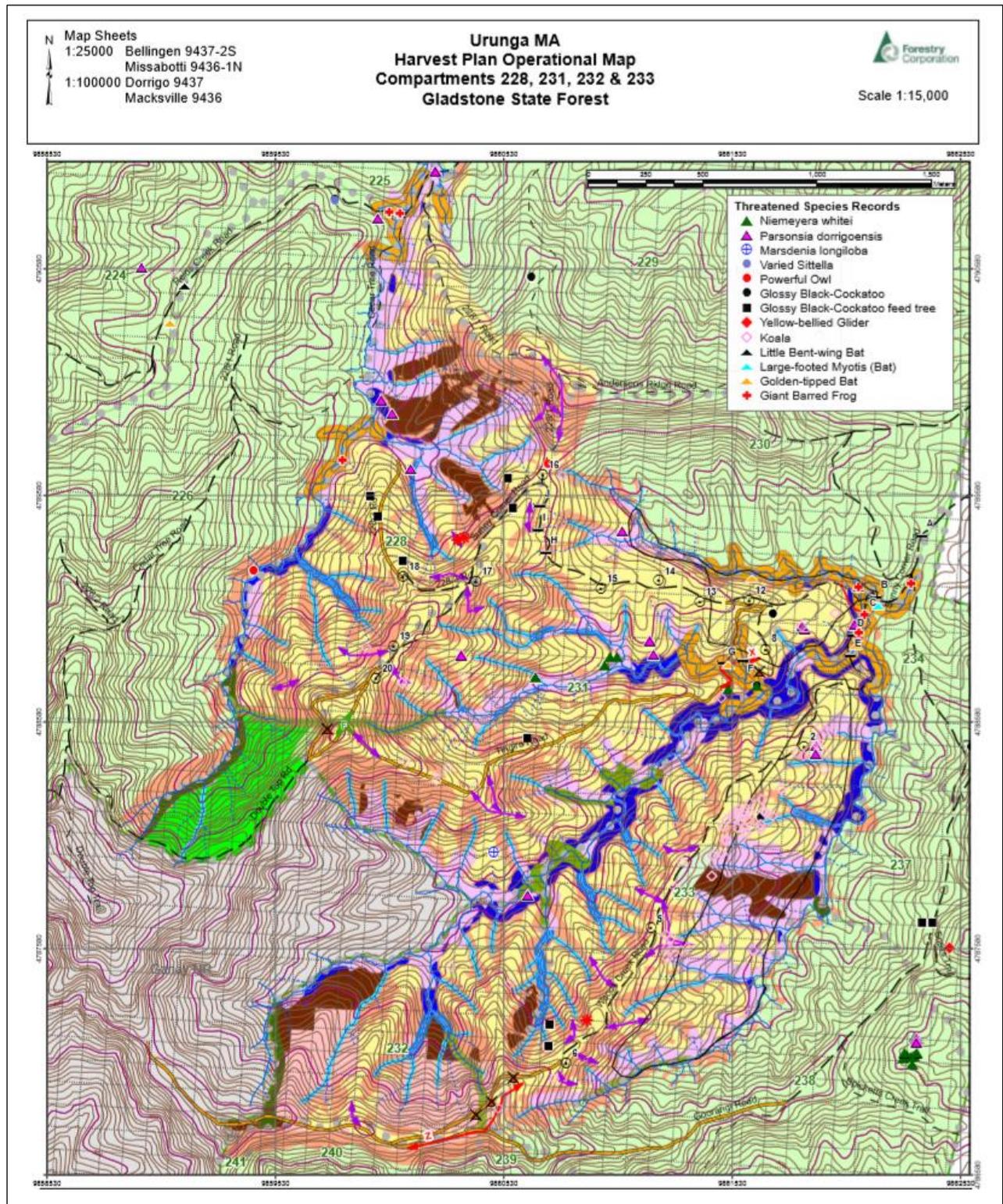
Figure 11: A harvesting plan for selective harvesting in Gladstone State Forest. In this map, the areas that are coloured yellow are available for harvesting. More than half of the total area is excluded permanently from harvesting to protect rainforest, old-growth, steep areas, riparian exclusions, other special management zones or due to being inaccessible.

