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KOALA HABITAT CONSERVATION PLAN

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WWF-Australia and partner conservation and animal welfare organisations extend our sincere thanks to David Paull and the other experts for researching and producing this plan. If koalas continue to roam and bellow across the forests and bushland of Eastern Australia come the end of the twenty-first century, those who come after us will have them to thank for helping save the koala from extinction in the wild.

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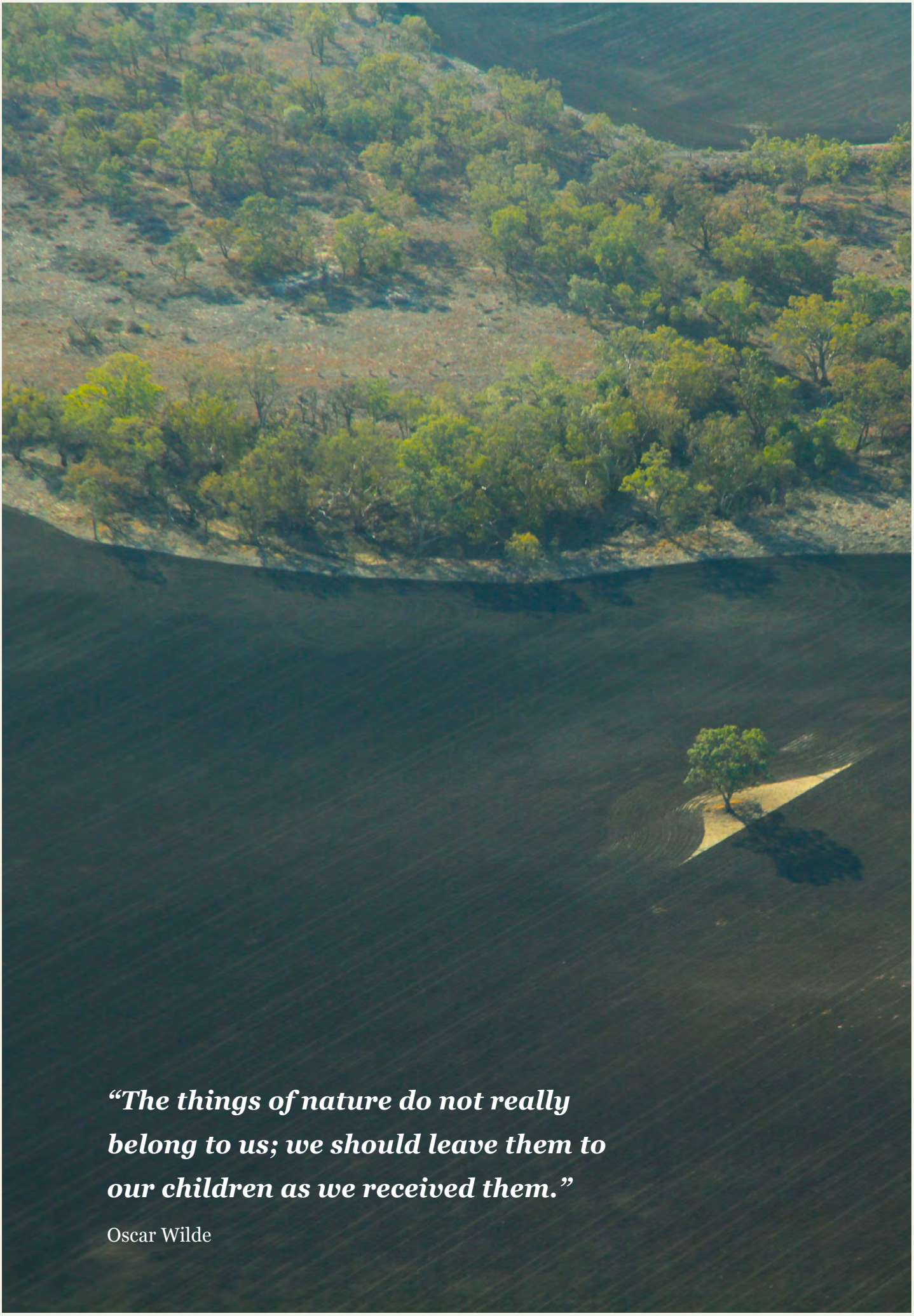

PADDOCK TREE IN CROPPING LANDS, WESTERN NSW © WWF-AUS / STUART BLANCH

"The things of nature do not really belong to us; we should leave them to our children as we received them."

Oscar Wilde

Foreword by WWF-Australia

The findings in this report show that koalas are declining in number. They have already been driven to extinction in many places across eastern Australia. The analyses identify koala populations in decline, and which are at risk of local and regional extinction in the next few decades. On current trends, the species faces extinction in the wild across most or all of New South Wales and Queensland this century unless threats are curtailed.

Just 230 years ago, many millions of koalas roamed the great forests and bushland of eastern Australia.

This report was prepared for WWF-Australia and leading conservation organisations by koala expert David Paull with expert input from more than 10 experts from the fields of conservation science, koala ecology, koala conservation, environmental law, assessment and management of native vegetation, forest ecology and koala nutrition.

WWF-Australia considers this plan to be the first such report produced by koala experts independent of governments and political influence that undertakes a comprehensive assessment of threats to koala habitat at the scale of the vulnerable population in eastern Australia. It proposes comprehensive legislative reforms and on-ground conservation measures to slow and reverse the decline towards extinction of the species in the wild in NSW, Queensland and the ACT.

The geographic scope of this plan is the three jurisdictions in which the vulnerable population of koalas listed under federal environmental law occur, namely New South Wales, Queensland and the Australian Capital Territory. However, due to challenges in securing access to accurate and current data and mapping regarding koala habitat and populations in Queensland, the focus is on NSW. The conservation organisations and authors hope to expand the detailed analyses conducted for koalas in NSW to Queensland, in collaboration with Queensland koala experts, in the future.

EXECUTIVE SUMMARY

This plan is the first produced by koala experts independent of governments and political influence to undertake a comprehensive assessment of threats to koala habitat at the scale of the vulnerable population in eastern Australia.

It proposes comprehensive legislative reforms and on-ground conservation actions to slow and reverse the decline towards extinction of the species in the wild in NSW, Queensland and the ACT.

Status of koalas and main threats

WEAK AND PERMISSIVE LAWS PASSED BY ALL LEVELS OF GOVERNMENT ARE DRIVING THE LOSS OF KOALA HABITAT IN NSW & QLD

The main driver of the loss and fragmentation of koala habitat are the weak and permissive laws passed by state, federal and local governments which allow excessive tree-clearing and deforestation. Without the right species of eucalypts and other trees, koalas have no homes or food.

Koala populations in both New South Wales and Queensland are declining and may face extinction in a few decades.

Between 1990 and 2016, at least 9.6 million hectares of vegetation have been bulldozed in NSW and Qld, including both primary and regrowth forests.

Native forest logging of koala habitat on public lands in NSW is set to increase in scale and magnitude with the passing of the new Coastal Integrated Forestry Operations Approvals.

Private native forestry is occurring extensively, though few details are publicly available. Codes of practice have generally had a limited ability to identify important koala habitat or koala usage, with the focus on self-assessment.

Laws and policies for approving major infrastructure projects, mines and state significant development often place protection of koala habitat as a low priority, if at all. Reliance upon offsetting and translocation of koalas to other forests is largely ineffective at preventing population decline.

Urban growth and infrastructure development in NSW and Qld are contributing to significant ongoing decline of coastal populations.

Lack of protected areas that conserve significant koala habitat and major population is still a significant issue in NSW and Qld.

Actions urgently required

Laws and policies, which regulate vegetation removal in New South Wales and Queensland, require urgent and significant strengthening in order to protect koala habitat.

Native forest logging on public lands needs to end immediately with the transferral of significant areas of state forest to the reserve estate. In the interim, forestry operations on public and private lands require strengthening with better enforcement in order to protect koala habitat.

© IMAGE PROVIDED BY COMMUNITY GROUPS VIA THE NATIONAL PARKS ASSOCIATION OF NSW

A NSW and Qld koala strategy should be truly whole-of-government and address the main threat of loss of koala habitat from tree-clearing and forest destruction, rather than focussing largely on the symptoms.

Expansion of the protected areas network is necessary to prevent further decline of koala populations. To assist government, WWF has identified Koala Habitat Priority Areas, which include:

More than 400,000 hectares of state forests, Crown land and other government lands by inclusion within the reserve system or provided with in perpetuity protection.

Approximately 500,000 hectares of freehold land that require in perpetuity protection or purchase or additions to the reserve system.

Key areas that require substantial increase in levels of protection in NSW include the north coast area of NSW; the inland forests of northwest NSW and the Murray Valley; and, the headwaters of the Georges and Nepean Rivers near Campbelltown in southwest Sydney.

In NSW, increased funding and technical assistance for landholders is urgently required for communities and businesses seeking to reforest koala habitat across over-cleared landscapes. This should involve a major increase in funding for the NSW Government's Biodiversity Conservation Trust, Environmental Trust and Saving Our Species program to scale-up investment in regenerating, revegetating and protecting koala habitat in perpetuity.

In Queensland, expansion of the protected areas network to conserve priority koala habitat is required across all areas of the state where koalas occur. This will include levels of commitment under the Qld Government's Land Restoration Fund.

The Australian Government should make saving the koala from extinction in the wild in eastern Australia this century a national priority. In the short-term, the Australian Government must amend or replace the federal *Environment Protection and Biodiversity Conservation Act* to enable stronger clearing triggers, stronger environmental assessment and compliance enforcement of developments that may affect koala habitat.

A new national Environment Act would underpin new independent institutions to drive policy to end major landclearing, including of koala habitat.

The Australian Government should develop an ambitious and well-funded national koala recovery plan designed to save koalas from extinction in the wild.

The Australian Environment Minister should commence the process for upgrading the status of koalas in NSW, Qld and the ACT from the current 'vulnerable' to 'endangered' in order to increase the national government's capacity to protect koala habitat.

ORPHAN KOALA JOEYS, SOUTHEAST QUEENSLAND, AUGUST 2017 © WWF-AUS / PATRICK HAMILTON

SUMMARY OF THREATS AND STATUS

Given that koala populations continue to decline to historic lows, koala populations in NSW and Queensland would likely qualify for 'upgrading' the current 'vulnerable' listing to 'endangered'.

Current koala situation in NSW and Queensland

The analysis provided in this Koala Habitat Conservation Plan (the Plan) shows that:

- The reserve system provides insufficient coverage of existing koala populations and habitat, accounting for only 13.6% of all known records in NSW. This will not prevent the imminent loss of koala populations, given that 67.4% of records are from private freehold lands and 8% from state forests, where threat trends continue to rise. Another 10.7% are found on crown lands.
- There is no widely accepted estimate of the total population size for Eastern Australia's vulnerable koala population. Official information on this is poor, notwithstanding the efforts over decades of an army of passionate people from community, government, Indigenous, research and consulting sectors who have studied this endearing species. There is a genuine need for better estimates of population sizes and trends. A compilation of the latest survey and estimate data presented here shows there are currently 37 to 38 metapopulations in NSW with a likely total population size of 15-28,000 animals. Southeast Queensland has a likely population size of 5,000 to 20,000 animals.
- Surveys and population models show the majority of metapopulations across NSW, Qld and the ACT are declining in abundance, with reduced ability for transfer of genetic materials between populations. Data presented here suggests 25 metapopulations are in decline in NSW, two are apparently stable, and 11 other metapopulations show a presence in recent surveys but with insufficient baseline data to determine trends.
- It is likely that koalas have already disappeared from large areas of their former range in western NSW and Queensland, suggesting habitat conditions in these areas are now inadequate to support koala populations. The pace of such local extinctions is growing, with climate change hastening declines. Many populations in coastal and western areas may already be functionally extinct. Remaining areas of potential koala habitat within their current range are often fragmented and reduced in size.
- Many existing populations are under high levels of local threat from ongoing land clearing, native forest logging, urban expansion, infrastructure development and the onset of climate change-related effects. This situation has been exacerbated by poor legislative and regulatory control over vegetation removal, poor environmental planning and increased levels of dog attack, disease and vehicle collisions.
- Given that koala populations continue to decline to historic lows, koala populations in NSW and Queensland would likely qualify for 'upgrading' the current 'vulnerable' listing to 'endangered'.

Threat assessment

- Weak and permissive laws, particularly in NSW and Queensland, that are supposed to regulate land clearing and deforestation, are the primary driver of the current koala extinction crisis. Primarily due to habitat loss and fragmentation, these landscape-scale impacts have precipitated increased levels of disease, vehicle strike, dog and cow attacks, dehydration and other impacts associated with high levels of human interaction.
- National Carbon Accounting Scheme figures show that from 1990-2016 approximately 2,200,000 hectares of native vegetation was cleared in NSW. While it is not clear how much of this was koala habitat, koala habitat modelling estimates reveal that 8,500,000 hectares has been cleared in NSW since European settlement, or 40% of modelled pre-1750 vegetation extent (based on the federal government's Species of National Environmental Significance habitat mapping). Some of the more important koala habitats have been cleared by approximately 70 to 95%.
- Sixty-five percent of the total loss of native forests in Australia has occurred in Queensland over the past four decades. Over just the 20-year period between 1995 and 2016, 3,600,000 hectares of remnant vegetation has been cleared in Queensland, with another 2,800,000 ha of regrowth cleared during the same period. It is not clear how much of this is koala habitat, although it is likely to be a significant proportion.
- The impacts of native forest logging on public lands in NSW have increased in scale and magnitude with the passing of the new Coastal Integrated Forestry Operations Approvals (IFOA), which set up intensive harvesting zones on the north coast similar to current practice on the south coast, with poor tree retention rates and poor levels of koala habitat protection.
- Private Native Forestry has been carried out extensively in NSW, although few details are publicly available. Codes of practice have generally had a limited ability to identify important koala habitat or koala usage, with the focus on self-assessment. The River Red Gum Code of Practice had no test to trigger koala actions until 2018, following a review of the codes. Since being transferred to the portfolio of the NSW Lands Minister, there are no guidance notes regarding koalas.
- Urban development, infrastructure and other major projects such as mining are now having major impacts on koalas by affecting the viability of local populations, reducing habitat extent, and increasing fragmentation. Construction of barriers with poor regard for koala ecology and movement also kills koalas, such as from vehicle collisions. Major projects or state significant projects have generally placed environmental outcomes towards the bottom of considerations by consent authorities, while placing greater emphasis on translocation, such as upgrades to the Pacific Highway near Ballina in NSW.
- Climate change is making Australia's normally challenging weather for koalas more extreme by exacerbating droughts, heat stress and bushfires. This kills koalas, whether directly such as by overheating and dehydration, or indirectly by degrading the eucalypt forests they live in. Leaf-eating animals are susceptible to declines in foliage quality, nutrient levels and water availability. Extended drought across NSW and Queensland has already coincided with a decline in koala numbers, along with habitat losses, which reduces the resilience of populations.

- Koala habitats are being increasingly affected by logging induced dieback throughout coastal NSW. Logging opens up gaps in the forest which are colonised by lantana and other weedy vines which suppress native regeneration and help the spread of sap-sucking insects and Bell Miners. Lantana is being spread by repeated logging, and stress from climate change, at an alarming rate.
- The koala habitat conservation and restoration measures proposed in this plan would also benefit a suite of other species inhabiting forests and bushland of Eastern Australia, many of which are threatened with extinction. Species which would benefit include including marsupials (such as Greater Glider, Yellow-bellied Glider, Spotted-tail Quoll, Eastern Quoll, Long-nosed Potoroo and Brush-tailed Phascogale), many species of bats, birds, reptiles, invertebrates and plants. Adoption of these recommendations would go a long way to reversing the broadscale biodiversity decline that is characterising the forests and bushland of NSW and Queensland.

Ways to better manage koalas

- Koala conservation is best implemented through the use of local expert knowledge and community participation, but requires a commitment to ongoing funding and increasing legislative protections. The proposals associated with the proposed 315,000 hectare Great Koala National Park for the Coffs Harbour hinterland are a good example of this approach. The analysis presented here provides strong validation for these proposals.
- Koala distribution and abundance surveys should be undertaken in ways that maximise the benefit for future monitoring and use the most effective techniques, which are intensive aerial-based surveys, transect surveys and dog-based surveys.
- Any mapping of koala habitat should be verified by on-ground surveys. Caution should always be used when relying on preferred tree species lists that are not derived from local information and do not take into account tree condition.
- Forage quality needs to be considered within assessments of habitat quality. This can either be done through plot-level assessments of the proportional representation of koala food tree species, or by sampling leaves from a representative sample of every koala food tree species on site for forage quality analyses. Forage quality analyses involve lab-based assessments for total foliar nitrogen, digestible nitrogen and formylated phloroglucinol compounds and unsubstituted B-ring flavanones.
- While faecal pellet surveys have limited use for describing population densities and size, faecal pellets are useful for monitoring the genetic diversity of populations. Further investment is needed to develop non-intrusive ways to test animals for health and disease, to assist communities to build a management profile for each population.

WILDLIFE IN CARE, SOUTHEAST QUEENSLAND, APRIL 2017 © DOUG GIMESY / WWF-AUS

NATIVE FOREST LOGGING DESTROYS KOALA HABITAT IN COASTAL NSW. © SUPPLIED BY COMMUNITY GROUPS VIA NATIONAL PARKS ASSOCIATION OF NSW

LAND CLEARING IN NORTHWEST NEW SOUTH WALES. OCTOBER 2012 © WWF-AUS

RECOMMENDATIONS FOR EXPANDING PROTECTED AREAS

Priorities for Expansion of the Protected Areas System in NSW

This report has focussed on priority koala lands across NSW due to issues with data availability for large areas of Queensland, although it is anticipated that a similar Queensland analysis with follow.

- The WWF koala hubs and priority areas identified in this study do not delineate all areas of importance for koalas, but they do identify those areas known to be of importance – areas with the highest modelled density of koalas. Koala habitat within these areas requires urgent protection and enhancement to first stabilise, then grow koala populations. Priority 1 areas are of the highest importance – known to support koala populations. Priority 2 lands are also of high importance and are likely to contain important koala habitat.
- Due to increasing threats to koalas in NSW state forests, there needs to be a significant increase in levels of protection for koalas. WWF Koala Habitat Priority Areas have identified 341,776 hectares of state forests for inclusion in the reserve system, with 180,368 hectares of state forests identified as being Priority 1 and 161,408 hectares as Priority 2.
- Some 71,094 hectares of Crown land plus other NSW Government lands, and Australian Government lands, were identified as high priorities for the protection of koala populations and habitat. Some of these areas should be transferred to the reserve estate, with others retained in the public system and managed as components of a regional system of retained and protected habitat. Of that, 54,380 hectares are identified as Priority 1 areas and 16,714 hectares as Priority 2 areas. Some of these lands are leasehold.

- One million hectares of land within the WWF Koala Habitat Priority Areas occur on freehold land. Within this area, 508,265 hectares of potential koala habitat was identified using existing vegetation mapping, containing 108,802 hectares of Priority 1 areas and 399,464 hectares of Priority 2 areas. Despite the limitations of the mapping used, this provides a strong focus for private land conservation in NSW, both in terms of private land investment and for habitat restoration and connectivity.
- Most koala populations rely to varying degrees upon effective conservation outcomes on private lands. The support of farmers, graziers, Indigenous land managers and conservation land managers for the survival of koalas is crucial. Adequate funding should not be reliant on offset arrangements and a range of private covenants. Significantly increased funding must be made available by government and non-government partners to support landowners who want to grow koala habitat. The overriding aim of private land covenants should be to strengthen the system of privately-held protected lands in perpetuity, with adequate incentives. NSW and Queensland need to substantially increase the level of funding for private land conservation as a matter of urgency. Examples of solutions for supporting enhanced private land conservation include the effective NSW Biodiversity Conservation Trust which is negotiating agreements for koala habitat conservation, Queensland Nature Refuges program, Indigenous Protected Areas, sanctuaries managed by a wide range of private land conservation trusts, and the evolving Queensland Land Restoration Fund.
- A range of community-led proposals for protected areas have been developed to conserve koala populations in NSW. These include the Great Koala National Park and associated additional areas on the NSW north coast, and the proposed Two Rivers Frontier Koala National Park in the headwaters of the Georges and Nepean Rivers in southwestern Sydney.
- There is also an urgent need to protect koala habitat on public lands in western NSW, particularly on the Liverpool Plains, within Pilliga Forest, and in the Murray Valley. New private and public reserves should also be declared adjacent to National Parks that already occur on mountain ranges that are potential higher-altitude climate refuges in a drying inland, such as Mt Kaputah, the Warrumbungles and the Liverpool Range. These areas are under increasing pressure from a number of factors, including climate change and habitat decline, and require a greater level of public and private land protection.
- Protecting koala populations most at risk from habitat loss around urban growth centres, particularly in western Sydney and other regional coastal cities and towns, is a priority.

KOALA JOEY (*PHASCOLARCTOS CINEREUS*) AND MUM EATING EUCALYPTUS LEAF. © DANGDUMRONG / WWF

RECOMMENDATIONS FOR LEGISLATIVE & POLICY REFORM

New South Wales

• The situation for koalas in NSW has become worse with the enactment of land management and biodiversity reforms in 2016/17, namely the *Local Land Services Amendment Act 2016* and *Biodiversity Conservation Act 2016* and regulations, and State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017. These need to be urgently overhauled and significantly strengthened to prevent the further loss and fragmentation of koala habitat. More broadly, legislative frameworks that regulate management of koala habitat that also require strengthening include in relation to planning, infrastructure development and state significant development.

- The *Biodiversity Conservation Act 2016* and the *Local Land Services Amendment Act 2016* require substantial amendment to ensure they:
  · are designed to prevent extinction and decrease levels of land clearing;
  · use a 'no net loss or better' standard for all development;
  · establish a Commissioner to provide independent advice and oversight;
  · ensure that assessment tools are based on the latest science;
  · establish environmental auditing and reporting on monitoring and biodiversity trends;
  · require comprehensive data;
  · commit to fully resourced compliance and enforcement; and,
  · establish clear targets to inform plans and assessments.

- The *Land Management (Native Vegetation) Code 2017* should be limited to only genuine low-impact activities. This action would remove the ability to clear high conservation value native vegetation under the Equity, Farm Plans and continuing use provisions. A new code would not permit self-assessed clearing of threatened ecological communities and habitat for the koala and other threatened species. This would require mapping all koala habitat as sensitive regulated land.
- Legal mechanisms are needed for effectively managing and protecting priority koala lands, requiring agreements to be on title and in perpetuity.
- Resourcing for ongoing private land conservation needs to be expanded significantly. Funding for reserve system management requires considerable and transparent increases in commitment.
- Due to the questionable scientific merits of the Biodiversity Offset Scheme in NSW, it should be overhauled to embrace the principles of ecologically sustainable development. Strategies and plans should be backed with verifiable science, and financial arrangements should not be made in lieu of land-based offsets. However, while current offset policy remains in place, offset rules need to be amended to prevent offsetting of koala habitat under the Biodiversity Conservation Act 2016, the *Biodiversity Assessment Methodology* and *Environmental Planning and Assessment Act 1979*.
- A robust NSW Koala Strategy would: prioritise the establishment of accurate koala habitat mapping and baseline population data across all metapopulations; enable the genetic and disease profiling of populations; assist the development ofpopulation-based Koala Plans of Management; identify key areas of koala linkages and habitat enhancement on private lands as priorities for investment; and develop a system of public science and monitoring for koalas.
- The State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP44) – needs to be strengthened so that it will be mandatory for councils to ensure that comprehensive koala plans of management are fully implemented within a certain time frame in all areas where koalas currently occur. The SEPP needs to be made effective across all land tenures, with legislative backing in all areas where koalas occur to protect habitat. This would include koala assessments under other codes, such as private native forestry, which need to be mandatory wherever potential koala habitat is present or mapped to occur. Assessments should include field surveys and data reviews and be undertaken by a wildlife ecologist. Size limits on assessable projects need to be removed if critical koala habitat is present. Any new Koala SEPP must take into account landscape factors such as refuge areas, rehabilitation zones and dispersal corridors. Monitoring, auditing and statutory review periods for the SEPP should be mandatory.
- In relation to Urban and Environmental-zone clearing, any new SEPP, local environment plan or development control plan provision under the NSW planning regime must include and contribute to state-wide biodiversity objectives and priorities. The aim must be to establish best-practice approaches to significant tree protection, such as by tree preservation orders. To improve public consultation, there should be minimum consultation requirements for councils and other Part 5 activities that includes consultation with experts in the required fields. The new Vegetation SEPP should be significantly strengthened.
- Only an end to all native forest logging on public lands in NSW will ensure that further loss of koala habitat can be avoided. All koala habitat in NSW state forests needs to be mapped and protected from logging, with priority compartments transferred to the reserve estate. As an interim measure, the Coastal IFOA needs to be overhauled so that: regulation is improved; wood supply is independently reviewed; the protection of currently mapped

old-growth and rainforest is maintained; increases in logging intensities are rescinded; protection is extended to all trees over one metre in diameter; protection for mature trees as recruitment hollow-bearing trees, koala food trees and nectar food trees is reinstated; and all existing protected riparian refuges enhanced with wider riparian buffers.