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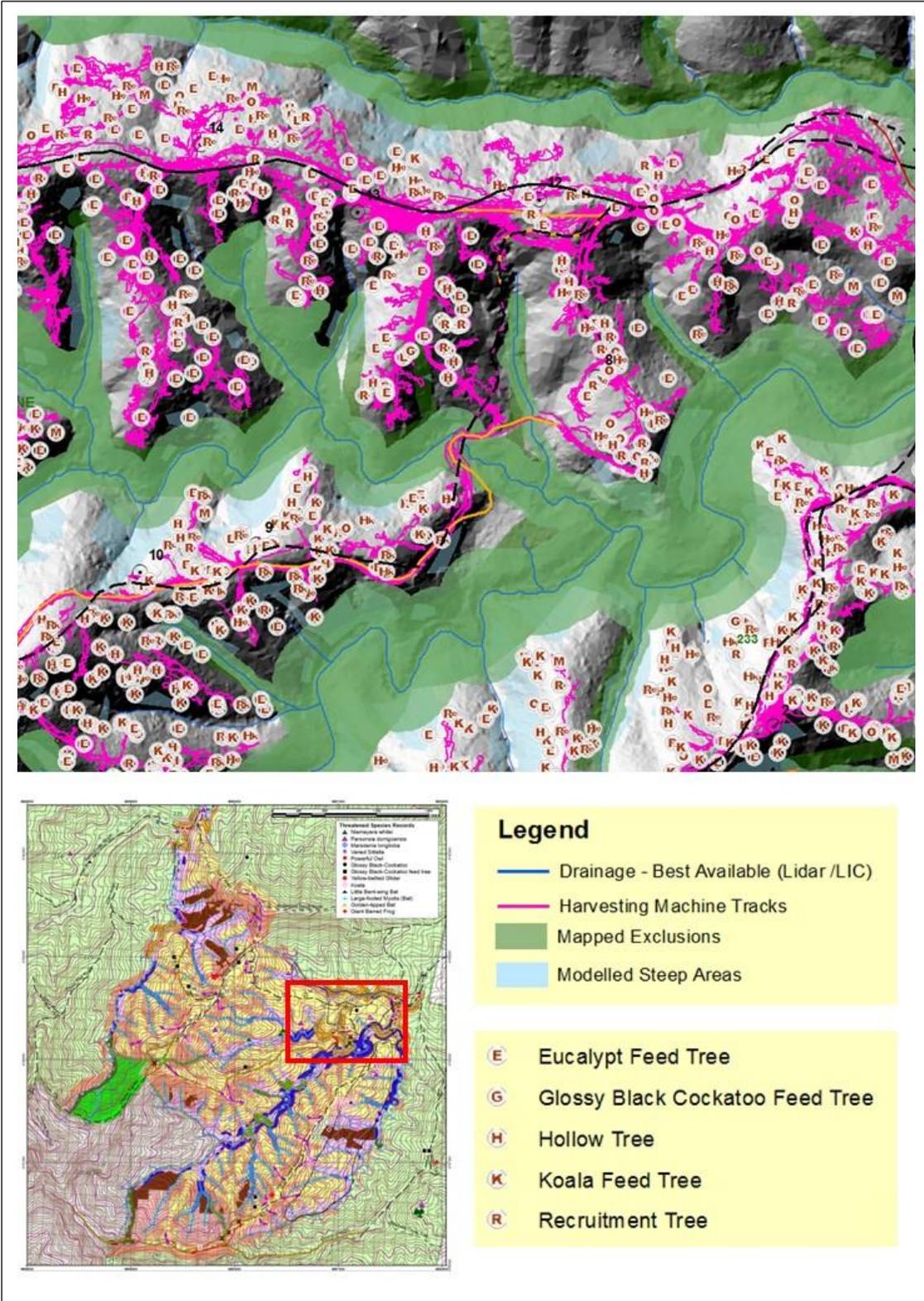
Figure 12: Map image showing compliance management in harvest areas. The circles indicate individual trees that have been identified and marked throughout the harvest area to ensure they are not removed during harvesting and will remain in the forest to ensure there is ongoing habitat while the young forest fully regenerates.

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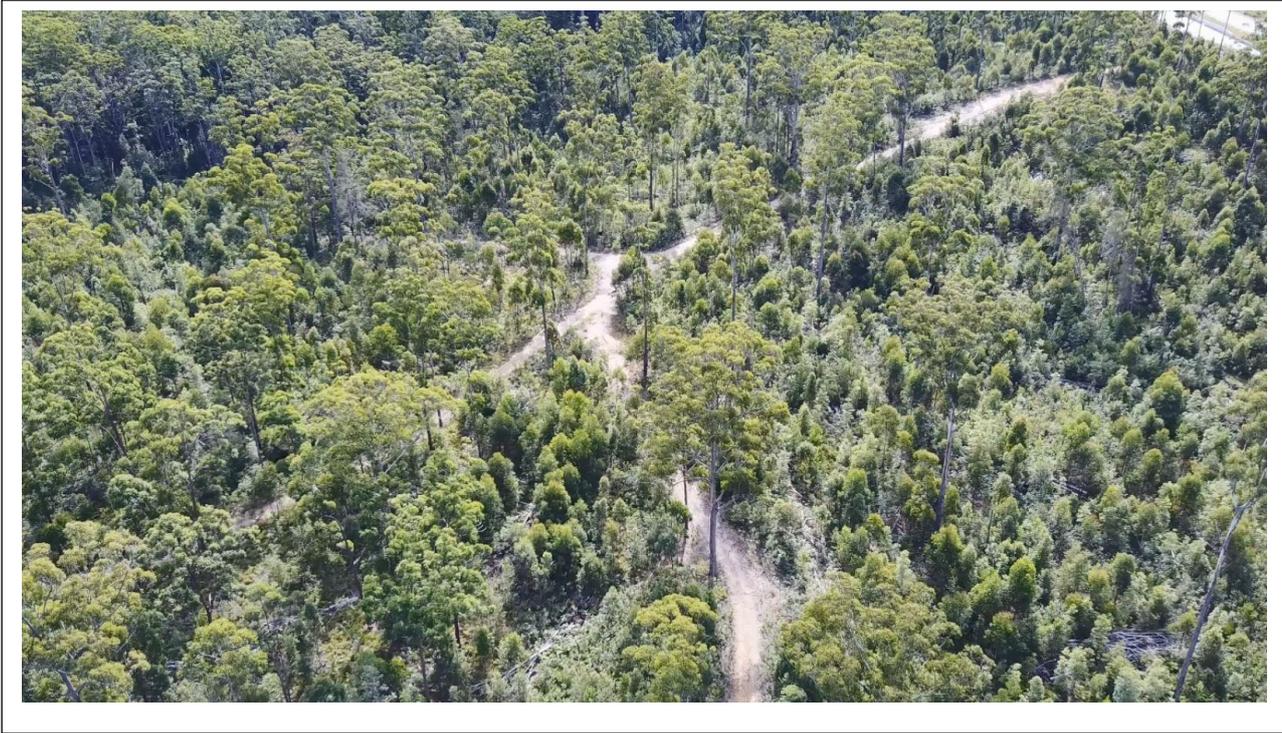
**Figure 13:** A regenerating regrowth blackbutt forest, 10 kilometres north of Urunga, five years after intensive harvesting showing a mix of the mature trees retained during the previous operation and young regeneration. This area has an active koala population today.

Figure 14: An active selective harvesting operation south of Port Macquarie showing the context of operations within a broader undisturbed landscape, as required under the Coastal IFOA and RFAs.

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The key points to be drawn from this are:

- the RFAs set up the comprehensive, adequate and representative (CAR) reserve system in the coastal areas of NSW that led to the transfer of the best quality habitat on State forest to the formal reserve system
- existing research and monitoring conducted on public forests showing koala occupancy is unaffected by harvesting (Law et al 2017, Law et al 2018)
- the new Coastal IFOA represents an improvement on previous regulations, with more than triple the number of koala browse trees retained compared to the previous settings
- the substantial increase in protections afforded by the new Coastal IFOA ensure State forests continue to provide a high level of protection where timber harvesting is permitted.