- Private native forestry codes in NSW need to ensure that limits on logging intensity and stream buffers are not reduced, statutory protections of koala habitat is increased and that pre-logging surveys for koalas are undertaken by independent ecologists.

Queensland

- Queensland laws have improved with the passing of the *Vegetation Management and Other Legislation Amendment Act* in May 2018, though more improvements need to be made to the *Vegetation Management Act* (VM Act) plus a number of environmental and planning laws.
- Amendments need to ensure that clearing laws cannot be overridden by planning development designations under the *Planning Act* or other decision-makers, such as the Coordinator-General. Mapping of koala habitat under the *Planning Act* needs to be extended to all local council areas as a priority.
- Limits to clearing, particularly for koala habitat, need to be legislated. This will prevent the ability of other laws, such as the *Economic Development Act 2012,* to override strong protections put in place for koalas under environment and planning laws.
- Development has generally been prioritised in South East Queensland over protection of koala habitat. A moratorium should be placed upon clearing of koala habitat until planning and development laws and regulations are amended to effectively conserve koala habitat and populations.
- Koala assessments must be undertaken using qualified wildlife ecologists to ensure they use the best available surveys and information. Expert surveys should preferably be undertaken alongside complementary approaches, such as citizen science surveys using knowledgeable community members, koala sniffing dogs, forage quality analyses and evolving hi-tech drone-mounted cameras to detect koalas in dense canopies assisted by object-recognition software algorithms.
- Remove the term ‘essential habitat’ and replace with ‘critical habitat’ and make a commitment to undertake mapping of critical koala habitat across all tenures in Queensland. Declare all critical habitat mapped on state land as critical habitat via regulations under the *Nature Conservation Act 1992* (NC Act). Remove the right to seek compensation for declaration as critical habitat.
- Amend the NC Act to create an offence when vegetation clearing of more than 2 hectares in size of critical koala habitat is ‘take’ of protected wildlife under s88 of the Act.
- Most importantly, the protection of essential (or critical) habitat under the VM Act across all areas of Queensland needs to be strengthened, especially the urban footprint by removing exemptions to vegetation clearing regulations, particularly under the *Planning Regulation 2017*; and give the State Department of Environment and Science concurrence power with respect to all development applications that may impact koala habitat.
- Pass legislation to amend the NC Act to introduce the new private protected land area Special Wildlife Reserve, which allows private landholders and conservation

groups to ensure the protection of private land that is high-value wildlife habitat to an equivalent level as national parks (in perpetuity with on-title covenant).

- Ensure the protection of climate refugia from clearing through amendments to the VM Act that require the mapping and protection from clearing of areas that are modelled to promote persistence of koalas and other wildlife in a changing climate.
- Require that cumulative environmental impacts from all proposed development impacts must be considered in development assessment through amendments to the *Environmental Protection Act 1994* (EP Act) and *Planning Act 2016*.
- A robust Queensland Koala Strategy should prioritise the establishment of accurate koala habitat mapping and baseline population data across all meta-populations; commit to legal protection of significant koala habitat across land tenures; genetic and disease profiling of populations; assist the development of population-based koala plans of management; identify key koala linkages and areas of habitat protection and enhancement on private lands as priorities for investment; a major expansion of the national parks system to effectively protect koala habitat and populations; and develop a system of public science and monitoring for koalas.
- Codes governing the management of vegetation in urban areas should be strengthened to provide uniform tree preservation rules for councils, provide protection for green spaces, and support local governments by investing in more green space and expanded urban tree canopies.
- Offset Policy in Queensland results in perhaps the poorest outcomes for biodiversity out of the three policies examined by providing such flexibility that allows proponents to settle offset liabilities through up-front financial arrangements. Such an approach is an incentive to clear bushland, and the relevant acts should be repealed and replaced by legislation that promotes verifiable outcomes consistent with ecologically sustainable development.
- Translocation policy in Queensland should be clarified to reflect the standards set out by the IUCN.

Commonwealth

- A strong national recovery plan for koalas should be produced in collaboration with jurisdictions and independent koala experts should be finalised with community input in 2019, with a commitment of significant additional federal funding.
- A new Australian Environment Act should be legislated that, inter alia, prohibits the clearing of significant koala habitat. The new law should replace the current *Environment Protection and Biodiversity Conservation Act (Cth)* and elevate environmental protection and biodiversity conservation to be the primary objective. It should contain a raft of reforms to ensure the current decline of koalas is arrested where possible, including the introduction of a wider range of triggers for Commonwealth intervention in development and a mandatory adherence to the principles of ESD. In the interim, a land clearing trigger should be legislated under the EPBC Act to enable the federal Environment Minister and environment department to protect significant koala from clearing.
- Referral guidelines should be amended to improve definitions to improve outcomes for koala, including in relation to critical habitat and significant impact.

LAND CLEARING WITH BULLDOZER, QUEENSLAND. © THE WILDERNESS SOCIETY

- A new Environment Act would not incorporate a requirement to undertake bilateral agreements between the Commonwealth and states for environmental assessments unless specific criteria were met that included adherence to ESD and international covenants. Current bilateral agreements that accredit assessment processes in place between the Commonwealth and the states should be revoked, including the current Regional Forest Agreements. This would eliminate the possibility of Commonwealth standards being compromised by weaker state protections or assessment procedures.
- Commonwealth offset policy needs to be strengthened so that it does not result in the ongoing loss of remnant vegetation and koala habitat, and state-based offset policies must meet strengthened national standards.
- The conservation of koalas and their habitat should be elevated to be a national policy priority for federal governments. This would involve seeking bipartisan political support and new ambitious policy commitments similar to initiatives led by federal governments over the past half century to save the Great Barrier Reef, restore the Murray-Darling Basin, and cease logging of rainforests.
- The Common Assessment Methodology established between federal, state and territory governments must be significantly amended or replaced to improve the capacity of jurisdictions to provide stronger state-based legal protection for koalas, including designating local populations as endangered. Federal and state governments should support and develop a nomination for World Heritage listing of major areas of tall and species-diverse eucalypt forests on the Dividing Range and foothills of Eastern Australia. This would help protect large areas of significant koala habitat and increase protection of major koala populations.
- The Australian Environment Minister should seek advice from the Threatened Species Scientific Committee on whether koalas in Qld/NSW/ACT should be listed as an endangered species under federal law, which would involve 'upgrading' the current vulnerable listing under the EPBC Act.

LANDCLEARING FIRES IN NORTHWEST NSW 2016 © WWF-AUS

ORPHAN KOALA JOEY HELD BY CLARE, *RETURN TO THE WILD* INC. MANAGER, BRISBANE, 24 AUGUST 2017. © WWF-AUS / PATRICK HAMILTON

LIST OF ABBREVIATIONS

ACRONYM	FULL NAME
AGS	Australian Group Selection
ANZECC	Australian and New Zealand Environment and Conservation Council
AOBV	Areas of Outstanding Biodiversity Value
ARKS	Areas of Regional Koala Significance (NSW)
BAM	Biodiversity Assessment Method (NSW)
BCT	Biodiversity Conservation Trust (NSW)
BMAD	Bell Miner Associated Dieback
CAM	Common Assessment Method
CAR	Comprehensiveness, Adequacy and Representativeness
CBD	Convention on Biological Diversity
CEEC	Critically Endangered Ecological Community
CKPoM	Comprehensive Koala Plan of Management
COA	Commonwealth of Australia
DBMP	Direct Benefit Management Plan (Qld)
DCP	Development Control Plan
DES	Department of Environment and Science (Qld)
DPI	Department of Primary Industries (NSW)
EDO	Environmental Defenders Office
EEC	Endangered Ecological Community
EOAM	Environmental Outcomes Assessment Methodology
ESD	Ecologically Sustainable Development
ESFM	Ecologically Sustainable Forest Management
FCNSW	Forestry Corporation of NSW
FQA	Forage Quality Analyses
GKNP	Great Koala National Park
HSI	Humane Society International
HUA	High Use Area
IBRA	Interim Biogeographic Regionalisation for Australia
ICAC	Independent Commission Against Corruption
IFOA	Integrated Forestry Operations Approvals
IKPOM	Individual Koala Plans of Management
IUCN	International Union for the Conservation of Nature
LEP	Local Environment Plan

LGA	Local Government Area
LLS	Local Land Services (NSW)
LPR	Living Planet Report
MNES	Matters of National Environmental Significance
MOU	Memorandum of Understanding
NCAS	National Carbon Accounting System
NCC	Nature Conservation Council of NSW
NEFA	North East Forest Alliance
NPA	National Parks Association of NSW
NPWS	National Parks and Wildlife Service (NSW)
NRC	Natural Resources Commission (NSW)
NRS	National Reserve System
NRSP	National Reserve System Program
NSWLEC	NSW Land and Environment Court
NVIS	Native Vegetation Information System
OAG	Offsets Assessment Guide (Commonwealth)
OEH	Office of Environment and Heritage (NSW)
PCT	Plant Community Type
PDA	Priority Development Area (Qld)
PNF	Private Native Forestry
PPA	Privately protected areas
PVA	Population Viability Analysis
PVP	Property Vegetation Plan
RFA	Regional Forest Agreement
RGBSAT	Regularised Grid-Based Spot Assessment Technique
RMS	Roads and Maritime Services (NSW)
SDAP	State Development Assessment Provision (Qld)
SEPP	State Environmental Planning Policy
SLATS	Statewide landcover and trees study
SSD	State Significant Development
SSI	State Significant Infrastructure
STS	Single Tree Selection
TP	Translocation Proposal
TSSC	Threatened Species Scientific Committee

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1. RATIONALE

"If we don't act swiftly and decisively, we risk losing all our wild populations of koalas in southeast Queensland in just a few more years. This will mean we have witnessed the demise of our state animal, and a key indicator of the health of our regional environments." (Rhodes et al. 2017).

There is a crisis now facing the survival of our wildlife into the future and few more so than Australia's iconic species, the koala. The findings of the World Wide Fund for Nature's flagship *Living Planet Report* (WWF 2018) indicated that global wildlife populations have, on average, declined by 60% in just over 40 years. The report names Eastern Australia as a deforestation hotspot, along with the Amazon and Sumatra. More than 517,000 hectares of native bushland were bulldozed over the past 17 years in Eastern Australia – an area almost twice the size of the Blue Mountains National Park.

Even more worrying is that the report found that iconic Australian animals, such as koalas, are declining at significantly faster rates than the global average, given rising levels of landclearing, habitat simplification and drought exacerbated by climate change in Eastern Australia. The best scientific advice on how to slow and even reverse this decline indicates this is not possible without a significant reduction in tree-clearing, actions to mitigate climate change effects and a major expansion of protected areas.

Other recent reports indicate that the koala may become extinct across most of its range in New South Wales as early as 2050, and highly likely by 2100, without significant reduction in rates of landclearing (WWF 2018). The listing advice of the federal Threatened Species Scientific Committee (TSSC), which formed the basis for the listing of the koala in Qld, NSW and the ACT as vulnerable to extinction in 2012, estimated a 33% decline from 31,400 to 21,000 individuals in NSW across the two decades from 1990 to 2010. A later expert estimate gave the median value somewhat higher, at 36,000 animals in 2012 (Adams-Hoskings et al. 2016), though the stated margin of error in this study makes this estimate questionable. The overriding population trend, however, is undeniable and most recent data supports the fact that there is an ongoing decline of populations in NSW.

For Queensland, the *South East Queensland Koala Population Modelling Study* (Rhodes *et al.* 2015) concluded that between 1996 and 2014 there was clear statistical evidence of a decline in koala population densities of around 80% in the Koala Coast and 54% in the Pine Rivers area, despite high levels of local protection.

There was also evidence that rates of decline have increased over time. The TSSC estimated there were approximately 25,000 animals in South-East Queensland, while current estimates now place this figure as low as 5,000. The size of populations across the rest of Queensland is less clear, particularly in the Wet Tropics, Central Mackay Coast, Brigalow Belt, Mitchell Downs and Upland bioregions. Anecdotal reports suggest very low current densities in these bioregions.

Populations have been displaying varying levels of decline, but some reports of population increases in NSW should be treated with caution until more robust data is available. Many more populations may be already lost or functionally extinct, particularly in the north-west areas of NSW and south-west areas of Queensland. In the ACT, there are currently no recognised indigenous populations, though an introduced population is still extant in the Tidbinbilla and Namadgi reserves.

Ongoing forest fragmentation and loss has seen an associated increase in koala mortality attributable to disease, stress and other ground-based vectors such as cars and dogs; climate change has also seen increases in fire frequency, droughts, heatwaves and decreases in foliar nutrition. As many koala declines have occurred in relatively untouched forests, climate change is thought to be a key issue for future koala conservation.

The evidence is clear. Government agencies have failed to ensure the future persistence of the koala in the wild across most of its range. Actions are needed urgently to reverse this overall trend. To this end, this Habitat Conservation Plan, using NSW as the primary example, will outline the key actions that governments need to urgently undertake to meet this objective. Central to this are:

- An overhaul of legislation, policies and strategies so that koala populations and habitat can be properly identified and protected during development processes and changes in land use;
- To identify where the expansion of the protected lands systems should occur so that koalas are given the best possible long-term protection of habitat throughout their range; and
- To identify clear priorities to guide recovery actions and increase landscape-level habitat protection and connectivity on private lands.

LAND CLEARING WITH BULLDOZER, OLIVE VALE, QUEENSLAND © THE WILDERNESS SOCIETY

LAND CLEARING STRATHMORE STATION, QUEENSLAND (SUPPLIED)

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ALMOST 58,000 HECTARES OF LAND HAS BEEN CLEARED AT STRATHMORE STATION IN QUEENSLAND. (SUPPLIED)

SATELLITE FOOTAGE SHOWS EXTENT OF LAND CLEARING IN QUEENSLAND BEFORE AND AFTER

2. CURRENT STATUS OF THE KOALA IN NSW

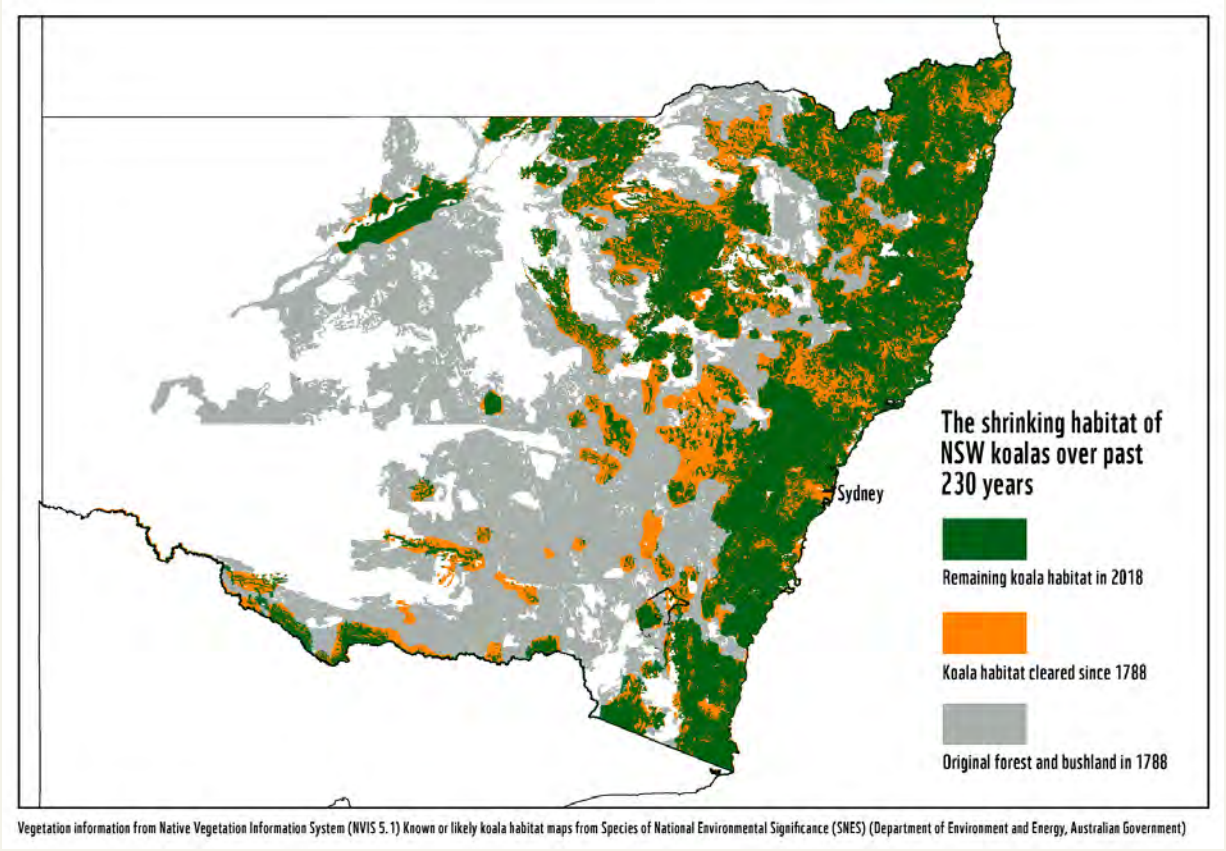
Extent of habitat loss

Loss of koala habitat in NSW since European settlement is difficult to accurately measure. The best available mapping is available from the Commonwealth's Species of National Environmental Significance (SNES) mapping for the koala. Figure 1 compares the modelled loss of forest and bushland habitats since European settlement to the current extent, and compares the restriction in range of koalas over the past 70 years based on koala records. Besides the significant decline in extent, what is most evident is the high degree of habitat fragmentation and loss of landscape connectivity across most of the state.

While this broadscale mapping is likely to over-estimate suitable koala habitat, it indicates that potential koala habitat in NSW has declined by about 40% since European settlement, amounting to a loss of some 8,500,000 ha.

Koalas have endured widespread habitat loss and high levels of shooting for export of their pelts to such an extent that in the 1940s the species was in danger of extinction. Koalas were largely wiped out in South Australia and Victoria. Evidence suggests numbers increased locally in some areas of NSW from 1950-1990, although other areas never recovered from the earlier population crash.

Another decline phase has been occurring since the 1990s (TSSC 2012), prompting the listing of the koala as a threatened species in NSW, Queensland and by the Commonwealth. Gordon et al. (2006) showed the difficulty of correlating koala numbers with the distribution of habitat in Queensland, which is a similar situation to NSW. While the extant coverage of forested habitat may still seem extensive, the current distribution and abundance of koalas in NSW suggests there are large areas of unoccupied habitat at the current time. This section will further explore the latest population trends and status.



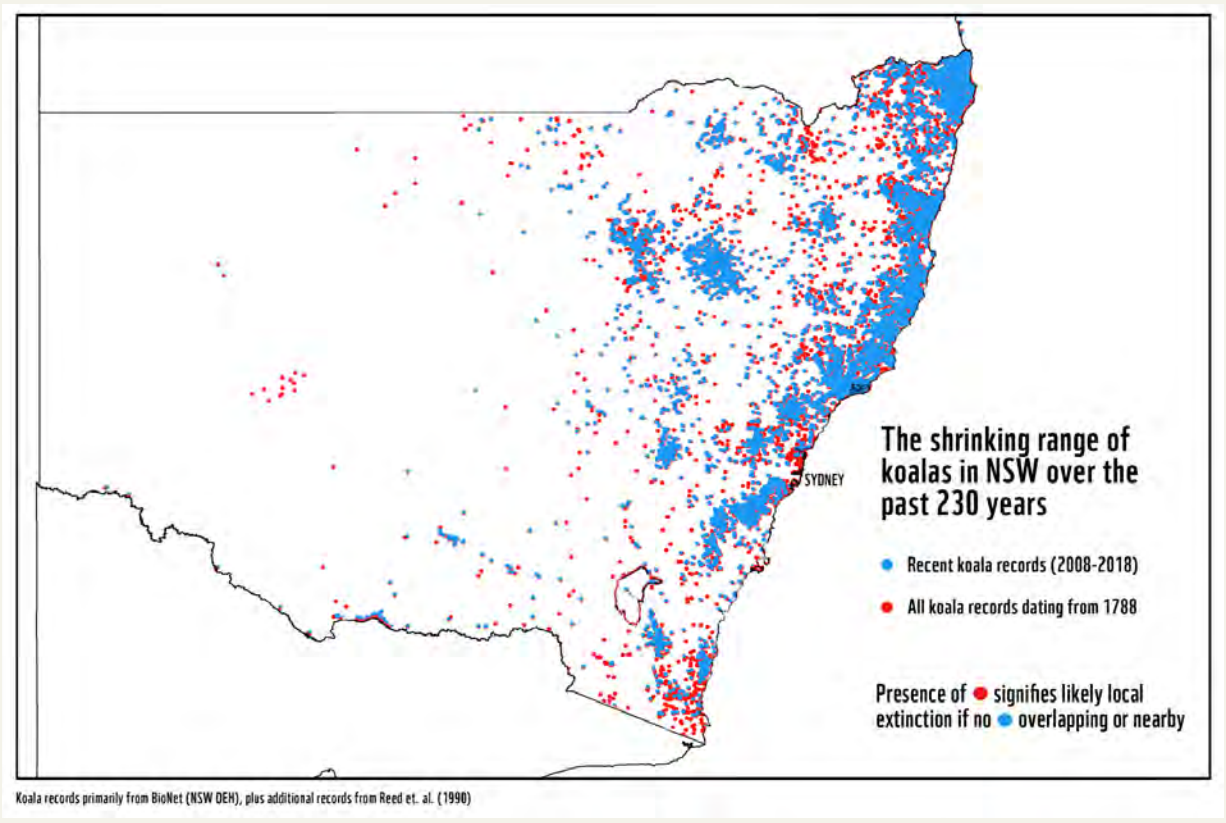


Figure 1. Loss of forest and bushland habitat in NSW since 1750 known or likely to have provided habitat for koalas, and reduction in range of koalas shown by reduced number of sightings of wild koalas. Pre-1750 and 2017 extant distribution of forests and bushland that contain koala habitat in NSW is based upon spatial vegetation layers contained in the Native Vegetation Information System version 5.1 provided by the Federal Department of the Environment and Energy. Change in koala range is based upon koala records held in the NSW BioNet repository managed by the NSW Office of Environment and Heritage.

LEVELS OF PROTECTION IN NEW SOUTH WALES

An analysis of all public koala records in NSW was undertaken to provide an understanding of the level of current protection and historic levels of usage by koalas of lands according to land tenure. Land tenure was classified as either reserve, state forest (irrespective of forest zoning), crown lands (other than two previous categories), and private freehold land. Patterns of usage are compared for each bioregion. There are 56,244 records of koalas in NSW and South-East Queensland in the BioNet database as of October 2018 that can be assigned to a tenure class. Nearly 80% of all records are from the North Coast bioregions.

Table 1. Proportion of koala records within each land tenure type across NSW.

BIOREGION*	RESERVE	STATE FOREST	CROWN LAND	TSR	FREEHOLD LAND	TOTAL
AA	1	0	0	0	0	1
BBS	592	313	242	61	1,271	2,492
CP	0	0	3	0	0	3
DRP	2	2	53	14	43	114
ML	0	0	8	0	0	8
MDD	0	0	6	0	1	7
Nand	7	1	64	37	163	273
NET	60	18	84	26	553	741
NNC	3,896	3,471	3,641	12	20,021	31,041
NSWS	13	3	146	4	100	266
Riv	28	9	7	0	24	68
SEC	429	318	33	0	184	964
SEH	220	8	210	1	1,694	2,133
SEQ	1,219	281	969	0	6,580	9,049
SB	1,182	84	543	0	7275	9,084
Total	**7,649 (13.6%)**	**4,508 (8.0%)**	**6,009 (10.7%)**	**155 (0.3%)**	**37,909 (67.4%)**	**56,244**

*AA: Australian Alps; BBS: Brigalow Belt South; CP: Cobar Peneplain; DRP: Darling Riverine Plains; ML: Mulga Lands; MDD: Murray Darling Depression; Nand: Nandewar; NET: New England Tablelands; NNC: NSW North Coast; NSWS: NSW South West Slopes; Riv: Riverina; SEC: South-East Corner; SEH: South-East Highlands; SEQ: South-East Queensland; SB: Sydney Basin.

Across the state, approximately 67.4% of all koala records are from private lands, highlighting the importance of this tenure to the conservation of koalas. This, in fact, is likely to be an under-estimate as koalas are less likely to be reported from private lands due to the lower overall survey effort. Only 13.6% of records are from the current reserve system, 8% from state forests and 11% of records from crown lands other than the previously mentioned two (including lands managed by local and state governments). The proportion of records from state forests in the North Coast bioregions is considerably higher at approximately 20%, highlighting the importance of this tenure for koalas on the North Coast. It is clear that current levels of protection are inadequate. Of all bioregions, the South-East Corner (SEC) has the highest level of protection for historic koala locations, with 44.5% of records from within the reserve system. The Riverina also scored high with 41.2% from the reserve system. To what extent koalas have been under-recorded from other land tenures in these bioregions is unclear.