2.3 The Private Native Forestry Code of Practice

A large proportion of forests in NSW (39.7 per cent) are on private lands. Native forestry is only conducted on a small sub-set of these forests. Forestry Corporation is involved in Private Native Forestry operations from time to time under agreements with landholders for timber harvesting and marketing. In these circumstances, forestry operations are conducted under the Private Native Forestry code, which in general is less onerous in terms of its environmental and reporting provisions than the IFOAs that apply on State forests.

A statutory review of Private Native Forestry is required later in 2019 and it would be beneficial to consider the current research into koalas as part of this review.

2.4 The old growth forest remapping program

The remapping of old growth forest is a Natural Resources Commission proposal designed to improve accuracy of mapping.

3. Term of reference (d) Identifying key areas of koala habitat on public and private land

3.1 Identifying areas at risk of land clearing

Land clearing is the permanent removal of vegetation, commonly carried out for the conversion of land for agriculture or to facilitate urban expansion, such as housing development or new road construction. Forestry Corporation is unable to provide information on the identification of areas that require protection from clearing. Clearing is not an activity carried out by Forestry Corporation.

3.2 Identifying areas at risk of logging

Sustainable timber harvesting and regeneration (logging) must be addressed separately from land clearing, as they are different activities.

Sustainable timber harvesting is the removal of a portion of selected trees from areas zoned as suitable and appropriate for timber production, in line with strict regulations to maintain habitat trees and connectivity with other adjoining forest, and the continual regeneration and regrowth of forests on that land with new trees. Timber harvesting results in temporal disturbance to small areas of some

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forests each year. Across the landscape over time, this timber harvesting leads to a mosaic of forest structures and age-classes that contain trees of many different ages and growth stage.

Significant investment has been made in NSW in identifying and protecting koala habitat on public land, in the development of the CAR reserve system as part of the RFA process. The areas where timber harvesting is permitted were identified as part of this process, and recent work has been done to comprehensively model and map koala habitat in these areas. As noted in section 1.2, recent habitat mapping model developed by the Department of Primary Industries' Forest Science Centre identified 1.6 million hectares of high suitability koala habitat on the NSW north coast, of which 14 per cent is available for harvesting, with strict prescriptions in place to protect koala populations.

Key conclusions:

- significant investment has already been made in identifying and protecting koala habitat on public land, in the development of the CAR reserve system as part of the RFA process
- a number of research projects in NSW have identified that identified that timber harvesting is not a significant threat to koala populations (Kavanagh et al 1995, Kavanagh et al 2007, Law et al 2018) and ongoing research continues to demonstrate that koalas use harvested forests at the same rate as unharvested forests.

3.3 Impacts of climate change

With the likelihood of higher occurrence of droughts and extreme heat days in the future there will be continuing pressure on some koala populations, particularly those in Western Districts subject to prolonged drought.

While the larger mitigations relevant to climate change are beyond the scope of this inquiry, there are two relevant precautionary mitigative measures that should be considered:

- re-invigorating fire management and prescribed burning across NSW forested landscapes which will have the impact of reducing hazardous wildfires in koala habitat.
- planting new trees in degraded (cleared) landscapes, which will have the effect of increasing the area and resources available for koalas across the NSW landscape.

4. Term of reference (e) the environmental, social and economic impacts of establishing new protected areas to conserve koala habitat, including national parks

McAlpine et al (2015) reviewed and identified the key threats to koalas as habitat loss, hotter droughts, disease, dog attack and vehicle collisions. Large scale urbanisation, agricultural development and mining, along with climate change were increasing risks requiring mitigation. They identified that habitat conservation will not resolve the issue of koala conservation.