The Sydney Basin has the highest proportion of historic records from private lands,

with 80.1%. The highland areas of the state also have a high proportion from private lands, the New England Tablelands with 74.6%, and South-East Highlands with 79.4% of all records from private lands. All these areas are highly exposed to ongoing habitat loss given the current regulatory regime in NSW.

The Darling Riverine Plains (DRP) and Nandewar have the lowest levels of protection, with 1.8% and 2.6% of historic records respectively within the current reserve system. The highest number of records in the DRP are from crown lands, but these are largely leasehold and so are subject to ongoing land clearing.

POPULATION RESILIENCE ANALYSIS

The genetic makeup of extant koala populations in NSW is poorly understood, although understanding the genetic health and relationships within and between populations is essential to providing koala populations with the best possible management outcomes. While numbers have often been the focus for assessments of koala population viability above a minimum threshold size, genetic diversity is arguably more important.

An example is provided by Lee *et al.* (2010) in their genetic study of Sydney koalas, where three discrete koala populations where identified (Figure 2). Little gene flow among these populations was inferred from the data, with high levels of genetic diversity present only in the Blue Mountains population, which is comparable to the highest levels previously published for any koala populations.

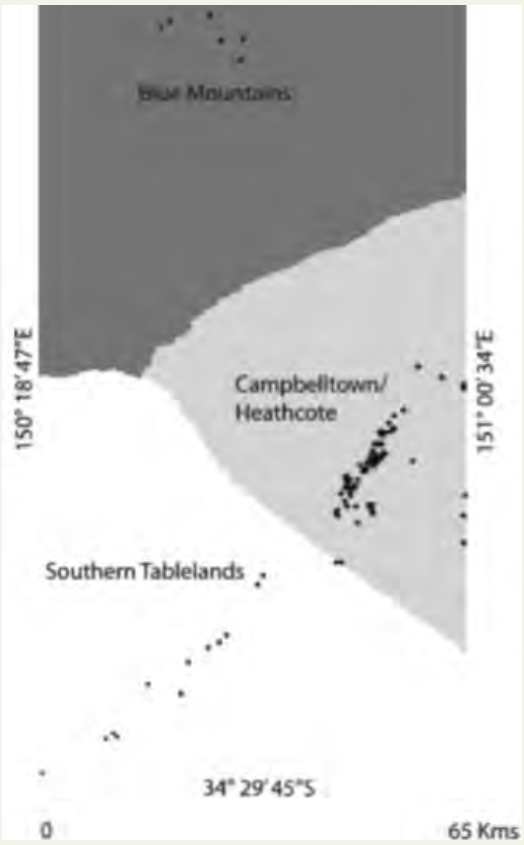


Figure 2. Populations of koalas in southwestern Sydney. Each dot represents genetic sampling location. (from Lee et al. 2010).

INJURED KOALA AND JOEY AT *RETURN TO THE WILD* INC., BRISBANE © ROBYN STENNER

By comparison, the Campbelltown/Heathcote population has a relatively low diversity, and there is evidence indicating this population has suffered a recent genetic bottleneck, implying a recent population crash and partial recovery. The Southern Tablelands population also has a relatively low genetic diversity, although no bottleneck was inferred. Although the Campbelltown/Heathcote and Southern Tablelands populations abut, the study found that there appears to be a barrier to gene flow that may be the result of geographic features, human alterations to the land or a combination of these. Lee et al. (2010) came to the following conclusions on how this understanding of local and regional-scale genetics can affect management:

"The fact that these are demographically separate populations has important implications for koala management in the Sydney region. The three confirmed koala populations should be considered separate management units and will need specific management plans tailored to the conservation issues and priorities of those regions ... The most effective and the simplest solution for conservation of koalas in the Sydney region would appear to be preventing or limiting any further loss of population connectivity."

For this report, a population is a *'group of conspecific individuals that is demographically, genetically, or spatially disjunct from other groups of individuals'* and a meta-population is a *'set of spatially disjunct populations, among which immigration can occur'*. So, while a population is the basic genetic unit in species ecology, the meta-population should be regarded as a zone of dispersal between populations that is important for managing the genetic health of adjacent populations, and thus an ideal management unit.

Despite a general lack of genetic information on each population in NSW, 37 extant meta-populations have been identified with records from the past 10 years, using the best information gathered from recent surveys and the public BioNet database (Table 2, Map 1). Previous work on this (Paull and Hughes 2016; Kendall 2017; Love and Sweeney 2015) has assisted this analysis. Substantial barriers to movement (eg. major rivers, developed areas and mountain ranges) have been used to approximate meta-population boundaries.

While these meta-population designations contain a number of genetically distinct populations, ongoing loss of habitat has reduced effective genetic contact between many of these. Another good example are the populations in many areas of the North Coast, where some have appeared to decline to a greater extent than others (Love and Sweeney 2015). Also, in the Sydney region abutting populations in the Campbelltown and more highland areas to the south appear to have lost genetic contact, most likely from human intervention, as it is probable they were in contact in pre-European times (Lee *et al.* 2010).

The analysis in Table 2 shows that the bioregions South-East Highlands and NSW North Coast have the highest number of meta-populations (six each) and the New England Tablelands has five. The two bioregions on the North Coast contain nearly 80% of all records from NSW and a total population of between 5-9,000 animals, according to estimates derived from community surveys a few years old with moderate reliability (Love and Sweeney 2015). Adams-Hoskings *et al.* (2016) estimated the North Coast Koala population at 8,367 koalas, with around a 50% overall decline. Recent estimates from the Southern Highlands indicate a population of approximately 3,700 animals (DSH 2018). Data for other regions is not as reliable,

though estimates provided here for the NET indicate it may support 2-4,000 animals, the Brigalow Belt South 1-3,000 and Sydney Basin 1-2,500 animals, based on recent survey data.

Table 2. Assessment of koala meta-populations in NSW.

#	Bioregion	Meta-population	Pop. size	Population Trend	Representation in Reserves	Exposure to Land use change	Climate Change exposure	Additional Reservation Potential	Future Resilience^
1	DRP	**Darling/Culgoa**	<100	decline	poor	high	high	low	**low**
2	DRP	**Lightning Ridge**	<100	decline	poor	high	high	low	**low**
3	BBS	**Moree**	<100	decline	poor	high	high	low	**low**
7	BBS	**Pilliga**	<100	decline	moderate	low	high	high	**moderate**
8	BBS	**Gunnedah**	>1000	decline	poor	high	moderate	high	**moderate**
4	Nand	**Nth Nandewar**	<100	decline	poor	high	moderate	moderate	**moderate**
5	Nand	**Inverell**	500-1000	more	poor	high	moderate	low	**Low-moderate**
6	Nand	**Kaputar**	<100	decline	poor	high	moderate	high	**moderate**
13	NET	**Tenterfield**	500-1000	more	moderate	moderate	low	moderate	**moderate**
12	NET	**Emmaville**	<100	decline	poor	high	low	low	**Low-moderate**
11	NET	**Guy Fawkes**	500-1000	more	poor	moderate	low	moderate	**moderate**
10	NET	**Armidale**	500-1000	more	poor	high	low	low	**Low-moderate**
9	NET	**Nowendoc**	500-1000	more	moderate	moderate	low	moderate	**moderate**
26	SEH	**Central Tablelands**	500-1000	more	poor	high	low	low	**Low - moderate**
28	SEH	**Taralga**	500-1000	decline	high	moderate	low	low	**Moderate - high**
30	SEH	**Sandy Point**	500-1000	decline	moderate	moderate	low	low	**moderate**
31	SEH	**Yass-Queanbeyan**	100 - 500	more	moderate	high	moderate	moderate	**Low-moderate**
33	SEH	**Monaro**	>1000	stable	moderate	low	low	moderate	**high**
36	SEH	**Alps**	100-500	stable	poor	low	low	low	**Moderate - high**
32	SSW	**Murrumbidgee**	100-500	decline	poor	moderate	high	moderate	**Low - moderate**
37	Riv	**Murray**	100-500	decline	moderate	moderate	moderate	moderate	**moderate**
35	SEC	**Southern Range**	100-500	decline	moderate	moderate	low	high	**Moderate - high**
34	SEC	**Bermagui**	<100	decline	moderate	moderate	low	moderate	**moderate**
29	SB	**MacArthur**	500-1000	more	poor	high	low	high	**moderate**
27	SB	**Patonga**	<100	decline	poor	high	low	low	**Low - moderate**
25	SB	**Blue Mountains**	100-500	decline	high	moderate	low	low	**Moderate - high**
24	SB	**Yengo**	100-500	decline	high	low	low	low	**high**
23	SB	**Port Stephens**	100-500	decline	moderate	high	low	low	**Low - moderate**
21	NNC	**Manning-Karuah**	100-500	decline	poor	moderate	low	high	**moderate**
22	NNC	**Barrington**	100-500	decline	moderate	moderate	low	high	**high**
20	NNC	**Hastings Manning**	>1000	decline	moderate	high	low	high	**moderate**
19	NNC	**MacLeay-Hastings**	500-1000	decline	low	high	low	high	**moderate**
18	NNC	**Bellinger-Nambucca-MacLeay**	>1000	decline	moderate	high	low	high	**moderate**
17	NNC	**Coffs-Guy Fawkes**	>2000	decline	moderate	high	low	high	**moderate - high**
16	SEQ	**Clarence Richmond**	>1000	decline	low	high	low	high	**moderate**
15	SEQ	**Far North east**	>2000	decline	low	high	low	high	**moderate - high**
14	SEQ	**Yabra-Toonumbar-Richmond Range**	>1000	decline	moderate	moderate	low	high	**high**

*Does not take into consideration potential for private land investment.

A number of meta-populations straddle highland and coastal range bioregions and are areas of important habitat linkage for the koala, particularly within the context of climate change, notably #13 Tenterfield, #11 Guy Fawkes, #9 Nowendoc, #28 Taralga and #35 Southern Ranges.

The resilience assessment provided in Table 2 is adapted from the scheme found in Rennison (2017), but is applied to populations rather than bioregions The location of the koala meta-populations are shown in the map 'Koala metapopulations" in the Appendices.

- **'Population size':** Reflects latest best estimates of total meta-population size from the latest unpublished data and is usually composite estimates of component populations, or less reliable estimates based on limited information. Currently, there are only eight meta-populations, with a total size estimated to be over 1,000 individuals – three from SEQ, three from NNC, Monaro (#33) and Gunnedah (#8). There are 11 meta-populations with probably less than 100 individuals, mainly from the Darling Riverine Plains, Brigalow Belt South and Nandewar bioregions. Using this information, the total size of the NSW population is likely to be 15,000-28,000 animals.
- **'Population trend':** Meta-populations are designated here as being either declining, apparently stable, or the category more koalas recorded in recent surveys than previously known. This apparent increase in records may be due to a lack of previous surveys or may represent actual local increases in numbers, but a lack of baseline makes this unclear. A stable trend indicates stable numbers across two survey periods. Most meta-populations are in decline in NSW, with Monaro the only meta-population apparently stable, and 11 others show good numbers in recent surveys but with an insufficient baseline to determine trends. Surveys of the MacArthur meta-population near Sydney have claimed population increases in some areas while declines in others (B. Durman, pers. comm.) so it has been given the overall rating of stable.
- **'Representation in reserve system':** How well extant populations are contained within the current reserve system. As the level of reservation overall is only 13.6%, scores are generally low.
- '**Exposure to Land-use Change':** Includes exposure to land clearing, intensive native forest logging and urbanisation under current regulatory regimes. Some coastal areas are subject to multiple threats or all three. Mining is also a significant threat in the BBS and SB bioregions.
- **'Exposure to Climate Change':** Assessment based on Adams-Hoskings et al. (2011) and Drielsma et al. (2014). The north-west populations are likely to experience most adverse impacts from climate change within the next 20 years. Coastal populations could be regarded as having a moderate impact from climate change, with increasing frequencies of fire predicted under any climate change scenario. The potential impact of fire on the higher number of small, disjunct populations in coastal areas can be catastrophic.
- **'Additional Reservation Potential':** Using data compiled from this report.
- **'Future Resilience':** Overall measure of resilience given the above measures, categorised into five scenarios – low, low-moderate, moderate, moderate-high and high. Appendix 1 shows there are 11 meta-populations

KOALA © DAVID PAULL.

with a moderate-high or high resilience under assessed scenarios, generally provided that there are significant additions to the reserve system. There are nine meta-populations with a low/low-moderate resilience. Most of these have higher levels of climate change exposure and/or less possibility of public land reservation. For most of these areas, significant investment in private land conservation is required for their resilience to improve. Particular meta-populations where private investment is urgently needed include Inverell, Gunnedah, Armidale and the Central Tablelands.

There are parts of NSW where koalas have not been seen for a long time (>20 years) and it is likely they have gone extinct. These are not considered in Map 1. These are populations from the Lower Murray; Murray-Darling Depression; Lower Macquarie; areas of the South-West Slopes, such as the Lachlan River; from near Boorowa and Parkes; the far South Coast; Albury area; the Barrenjoey Peninsula on Sydney's northern beaches; and the Upper Hunter. Koalas were presumably found within the Cobar Peneplain and Mulga Lands, but a lack of records from these areas makes this uncertain.

A shortcoming of this resilience analysis is that many more populations are likely to have become extinct or functionally extinct than just the above-mentioned areas. A large number of meta-populations in NSW are now just represented by one or two very small, highly disjunct populations, such as the Pilliga, Central Tablelands and Moree areas. Two small coastal populations that are now believed to be functionally extinct were found at Iluka, in the Clarence Valley, and the north Sydney population in Warringah LGA.

Two meta-populations identified here, #1 and #2, both from the DRP bioregion, may also already be at least functionally extinct, as there have been no reported sightings for over 10 years.

One meta-population, identified here as #31, encompasses three disparate populations at Queanbeyan, the ACT and within Yass LGA on the upper Murrumbidgee. The ACT populations are the survivors of an historical translocation program and reside within the Tidbinbilla and Namadgi reserves, although indigenous populations have recently been surveyed east of Queanbeyan and around Yass. Both of these populations do have some refuge at Yanununbeyan State Conservation Area and Mundoonen Nature Reserve respectively.

In conclusion, and based on the above information, koalas in NSW are in crisis. Given the poor levels of current protection, the known population trends of existing populations, increasing level of threat, including increased habitat loss and fragmentation and poor legislative safeguards, the koala population in NSW would have qualified to be listed as endangered, however the Common Assessment Method now prevents state listings where species occur in more than one state.

As in NSW, more accurate understanding of some populations in Queensland may hinder a more precise assessment of koala status, particularly outside the SEQ area, however the trend in SEQ is the same as NSW by all credible accounts, and an endangered status for the koala in Queensland would be justified. Disappointingly, the current Common Assessment Method (CAM) prevents the state listing of populations to a higher threat level (see Ch. 5.3).

Given the predicament of the koala in both NSW and Queensland, the koala would qualify as endangered under current Commonwealth law, pending a review of the koala's status and consistency with the new CAM guidelines by the Threatened Species Scientific Committee.

3. KEY THREATS TO KOALAS

'Following the repeal of the Native Vegetation Act in August 2017, habitat fully and partly cleared almost tripled in one year in parts of north-western NSW.'

3.1 LAND CLEARING

New South Wales

Like other states of Australia, NSW has historically undergone significant levels of clearing of native vegetation and habitat simplification. In particular, these land practices have disproportionately affected the plains/woodland, floodplain and river-flat ecosystems because they tend to occur on the better, clayey and alluvial soils, which are more agriculturally productive. As a result, many of these ecosystems are currently listed as threatened under both NSW and Commonwealth legislation. They are also still some of the more important koala habitats today. These are described below.

- Perhaps once one of the most widespread communities on the inland tablelands and slopes used by koalas, **White Box Yellow Red Gum Woodland**, once occurring over 3,700,000 ha of NSW, has declined by 93% of its former extent (leaving 250,000 ha in 2002, TSSC 2002). Ongoing clearing, particularly for mining, has occurred since the listing and it is now regarded as being critically endangered under the EPBC Act.
- **Coolibah Black Box Woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions.** These woodlands of the formerly frequently flooded channels and outer floodplains of the upper Darling tributaries originally had a combined distribution in NSW of about 1.2-2 million ha. More than two-thirds of the original coolibah woodland communities have been cleared since colonisation. The greatest extent of change has occurred in the northern parts of the Central Division, where in some areas less than 20% of the original woodland is thought to remain.
- **Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.** On the basis of regional estimates, 67-92% of the pre-European extent of inland grey box sub-communities have been cleared, with highest levels from the central and south slopes region.
- **Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions** supports koalas due to the presence of E. tereticornis, E. camaldulensis and E. melliodora. It occupies an area of less than 50,000 ha.
- **Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast bioregions.** Only about 27% (less than 500 ha) of the original distribution survives and this is highly fragmented.
- Both **River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions** and **Subtropical coastal floodplain forest of the NSW North Coast bioregion** have not had their pre-European extents accurately mapped, though

the broad category of Coastal Floodplain Wetlands, which includes these forest types, currently covers 800-1400 km2, representing less than 30% of the original extent of this broadly defined vegetation class.

- **Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions.** The exact amount of its original extent is unknown but it is much less than 30% according to the conservation advice on this listing. There is less than 350 ha of native vegetation attributable to this community on the Tweed lowlands, less than 2,500 ha on the Clarence floodplain, less than 700 ha on the Macleay floodplain, up to 7,000 ha in the lower Hunter–Central Coast district, and less than 1,000 ha in the Sydney-South Coast region.
- **Grey Gum Wet Sclerophyll Forest in the NSW North Coast Bioregion.** NPWS (1999) estimated that approximately 69% of its former extent has been cleared. This large reduction is evident from relic trees of characteristic species that remain in otherwise cleared landscapes within the community's former extent.
- **Cumberland Plain Woodland in the Sydney Basin Bioregion** and **Shale-Gravel Transition Forest.** The total extent of woody vegetation referred to as Cumberland Plain Woodland was 11,054 ha, representing 8.8 % of the pre-European distribution of the community. For that part of the community's distribution to the east of the Hawkesbury-Nepean River, earlier mapping at coarser resolution suggests a similar level of depletion, with an estimated 6,420 ha of Cumberland Plain Woodlands, representing 6% of the pre-European distribution. For Shale-gravel Transition Forest, as of 2008 around 1,857 fragmented patches are left with an average patch size of 3.3 ha. The remaining total is 11,000 ha or around 9% of pre-European distribution. .

More recently, rates of broadscale land clearing (both illegal and approved) have risen and fallen and risen again in NSW, despite stated policy goals to eliminate such clearing. Figure 3 compares the rates of clearing in NSW using two satellite imagery assessment methods – one the Spot5/SLATS system used to monitor land clearing in NSW and the other the National Carbon Accounting System (NCAS), from 1990-2016. While not obvious from the NSW Government SLATS data, the NCAS data shows that from 1990-2016 approximately 2,200,000 ha of native vegetation was cleared in NSW. A spike in land clearing occurred following the introduction of the former *Native Vegetation Act 2003*, with rates falling after 2007 and then falling to the lowest point on record in 2015 (<60,000 ha / year).

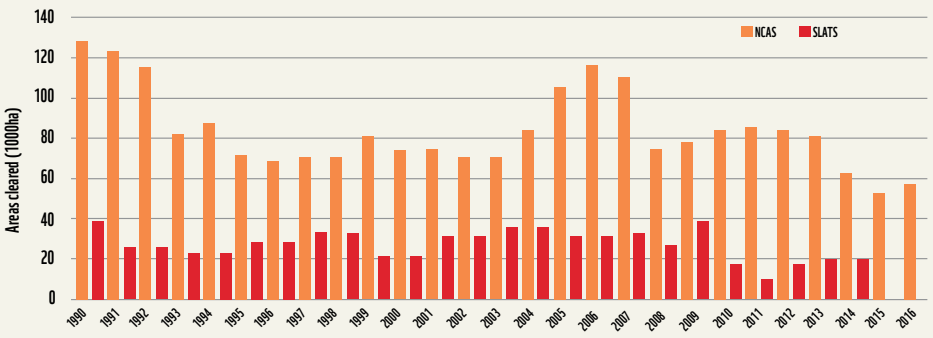


Figure 3. Rates of land clearing in NSW (1990-2016) (from WWF-Australia and NCC 2018). The chart shows a comparison of total land clearing in NSW as estimated by the NSW Government's Statewide Land and Tree Study (SLATS, excluding fires and plantation harvest) (red bars) and as estimated by the Australian Government's National Carbon Accounting System (NCAS) (orange bars).

The significant discrepancies between the two datasets are not readily apparent, with the NSW SLATS data showing significantly less clearing than the NCAS, despite the fact that NCAS includes only forest cover loss (foliage cover of 20% or more), not

loss of bushland with sparser tree cover, which the SLATS system was supposed to capture. The NSW Government also swapped methodology in 2009/10 to one that uses predominantly SPOT5 satellite photos, rather than a Landsat-based one. This was accompanied by a sudden drop in areas of clearing reported. When compared, the total area cleared from 2009-2011 detected using Landsat was 104,700 hectares – nearly double the 57,400 hectares detected using SPOT5.

To counter these discrepancies in public data as well as the refusal of the NSW Government to release the latest data following the introduction of the *Biodiversity Conservation Act 2016*, the NSW Nature Conservation Council and WWF-Australia conducted a reliable assessment of clearing activity in a restricted area of NSW using labour-intensive visual inspection (WWF/NCC 2018).

Figure 4 shows that following the repeal of the *Native Vegetation Ac*t in August 2017, habitat fully and partly cleared almost tripled in one year in parts of north-western NSW. The analysis focused on a 22,173 km2 area around Moree and Collarenebri, and compared clearing rates for 2016-17 and 2017-18. It showed that annual clearing rates jumped from 2,845 hectares in 2016-17 to 8,194 hectares in 2017-18. Bulldozing in these areas has destroyed habitat for 247 native species, including 5,246 hectares of koala habitat.

The situation for koalas in NSW worsened with the enactment of the 2016/17 biodiversity laws and regulations that have placed 99% of koala habitat on private land at risk of clearing, according to an internal OEH briefing note to the Minister for Environment, Gabrielle Upton, acquired through Freedom of Information. Another independent assessment conducted by EcoLogical Australia (2016) estimated that approximately 8,000,000 ha of land in NSW has been put at risk of clearing by just one new code, in the new Local Land Services Regulation, namely the Equity Code. This new regulation also reintroduced other mechanisms giving landowners increased flexibility to clear, and only provides protection to critically endangered ecological communities or clearing of habitat for critically endangered species.

The new B*iodiversity Conservation Act 2016* removes a key concept of 'red flag' or 'no go' cases of high ecological impact, replacing this with a category of "serious and irreversible impacts" limited to critically endangered matters. It has removed the concept of "critical habitat' and replaced it with "Area of Outstanding Biodiversity Value", which is not exempt from development. While the new Koala Strategy for NSW sets up a comprehensive koala habitat mapping program, there is no requirement for development to be restricted in mapped areas under the regulatory code.

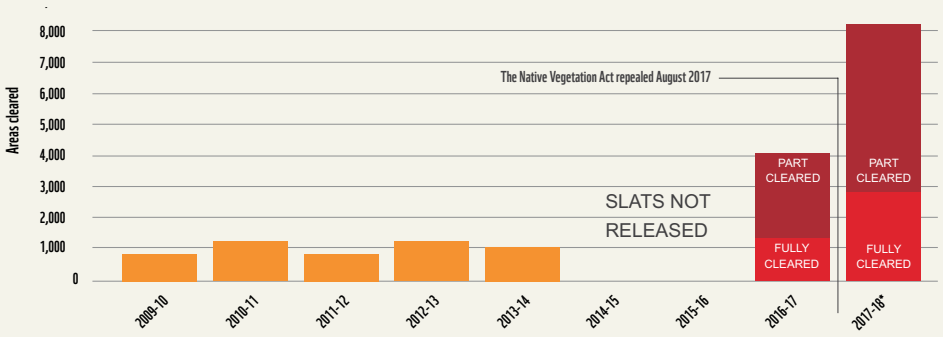


Figure 4. Recent land clearing rates in the Moree and Collarenebri area of North-west NSW (from WWF-Australia and NCC, 2018). The chart shows the area of land cleared each year in the study 22,000 km2 area according to NSW SLATS from 2009 to 2014, and fully or partly cleared according to this analysis for 2016-18. * see Figure 2, WWF-Australia and NCC (2018) for details.

The BC Act also updates the existing Offset Policy in NSW, such that under the new biodiversity assessment method, (or BAM), direct 'like for like' offsetting requirements are relaxed and can be circumvented. There is a new option to pay money in lieu of establishing an actual land-based offset. Offset areas and set asides may be cleared and offset again later rather than actually protecting land in perpetuity. All these provisions are likely to result in ongoing net loss of threatened species and communities, including that of the koala. The BC Act also removes the category of endangered populations for those species already listed under the act as being threatened across NSW, even though they may be listed with a lesser degree of threat, ie. vulnerable.

The new regulatory regime in NSW is accompanied by a new framework to facilitate large-scale development on private land through the use of offsets, a system of biodiversity certification that lacks clear criteria and environmental standards suitable for a strategic environmental assessment. The criteria of no net loss for impacts on agricultural land is merely designed to allow for offsetting arrangements to be applied.

There are several other issues inhibiting the timely, transparent and accurate assessment of the extent, type and quality of ecosystems in NSW, particularly an incomplete state-wide ecosystem mapping system; long delays in the publication of data and reports; inadequate presentation of data on deforestation in reports and in public registers by the NSW Government; and inadequate compliance technology and systems, as there is no system in place to monitor lawful or unlawful clearing in real-time, even though up-to-the minute, high-resolution satellite imagery is available, for example as used by the Queensland Government's Early Detection System.

Following the introduction of the *Biodiversity Conservation Ac*t, it is estimated that 99% of identified koala habitat on private land in NSW is now at risk of being cleared. This has to be placed within the context that only 9% of native vegetation in NSW remains intact. Of the remainder, 52% of native vegetation is uncleared but degraded by land-use, principally grazing, while the remaining 39% has already been cleared or converted to intensive land-use.

Given the provisions allowing for greater levels of clearing on private land under the current acts and that nearly half of all koala records are from private land with all meta-populations showing some reliance on private lands, the future of the koala in NSW remains under grave threat, with many populations facing extinction in the near future (NCC/WWF 2018).

Queensland

Queensland has been regarded as the national hotspot for land clearing in more recent times, accounting for up to 65% of the total loss of native forests in Australia over the past four decades. Levels have fluctuated considerably, largely in response to changes in regulatory regimes.

Over the 20-year period between 1995 and 2016, 3,600,000 hectares of remnant vegetation was cleared in Queensland. Another 2,800,000 hectares of regrowth was cleared during the same period (Climate Council, 2018).

The relaxation of land clearing regulations in 2013 led to a significant increase in the vegetation clearing, with more than 1,000,000 ha of woody vegetation (of which 41% was remnant vegetation) being cleared in Queensland between 2012-13 and 2015-16 (Figure 6). This was the highest since 2003-04, when it then peaked at 490,000 ha/year. Some 395,000 ha of woody vegetation was cleared in 2015-2016 alone. This is equivalent to roughly half of the Brazilian Amazonian rainforest cleared in 2016. These figures were obtained from the 2017 Queensland Government's SLATS report.

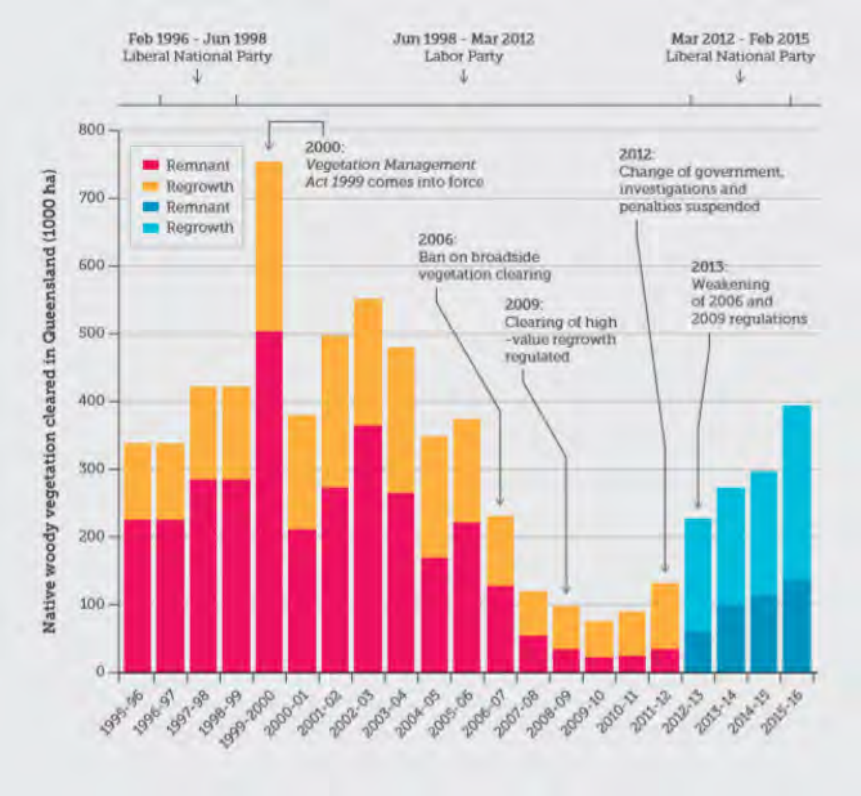


Figure 5. Land clearing statistics for Queensland 1995-2016 (from Stefan and Dean 2018). The chart depicts a history of vegetation clearing in Queensland showing increased clearing rates in blue. Remnant vegetation is woody vegetation that has not been previously allowed to regrow to maturity after earlier clearing. Regrowth is woody vegetation that has been cleared and is in the process of regrowing but has not yet reached maturity.

The surge in clearing rates after 2013 is thought to be a direct result of the change in vegetation laws that occurred under the LNP Government led by Campbell Newman. These changes allowed clearing if actions met 'high-value' agricultural project standards, but in fact created a legal loophole leading to the surge in clearing.

Leaked figures show that land clearing of woody vegetation in Queensland last year was around 278,000 ha. WWF reported that if 24 of the 47 current pending approvals in Queensland were cleared, it would add 12 million tonnes of CO_2 to the atmosphere, which is about 40% of what the Federal Government has just purchased in carbon credit abatement under its Direct Action Plan (WWF 2018).

In May 2018 the Queensland Government amended the *Vegetation Management Act 1999* (VM Act) to provide stronger protections for mature forests and bushland, although significant loopholes remain that allow koala habitat to be bulldozed. The amendments remove the conditions associated with high value agricultural development and should lead to a tripling of protected forest areas in Queensland from an estimated 500,000 ha to an estimated 1.8 million hectares. It also sets up a complementary Land Restoration Fund, aimed at re-establishing vegetation and protecting existing vegetation. The VM Act also contains restrictions on using land-based carbon storage, stating that this type of landscape storage should not be used to offset emissions from burning fossil fuels.

In December 2018, the Queensland Government's Statewide Landcover and Trees Study (SLATS) data for 2016-17 and 2017-18 showed that 356,000 hectares of forest and bushland were cleared in 2016-17 and 392,000 hectares were cleared in 2017-18.

As the data covers a period up to 1 August 2017, most of the deforestation occurred before the Queensland Government introduced new laws in May aimed at curbing the state's rate of land clearing. However, this data further highlights the need for strong laws to reduce rates of land clearing.

Unlike NSW, the Queensland Government has a comprehensive statewide map of regional ecosystems based on vegetation types, soil types and bioregions. The Queensland system also indicates ecosystem condition (remnant, regrowth, etc.) and conservation status, placing it considerably ahead of the current state of mapping in NSW in terms of environmental planning and biodiversity conservation. The Queensland Government has also developed a koala habitat planning layer that identifies parcels of land as koala habitat under the Planning Act for parts of the SEQ region.

Figure 6. Broadscale clearing in Queensland and NSW has continued with generally poor regulation over the past 30 years. Clearing near Tottenham NSW, 2001. Credit David Paull

3.2 NATIVE FOREST LOGGING

North Coast

Public Native Forests

Until the late 1990s there was no systematic protection provided to koala habitat in public native forests. Logging prescriptions for koalas were applied across all public forests under Threatened Species Licences issued as components of regional Integrated Forestry Operations Approvals (IFOAs) from 1998.

The IFOA required pre-logging surveys for koalas and their scats (faecal pellets). Where exceptional numbers of koala scats were found, the protection of high-use trees and 20 metre buffers were required as a koala High Use Area (HUA). On average, across the 13,400 ha (DPI 2018) of native forests on state forests logged each year, only around 13 hectares per annum (NRC 2016) was excluded from logging as koala HUAs, with these able to be logged the next time around. The temporary protection of just 0.1% of forests for koalas is attributed to the high thresholds for identifying koala HUAs, the minimal protection applied, inherent problems with the detection ability and persistence of scats (EPA 2016), and the "Forestry Corporation's failure to undertake searches for evidence of koalas in compliance with the licence" (EPA 2014).

"... If you don't look, you don't find and if you don't find, you don't protect."
- EPA 2014

Further, the EPA submitted that "... if you don't look, you don't find and if you don't find, you don't protect" (EPA 2014).

While only limited areas of koala habitat in patches around 4 ha were protected as koala HUAs, their retention appears to have been of benefit, as Law *et al.* (2018) found: "Koala high-use areas supported nearly three times the bellow rate (3.1 bellows per night) as other treatments".

In logging areas where evidence of koalas was found, the requirement was that five koala food trees per hectare be protected, which applied to about one-third of logging areas (NRC 2016). It is well known that, particularly for roosting, koalas prefer larger trees (EPA 2016), though in northern NSW there was no minimum size for retained food trees.

The effectiveness of these minimal tree retention requirements has never been assessed, though they certainly haven't arrested the decline of koalas, with once high-quality habitat now "sink habitats impacted by disturbance events", where mortality exceeds reproduction (EPA 2016). The EPA (2016) found: "Areas of higher activity positively correlated with greater abundance and diversity of local koala feed trees, trees and forest structure of a more mature size class, and areas of least disturbance".

The EPA's (2016) Expert Koala Panel compared various modelling and mapping approaches with ground surveys, concluding "that koalas are frequently absent from areas of good quality 'potential' habitat because of past disturbance", recommending that forestry surveys should "be undertaken within suitable habitat to determine koala occupancy and habitat utilisation", with "the primary intent and focus ... to identify the location, distribution and extent of areas that are supporting extant/ resident koala populations" for protection.

Against the advice of its expert panel, the EPA decided to abandon pre-logging koala surveys and instead commissioned DPI-Forests (Law et al. 2017) to prepare a model of koala habitat to use for the regulation of public forests.

The new 2018 Coastal IFOA now applies koala prescriptions based on modelled

Until the late 1990s there was no systematic protection provided to koala habitat in public native forests.

habitat, requiring the retention of 10 koala food trees, over 20 cm in diametre per hectare in modelled high-quality habitat, and five koala food trees per hectare in logging areas with large areas of modelled medium-quality habitat. The Expert Fauna Panel convened for the new IFOA, and the EPA, recommended retention rates of 25 koala food trees per hectare over 25 cm diameter in high-quality habitat and 15-20 food trees in medium-quality habitat, though the NRC (2016) adopted the Forestry Corporation proposal ostensibly because of the impact on timber supply.

The Office of Environment and Heritage (OEH 2018) complained that "the rates are less than half those originally proposed by the Expert Fauna Panel".

Even with the reduced prescription, the NRC considered this would have a significant impact on timber supply and recommended that 58,600 ha of mapped old-growth forest and an unspecified area of rainforest within the Comprehensive Adequate and Representative reserve system be subject to remapping, and areas remapped as not being old-growth or rainforest be made available for logging to offset claimed shortfalls (NRC 2018).

A trial application of their new criteria and methodology resulted in 88% of mapped old-growth forest and 62% of mapped rainforest being deleted. Irrespective of definitional changes, these are forests dominated by mature and old trees and thus of outstanding habitat value as refuges in an increasingly young landscape. Some 28% of the mapped old-growth forest proposed for deletion is identified as medium-high quality koala habitat.

North Coast Intensive Zone

Under the new Coastal IFOA, logging intensity will be increased across state forests. For north-eastern NSW, the previous IFOA allowed two logging regimes: Single Tree Retention (STS) and Australian Group Selection (AGS). STS requires the retention of 60% basal area and all trees under 20 cm in diameter. AGS allows the staged clear-felling of 90% of the logging area over 21 years, with the size of clear-fells limited to 0.25 ha (50 m by 50 m).

Since 2006, the Forestry Corporation has been practicing a form of STS called "Regeneration Single Tree Selection", which is considered by forest conservation experts as not complying with legal silvicultural requirements (Pugh 2017a, Figure 7). This is a clear-felling regime described as "no upper coupe size limit, coupes range in size from 5 hectares to over 100 hectares, 4 harvest cycles, 7-year average gap, 21 years until all harvested" (NRC 2016). On behalf of the Environment Minister, the EPA (Pugh 2017a) stated this "is not consistent with the definition and intent of STS (Single Tree Selection) in the Integrated Forestry Operations Approval (IFOA) as well as FCNSW's own silvicultural guidelines".

IMAGES PROVIDED BY COMMUNITY GROUPS VIA THE NATIONAL PARKS ASSOCIATION OF NSW

Figure 7. "Regeneration Single Tree Selection" as practiced in modelled high-quality koala habitat in Lorne State Forest in 2017.

Over the period from 2006 to 2017, between Coffs Harbour and Taree, the Forestry Corporation subjected 74,906 ha to the logging practices of medium, heavy and regeneration Single Tree Selection, involving 41-100% basal area removal, which is considered unlawful by forest conservation experts (Pugh 2017a). This comprised 23,742 ha (32%) of modelled high-quality koala habitat with 717 koala records.

In November 2018 the NSW Government released the new Coastal Integrated Forestry Operations Approval (IFOA) to regulate public native forest logging, which was given effect through the *Forestry Legislation Amendment Act 2018*. From April 2018, Local Land Services assumed responsibility for approvals and advisory services for private native forestry (PNF) from the Environment Protection Authority (EPA). *The Forestry Legislation Amendment Act 2018* regularised this by transferring responsibility for preparation of PNF codes of practice to the Minister for Lands and Forestry. The new PNF codes are currently under preparation.

Under the 2018 Coastal IFOA, the NSW Government has now established a North Coast Intensive Zone covering 140,000 ha of state forests between Grafton and Taree. Outside exclusion areas, there will be no minimum tree retention requirements aside from retention of some hollow-bearing trees and the prescribed numbers of koala food trees in modelled habitat. This will effectively regularise the Forestry Corporation's current logging and allow the clear-felling of up to 45-60 ha at a time.

Of particular concern is that this clear-felling zone includes a disproportionate area of the best koala habitat identified within state forests in north-eastern NSW, encompassing 39% of modelled high-quality koala habitat (Pugh 2017a). It also encompasses 33% of the OEH Koala Hubs on state forests, which are "areas of currently known significant koala occupancy that indicate clusters of resident populations" (Pugh 2018). Given that this form of alternate coupe clear-felling is partially attributed as a cause of the decline of koalas in the south-east forests (Lunney *et al.* 2014), it is outrageous that it is now to be routinely practiced in some of the best koala habitat left in north-eastern NSW.

Private Native Forestry

Under the *Native Vegetation Act 2003*, harvesting and associated logging operations conducted for the purposes of Private Native Forestry (PNF) require an approved Property Vegetation Plan and to be undertaken in accordance with PNF Code of Practice. In 2007, the first PNF Code of Practices that made mention of koalas were introduced.

The prescription requires that logging be excluded from core koala habitat identified in accordance with SEPP 44; the establishment of 20 m exclusion zones around trees with koalas or >20 koala scats found under them; and the retention of 15 potential food trees (>30 centimetre diameter) per hectare where there is evidence of koalas. The principal problem is that there is no requirement to survey for koalas, so the prescription is rarely triggered, and SEPP 44 has been inconsistently applied meaning that few Local Government Authorities have actually identified koala habitat.

The process is currently under transition, with the responsibility for preparing codes of practice for PNF recently transferred from the Minister for Environment to the Minister for Lands and Forests, who is in the process of rewriting the codes. The responsibility for regulation of PNF has been transferred from the Environment Protection Authority to Local Land Services. The EPA will retain an enforcement role.

While the specific koala prescription is rarely triggered because of the lack of surveys, it is at risk of being further weakened. Overall habitat protection may be reduced if the current limits on logging intensity and stream buffers are reduced, as

has been implemented for public lands. The highest priority is to require pre-logging surveys for koalas and other threatened species and to implement the SEPP 44 intent to exclude logging from core koala habitat.

South Coast

Public Lands

Koala populations have declined dramatically on the South Coast over the past century, from being common enough to support a commercial pelt industry to now being extremely rare, with widespread localised extinctions. Contributing factors have been identified as hunting, clearing, logging and climate change (Lunney *et al.* 2014).

Logging prescriptions for koalas were applied across all public forests under Threatened Species Licences issued as components of regional Integrated Forestry Operations Approvals (IFOAs) in 1999. These required 50 m buffers to be established around trees where koala scats were found in pre-logging surveys, with a corridor linking the retained area to other retained habitat and 150 ha of suitable koala habitat retained within 1.5 kilometres of the trees (this could be logged in the Eden area but not subject to integrated "regeneration" harvesting). Where there was evidence of koalas in a logging area, 10 koala food trees per hectare over 30 cm diameter were to be retained (Figure 8).

This did nothing to arrest the precipitous decline of koalas in the south-east. One of the most significant populations left at Tantawangalo–Yurammie appears to have been eliminated in 1996 prior to it being partially transferred into national park in 1999.

Following community protests, in 2016 the Murrah Flora Reserves were created over 11,811 ha of state forests to protect the most important koala population remaining. By then, the remnant population had been reduced to some 30-60 koalas. The Forestry Corporation retains ownership, though the flora reserves are managed by the National Parks and Wildlife Service, in consultation with the Biamanga Board. Long-term protection is still not guaranteed, with the *Narooma News* (3 March 2016) reporting the local state member Andrew Constance as stating,

"the forests were converted to flora reserves – which cannot be logged – instead of national parks, so in the future the option of harvesting them again could be considered".

The new 2018 Coastal IFOA now requires pre-logging koala surveys in eight state forests and in the vicinity of koala records. The Forestry Corporation can either undertake scat surveys based on 1 km grids or do an acoustic survey based on 100 ha sampling. Such low sampling may miss any koalas present, given their low densities and problems with Forestry Corporation surveys (i.e. EPA 2014). The EPA will develop specific requirements on a case by case basis where koalas are found.

Figure 8. Impact of Intensive logging on the south coastal ranges of NSW.

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Private Native Forestry

Given that koala populations are in such dire straits on the South Coast, it is astounding that the Private Native Forestry (PNF) Code only offers token protection for them.

The prescription requires that logging be excluded from core koala habitat identified in accordance with SEPP 44; the establishment of 20 m exclusion zones around trees with koalas or koala scats found under them; and the retention of 15 potential food trees (>30cm diameter) per hectare where there is evidence of koalas in the vicinity.

There have been no Comprehensive Koala Plans of Management adopted in south-eastern NSW and thus no core habitat identified in accordance with SEPP 44. The PNF Code recognises that koala populations are generally sparse or of low density on the South Coast and so scats are rarely encountered. However, the principal problem is that there is no requirement to survey for koalas, so even if koalas are present, scats or other evidence of koalas is unlikely to be found unless there are thorough pre-logging surveys.

Western NSW

Public Lands

Logging of timber has been practiced widely in western NSW, particularly among the cypress ironbark forests of north-western NSW, the cypress forest of the south-west and the red gum forests of the Murray region.

Returns from these operations have been steadily decreasing over the years as sawlog size has diminished, and there have been significant mill closures, particularly in the north-west over more recent years with few current operations being conducted. Past operations in this region have been very destructive, leaving low levels of mature tree recruitment, with <10% of the original cover of mature trees in commercial areas of forest. More recent operations included integrated ironbark and cypress harvesting, which cleared large gaps in the forest, taking the

recruitment tree cohort. Despite the benefits of thinning cypress pine for timber production, there has been little attempt to undertake this in public forests since the Western Regional Assessment was completed in 2003. In the south-west, based at Narrandera, cypress operations continue in small scattered forests, further reducing the recruitment of mature trees.

The most destructive logging regimes for the koala are in the Murray forests, particularly Koondrook State forest, where the logging of over-mature river red gums is still occurring, albeit at reduced levels since most jobs in this industry were lost several years ago, though more recent lobbying has indicated the industry would like to step up operations in the west. These forests are potentially key koala habitat in what must be regarded as a refuge for this species in the face of climate change, given the proximity of permanent water and the flooding events these forests require.

Use of the Australian Group Selection (AGS) and Single Tree Selection (STS) harvesting regimes is undertaken in these forests and has resulted in a low level of mature tree recruitment and extensive gaps in tree cover. Koala exclusion protocols are in place, but only leave 30 m around trees where koalas are present and 100 m for high-use trees. Koala protection in these forests is entirely dependent upon what trees koalas happen to be in just prior to logging, as there are no koala habitat protection zones in the harvested forests of the Murray. A recent audit by the EPA shows that pre-logging habitat mark-ups are not routinely undertaken. This may explain the scarcity of koalas recorded in the logged forests of the Murray, despite the high levels of human activity and the preferred nature of the habitat to koalas.

Now the industry is pushing to open up areas of the Murray Valley National Park for logging, which would either mean de-listing of areas as national park or some form of logging under the guise of ecological benefit. This is a sure sign of the unsustainability of the current industry, which must surely be phased out if remaining red gum forests are to be retained in good health and capable of providing refuge habitat for koalas and a wide variety of other threatened fauna and flora into the future.

Private Lands

Until the newest Private Native Forest Code of Practice for the River Red Gum Forests, which provides for a koala site assessment protocol based on SEPP 44 standards, none of the previous codes for private red gum logging had any koala specific provisions. This code of practice is applied throughout all river red gum forests (generally found within river basins) in western NSW from the Queensland border to the Victorian border. The fact that at no time until now had adequate koala assessment protocols been in force (at least in principle) reflects the lack of regard NSW authorities have had for koala issues. The lack of koala data from the Murray forests suggests the koala has gone unrecorded during timber operations on public land and that this practice has been transferred to the private sector.

Figure 9. A long history of logging in Murray Valley forests has seen a significant reduction in old-growth forest cover.

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3.3 URBAN DEVELOPMENT

Urban expansion continues to threaten koalas, particularly in coastal regions, and has been responsible for some of the worst examples of habitat loss for koalas. Urban development also exacerbates the associated threats of predation by dogs, vehicle strike and disease.

Some of the worst examples of rampant urban development with little regard for peri-urban populations of koalas, mostly for residential housing estates and associated infrastructure, have occurred in the Greater Brisbane Area, on the Gold Coast and in the Campbelltown area of western Sydney. Other hotspots in NSW include the urban interface around Port Macquarie and Port Stephens.

South-East Queensland

South-East Queensland (SEQ) over the past few decades has been one of the fastest growing human populations in Australia. Figures on koala decline associated with urban development on the Koala Coast show that koalas have declined by 64% over 10 years, from an estimated 6,250 to 2,280 koalas in 2009 and is considered to be approaching functional extinction (Queensland Department of Environment and Resource Management 2009). In the Pine Rivers District, to the north of the Koala Coast, the urban population of koalas declined by 45%, and the bushland population by 15% in a similar timeframe (GHD 2008), leading to an overall decline of 40% from an estimated 4,600 in 2001 (Dique et al. 2003) to less than 2,700 in 2008.

This trend is not isolated. All SEQ coastal local government areas (Sunshine Coast, Moreton Bay, Brisbane, Redland, Logan, Gold Coast and Ipswich) appear to be following a downward trend, as evidenced by a rapid increase in the numbers of injured and deceased animals reported to animal carer organisations, then followed by a decline in reporting, most likely due to a crash in koala numbers. The drought between 2001 and 2007 inhibited any recovery (McDonnell 2010). A similar trend in the reporting of koalas to animal carer groups has also been documented in Port Stephens in NSW (HKPS 2015).

A key example of the lack of consideration within planning and development for biodiversity, and koalas in particular, is the East Coomera Estate Project within the Gold Coast LGA (see Figure 10). Here, the local population of about 500 animals (BioLink 2007b) were subject to the incremental removal of koala habitat from 2008, involving the translocation of at least 250 animals, of which at least half have subsequently died (ABC 2018) and the loss of 800 ha (about 34%) of the original extent of habitat so far. Wildlife carer records show mortality in the remaining population has increased, mainly due to vehicle strike and dog attack (GCB 2017).

Despite this loss of animals and habitat, consultants for Gold Coast Council claimed that the original population had not diminished 10 years later in a redacted report (BioLink 2017). This area was once the largest remaining patch of lowland swamp mahogany and red gum forest in the LGA.

Campbelltown

In all of the above cases, poor planning, primarily at the local government level, has been the key factor in this ongoing loss of habitat. Equally to blame are poor

outcomes from offset arrangements established with the consent of State and Commonwealth authorities. Another current example is the 'biocertification' of the strategic plan for western Sydney residential expansion and highway upgrade, which will further reduce habitat connectivity for a koala population already exposed to urban development. One component of this is the 'Gilead' residential development which will remove 216 ha of land in the middle of known koala habitat. The developer is permitted to offset vegetation removal by improving habitat on the adjoining Noorumba Reserve.

Originally, offset arrangements that developers were required to use in NSW were based on anticipated biodiversity gains derived from additional management arrangements, including greater protection. However, a string of updated policies and guidelines have watered down offset outcomes in NSW, such that now developers more or less can meet their obligations through investment in a government fund.