Evidence shows that koala populations in reserved areas are subject to many threats that can cause them to decline locally. As noted in the Iluka example in section 1.4 of this document, a national park

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did not dilute the threat of wildfire, roads and dog attack. In other areas, severe wildfires have lead to large scale koala mortality, including in the Warrumbungle's National Park in 2013 and Lake Innes Nature Reserve near Port Macquarie in 1994.

Accordingly, the strength of any proposal to set aside new areas for koala habitat will depend on the size, location and current land use of proposed protected areas. For example, a proposal to create new reserves by planting or revegetating previously cleared private land would differ greatly from a proposal to establish a national park in an area that is already forested.

Creating new reserves on areas of koala habitat that might otherwise be subject to permanent clearing has the most merit, particularly if this is also linked to a broader program of koala conservation measures in the surrounding landscape. Most significant land clearing developments that result in permanent land use change need to provide compensatory habitat through biodiversity offsets. This may lead to significant private land investment in habitat that could form strategic reserves for koala habitat and placed under conservation management. However, the creation of new reserve areas that are small, isolated and surrounded by conflicting land uses and threats will not address the underlying threats.

Creating large reserve areas where there are currently no threats to a known koala population by changing land tenure from State forest to national park will provide little additional conservation benefit.

While no specific proposal has been set forward in the terms of reference, a proposal that has been discussed broadly recently is the conversion of productive State forest to conservation reserves on the north coast of NSW to create a Great Koala National Park (GKNP). This specific proposal covers the highest productivity, highest demand timber in NSW and would reduce the availability for high quality logs of desired species by around 40 per cent.

The Australian Forest Products Association released economic modelling indicating that proposal would cost $757 million a year to the NSW economy and cut almost 2000 jobs. Ximenes et al (2016) reported that the cost of transition of the NSW public native forests from timber production to conservation reserves would be $3.36B on the north coast, not accounting for predicted decline in regional employment.

Importantly, the creation of this proposed reserve does not address any known threat or cause of decline.

Before any land use change, consideration must be given to:

- establishing baseline data on the koala population across the landscape in the area identified and an ongoing monitoring program to identify changes over time
- identifying the key threat to the local koala population and the land management activities in that will best mitigate that threat as well as the threat of drought, heat waves and wildfires, and monitoring it over time
- completing a thorough review of existing land use and any direct or indirect economic implications stemming from the specific proposal.

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Tenure change will not address risks to koalas, as threats to koalas are not tenure-specific. Any measures proposed to improve koala conservation in NSW must be based on sound scientific, land management principles.

5. Term of reference (f) any other related matter

Recent research shows historic koala population estimates are not reliable, with populations on the north coast found to be ten times greater than previously estimated. There remains a need for better monitoring across other regions to ensure decisions about conservation measures are based on data.

There are also further opportunities to focus on threat abatement strategies such as:
- managing fire in the landscape
- planting trees in degraded landscapes
- managing roads and development and predators in areas with suitable koala habitat
- investing in epidemiological research round disease
- consideration of translocation or breeding strategies for areas where koalas no longer occupy suitable habitat due to historical impacts.

However, the success of any koala conservation strategies now or into the future will only be measurable if NSW moves to implement a system of monitoring for koalas over the long term.

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Glossary

CAR National Reserve System – The Regional Forest Agreement establishes a Comprehensive, Adequate and Representative (CAR) Reserve System that is based on nationally agreed criteria for the protection of forest biodiversity, old-growth and wilderness values.

CIFOA – Coastal Integrated Forestry Operations Approval. The regulations governing native forestry in NSW State forests.

DPI Forest Science Centre – Department of Primary Industries' Forest Science Centre

ESFM – Ecologically Sustainable Forest Management.

EPA – NSW Environment Protection Authority.

IBRA – Interim Biogeographic Regionalisation for Australia.

IFOA – Integrated Forestry Operations Approval. The regulations governing native forestry in NSW State forests.

LIDAR – remote sensing technology.

RFA – Regional Forest Agreement.

NRC – Natural Resources Commission.

OEH – Office of Environment and Heritage.

PNF Code – Private Native Forestry Code. The regulations governing native forestry on private land in NSW.

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