Additional National Parks and planning protections are required to protect habitat around urban growth areas in the Campbelltown region, particularly for the state's only chlamydia-free koala population. Establishment of a National Park to provide north-south connectivity along the Georges River, plus the proposed Two Rivers Koala Frontier National Park to maintain east-west connectivity between the Georges and Nepean Rivers, are key opportunities. Further riparian koala connectivity needs are wide buffers around rivers, with setbacks of at least 425m around rivers and 250m around creeks, in accordance with expert advice.

Recently, the Labor Party has committed to establishing an additional protected area, Georges River Koala National Park, west of the Georges River, and the Liberal Party a reserve in approximately the same location. However, none of these additions will completely compensate for the loss of habitat in a sensitive area of connectivity for this population.

In this case, the end result will be a net loss of koala habitat, an increasingly isolated reserve and a new residential estate in an area only recently identified as having perhaps the only population in NSW where an increase in koala numbers has been documented. Recent studies, as yet unpublished, show that the MacArthur meta-population seems to have increased its distribution into coastal areas of the Illawarra, but yet is under increasing pressure from habitat loss in the central parts of its range. It seems that despite an earlier population crash, this population is apparently showing few clinical signs of disease and so is a particularly important population for NSW (B. Durman, pers. comm.)

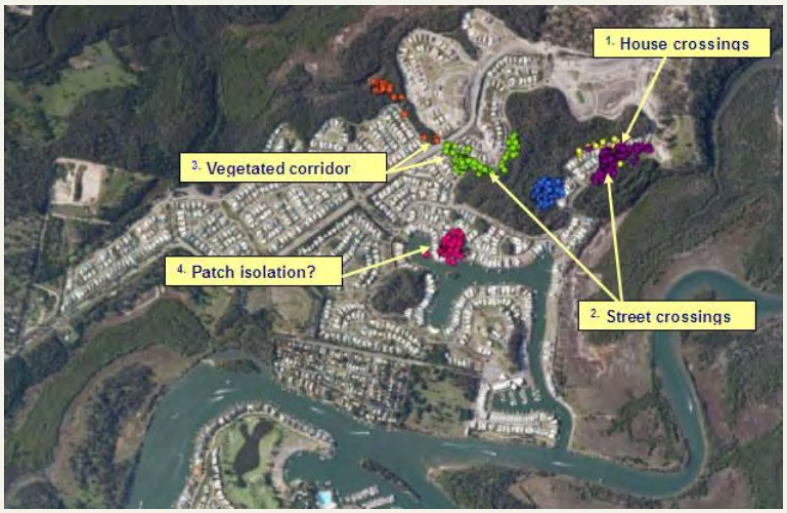

Figure 10. East Coomera estate development in progress, Gold Coast LGA. Coloured dots represent tracking results of individual koalas. Clumped activity patterns suggest individuals congregating around restricted dispersal points. The future viability of this population does not look promising.

3.4 TRANSPORT

Linear infrastructure development, such as rail and road, poses significant issues for koalas and wildlife in general for several reasons. These are summarised below.

- *Projects designated as state significant projects.* This generally means that there is little recourse available as to whether the project should proceed, so chief issues that arise are to do with location. The use of offset policy is generally used to mitigate impacts.
- *Lower thresholds for avoidance, with projects tending to target existing bushland to reduce issues with private landowners.* For example, the Inland Rail project has targeted several areas of koala habitat in NSW and Qld. The Croppa Creek section of the line represents one of the last few locations where this species exists. Raising the highway above the tree canopy, for example the Hunter Expressway, and the use of tunnels are ways sensitive areas can be avoided, although these measures are rarely undertaken.
- *Infrastructure creates significant barriers to the dispersal of terrestrial species.* Highways such as the current Woolgoolga to Ballina Pacific Highway Upgrade, which was approved to cut through a nationally significant koala population of around 200 animals, are multi-laned death traps for wildlife attempting to disperse. Rail lines can also offer significant barriers. State authorities have tended to deal with this issue by erecting barriers to prevent movement, while allowing crossing points for terrestrial species. This has tended to be underpasses, although in many cases wildlife can still access the highway using structures such as interchange ramps. Barriers such as highways increase fragmentation. In some cases, as in the Ballina example, they can further fragment existing at-risk koala populations.
- *Transport infrastructure approvals tend to be staged, due to their length, with separate approvals for different sections of the line.* In these cases, the cumulative impact of the development becomes a significant issue. Queensland legislation requires cumulative impact be considered separately, though in Commonwealth and NSW law consideration of this is generally written into the development requirements, as there are no specific guidelines as to how cumulative impact assessments should be undertaken under the EPA Act, BC Act or the EPBC Act.
- *There is often poor use of the latest science.* Overpasses, such as land bridges, have been poorly implemented in Australia despite their wide use internationally. These are particularly important to traffic susceptible wildlife such as the koala and, in view of their demonstrated utility overseas, it is difficult to understand the paucity of funds invested to enable wildlife to navigate around transport corridors in Australia.

In the Woolgoolga to Ballina Pacific Highway Upgrade, the Roads and Maritime Services (RMS) was required to complete a Ballina Koala Plan and Population Viability Analysis (PVA) only before major work could start on the koala sensitive section between Broadwater and Coolgardi. These matters should have been dealt with prior to consent being given so as route location and other avoidance measures could be properly canvassed.

The local koala population already had roads to deal with prior to the construction of the highway and some points had existing measures to help wildlife cross. The PVA undertaken by consultants Niche (2016) found mitigation measures on existing roads near the project would offset impact of the upgrade on the local koala population and further proposed mitigation could improve the situation for koalas based on current predictions, but also found that "… the Ballina koala population would decline with or without the upgraded highway due to disease, predators and koala deaths on roads other than the highway". Strong questions have been raised about the assumptions used in this PVA by IFAW and other community groups (IFAW 2016).

This outcome could have been avoided because the presence of the population was known to be regionally and nationally significant and there were alternative routes available that would have avoided impacts on the koalas. But the government chose to construct the highway through the koala colony, citing a need to reduce costs. While it is arguable that the local population was already in trouble, the upgrade has made its ultimate extinction more likely, which is surely a perverse outcome.

3.5 CLIMATE CHANGE

Climate change is increasingly acknowledged as a key threat to the koala, as it is expected to lead to increased temperatures, changes to rainfall, increasing frequency and intensity of droughts, and increased fire risk over much of the koala's range (Natural Resource Management Ministerial Council 2010). Increased temperatures inland are expected to cause the koala's range to contract eastward (Dunlop and Brown 2008; Queensland Office of Climate Change 2008; Werner et al. 2009; Adams-Hosking 2011; Adams-Hosking et al. 2011). This effect will be compounded by extended drought that may be expected under climate change scenarios (Queensland Office of Climate Change 2008). In the south of the koala's range, in Victoria, more hot days, increased risk of intense fire and more droughts are expected (Victorian Department of Sustainability and Environment 2009). Adams-Hosking (2011) estimated, using bioclimatic modelling, that the koala's range, and particularly its core (10-90%) range, will contract by 20-30% by 2030, leaving bioregions such the Cobar Peneplain, Darling Riverine Plains, Murray Darling Depression, Mulga Lands, Mitchell Grass Downs and Einasleigh Uplands uninhabitable for koalas, with areas such as the Brigalow Belt bioregions becoming significantly more marginal.

There have been several documented instances of koala population crashes as a result of severe drought in the recent past, where range contractions to wetter areas (Sullivan *et al.* 2003) and to refuge habitat associated with water features (Gordon *et al.* 1988) in western Queensland have been noted. More recent evidence from the Pilliga forest in NSW suggest that while declines were first noticed following the 2003-6 drought, by 2013 the few remaining koalas showed signs of localised refugial persistence, with a distributional decline of 80% of its range across the forest (Lunney *et al.* 2017). Anecdotal searches over the past two years have not detected koalas except in the southern edges of the forest, Warrumbungle National Park and the Castlereagh River. This is a significant retraction in the range of this population in the past 15 or so years.

Drought length can have significant implications for the capacity of a population to recover (Gordon et al. 1988) through the poor recruitment of breeding animals. Ongoing drought can also have severe local environmental impacts, such as dropping water tables and tree dieback along streams. Dying streamside vegetation and likely declines in forage quality has been noted in Moorinya National Park in central western Queensland and is also now widespread through the Pilliga forest. This has included older trees – a sign of decreasing resilience and long-term decline (D. Paull, pers. obs.).

The effects of ongoing habitat loss and fragmentation can only exacerbate the impacts of drought, by increasing movement distances for koalas and further reducing habitat quality and quantity. Such a situation is apparent in the Gwydir floodplain of northern NSW, where the combination of prolonged drought and increasing rates of land clearing has rapidly increased the koala extinction risk (P. Spark, pers. comm).

Drought may also be a significant factor in the decline of koalas in coastal areas. Adams-Hosking et al. (2014) noted loss of koalas from drier sites and suggests that drought-related stress may have made koalas more susceptible to disease. Densities of koalas in SEQ, as noted by Rhodes et al. (2016), has also declined in intact areas of national park, suggesting signs of prolonged drought.

The incidence and intensity of fire may also be exacerbated by climate change and is a substantial risk in areas of more extensive forest as well as smaller patches.

Modification of fire regimes through more frequent, less intensive burning did not improve modelled population viability (Lunney *et al.* 2007).

Increasing atmospheric CO2 has effects on the ratios of carbon to nitrogen, which leads to an increase in the concentrations of carbon-based anti-herbivore compounds like tannins, while nitrogen (protein) decreases (Lawler *et al.* 1997). DeGabriel *et al.* (2009) showed that the balance between tannins and proteins determines protein digestibility and that subtle differences may have profound effects on the reproductive success of eucalypt folivores. The current consensus is that koala population dynamics are likely to be negatively impacted by the changes in leaf chemistry induced by elevated CO2. It has been recently possible to assess forest nutritional quality using airborne hyperspectral data to potentially map forage quality for koalas remotely (Youngentob *et al.* 2012).

Forage quality needs to be considered within assessments of habitat quality. This can either be done through plot-level assessments of the proportional representation of koala food tree species, or by sampling leaves from a representative sample of every koala food tree species on site for forage quality analyses. Forage quality analyses involve lab-based assessments for total foliar nitrogen, digestible nitrogen and formylated phloroglucinol compounds and unsubstituted B-ring flavanones (Marsh *et al.* 2019).

IMAGE © DAVID PAULL.

Figure 11. Refuge site for koalas in Pilliga Forest in 2013. This wetlands has since dried up.

3.6 LOGGING DIEBACK

Large areas of koala habitat are being affected by logging-induced dieback throughout coastal NSW. It is being spread by repeated logging and stress from climate change at an alarming rate.

Logging opens up the forest canopy, allowing increased light to reach the forest floor, which combined with soil disturbance can allow weeds to proliferate. Particular problems occur in eucalypt forests when lantana (and in some places native vines) proliferate and suppress regeneration, with the altered structure providing perfect habitat for the native bird the bell miner to multiply and aggressively exclude most other native species. This facilitates outbreaks of sap-sucking insects called psyllids that literally drain the life out of the eucalypts. It is called Bell Miner Associated Dieback (BMAD), although is logging-induced ecosystem collapse.

It was first recognised in the 1940s in the Gosford area. Bird et al. (1975) report Moore (1962) as finding that "there were more than 150 separate occurrences of variable extent up to 1,500 ha". For north-eastern NSW, Stone et al. (1995) reported: "More recently, District staff have reported that affected areas are increasing in size and that previously unaffected areas are developing symptoms", attributing it to "the proportion of moist sclerophyll forest being exposed to selective logging ... increasing throughout the state".

Jurskis and Walmsley (2012) identify the extent of the problem in southern NSW, noting: "In 2001 Jurskis and Turner ... recorded observations of eucalypt decline in each coastal drainage system within Bega Valley Shire. Six hours of helicopter survey in 2002 identified 10,000 hectares of declining forest in three coastal regions. In the Eden Region, Jaggers (2004) estimated that roughly 20% of about a half a million hectares of forest appeared to be declining and a further 10% consisted of types that are prone to decline, in young stands that were below the age when decline becomes apparent. Limited sampling in the Batemans Bay Region during a drought in 2002 indicated that about 28% of state forests were stressed".

Wardell-Johnson et al. (2006) stated:

"The severity of the BMAD problem is such that tens of thousands of hectares in north-eastern NSW is currently affected with over 2.5 million hectares considered potentially vulnerable (Ron Billyard, pers. comm. November 2004). ... BMAD occurs on both public and private land and the area affected is expanding rapidly. The severe impact of this form of forest canopy dieback has profound implications for the conservation of the internationally significant biodiversity of the region".

In some state forests, over 60% of the eucalypt forests can be affected. For example,

a 2004 assessment of 23,700 ha of eucalypt forest on the Richmond Range in north-eastern NSW identified 37% as moderately to severely affected by BMAD and 25% as mildly affected (Stone *et al.* 2005). At its worst, the forest can be reduced to a sea of lantana overtopped by dead and dying eucalypts.

In 2008, the NSW Scientific Committee listed Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners as a Key Threatening Process, noting:

"Broad-scale canopy dieback associated with psyllids and Bell Miners usually occurs in disturbed landscapes, and involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion (Wardell-Johnson *et al.* 2006) ... Over-abundant psyllid populations and Bell Miner colonies tend to be initiated in sites with high soil moisture and suitable tree species where tree canopy cover has been reduced by 35-65 % and which contain a dense understorey, often of *Lantana camara*".

Most recently, DPI-Forests (Silver and Carnegie 2017) used helicopter sketch-mapping to identify 44,777 ha of BMAD north from Taree to the Queensland border. Comparison with other mapping indicates that there is something like double this area affected.

Despite numerous studies confirming logging as the primary initiator of BMAD, the NSW Government remains in denial about causes and effects, so that logging of affected and susceptible stands can continue. As the forests sicken and die, so too does the habitat and food for koalas.

The Forestry Corporation recently abandoned five state forests for timber production (Mt. Lindesay, Donaldson, Unumgar, Bald Knob and Woodenbong), comprising 11,000 ha around Woodenbong in north-eastern NSW, because of the extent of BMAD and Endangered Ecological Communities (NRC 2016). Of the 7,740 ha of eucalypt forests within these areas, 35% was conservatively mapped by Silver and Carnegie (2017) as being affected by BMAD. There are 168 koala records in these forests, of which 61% occur in mapped BMAD areas, demonstrating that what was the best koala habitat is now the worst affected.

Monitoring of forest health following logging in 2007 in Mount Lindesay State Forest found that after six years logging and burning had increased lantana by 145% and bell miners by 104% compared to controls, with 10-20% declines in the canopy health of remaining koala food trees such as grey gum, grey box and flooded gum (Forestry Corporation 2015). In Donaldson State Forest, fire and mechanical treatments resulted in 420% increases in lantana and 460% increases in bell miners after eight years (Forestry Corporation 2015).

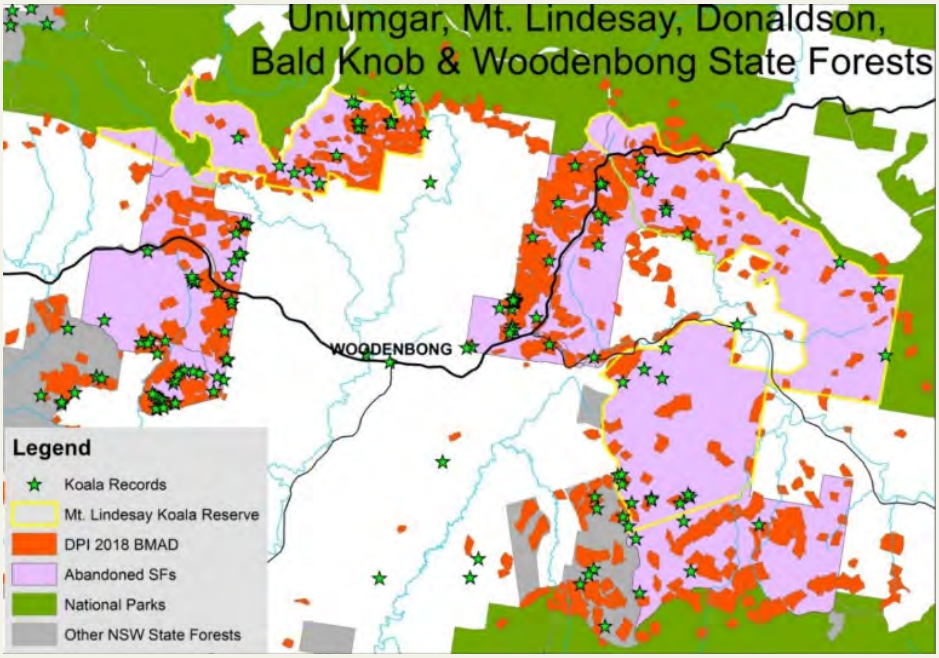

Figure 12. Koala records in relation to Bell Miner-Associated Dieback as under-mapped by DPI-Forestry (Silver and Carnegie 2017). Areas of state forest abandoned for timber production (pink areas) and the proposed Mt. Lindesay Koala Reserve (see yellow outline). Note the high correlation of koala records with dieback areas, emphasising the urgent need for protection and rehabilitation of these important areas.

In 2018 the NSW Government announced it would create 12 "new" koala reserves covering 20,000 ha of unproductive forests as a key pillar of its koala strategy. Four of these have no records of koalas, and only two have records within the past 10 years, one of which encompasses 5,600 ha of the abandoned Mt. Lindesay forests. Mt. Lindesay is to remain under the ownership of the Forestry Corporation but be managed by the NPWS, with as yet no funding to undertake the massive rehabilitation required. Experience has shown that BMAD can be simply controlled by removing the lantana, although at a cost of around $1,000 a hectare this is an expensive task given the scale of the problem.

4. BUILDING A PROTECTED LAND SYSTEM FOR THE KOALA

4.1 IDENTIFYING PRIORITY LANDS FOR THE KOALA

If there is an intent to arrest the alarming decline in koalas, then there is no higher priority than to protect remaining koala habitat from further degradation and clearing, and to begin rehabilitating habitats and linkages. This chapter outlines a modelled approach to identifying key (priority) remaining koala habitat areas for this purpose, using existing mapping and location data.

Population density models are useful tools to predict priority areas for species conservation and elucidating population trends, although, like all models, they rely on substantial amounts of data on species numbers and distribution. Rhodes *et al.* (2015) developed a reliable population density model for koalas in SEQ using a unique long-term data set of koala surveys. This relied on data generated by repeat surveys from transect counts, generally regarded as one of the best techniques for determining local koala density (Dique et al. 2003; 2004). Other areas of Queensland were not included in the model because of a lack of verifiable data.

In NSW, this approach has been inhibited by a lack of repeat surveys and monitoring data in nearly all regions of the state, despite such research being a priority of the previous NSW Koala Recovery Plan.

In response to this lack of data, the *Independent Review into the Decline of Koala Populations in Key Areas of NSW* (NSW Chief Scientist and Engineer 2016), outlined the need to identify:

- Key koala populations and their threats (Recommendation 1); and
- Regional-scale threat information, which, together with habitat mapping and likelihood of occurrence data, should be used to prioritise conservation management actions (Recommendation 7).

In NSW to date, there have been a variety of attempts to extrapolate from records to identify important koala habitat across the landscape, though these attempts have been of limited success because of the biases in the records, the failure of vegetation mapping to adequately represent the localised abundance and diversity of koala food trees, the failure to account for forest structure, and the elimination of koalas from otherwise suitable habitat by logging, fire, disease or predation (EPA 2016).

The EPA's (2016) Expert Koala Panel compared various modelling and mapping approaches with ground surveys, concluding "the available methods tested cannot produce an accurate and reliable map of koala habitat at the local scale for the purpose of managing koala populations and associated habitat in a state forest context. Furthermore, these koala habitat maps cannot be used to indicate or predict koala occupancy".

As identified by Rennison and Fisher (2018):

"The fickle nature of koala distribution patterns in NSW highlights the importance of investing significant effort to identify lands currently occupied by koalas, and to focus on the protection of koalas where they reside, rather than protecting habitat as a surrogate for koala occupancy".

The Office of Environment and Heritage (OEH) has been involved in developing a Framework for the Spatial Prioritisation of Koala Conservation Actions in NSW (Rennison and Fisher 2018). The process has involved the identification of Areas of Regional Koala Significance (ARKS). OEH has applied koala records to identify and map 48 ARKS and the distribution of habitat and threats within each. This has been supplemented by analyses of koala records to "define areas of currently known significant koala occupancy that indicate clusters of resident populations known as Koala Hubs".

WWF hubs derivation

The WWF analysis provided in this report mirrors the approach taken by the OEH's Hub analysis, which the conservation organisations generally strongly support, except this study has:

- Used substantially more data (56,000) than was available to OEH at the time that study was undertaken (22,000);
- Identified priority lands for habitat protection across all land tenures; and
- Used a vector-based buffering of collated records.

All NSW koala records on the BioNet database were downloaded where a preliminary distance filtering of the records analysis was undertaken (download October 2018). As undertaken by OEH, only clusters of three or more records within 500 m were retained for analysis. These were further filtered to exclude isolated (more than 2 km) clusters below 300 ha to ensure that only locally significant populations were considered. In their analysis, the OEH removed single generation records older than the current generation period, to ensure hubs represent 'resident populations'. However in the WWF analysis presented here, those records were maintained because the patchiness of koala records in time and because to do so would detract from identifying the extent of important koala habitat.

The filtered koala records were then joined to a 500 m buffer based on spatial location and areas were calculated in hectares. To create the 2 km buffers, koala records that fell inside the 500 m buffers that contained three or more koala records and were greater than 300 ha were then buffered to 2 km (boundaries merged) to identify 500 m buffers that were outliers outside identified hubs.

Koala distribution outside the hubs is accounted for in this report through low density koala areas. Records of koalas outside the 2 km buffers were given a 1 km buffer to show the full spatial distribution of koalas.

The WWF Koala 'Hubs' in NSW and 'low density koala areas' are shown in Map 2.

Priority areas

This assessment is limited to identifying the high priority areas to aim to protect and manage for recovery of koala populations. It is important to recognise that these are only known priority areas based on existing reported koala sightings. There are many other areas of occupied habitat that occur and need protection for an adequate and comprehensive koala reserve system. There is an urgent need to undertake systematic regional surveys to identify all areas of resident populations to target for protection if koalas are to achieve the habitat protection required to halt their decline towards extinction.

For this assessment, the OEH Koala Hubs were combined with the WWF 500 m Koala Hubs to identify the highest priority areas (Priority 1) to target for koala protection measures. The WWF 2 km Koala Hubs were used to identify the next highest priority areas (Priority 2) to target outside Priority 1 areas. The area within the 2 km boundary is referred to here as WWF Koala Habitat Priority Areas. These are shown on Maps 3-12.

The hubs data will likely overlook areas of occupied habitat that need protection to achieve an adequate koala protection system as there will be important areas for koalas that are not reflected by existing records. There is therefore an urgent need to undertake systematic regional surveys to identify all areas of resident populations to target for protection if koalas are to achieve the protection required to halt their decline towards extinction. As shown by the more comprehensive assessment for the proposed Great Koala National Park, there is still a lot more to be done at a regional level.

It is considered that the protection and management of the identified priority areas for koalas are urgent requirements to help arrest the alarming decline in koala populations in NSW and to begin their recovery. Further surveys are required to identify additional areas.

State forests

For state forests, reserve priorities were identified based on the intersection of state forest compartments (as mapped by the Forestry Corporation of NSW) with Priority 1 and 2 Koala Hubs. Compartments are often delineated based on natural boundaries such as ridges and creeks, so they are the best selection units for identifying koala reserves. These were cut as necessary to exclude large areas of plantations and to better reflect priority habitat.

Compartments with significant overlap with Priority 1 Koala Hubs were the first selected. Compartments were then added to consolidate boundaries and provide linkages to nearby national parks and koala habitat. In doing this, reference was made to koala records and, where available, koala models (Law et al. 2017). This process was repeated for Priority 2 areas.

Crown Lands

The identification of land tenure was derived from the State Government's current cadastre data for Local Government Areas. This identifies land tenures as freehold, Crown land, NSW Government, Australian Government, Local Government and unknown.

Lots identified as Crown land, NSW Government and Australian Government lands within the koala priority areas were reviewed by reference to the 'Six Maps' website (https://maps.six.nsw.gov.au/) , which enables the identification of forest cover, cleared and developed areas, and an indication of usage. Lots, or parts of lots, that

are extensively cleared, are developed, have buildings or have identified uses (such as cemeteries, scout camps, rifle ranges, sports facilities, etc.) were excluded. Where parts of a lot appeared to have significant areas of potential koala habitat, the developed areas were cut out. Koala records were taken into account.

As well as freehold lands, lots identified as unknown and Local Government were excluded from lot selection, though were included with private lands for subsequent assessments.

Private Lands

For freehold lands, the Commonwealth's 2018 mapping (NVIS 5.1) of broad vegetation types was applied. It was considered that within the priority areas the eucalypt-dominated vegetation types could be considered as likely koala habitat. The categories utilised were:

The identification of Priority 1 and 2 freehold lands were simply identified by the application of the priority Koala Hubs to this broad mapping. While this is broad mapping, it highlights those areas of private land that should be considered a priority for koala conservation measures.

The vegetation mapping is broad and does not identify the distribution of preferred food trees and core habitat, with many smaller patches of essential habitat missing. By its nature, it does account for linkages within patches, although there is no consideration of habitat linkages between patches. It is emphasised that these are based on the limited available information and only represent some of the priority areas on private lands, though do provide a start for where investment in koala conservation on private lands should be focussed.

4.2 EXPANDING PROTECTION ON PUBLIC LANDS

State forests

In summary, application of the Priority 1 and 2 areas analysis resulted in 341,776 hectares of state forests being identified as high priorities for inclusion in the reserve system to protect koalas. Some 180,368 hectares of state forests are identified as the highest priority (Priority 1) and 161,408 hectares as high priority (Priority 2), for inclusion in national parks.

The total area of state forests is 2,181,309 hectares. The Reserve Priority areas thus represent 15.7% of state forests. Of the 7,671 koala records within state forests, 85% occur within the WWF Priority Koala Habitat Areas, demonstrating their outstanding importance to koalas. State forests that require urgent protection are listed in Appendix 2, while areas of state forest in hectares are shown as per OEH ARKS in Table 3. In general, the OEH ARKS and WWF Priority Koala Habitat areas showed a high level of correspondence.

Table 3. Proposed state forest koala reserves grouped into OEH Areas of Regional Koala Significance.

BIOREGION	OEH ARKS	STATE FOREST (HA)	KOALA RECORDS
South Eastern Queensland	Banyabba	16,254	773
(NSW section)	Far north-east Hinterland	1,097	6
	Mt Pikapene	3,105	108
	North Grafton	637	15
	Southern Clarence	2,393	32
	Woodenbong	21,989	341
Sub-total		45,475	1,275
NSW North Coast	Barrington	6,565	208
	Belmore River	6,076	64
	Clouds Creek	26,702	587
	Coffs Harbour - North Bellingen	43,621	1,528
	Comboyne	32,817	329
	Crowdy Bay	90	1
	Girard - Ewingar	6,722	74
	Karuah - Myall Lakes	2,188	16
	Kiwarrak	6,586	51
	North Macleay - Nambucca	40,334	913
	Port Macquarie	687	4
	Wallingat NP	1,127	16
	Wang Wauk SF	18,815	411
	Wilson River	18,859	196
Sub-total		211,18	4,398
Sydney Basin	Bungonia	3,072	102
	Lower Hunter	6,654	33
Sub-total		9,726	135
South East Corner	Murrah	14,346	263
	Nullica	2,313	17
Sub-total		16,659	280
South Eastern Highlands	Nullica	1,405	2
Brigalow Belt South	Gunnedah	3,375	56
	Pilliga	53,923	395
Sub-total		57,298	451
NSW South Western Slopes	Narrandera	4	1
GRAND TOTALS		341,756	6,542

While survey effort is unknown, 68% of the proposed reserves have had koalas recorded within them in the past decade, indicating current usage. A further 23% have had koalas recorded within the past 20 years, indicating that they are likely to retain koalas, however diminished.

Most state forest priority lands are found on the North Coast bioregions (73 on the NSW North Coast and 26 in South-East Queensland), with 14 from the Brigalow Belt South, eight from the South-East Corner, two from the South-East Highlands and only one small forest near Narrandera. The Murray Forests did not have enough database records to constitute being a priority region, nevertheless these forests require urgent protection within the reserve system, particularly Koondrook SF. Some of the priority state forests on the North Coast partially occur on the New England Tablelands and should be regarded as important refuges in the context of climate change.

For the Brigalow Belt forests, some are within the Pilliga region, for which further reservation is recommended, while a series of important koala refuges are found along the southern part of the Liverpool Plains, namely Blackjack, Goran, Breeza and Doona state forests. The latter three form an archipelago central to the koala's present distribution, particularly those now confined to the southern parts of the plains due to clearing and drought (P. Spark, pers. comm., 2018). Therefore, these forests are important climate change refuges for the koala on the Liverpool Plains.

In the South-East Corner, priority state forests for koalas are found in two groups: one corresponding to the coastal Murra ARKS area, between Bermagui and Bega; and the other group corresponding to the location of the Nullica ARKS in the southern ranges. In the latter, the most important forests that require protection are Bermagui, Murrah, Tanja and Yurammie.

On the North Coast, it is evident that many of the compartments selected through the priority analysis include areas in which koala habitat has been degraded by the removal of mature food trees, intensive logging and weed invasion. For example, the EPA (2016) surveyed two areas of high-quality koala habitat in Clouds Creek State forest (Clouds Creek ARKS) and Maria River State Forest (Belmore River/ Wilson River ARKS) (both identified as the highest priority for reservation in this assessment) and concluded:

"Given the SAT results for Clouds Creek and to a lesser extent, Maria River SF, in combination with the degree of habitat disturbance (logging and fire) identified in the field, it would be reasonable to conclude that the high activity areas were sink habitats, as less than 30% total habitat utilisation was recorded, in addition to <5% of resident habitat area recorded" (p82).

Similarly, Biolink's (2013) report Port Macquarie-Hastings Koala Habitat and Population Assessment found that large areas of high priority habitat on state forests inland from Port Macquarie (Comboyne/Port Macquarie/Crowdy Bay ARKS) had been degraded:

"... koala activity was recorded less commonly from areas of state forest where field data and other knowledge strongly points to cumulative impacts of logging over time resulting in significantly lower size classes of preferred food tree species which in turn results in a lower koala carrying capacity".

Biolink identified the need to minimise "threatening processes such as logging that otherwise work to limit koala population growth", considering "where they are not, large patches of otherwise suitable habitat (e.g. state forests) can be demonstrated to no longer support substantive koala populations".

Provided there are no impediments to regeneration, habitat values for koalas in these proposed reserves should improve as trees age and provide increased resources, though in areas where management has aimed to convert forests to monocultures of blackbutt, active intervention will be required to restore the diversity of koala food trees.

Extensive areas (ie Woodenbong ARKS) are also known to have been invaded by lantana and suffering from dieback (Pugh 2018). Where increasing numbers of koala food trees are sick, dying or dead, dense lantana inhibits koala movement and aggressive bell miners harass koalas. Parts of these proposed reserves require active intervention to remove the lantana and thus allow the forests to recover.

Climate change is causing an increase in extreme temperatures and droughts, resulting in increased water stress for koalas. The increase in water use by converting forests to regrowth is another contributing factor that can be mitigated by allowing forests to mature, though it is unknown whether this can mitigate the escalating impacts of climate change in some proposed reserves.

In a few of the proposed koala reserves, where koalas were historically found, they may have since been eliminated. The restoration of such areas to improve their habitat values allows for the potential of recolonisation. For example, while the population of koalas in Tantawangalo State Forest appears to have been eliminated in the late 1990s, "… as ghost habitat, it retains its potential to once again support a koala population should koalas recolonise this area in the future" (Lunney *et al.* 2014).

As verification of the importance of the proposed koala reserves, those in the SEQ and NSW North Coast bioregions were compared to DPI-Forestry's (Law *et al.* 2017) koala model. The model is primarily based on the variables of wildfire frequency, soil classes, floristic mapping and elevation where these corresponded with presence only records. This model therefore suffers from the bias of known records, inadequate identification of the distribution of food trees in current vegetation mapping and the failure to take into account vegetation structure.

Law *et al.* (2018) used week-long recordings of koala calls in modelled moderate-high quality habitat at 171 sites in state forests in the breeding season to validate the modelling, finding evidence of koalas at 62% of sites. Given that this method only records the presence of calling males, which could be dispersing males seeking females, it provides no indication of the presence of stable populations. To the contrary, the evidence is that for many sites there was low occupancy, as at the 65 sites where Law et al. (2017) undertook scat searches and found just one scat at nine sites and two scats at two sites – finding single scats under 13 (0.5%) out of 2,600 trees searched. So, while most sites had koalas somewhere in the vicinity, the indications are of low densities. This verifies that while still widespread in potential habitat, koalas are in serious trouble.

Nevertheless, modelled habitat provides another measure of likely koala occupancy. Overall, 61% of the identified koala reserves comprise medium-high quality koala habitat as identified by DPI-Forestry. Most significantly, the model identifies significant areas of potentially moderate-high koala habitat in the proposed koala reserves that do not have recent, if any, koala records.

As well as the limitations of record-based assessments, it is important to recognise that even low-density koala habitat is important for maintaining regional populations and allowing for dispersal between areas of higher quality habitat.

Sink habitat is where koala populations are in decline and, on their own, would not be able to support a population. It is essential that the remaining areas of source

habitat are protected and those areas where habitat has been degraded by logging and dieback assisted to recover their habitat values. Some areas will recover their values as existing trees mature, but enrichment planting of food trees and active weed control will be required in others.

The good news is that while populations are reduced and in danger of collapse, koalas are persisting in many heavily disturbed areas, aided by logging exclusion areas. However, as logging intensity increases and riparian and old-growth exclusion areas are reduced, they are unlikely to persist unless these priority areas are protected from further degradation.

Further surveys will identify additional areas of importance for koalas that should be reserved, as will consideration of other criteria for reservation. The priority lands are those that the available records identify that we need to urgently reserve to protect resident koala populations and allow habitat recovery to help stabilise these core populations.

Crown Lands

A total of 71,094 hectare of Crown, NSW Government and Australian Government lands that have been identified as known high priorities for the protection of koala habitat and linkages. Some of these areas should be made into national parks, and others managed as components of regional systems of retained habitat. Some 54,380 hectare is identified as Priority 1 lots and 16,714 hectare as Priority 2 (Table 4).

Many of the Crown lands identified through this process are small lots or narrow strips, which were included because of their likely significance in maintaining local populations and facilitating dispersal across the landscape. The Crown lots have an average size of 15.6 ha.

The Sydney Basin bioregion has a high areal extent of NSW and Australian Government lands that are likely to contain priority koala habitat. The importance of these areas for local koala populations needs to be recognised and acknowledged by the relevant authorities, and recovery actions implemented to ensure the survival of koalas in these areas into the future.

Particular importance was attributed to vegetation near streams, given the importance of these areas as drought refuges for koalas. Despite the increased mortality of koalas near roads, narrow roadside reserves were selected in a number of localities because of the need to facilitate dispersal across roads (while reducing mortalities) and because in some landscapes they are the only linking habitat left.

It is considered that some of the identified high priority areas of Crown and government lands should be considered for protection as national parks or State Conservation Areas, with other areas protected from further alienation and habitat clearing while being actively managed for koala conservation. These should be considered as the basis for any strategy to recover local koala populations and provide for regional dispersal, particularly around urban areas where many small vegetated lots remain.

There are many areas of cleared Crown lands not identified in this review within the Priority 1 and 2 areas that should be considered for revegetation with koala food trees as part of any recovery plan. Similarly, it is evident that the unassessed lot categories of unknown and Local Government can make a significant contribution towards koala conservation within the priority areas.

Table 4. Summary of Crown and government lands identified as conservation priorities.

BIOREGION	TENURE	LOTS (NO)	HECTARES
South Eastern Queensland (NSW Section)	Crown	323	2058
	NSW Government	22	98
NSW North Coast	Crown	688	7080
	Australian Government	1	650
	NSW Government	44	1401
Sydney Basin	Crown	485	11634
	Australian Government	7	18106
	NSW Government	2	20511
South East Corner	Crown	35	273
	Australian Government	1	19
South Eastern Highlands	Crown	170	4543
New England Tablelands	Crown	25	298
	NSW Government	1	89
Brigalow Belt South	Crown	133	3013
Nandewar	Crown	39	442
NSW South Western Slopes	Crown	32	834
Riverina	Crown	3	45
GRAND TOTAL		**2011**	**71094**

4.3 PRIVATE LAND CONSERVATION PRIORITIES

One million hectares of lands within the Koala Hubs occurs outside national parks, state forests and the selected Crown and government lands. For these lands, the Commonwealth's 2018 Native Vegetation Information System mapping (NVIS 5.1) of broad vegetation systems for NSW was assessed in relation to koala records to identify vegetation systems that provide potential koala habitat.

Table 5 identifies 19 vegetation systems that were used to identify 508,265 hectares of potential habitat for koalas within Koala Hubs, conservatively including the unknown and unspecified systems for completeness. These vegetation systems were selected for indicative mapping.

It is emphasised that this is broad mapping of vegetation from a mixture of sources and is thus only indicative of where priority koala habitat occurs. It is evident that to varying extents koalas utilise areas within, or move through, most of the Commonwealth's broad vegetation systems.

The majority of koala records are in areas identified as predominantly cleared or non-native, which in part is due to the smaller unmapped habitat patches and food trees on these lands and the movement of koalas across the landscape. They also reflect the more frequent observation of koalas near urban areas, with often repeat sightings of the same individuals. Some of these also reflect historical use of lands that have since been cleared.

Table 5. Private koala priority areas according to vegetation system in NSW

VEGETATION SYSTEM NAME	AREA (HA)	KOALA RECORDS (NUMBERS)
Callitris forests and woodlands	13,388	212
Casuarina and Allocasuarina forests and woodlands	1,039	99
Eucalyptus (+/- tall) open forest with a dense broad-leaved and/or tree-fern understorey (wet sclerophyll)	28,117	408
Eucalyptus open forests with a grassy understorey	41,396	441
Eucalyptus open forests with a shrubby understorey	23,816	1,513
Eucalyptus tall open forest with a fine-leaved shrubby understorey	459	*2,684
Eucalyptus tall open forests and open forests with ferns, herbs, sedges, rushes or wet tussock grasses	14,183	230
Eucalyptus woodlands with a shrubby understorey	969	46
Eucalyptus woodlands with a tussock grass understorey	1,111	42
Low open forest	11,797	230
Low woodland	553	8
Melaleuca open forests and woodlands	5,073	208
Mid closed forest	8,476	168
Mid open forest	321,004	8,624
Mid open woodland	20	10
Mid woodland	25,309	722
Tall open forest	10,882	257
Native (unspecified)	46	4
Unknown	626	89
MAPPED TOTALS	**508,265**	**15,995**
Other native (rainforest, heath, wattle, shrubland, mallee, sedgelands)	24,483	372
non terrestrial vegetation	9,207	85
Predominately cleared or non-native	498,679	20,663
GRAND TOTAL	**1,040,634**	**37,115**

**The unusually high number of sightings in this vegetation system largely resulted from multiple sightings of named individuals at Hawks Nest.*

The identification of Priority 1 and 2 freehold lands was undertaken by the intersection of the mapped potential koala habitat vegetation systems with the WWF Koala Habitat Priority Areas (Table 6). This identifies 108,802 ha as being Priority 1 and 399,464 ha as Priority 2. While this is broad mapping and does not identify the distribution of preferred food trees and critical habitat, with many smaller patches not identified by the mapping, it highlights those areas of private land that should be considered a priority for assessment for koalas. It is emphasised that these are based on the limited available information and only represent some of the priority areas on private lands. However, it does provide a start for where investment in koala conservation on private lands and linkages should be focussed.

Table 6. Potential koala vegetation, as identified in WWF Priority Lands analysis. Grouped according to protection priorities on freehold land within IBRA regions.

BIOREGION	PRIORITY 1 (HA)	PRIORITY 2 (HA)	TOTALS (HA)
South Eastern Queensland (NSW)	11,691	54,138	65,828
NSW North Coast	36,638	114,197	150,835
Sydney Basin	29,990	80,407	110,398
South East Corner	2,991	17,474	20,465
South Eastern Highlands	8,251	3,3911	42,163
New England Tablelands	464	2,153	2,617
Nandewar	929	8,983	9,912
Brigalow Belt South	16,718	84,708	101,426
NSW South Western Slopes	1,023	2,933	3,957
Riverina	75	468	544
TOTALS	**108,770**	**399,373**	**508,143**

The priority Koala Hubs identify key areas that should be prioritised for the preparation of Comprehensive Koala Plans of Management. Governments need to focus resources and assistance (i.e. koala habitat mapping) on completing plans for these areas. These need to consider the contribution of Crown and government lands, along with council and unknown lands, to regional systems of retained habitat.

For a limited number of areas, councils have prepared Comprehensive Koala Plans of Management in accordance with SEPP 44. Despite SEPP 44 being introduced in 1995, there has been limited progress in implementing it. There is an urgent need to complete the SEPP 44 process of identifying core koala habitat, linkages and threats across all Local Government Areas.

It is recognised that many of these areas have been significantly degraded and will require rehabilitation. Koala populations in some areas have been significantly diminished, however given the evidence of previous occupancy it is expected that as habitat values improve over time so, too, will koala abundances increase. In vulnerable areas, recovery will be constrained by the growing impacts of climate change.

The identified priority areas need to be the immediate focus of measures and incentives to protect koala habitat from clearing, urbanisation, private native forest logging, further fragmentation and other threats. Within these areas there is a need to identify and protect core koala habitat and increase connectivity between patches.

The analysis provided here will assist identifying linkages within the identified WWF Priority Koala Habitat areas. The identification of habitat linkages between patches would require further ground-truthing between the WWF Priority Koala Habitat areas.

Byron Shire verification of private land priorities

To assess the accuracy of the Private Land Priorities identified in this report, the mapping was compared to more accurate mapping available for Byron Shire (Table 7). This was useful, as large areas of the shire are contained within WWH Koala Habitat Priorities but have little mapped vegetation.

Byron Shire has recently undertaken vegetation mapping, including mapping of koala habitat in accordance with SEPP 44. This was reviewed at the Plant Community Type Class level with the 2016 koala records and SEPP 44 habitat mapping to identify those classes of most importance to koalas.

As reported previously (EPA 2016), it shows that neither koala records nor SEPP 44 mapping are sufficient on their own to fully encompass habitat of importance to koalas. It confirms the importance of native vegetation containing eucalypts and Swamp Mahogany for koalas (64.3% of records), plus the importance of planted vegetation where this contains koala food trees (6.8% of records). It also shows the importance of vegetation dominated (>50%) by camphor laurel (5.7% records), rainforest (3.5% records) and land mapped as cleared (19.2% records). These latter classes are thought to reflect the distribution of koala food trees through these areas, their use by koalas for dispersal, and the bias of records to where people live.

Table 7. Byron Shire: Principal Plant Community Type classes of importance to koalas by comparison to records and SEPP 44 (Classes 1, 2 and 3) mapping.

Plant Community Type Classes		Koala Records		SEPP 44 Classes 1,2	
	Area (ha)	Number	%	Area (ha)	% PCT
North Coast Wet Sclerophyll Forests	4,313	1,166	57.8	824	19
Coastal Swamp Forests	1,509	98	4.9	459	30
Coastal Floodplain Wetlands	247	10	0.5	194	79
Coastal Dune Dry Sclerophyll Forests	230	7	0.3	127	55
North Coast Dry Sclerophyll Forests	498	7	0.3	112	22
Coastal Heath Swamps	49	6	0.3	22	45
Northern Hinterland Wet Sclerophyll Forests	263	3	0.1	18	7
Priority Native Vegetation Sub-total	7,109	1297	64.3	1,756	25
Planted	4,270	138	6.8	178	4
Camphor Laurel	5,207	114	5.7	76	1
Rainforest	7,164	70	3.5		
Cleared	25,583	388	19.2		
Other	336	9	0.4		
Shire totals	50,166	2,016			

The 7,109 hectares of priority native vegetation for koalas identified above was mapped and used to review the outputs from this project.

A comparison showed that 71% of the WWF priorities were confirmed as Byron Shire koala priorities for native vegetation, though 56% of Byron priority koala native vegetation was missed. This is attributed to the broad nature and inaccuracies of the Commonwealth mapping utilised, with numerous smaller areas of native vegetation

excluded or incorporated into broad classes (ie rainforest, camphor laurel) not utilised for the WWF priority vegetation.

At the broader level, 94% of Byron priority koala native vegetation and 98% of SEPP 44 (Classes 1, 2 and 3) habitat mapping is included. This confirms that because of the broad nature of the vegetation mapping utilised in this assessment it is only indicative and that the Koala Hubs should be utilised as the basis for prioritising koala planning on private lands, along with consideration of nearby habitat. These need to be considered with the best mapping locally available. It also emphasises the need to consider all vegetation and movement corridors when planning systems of retained habitat for koalas.

KOALA IN TREE NEXT TO LANDCLEARED AREA, NORTHWEST NEW SOUTH WALES, OCTOBER 2012.

5. KEY LEGISLATIVE AND POLICY REFORMS

5.1 NEW SOUTH WALES

Failure of new legislative regime

The following laws and policies in NSW are currently adversely affecting the survival of koala populations:

- *Biodiversity Conservation Act 2016* (and related Regulation, Biodiversity Assessment Method and Calculator);
- *Local Land Services Amendment Act 2016;*
- *Land Management (Native Vegetation) Code 2017;*
- *Environmental Planning and Assessment Act 1979;*
- *Forestry Legislation Amendment Act 2018* (established new Coastal IFOA and transferred responsibility for preparation of PNF codes of practice to the Minister for Lands and Forestry);
- Private Native Forestry Code of Practice;
- State Environmental Planning Policy 44 - Koala Habitat (SEPP 44); and
- State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017.

In 2016, the NSW Government passed new laws regulating tree-clearing and impacts on biodiversity. The *Biodiversity Conservation Act 2016* and amendments to the Local Land Services Act repealed and replaced the *Native Vegetation Act 2003*, *Threatened Species Conservation Act 1995, Nature Conservation Trust A*ct and parts of the *National Parks and Wildlife Act*.

The new laws were introduced with a funding commitment of $240 million over five years to support private land conservation, with $70 million each subsequent year depending on performance reviews. Funds are administered by a new Biodiversity Conservation Trust guided by a Biodiversity Conservation Investment Strategy. There are priority areas identified in the strategy covering koala habitat.

While the new investment in private land conservation is essential for the survival of NSW koala populations, it may be undermined by the impacts of the new laws across the NSW landscape that allow increased clearing at the local scale and increased offsetting – effectively a net loss of koala habitat.

In their submissions to the new legislative regime, the NSW Environmental Defenders Office (EDO NSW 2016 a,b,c,d) concluded that the proposed laws are a retrograde step for NSW biodiversity and land management. While additional investment in private land conservation is proposed, the EDO NSW contends that once monies have been spent, the weakened laws will remain. Clearly the new environmental regulatory and management regime in NSW needs to be overhauled in a significant way as it fails to prevent further land clearing and loss of biodiversity.

"If you compare the laws that are being proposed with the laws that are being repealed, clearing will increase."

"The BC Bill may have familiar types of provisions for threatened species, but our analysis of the overall reform package shows the prognosis for these species does not improve. While on one hand the BC Bill carries over provisions of our current threatened species laws ... the draft Local Land Services Amendment Bill (LLS Bill) will increase known threats to those species. The Bills fail to tackle the conflict between the need to reduce the impact of listed key threatening processes on biodiversity and permitting more land clearing via self-assessed Codes and discretionary development applications. For example, the BC Bill lists "loss of hollow bearing trees" as a key threatening process, while the LLS Bill allows clearing of paddock trees without approval. Investment in private land conservation is intended to improve connectivity, whilst code-based clearing allows for the clearing of peninsulas of native vegetation."

In summary, if you compare the laws that are being proposed with the laws that are being repealed, clearing will increase, offsets will expand – thereby justifying further clearing, private conservation will flourish in some areas but struggle in others, threatened species considerations can be traded off, and the new regime will not actually achieve the intended equity."

The EDO NSW (2016 a,b,c,d) identified over 200 recommendations to improve the proposed regulatory package (EDO 2016e).

The bills were passed in late 2016 without addressing the concerns raised. The new laws, which took effect in August 2017, have a number of key elements that are problematic for koala habitat protection, including:

- Relaxed tree-clearing rules, whereby most clearing can now be done under a self-assessable code, with some LLS notification and certification requirements but no formal assessment and approval required, including in endangered ecological communities or koala habitat.
- Although the new laws have been in force for over a year, the regulatory map that indicates which land is regulated by tree-clearing laws is not yet published. The mapping that has been done on sensitive and vulnerable areas is not comprehensive or always accurate.
- Local threatened populations can no longer be listed under the legislation.
- Offsetting rules have been relaxed so that like for like requirements can be circumvented by payment into a fund, and there can be a discretion to vary offset requirements.

In contrast, a best practice legal regime for biodiversity in NSW would:

- Significantly decrease levels of land clearing, particularly of remnant forests and woodlands that provide habitat for koalas;
- Apply a no net loss or better standard to all development;
- Address key threats, such as broadscale land clearing of remnant vegetation and climate change;
- Establish a NSW Environment Commission or Biodiversity Commissioner to provide independent advice and oversight;

- Mandate the use of leading practice, scientifically robust assessment tools;
- Invest in long-term private land conservation;
- Clearly require comprehensive data, monitoring, reporting on condition and trends (environmental accounts);
- Limit indirect offsetting;
- Commit to fully resourced compliance and enforcement; and
- Entrust NRM bodies with the responsibility of working with landholders, having expertise to do assessments and make NRM plans that relate to clear targets.

In its successful challenge to the making of the Land Management (Native Vegetation) Code 2017, the EDO NSW (2018) found little of merit in the regulation, noting that the "code allows broadscale land clearing without any checks or balances. In conceding that they failed to follow due process, the Government gives the strong impression of making laws on the run. This is not simply a matter of incorrect paperwork. Ecologically sustainable development is not just another box to tick – the Environment Minister has a legal responsibility to protect biodiversity in this state. Land clearing is a major threat to biodiversity, as habitat for many animals and birds is wiped out, along with thousands of hectares of native vegetation".

The NSW Nature Conservation Council challenged the code on the basis that it did not properly have the concurrence of the Minister for the Environment as legally required, and it failed to take into account the mandatory principles of Ecologically Sustainable Development (ESD). The court agreed and ruled the code invalid, however, signoff with the Environment Minister was achieved and the code was rushed back through for approval the next day, still without addressing the ESD issues.

Private Land Conservation

Australia has a long history of private land conservation programs, including Landcare, Land for Wildlife, tender-based approaches, conservation covenants, revolving funds and land trust holdings. Some have had considerable success (eg Landcare), while others, such as Biobanking Agreements, have enjoyed less success.

Despite good private landowner support for private conservation, biodiversity has continued to decline in Australia. The koala is a typical species that has disproportional reliance on private land conservation, with 67% of all known records from private land. In some regions it is much higher, such as on the North Coast, Sydney Basin, and highland and western populations of NSW. The overriding reason for this is the historical extent to which the best koala habitat has been cleared for agricultural land-use. Thus, without strong incentives for targeting better protection for koala habitat, it is likely that more koala populations will become extinct in the near future if current laws are not changed.

The new biodiversity legislation regime in NSW has, however, reduced the range of conservation agreement options available to landholders to just three types of agreement:

- **Biodiversity Stewardship Agreements** – these enable payments to landholders for sites that will be able to generate offset credits (similar to existing biobank sites);

- **Biodiversity Conservation Agreements** – with smaller stewardship payments for the management of high conservation value land, much like the previous conservation agreements; and
- **Wildlife refuges** – with more flexible grants for landholders to set aside land for conservation, which may be converted to higher agreements later. These are not necessarily made into in perpetuity agreements on title, and wildlife refuges can be rescinded with a change of land ownership or land-use.

The new legislative regime in NSW has set up the delivery of private land conservation agreements and funding through a Biodiversity Conservation Trust (BCT) and has dropped support for the previous Nature Conservation Trust revolving fund program through legislation. The BCT intends to encourage landowner participation by setting up a number of delivery programs; conservation tenders (including a koala habitat conservation tender), where farmers make bids for funding; a fixed-rate offer program of $/ha for in-perpetuity conservation agreements, mainly for lands on the tablelands, western slopes and plains; a Conservation Partners Program, to promote conservation agreements and wildlife refuges where landowners submit expressions of interest; a revolving fund, whereby land will be purchased and sold on with management covenants; and a Biodiversity Offset Program to deliver their Stewardship Agreements, with a special emphasis on Western Sydney and Sydney-Hunter-South East, all population growth areas with at-risk koala populations.

While the BCT offers a range of mechanisms and delivery strategies, it is too early to make a proper assessment of the work of the trust. Koala-based agreements have been established (BCT 2018), though there appears to be an unnecessary size limit on properties that can receive funding for some parts of the state.

Key shortcomings of this private land conservation effort are:

- The government-run system places complete reliance on short-term political, budgetary decisions to achieve biodiversity gains, rather than on protections enshrined in law to prevent continued biodiversity decline. As with the limited funds under the previous Native Vegetation Act 2003, farmers eagerly took the opportunity to invest in fencing and construction projects, though after four years there were usually no follow-on actions. This program has the same short-term funding model. As the NSW EDO points out in its 2016 submission, under the new regime, "... we will be left with a system that allows increased clearing at a site scale, with little or no incentive funding for farmers and private landholders to protect the biodiversity value of their properties".
- There is a strong argument that the amounts allocated by the NSW Government for the funding strategy are insufficient, amounting to a commitment for $240 million over five years to support private land conservation, with $70 million each subsequent year dependent on performance reviews. Koalas received $22 million over the same period and across the whole state. The NSW Government needs to substantially increase commitments by the order of one billion dollars to spur a rapid uptake in private conservation across the state, including to regrow and grow new forest koala habitat.
- The chief issue with Stewardship Agreements is that they are an offset-based scheme designed to facilitate further clearing. Given the issues connected with offsetting policy in NSW (see Section on offsets below), it nearly always results in a net loss outcome.

While establishing a robust, private land conservation system is a must in Australia, the overriding objective for koalas should be for in-perpetuity protection of habitat, registered as on-title covenants. As with the objectives of the National Reserve System Program (NRSP), the use of covenants within Biodiversity Conservation Agreements, while not currently mandatory, can facilitate the off-park reserve system in NSW consistent with the Convention on Biological Diversity's principles of comprehensiveness, adequacy and representativeness (CAR). These principles also need to be enshrined in NSW law.

The IUCN's Privately Protected Area program and the NRSP include a number of management categories, providing some flexibility for how areas are used and managed, including habitat/species reserves, which are "... areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category".

Such a designation is suitable for the development management actions for matters under a specific threat, such as the koala. This habitat/species reserve category should be adopted under the NPW Act as a type of tenure with similar levels of protection afforded by a national park or nature reserve. Such a category could support the development of a series of koala parks, specifically for private lands.

In NSW, the allowable activities within the category of state conservation area should be amended to allow recreational activities, but to prohibit mining exploration. Exploration activities themselves can have significant localised impacts.

Biocertification as a form of strategic assessment is a concept with merit, although it runs into issues of unacceptable loss at larger strategic scales. However, as the current scheme is tied to assessments using the BAM and Offset Calculator, the scheme under Part 8 of the BC Bill should be withdrawn. If retained, biocertification must contain as a primary objective that the plan, policy or program for an area meets a no net loss or better test for biodiversity and other environmental outcomes (reflecting the former NSW Environmental Outcomes Assessment Methodology (EOAM) under the old *Native Vegetation Act 2003* and the need to maintain or improve environmental outcomes). The new streamlined strategic biocertification option should be removed in the absence of clear criteria and environmental standards.

Offset Policy

The development of the principles associated with offsetting impacts on biodiversity have had about a 20-year history in Australia. With the concept becoming codified under law in NSW, Queensland and federally, it has become a standard approach to mitigating development impacts, particularly for larger urban, mining and infrastructure projects. In the states, it has become a measure for assessing the acceptability of the project itself, through the use of programs that measure biodiversity loss and gain using a system of credits (eg the former BioBanking Methodology in NSW).

The science behind the offset principle in biodiversity relies on creating biodiversity gains through management actions and increasing protection on other lands that outweigh the loss caused by the action itself. If this can be reliably measured using a standardised method, then consent authorities can have more certainty on the

acceptability of the environmental impact.

NSW led the way in this approach with its biobanking methodology and associated calculator (based on an earlier version used to measure impacts under the *Native Vegetation Conservation Act 1997*, the Environmental Outcomes Assessment Methodology (EOAM)). However, a number of issues quickly emerged when the scheme was implemented in 2008, particularly low levels of uptake. With subsequent versions of the methodology, now with the Biodiversity Assessment Method (BAM) under the new act, these issues have become magnified, such that it is now doubtful whether offset strategies can deliver scientifically-verifiable gains in biodiversity.

The EDO NSW (2016) recommended in its submission that offsetting under the current system should not proceed:

"Our primary concern … is that the focus on creating a market for biodiversity credits undermines the legislative goal of achieving biodiversity outcomes. At the Stakeholder Workshop it was stated that the primary goal of the Calculator is to make the biodiversity credit market work, not to deliver environmental outcomes. This framework is obvious in a number of assumptions within the Calculator that fail to adequately consider the consequences to biodiversity. We therefore do not believe that the offsets regime as proposed should be implemented".

The BAM, which establishes a single method for assessing and calculating impact liability, has watered down existing offset rules and needs to be rescinded. However, any reforms to the BAM need to deal more effectively with what constitutes a serious or irreversible impact. Such an impact, where a red flag is raised, should be clearly defined and have an objective test under the EPA Act. Offset policy should be consistent with ESD principles (which call for preventative and precautionary measures) and any approval would require consultation or concurrence between the environmental agency and the consent authority.

The list of matters constituting an irreplaceable, red flag or serious or irreversible impact should include:

- Any impact upon critically endangered species and ecological communities (those at risk of extinction), Areas of Outstanding Biodiversity Value, and Nationally and Internationally Important Wetlands (i.e. Ramsar wetlands and/or those listed in the Commonwealth Directory of Important Wetlands);
- In the opinion of an ecological expert, any significant effect upon the local population viability of any threatened species or ecological community, including vulnerable species and ecological communities and critical habitats;
- In the opinion of an ecological expert, any significant effect upon important rivers and biodiversity corridors. A public register of acknowledged habitat corridors or important rehabilitation zones must be identified as a matter of priority;
- Consideration of how areas of culturally significant biodiversity could be protected, in full consultation with Aboriginal peoples; and
- Strong BAM thresholds, including consideration of direct, indirect, cumulative and staged impacts.

There are a number of other changes that the EDO NSW (2016) recommend be made to the EPA Act to reduce perverse biodiversity outcomes from offsetting arrangements. These include:

- Major projects (SSD/SSI) not be exempted from mandatory conditions to avoid, mitigate and (as a last resort) offset their impacts;
- Any approval should impose conditions as required by the BAM and its associated assessment report;
- Major projects that will have serious and/or irreversible impacts must be refused, with oversight, advice or concurrence from OEH as to any future redesign or relocation;
- All projects, but most of all major projects, should be assessed at arms-length from the developer or be accompanied by an independent peer-review;
- To avoid perverse outcomes to sensitive areas, SSD and SSI categories should be revised to determine which projects (if any) should continue to be considered State Significant; and
- The ICAC should be consulted on whether discretion in applying (and discounting) results of Biodiversity Development Assessment Reports could increase corruption risks.

Other changes are required to improve offsetting outcomes, including:

- Consent authorities such as local councils or Local Land Services should not have discretion to reduce biodiversity offset credits required on socio-economic grounds under Part 4;
- Thresholds for serious and irreversible impact must clarify the interaction between biodiversity assessment of subdivisions by local governments and subsequent complying development, as the Government continues to significantly expand complying development, while the BC Act excludes the BAM from this category;
- Ensuring cumulative impacts of complying and any major project development are fully assessed through a clear methodology defined under the BC Act;
- Part 5 activities should not be exempt from the BAM or serious/irreversible impact restrictions. Mining/gas exploration should be assessed under Part 4 (with consent), not Part 5; and
- The Vegetation SEPP, which was created to allow offsetting arrangements in non-rural areas, be amended.

There is increasing scientific evidence that offsets do not achieve what they set out to do. In fact, they can have perverse conservation outcomes both for biodiversity conservation (results in net loss) and the public's perception of conservation action (the impacts of development are considered acceptable because we can offset) (Devictor 2015; Maron et al. 2015; Bull et al. 2015; Moreno-Mateos et al. 2015; Spash 2015). All studies suggest that offsets are often not the most appropriate means for conserving biodiversity and should be a tool of last choice and not a standard approach for approvals.

Key issues that undermine the scientific credibility of offset policies and the use of the BAM and offset calculator currently being implemented are:

- it replaces expert scientific opinion;
- does not adequately account for indirect impacts, cumulative impacts, genetic diversity, carbon accounting and other local important ecological processes, such as local hydrology;
- there are serious questions on whether changing land management regimes can offset clearing;
- offsetting can only work if like for like criteria are maintained;
- the removal of impact thresholds and limits to removal even for critically endangered matters, in fact there is a poor consideration of irreversibility as the lack of limits or caps for ecosystem loss has hindered the feasibility of offset strategies and has led to further levels of biodiversity decline; and
- lack of enforcement of timely outcomes, and often not accounting for questions of additionality adequately.

A significant issue is that current offset policy contributes to net loss. If the koala is considered, it is likely that any further loss of space and increased fragmentation for increasingly isolated problems will lead to further population extinctions. Commonwealth and states must adopt no further loss strategies for native vegetation and threatened species habitat, particularly for mature and remnant vegetation. A serious issue is the decreasing availability of like for like outcomes due to habitat loss and we have crossed the threshold for minimum levels of retention for many ecosystems, including those that support koalas, e.g., white box/ yellow box red gum woodland and Derived Grasslands CEEC.

State Environmental Planning Policy 44 (Koala Habitat Protection)

The NSW planning policy regarding the protection of koala habitat (State Environmental Planning Policy 44, or SEPP 44) is designed to provide some protection for koala habitat, mainly through avoidance. SEPP 44 came into effect in 1995, with the aim to "encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".

To achieve this aim, SEPP 44 requires councils to address koala conservation through either a Comprehensive Koala Plan of Management (CKPoM) that will apply to part or the whole of a Local Government Area, using mapped categories of habitat (primary, secondary, habitat buffers, habitat linkages and supplementary habitat), or through Individual Koala Plans of Management (IKPoM) for specific site/ developments, where a CKPoM is not available. It is a poor indictment on the NSW Government's lack of commitment to koala conservation that after 18 years only four shire-wide (Coffs Harbour, Port Stephens, Bellingen and Ballina) and two partial CKPoMs (Lismore and Kempsey) have been adopted. Draft CKPoMs have been developed by various other local councils but either not formally implemented or not legally enforced by the NSW Government under planning laws, including Gunnedah Shire Council, Snowy Monaro Regional Council and Campbelltown Council.

While any given Local Government Area still has its CKPoM pending, koala

ssessments are undertaken on a site by site basis as the need arises using the activity test, which categorises habitat according to three different levels of observable koala usage – core, potential or non-habitat. Core habitat can only be identified when on-site observations can identify prolonged use of a site by koalas or signs of breeding activity. Under this approach, habitat can be optimal for koalas but is only rated as being potential habitat if the level of usage is not detected.

The provisions of SEPP 44 establish that local councils cannot approve development on lands greater than 1 ha without an investigation of potential and core koala habitat. Where there is no applicable CKPoM, a site-specific IKPoM must accompany any development application (DA) where core koala habitat is found to occur.

The fundamental flaws in this approach are that only councils are required to prepare IKPoMs (Ministers, government departments and other approval bodies are exempt), they are prepared by the developer, and they are only prepared at the end of the planning process after rezonings, Development Control Plans and Masterplans may have already approved core koala habitat for clearing and development. Even then, they may only require future monitoring. It is shutting the door after the horse has bolted.

SEPP 44 use of the activity test in the policy was to facilitate development at the local government planning level, but was designed as an interim measure, in the absence of more robust strategic koala habitat mapping and the development of the CKPoM. Despite a lack of any assessment of SEPP 44's effectiveness so far, key issues with this policy include:

- A poor level of implementation of CKPoMs across the state. The NSW Government needs to act in this regard and councils need to be given timelines with assistance for CKPoMs to be developed and applied as statutory documents.
- In the absence of a CKPoM, activity tests do not protect unoccupied koala habitat. A snapshot activity assessment approach does not take into account changing levels of usage by koalas within their home ranges and so will inevitably lead to the loss of koala habitat. Within the context of declining koala populations, a limited scat survey will become less effective in identifying important koala habitat or even koala presence.
- The category of critical koala habitat should be applied instead of the activity test, meaning any habitat that is likely to be used by an existing population and would include primary and secondary habitat linkages and habitat buffers as defined under the current SEPP 44.

For the first time, the 2007 Private Native Forestry (PNF) Code of Practice included the requirement that logging be excluded from core koala habitat identified in accordance with the activity test in SEPP 44. The obvious limitation of this approach is that assessments are not triggered if koalas are not known from the location and the paucity of mapping of koala habitat. The Coffs Harbour CKPoM was prepared in 1999 by the National Parks and Wildlife Service and Coffs Harbour City Council and was given conditional approval by the then Director General of the Department of Planning in 2000. It is one of the few that identifies core koala habitat, although despite the PNF Code, by 2010 60 properties encompassing 2,000 ha of the 19,000 ha of identified koala habitat were approved for PNF. The then Department of Environment, Climate Change and Water justified the approvals on the grounds that the CKPoM "is not officially gazetted" (Pugh 2017b).

The NSW Government is currently reviewing SEPP 44. Despite the commitment to develop best practice planning guidelines for koalas the NSW Koala Strategy does

not commit to improve outcomes through the review of SEPP 44 or the planning system more broadly, making the future application of the SEPP unclear. In light of this, the following recommendations need to be pursued:

- Koala assessments under other codes, such as PNF, need to be mandatory wherever potential koala habitat is present or mapped to occur. Assessments should include field survey and data reviews and should be undertaken by a wildlife ecologist. Any areas identified as critical koala habitat should be given full protection, including within NSW regulations, LEPs and PNF codes;
- Size limits on assessable projects, if critical koala habitat is present, need to be a removed;
- SEPP 44 must be climate change ready – take into account landscape factors such as refuge areas, rehabilitation zones and dispersal corridors as the climate warms and becomes more extreme; and
- Monitoring, auditing and statutory review periods for SEPP 44 should be mandatory.

The protection of koalas, particularly on private or local government lands, needs to adopt a more precautionary approach, with a revised definition of what constitutes koala habitat requiring protection. The establishment of CKPoMs across all Local Government Areas where koalas occur needs to be undertaken as a matter of priority. Each CKPoM needs to effectively deal with the conservation of koalas at both the meta- and local population levels within its jurisdiction. This will require a landscape approach that will protect habitat used by koalas and promote koala habitat usage and dispersal throughout the Local Government Area and into adjoining LGAs. This will require the identification of habitat linkages and priority sites to facilitate road crossings. The current requirements to incorporate koala habitat into Environment Protection Zones, and exclude PNF, should be maintained.

Urban Bushland and Trees

Urban bushland and trees are vital, not only for human well-being and climate change adaptation but also for biodiversity outcomes. This is particularly true for the koala in coastal zones. Koalas inhabit peri-urban zones, close to where people live, and are becoming increasingly hemmed in by urban expansion. Increasingly, these areas are dangerous places for koalas to inhabit, with dog attacks, vehicle strikes, disease infections and loss of urban trees on the rise. Consent authorities are generally local government, but are greatly influenced by state planning policies.

In urban areas utilised by koalas as habitat or for dispersal, it is essential to incorporate measures into planning instruments and development approvals that enhance habitat, calm traffic, facilitate crossings of busy roads, avoid conflict with domestic dogs, limit obstructions to movement (fencing), and address drownings in swimming pools.

The NSW biodiversity reforms included a new State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP). The Vegetation SEPP has widened the use of offsets by extending the Offset Policy to non-rural areas, where the focus is again on removal and not increasing tree cover in cities and towns. This is the wrong approach to increasing shade, biodiversity outcomes and climate resilience in urban areas. The Vegetation SEPP should be amended to remove these offset provisions. NSW has an existing State Environmental Planning Policy 19

- Bushland in Urban Areas but this has a very limited application and could be strengthened. Any new State Environmental Planning Policy (SEPP) and Development Control Plan (DCP) under the NSW planning regime must include and contribute to statewide and Local Land Service biodiversity objectives and priorities to establish the best-practice approach to significant tree protection, such as by Tree Preservation Orders, and the protection of areas of remnant vegetation and koala habitat.

To improve public consultation, any urban SEPP should set minimum consultation requirements for local council and other Part 5 activities that include experts in the required fields.

Translocation

NSW policies regarding the translocation of wildlife were reviewed in 2018, but generally follow the (Draft) ANZECC Policy for Translocation of Threatened Animals in Australia, which in turn follows the principles laid down by the IUCN. This explicitly states that the:

(S) 5.18 Translocation of threatened fauna should not be used as an ameliorative measure for developments where such action is proposed in lieu of in situ conservation.

The current policy in NSW only allows translocation where:

- It follows the principles laid down by IUCN (1987) and takes note of the reintroduction guidelines provided by IUCN (1998);
- The only translocations that should be approved include releases from captive-bred stock to the wild or fenced to exclude predators;
- Proposed translocations are supported by a "Translocation Proposal" (TP) covering all relevant matters, including the effects of the proposed translocation on the conservation values of the target area and should complement, not duplicate, any existing impact assessment procedure required by legislation;
- A TP is part of a species Recovery Plan. Any proposal outside a Recovery Plan must show that the translocation is part of an overall plan that will benefit the conservation of the threatened species concerned; and
- The introduction of species to habitats or locations from which they have not been recorded in historical times will not be approved unless there are exceptionally strong conservation reasons for so doing.

While the recent NSW Government review makes no explicit recommendation to translocate koalas to unoccupied habitat, particularly to allow development to occur, these matters still appear to be on the table. The removal of population-scale numbers of animals would be unacceptable under the current policy, but such a TP was approved for the Shenhua Watermark Coal Mine on the Liverpool Plains, which planned to translocate over 200 koalas to areas where they had no strong historic presence or where there were other koalas present. Despite objections from the OEH, as it was in violation of policy, this proposal was approved by both the NSW and Commonwealth governments.

NSW Koala Strategy

In its submission on the NSW Koala Strategy (May 2018), the EDO NSW concluded that because the new laws do not protect koala habitat, do not identify priority koala areas and do not identify where restoration actions are urgently needed, this has undermined the intent of the strategy to ensure the survival of koalas in NSW.

The NSW Chief Scientist and Engineer's Report of the *Independent Review into the Decline of Koala Populations in Key Areas of NSW in 2016* stated that in order to ensure survival of the koala in NSW, this "... will require actions to protect, rehabilitate and connect koala habitat, as well as a range of actions to manage and mitigate threats to koalas. Some threats to koalas are widespread and others vary in intensity between bioregions. Therefore, some threats will require statewide action, for example, through appropriate policy settings and investment in data collection, while others need to be addressed on the ground regionally or locally." (NSW Chief Scientist and Engineer, 2016)

While also advocating a triage approach, to determine where efforts should go:

"An important finding of this review is that it may not be possible to ensure all koala populations continue to persist in all locations. There are some populations where government and community action can help secure ongoing viability but there are also areas where the historical land use decisions, current competing land uses, as well as risks from road strike, dog attack and, in some areas, drought and bushfire events mean that it will be much more difficult to secure those populations. Government will need to make clear choices and invest resources where it is most likely to make a difference."

While the strategy has developed some positive commitments to fill knowledge gaps on koala distribution and abundance, it will fail to improve or stabilise the worsening extinction threat for koalas in NSW because it:

- **Lacks effective responses from environment agencies addressing habitat loss.** The lack of a whole of government response has undermined the effectiveness of koala recovery actions in the past, particularly in relation to private land conservation, where an estimated 67% of all koalas exist. The strategy does not commit to protecting koala habitat on private land from being bulldozed, with an estimated 7,000,000 ha of koala habitat able to legally be cleared (Blanch et al. 2018). In addition, there are no specific actions in the strategy to incentivise industry to adopt best practice management for koalas, other than to "develop a best practice planning guideline for koalas".
- **Is silent on major expansion of protected areas to conserve core koala habitat.** The NSW Government has stated it would create over 24,000 ha of new koala reserves and parks from state forest transfers, however the lands initially identified show the government is not prioritising areas of important habitat. The 12 koala reserves announced are not priority areas, with 10 already protected in forestry management zones, four containing no koala records and only three containing high-quality koala habitat. Many of the reserves are degraded and will require major rehabilitation from excess logging and Bell Miner Associated Dieback.
- **Omits major funding commitments and locations to identify and restore koala habitat and dispersal corridors.** The government has committed to spend some $20 million to purchase only "prime koala habitat". However, there is no plan to identify and begin recovery actions in

- areas of important koala habitat and linkage areas. There is no priority for recovery actions on private land.
- **Makes no mention of the key regulatory frameworks that should be used for protecting koala habitat,** particularly the *Biodiversity Conservation Act* and *Local Land Services Act* and associated regulations and codes, and Vegetation SEPP. The strategy fails to address the review's recommendation to "include koala habitat in Category 2 (Regulated Land) on the native vegetation regulatory map and identifying and implementing controls as appropriate". Environmental consultancy Eco Logical Australia (2016) identified 2.2 million hectares of known or likely koala habitat that may be cleared under the Equity Code which is not protected under Category 2.

The OEH is currently developing a Koala Research Plan, pursuant to furthering the NSW Koala Strategy's goal

"... to stabilise and then increase koala numbers over the long-term, ensuring genetically diverse populations across NSW"

but research actions identified so far has contented itself with investigating broader questions relating to habitat restoration and climate change impacts. The OEH has also commenced a state-wide habitat mapping program and baseline surveys in target areas using the best available mapping data and expert local knowledge from around the state. Whilst not publicly available at the time of releasing this plan, draft mapping viewed by the authors and conservation organisations indicate the koala habitat suitability mapping will likely be very detailed and valuable in guiding on-ground koala conservation and legal protection.

However, the failure of the current legislative regime to protect koala habitat on private and public lands means that the primary objectives of the strategy cannot be achieved. Instead, this failure is likely to continue the extinction crisis facing koalas.

NSW Forestry Reform

The current Coastal Integrated Forestry Operations Approvals regime in force in NSW state forests was adopted in 2018 and approved by the Commonwealth under new Regional Forest Agreements (RFAs). The new Coastal IFOA pose a severe risk to the viability of many koala populations on the north and south coasts due to the intensive nature of operations and current poor standard of regulations and harvesting prescriptions.

When NSW conservation groups became aware that the NSW Government was proposing to significantly reduce and weaken environmental protections in the new Coastal IFOA they withdrew all support for the process and adopted the position of opposing all logging of public native forests. While only 13% of the 3,148 submissions supported the new Coastal IFOA, the NSW Government ignored community concerns and proceeded with its implementation, with only minor amendments.

It is still the position of non-government organisations with strong community support in NSW to oppose native forest logging on public lands, with strong concerns over the conduct of operations on private lands.

There were 5,400 public submissions to the Independent Review of the Report on Progress with the NSW RFAs 2004-2014, with only 23 in support (Waller 2018). Waller considered that a more thorough impartial review was required to properly and objectively assess the science and evidence from the many (sometimes conflicting) studies on the industry, recommending:

"The Parties conduct a contemporary review of the native forest timber industry considering the effect of climate change, the overall conservation status of the forest, the socio-economic position of relevant rural communities and support for the industry".

The Commonwealth decided against such a review, instead primarily relying on assessments undertaken 20 years before and a claim that the new RFAs were only a variation. The new RFAs were extended for 20 years, until 2039, but have evergreening provisions that allow for extensions every five years, subject to token reviews, so they are theoretically indefinite.

For public lands, the new RFAs rely upon NSW's Coastal IFOA for regulation of native forest logging operations by the Forestry Corporation of NSW on state forests and other Crown timber lands. The 2018 Coastal IFOA has replaced the four IFOAs that operated across eastern NSW for the past 20 years (Upper North East, Lower North East, Southern and Eden). It should be noted that community opposition to IFOAs grew over the life of the past IFOAs due to the removal of stream and erosion protection licences for most operations in 2004, the weakening and removal of protections for many threatened species, allowance of activities in contravention of stated principles for ecologically sustainable forest management (ESFM), logging intensities well in excess of those specifically allowed, and grossly inadequate compliance and enforcement.

Even the small sample of breaches that Justice Pepper (Director-General, Department of Environment, Climate Change and Water v Forestry Commission of New South Wales [2011] NSWLEC 102) reviewed led her to conclude:

"However, in my view, the number of convictions suggests either a pattern of continuing disobedience in respect of environmental laws generally or, at the very least, a cavalier attitude to compliance with such laws ... Given the number of offences the Forestry Commission has been convicted of and in light of the additional enforcement notices issued against it, I find that the Forestry Commission's conduct does manifest a reckless attitude towards compliance with its environmental obligations ..."

The lax and ineffective regulation by the EPA has achieved little to improve compliance. Now that compliance has been handed back to DPI-Forestry there is little anticipation that this will improve.

The EDO NSW (2018) provided a detailed submission on the Draft Coastal IFOA. The submission provided detailed assessment on high-level forestry policy drivers and nine key themes in the Draft IFOA.

The new Coastal IFOA koala prescriptions are discussed in Section 3.2 on native forest logging. In north-eastern NSW, the requirement to undertake pre-logging surveys for koalas to identify Koala High Use Areas to be excluded from logging has been removed. The requirement to retain five koala food trees in areas where koalas occur has been replaced with requirements to retain five small food trees in modelled medium-quality habitat and 10 small food trees in modelled high-quality habitat.

This approach is contrary to the recommendations of the EPA's (2016) Expert Koala

Panel, which basically recommended pre-logging surveys and the protection of extant/resident koala populations. The tree retention rates are less than half that recommended by the IFOA Expert Fauna Panel (NRC 2016, OEH 2018) and are of a smaller size. The OEH (2018) submitted:

"There appears to be a reduction in protections offered to koalas under the Draft Coastal IFOA. Koalas are selective both in their choice of food tree species and in their choice of individual trees. The scientific basis for proposed tree retention rates in the Draft Coastal IFOA is not clear, and the rates are less than half those originally proposed by the Expert Fauna Panel.

"While koalas will use small trees, research has shown that they selectively prefer larger trees. In our experience, the proposed minimum tree retention size of 20 cm dbh will be inadequate to support koala populations and should be increased to a minimum of 30 cm dbh. Many koala food trees are also desired timber species, so there is a high likelihood that larger trees will be favoured for harvesting, leaving small retained trees subject to the elevated mortality rates experienced in exposed, intensively-logged coupes.

"Koalas require large areas of connected habitat for long-term viability. The increased logging intensity proposed under the draft Coastal IFOA is expected to impact koalas through diminished feed and shelter tree resources. Animals will need to spend more time traversing the ground as they move between suitable trees that remain, which is likely to increase koala mortality."

For southern NSW, pre-logging surveys are required in eight state forests, with prescriptions to be at the discretion of the EPA if koalas are found.

It is imperative that high-moderate use koala habitat in state forests of NSW be protected from logging activities. Pre-logging surveys should occur in every compartment opened up for logging. Where koala activity or known habitat is found to be present, these areas should be mapped and excluded from logging.

There are a variety of other changes to prescriptions in the Coastal IFOA that will significantly compound impacts on koalas that need to be rescinded. Specific requirements to undo retrograde changes are as follows:

- **Wood supply claims and commitments must be urgently, transparently and independently reviewed.**

The new Coastal IFOA was predicated on the fact it would result in no net change to wood supply, no erosion of environmental values, and no reductions in the CAR reserve system. In negotiations between the EPA and Forestry Corporation there were numerous compromises made on the basis of maintaining resources, though there were a variety of unresolved prescriptions.

In its advice on the IFOA process for north-eastern NSW, the Natural Resources Commission (NRC 2016) stated that maintaining environmental values and current wood supply levels was "not mutually achievable", so on the basis of claimed yield impacts they sided with the Forestry Corporation's position of no net loss to wood supply by overriding the EPA's position on the minimum area of landscape exclusions, numbers and size of trees to be retained for koalas, sizes of "giant trees" to be retained, size of patches allowed for clear-felling and basal area retention under "selective" logging (NRC 2016).

Even then, to meet a remaining claimed shortfall due to koala prescriptions and Endangered Ecological Communities, the NRC (2018) recommended adopting new targets, criteria and methodologies to remap old-growth forest and rainforest within the CAR reserve system to make areas that do not satisfy the new criteria available

for logging. Their trial identified 67,762 ha of protected old-growth forest in north-eastern NSW as potentially available for logging, with 88% identified as not being old-growth under the new criteria. For rainforest, 62% was remapped under the new criteria as not being rainforest.

The fundamental problem is that the Forestry Corporation's resource modelling shows a surplus of high-quality sawlogs, which the NRC turned into a deficit by excluding plantation hardwoods from its calculations (Pugh 2018c). The rationale for reducing environmental prescriptions, including those for koalas, and opening up old-growth and rainforest for logging, is thus challenged as unjustifiable.

- **The protection of currently mapped old-growth and rainforest in the CAR reserve system needs to be maintained.**

Irrespective of the definition, the currently retained patches of mapped old-growth forest scattered throughout logging areas are dominated by mature and old-growth trees that are becoming of increasing importance to a plethora of species relying on the abundance of resources such trees provide in a matrix of younger and younger regrowth. Twenty-eight percent of the mapped old-growth forest proposed for logging is modelled as medium-high quality koala habitat. The OEH (2018) considered that:

"... [high conservation value] old growth was identified for protection as part of the CAR reserve in 1998. It was comprised of older forest (mapped as 'candidate' old growth) that also scored highly for irreplaceability (a measure of significance to biodiversity conservation) and threatened species habitat value. Under the Draft Coastal IFOA, biodiversity values of harvest area will be reduced as the area becomes progressively younger (potentially 21 years old or less). For threatened species, this places greater significance on adequately protecting existing HCV old growth areas."

"... The NEB recommends that areas of HCV old growth that have been protected for at least 20 years (NRC 2018) are not made available for logging. This will minimise impacts on threatened species."

- **Increases in logging intensities will greatly amplify current impacts on biodiversity and need to be rescinded.**

The Coastal IFOA maintains the current alternate coupe clear-felling regime in the Eden region and extends it to the North Coast with a North Coast Intensive Zone covering 140,000 ha of state forests from Grafton to Taree, where 40-60 ha clear-fells are intended (described in Section 2.3 on Native Forest Logging). This includes over one-third of modelled high-quality koala habitat and OEH Koala Hubs on north-eastern NSW state forests.

"For the balance of state forests logging intensity is to be significantly increased from a Single Tree Selection regime requiring retention of 60% basal area and all trees under 20 cm diameter, to regimes requiring retention 10m2 - 12m2 of basal area per hectare of the logging area.

Brian Tolhurst, the EPA representative on the Threatened Species Expert Panel, considered (EPA 2018) that the :

"... Removal of standing trees below a basal area of around 18-20m2/ha will reduce the structure of these native forests to such a simple form that the ecological processes will be severely diminished or non-functioning. Even in the best-case scenario it will take many decades or even centuries of recovery for any level of native forest ecological function to be restored after this intensity and scale of impact."

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A typical healthily stocked blackbutt forest could be expected to have a basal area of around 30-40 m2/ha. Currently, under the IFOA, a 40% removal would limit the minimum basal area retention of 18 m2/ha in the worst-case scenario. The new retention limits under the Coastal IFOA are set well below this and would significantly change the outcomes of the STS practice if the range of values proposed are adopted.

The EPA (NRC 2016) proposed a compromise position of 12-14m2/ha, although they were overridden by the NRC on the grounds of resource requirements. As the OEH (2018) observed:

"This proposed minimum basal area retention of trees in the harvest areas is below the minimum threshold required to maintain habitat values advised by the majority of the Expert Fauna Panel."

- **Protection should be extended to all giant trees over one metre in diameter.**

Brian Tolhurst, the EPA representative on the Threatened Species Expert Panel recommended (EPA 2018) that:

"All trees greater than or equal to 100 centimetres diameter at breast height should

be retained and protected as a matter of urgency. Not only do these provide the best opportunity to develop the large hollows required by many species, they also provide more flowers, fruit, nectar and seed along with nesting opportunities for large birds such as raptors. At this stage of the harvesting cycles across coastal NSW all remaining large trees are part of a limited resource and are critical for many threatened species and populations to survive."

Such trees are also important for koalas. The EPA compromise was that retained giant trees should be a "minimum 135 centimetres blackbutt, minimum 120 centimetres all other species", with the NRC deciding to limit protection to blackbutt and alpine ash over a 1.6m diameter and trees over 1.4m diameter for all other species, "to have limited impact on wood supply" (NRC 2016).

- **Protection of mature trees as recruitment hollow-bearing trees, koala food trees and nectar food trees needs to be reinstated.**

The older a tree gets, the more browse (including for koalas), nectar and seeds they provide for wildlife. Large, mature trees are also essential to replace vital hollow-bearing trees as they die. The requirements were to retain 3-5 mature nectar food trees per hectare and a large mature recruitment tree for each hollow-bearing tree retained. Because of the declining availability of large, high-quality sawlogs, the new Coastal IFO removes the requirements to retain these vital resources except in the vicinity of limited records of the nectivorous swift parrot and regent honeyeater. The failure to retain a range of size classes negates any pretence of ESFM. As observed by the OEH (2018):

"The Draft Coastal IFOA proposes removing the existing requirement to protect habitat 'recruitment trees'. Over time, this will reduce the number of large habitat trees retained for ecological purposes in harvest areas, as trees die and are not replaced. Recruitment trees identified previously will now be available for harvesting, further reducing the persistent availability of larger trees as a critical habitat element for threatened and protected fauna."

- **All existing protected riparian refuges need to remain protected and riparian buffers expanded as vital climatic refugia.**

Headwater streams are of overwhelming importance for the health of rivers as this is where most of the interaction between the terrestrial and aquatic realms occurs. The higher soil moisture, diverse vegetation and more intact vegetation near streams gives them exceptional wildlife values and makes riparian vegetation essential drought refugia, including for koalas. The science is that we should be establishing buffers at least 30 m wide around these headwater streams (i.e. Hansen et al. 2010). Given that the most intact vegetation remaining in logging areas is in riparian areas that have been protected for decades, the Threatened Species Expert Panel (EPA 2018) recommended that all currently protected riparian vegetation remain protected. To reduce impacts on timber supply, the new Coastal IFOA reduces already inadequate buffers around headwater streams from mostly 10 m down to mostly 5 m, opening up thousands of hectares of long protected riparian vegetation, including important koala refugia, to logging.

It is clear that koalas will continue to decline under the intensified logging regimes promoted by the new Coastal IFOA. While redressing the prescriptions identified above, and the retention of large food trees, will help mitigate impacts, on their own they will simply perpetuate the koala's ongoing decline. What is needed is the full protection and rehabilitation of large areas of source koala habitat, with incorporation into the national parks estate, and free from Forestry Corporation mismanagement.

- **Western forests in NSW**

Native forest logging on public lands in western forests in NSW should be rapidly phased out. Because of high levels of historic land clearing in the western regions and the signs of increasing levels of clearing under new laws in NSW, the value of these forests for biodiversity, carbon sequestration, water recharge and koalas has increased.

The proposed de-gazettal of Murray Valley National Park (ABC 2017) should be rejected. Neither logging nor ecological thinning should be approved as these forests provide important koala habitat and have been extensively logged. Logging in Koondrook State Forest must cease as the resource is running out. This forest must be allowed to regenerate to enhance the climate change refuge value of the Murray River, particularly for koalas. There are a significant number of other state forests in western NSW that should be transferred to the national park estate. These are elaborated on later in this report.

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5.2 QUEENSLAND

The following laws and policies in Queensland are currently adversely affecting the survival of koala populations:

- *Vegetation Management Act 1999;*
- *Nature Conservation Act 1992;*
- *Planning Act 2016;*
- *Planning Regulation 2017;*
- *Environmental Protection Act 1994;*
- *Environmental Offsets Act 2014*, which outlines the framework for environmental offsets in Qld;
- *Environmental Offsets Regulation 2014* (the Offsets Regulation); and
- *Environmental Offsets Policy* (the Offset Policy).

A key recent achievement of the current Queensland Government has been legislative changes to Queensland's land clearing laws. The Vegetation Management and Other Legislation Amendment Act 2018 was introduced to strengthen the Vegetation Management Act in May 2018 in response to annual rates of land clearing of between 356,000 and 392,000 ha per annum for the period 2015/16 to 2017/18 (DES 2018a). The act contains provisions to:

- Remove the so-called 'high-value agriculture' loophole as a relevant clearing purpose, introduced by the Newman LNP Government;
- Protect high-value regrowing woodlands, re-protecting many woodlands exposed to clearing, but with a widened definition of high conservation value regrowth;
- Scrap the self-assessed code for thinning, although the amended VM Act does still allow for limited managing thickened vegetation under development application processes;
- Extend riparian protections in catchments draining to the Great Barrier Reef to all reef catchments; and
- Axe existing Area Management Plans, which have allowed for regional clearing, although most will be phased out over two years rather than being terminated now.

The Queensland Conservation Council (QCC) welcomed the release of the final report from the Koala Expert Panel in May 2018, and the Queensland Government's proposed responses, which are supposed to guide koala conservation in the state (DES 2018b). The panel recommended a suite of actions be taken at the state and local government level, including:

- Measures to protect existing key habitat areas within and outside of the urban footprint;
- Actions to create regenerated areas for habitation;

- A new overarching koala strategy; and
- A high-level Advisory Council to provide policy direction and monitor progress.

The Queensland Government has commenced a targeted high-quality koala habitat and threat mapping program. Since 1996, the Queensland Government has invested in baseline and monitoring surveys of koalas in South-East Queensland with the aim of understanding koala distribution, abundance, ecology and population dynamics. Initial monitoring surveys were constrained to the Koala Coast and Pine Rivers Shire areas, and have been extended to other Local Government Areas in SEQ, but not outside this region, where the current status of koalas remains uncertain.

The Queensland Government committed to developing and commencing implementation of a koala conservation strategy for South-East Queensland. The strategy will detail how the panel's recommended actions will be resourced and delivered. The Queensland Government has stated the strategy will:

- Identify clear, realistic and measurable time-based targets for koala habitat and populations;
- Identify a network of connected priority areas that will be the primary focus of conservation efforts;
- Identify the activities that will be undertaken, where, when and by whom;
- Describe a monitoring and evaluation strategy that measures progress against targets; and
- Review and clarify the planning regulatory provisions related to koala habitat.
-

NSW Forestry Reform

The EDO Qld (2017) has compiled a package of further reforms that are required if the recommendations of the Expert Koala Panel are to be implemented both legislatively and through the promised koala strategy. The following general reforms are essential to ending the clearing of koala habitat and supporting habitat.

- Further amending the Vegetation Management Act and other laws to prohibit the clearing of koala habitat. Further, these provisions should not be able to be overridden by the Coordinator-General or provisions in other statutes, such as the declaration of State Development Areas pursuant to s77 of the State Development and Public Works Organisation Act 1971 (Qld).
- Extend koala protections outside of SEQ. The koala is listed as a threatened species throughout Queensland, yet current strategies have prioritised SEQ while land clearing and climate change are two key issues for koalas across millions of hectares of koala habitat outside SEQ.
- Better detection of koalas during assessment using mandatory qualified wildlife ecologists to undertake surveys for application documents in areas that are or could be koala habitat – to ensure the assessment of applications is well informed.

Improving planning laws

- Reducing trigger of Queensland Government involvement in clearing proposals in Planning Regulation from 5 ha to 1 ha.

- Revising State Development Assessment Provision (SDAP) rules regarding native vegetation clearing and biodiversity.
- Creating a Koala SDAP to address matters relating to both the construction of works and, where appropriate, the ongoing use of land after works are completed.
- Reduce the number and complexity of exemptions from development assessment. For example, this would entail removing the exemption from vegetation clearing restrictions for urban purpose urban area under Schedule 21, Part 2 of the Planning Regulation.
- Develop new development assessment requirements for SEQ such that they:
    - (i) do not permit clearing of core and non-core habitat (remnant, regrowth and scattered trees) inside identified priority areas for koalas, regardless of whether inside or outside the Urban Footprint.
    - (ii) do not permit clearing of core and non-core habitat (remnant and regrowth) outside of the Urban Footprint and outside of identified priority areas for koalas.
    - (iii) avoid clearing of core habitat (remnant and regrowth) inside the Urban Footprint, and outside identified priority areas for koalas, with any residual impacts offset as a last resort.

Encourage restoration and revegetation

There needs to be a requirement for the revegetation of properties in Great Barrier Reef catchments through amendments to applicable codes under the *Vegetation Management Act 1999* (VM Act) and *Planning Act 2016* and providing for this to be a mandatory condition on any relevant permits provided under the *Planning Act 2016*. This will assist in the recovery of the Great Barrier Reef through reduced impacts to water quality and improve the health of regional ecosystems and threatened species habitats.

A similar emphasis on revegetation should be put in place for areas of mapped koala habitat. The Queensland Land Restoration Fund should enhance investment in landscape repair and carbon storage that restores and enhances koala habitat.

Other actions include

- Reform terminology - combining “essential habitat” and “critical habitat”, two similar terms about habitat for wildlife is confusing. There has to be a commitment to undertaking mapping of critical koala habitat across all tenures in Queensland. Declare all critical habitat mapped on state land as critical habitat via regulation under the *Nature Conservation Act 1992* (NC Act). Remove the right to seek compensation for declaration as critical habitat on state land under the NC Act. (54) undertaking their duties.
- Amend the *Nature Conservation Act* such that any vegetation clearing over 2 hectare in size of critical habitat is ‘take’ of protected wildlife under s88 NC Act and therefore an offence under the NC Act. There are defences available for this provision.
- Until terminology is reformed, strengthen protection of essential habitat under the VM Act across all areas of Queensland,

especially the urban footprint: (a) remove exemptions to vegetation clearing regulations for example, remove the exemptions which allow clearing of essential habitat for broadly defined ''urban purpose in an urban area', 'PDA-related development' and resource activities in the Planning Regulation 2017; and (b) give the state Department of Environment and Science concurrence powers with respect to all development applications which may impact essential habitat (with sufficient resources to fulfil this power, or delegation to accredited local councils).

- Pass legislation to amend the NC Act to introduce the new private protected land area 'Special Wildlife Reserve' which allows private landholders and conservation groups to ensure the protection of private land that is high value wildlife habitat to an equivalent level as national parks.
- Ensure the protection of climate refugia from clearing through amendments to the VMA which require the mapping and protection from clearing of areas that are modelled to promote species persistence and ecosystem resilience in a changing climate.
- Require that cumulative environmental impacts from all proposed development impacts must be considered in development assessment through amendments to the *Environmental Protection Act 1994* (EP Act) and *Planning Act 2016*.

Urban Bushland and Trees

In Queensland urban areas utilised by koalas as habitat or for dispersal, it is essential to incorporate measures into planning instruments and development approvals that enhance habitat, calm traffic, facilitate crossings of busy roads, avoid conflicts with domestic dogs, limit obstructions to movement (fencing) and address drownings in swimming pools.

In existing urban bushland, trees and green spaces need to be protected by removing provisions that allow clearing of koala food trees to occur under various instruments, such as the Vegetation in Non-Rural Areas State Environmental Planning Policy (Qld), Exempt and Complying Development Code and the 10/50 Bushfire Code. The government must mandate robust, uniform tree preservation rules for councils, provide legal protection for green spaces, and support local governments by investing in increasing green space and expanding urban tree canopies.

Translocation

Like NSW, the Queensland Fauna Translocation Policy has been under review in 2018. Currently it is generally consistent with the (Draft) ANZECC Policy for Translocation of Threatened Animals in Australia which in turn follows the principles as laid down by the IUCN. This explicitly state that the:

(S) 5.18 Translocation of threatened fauna should not be used as an ameliorative measure for developments where such action is proposed in lieu of in situ conservation.

In Queensland, the government has met with koala experts and vets to review a

"translocation policy" that led to more than 100 koalas dying after being shifted from Coomera on the Gold Coast. The exercise, between 2008 and 2014, was regarded as Queensland's largest koala translocation exercise, but the outcome was only released late in 2018.

The Queensland Koala Expert Panel (Rhodes *et al.* 2017) recommended that a new koala translocation policy (currently in the Queensland Koala Conservation Plan) be reviewed so that it: is consistent with best-practice international IUCN guidelines and it "... ensures translocation cannot be considered during the development assessment process as an 'alternative' to in-situ habitat and population protection". Yet at the same time would allow for the "... regulated translocation to be used as a component of the management of at-risk koalas where this is considered to be beneficial for koalas both on animal welfare and conservation grounds" and "... enables regulated translocation to be considered as a strategic tool for koala population management, re-introductions, and genetic management".

But exactly what an at-risk koala is in this context is not clear and may pave the way for an at-risk designation to be made, for example on populations with high levels of sickness or rates of vehicle collision, such as on the urban interface. There is little doubt that peri-urban koalas and populations subject to agricultural impact are under the greatest levels of threat in Australia. Unless planning laws accommodate these populations, further local extinctions will occur.

Offset Policy

The *Environmental Offsets Act 2014* (Qld) (the Offsets Act) outlines the framework for environmental offsets in Queensland, including the delivery of offsets across jurisdictions, limits on when an offset condition may be imposed and subsequent assessment, delivery and compliance with offset conditions. *The Environmental Offsets Act* is supported by the *Environmental Offsets Regulation 2014* (the Offsets Regulation) and the Queensland Environmental Offsets Policy (the Policy). The Policy provides a decision-support tool to enable administering agencies to assess offsets proposals to ensure they meet the requirements of the Offsets Act.

There is discretion in the legislation to try and balance economic, social, as well as environmental interests. The policy states "... for instance, if the assessment identifies that there will be a significant residual impact on a matter, but the social and economic benefits of the proposed activity are considered to outweigh the environmental impacts, the administering agency for the prescribed activity may decide that an offset requirement will not be imposed as a condition of the authority".

There are some exceptions, which require mandatory offsets, such as clearing requirements for threatened species under the *Nature Conservation Act 1992*. Local governments cannot require an offset for impacts on Matters of State Environmental Significance or Matters of National Environmental Significance, with the exception of koalas in limited areas of SEQ.

In accordance with the *Environmental Offsets Act*, environmental offsets must achieve a conservation outcome for the impacted matter. Under the act, however, an offset is selected, designed, and managed only to maintain the viability of the matter, in other words to maintain the status quo as if the development and offset had not occurred, and not a 'maintain or improve outcome' as required by Commonwealth legislation.

However, the greatest failure of the Environmental Offsets Act and Policy is that it allows for a financial settlement prior to approval. Proponents have a choice from three options: a financial settlement offset; a proponent-driven offset; or a combination of proponent-driven offset and financial settlement offset.

Under the policy, the proponent is also given two options for delivering a conservation outcome for a proponent-driven land-based offset. or, they may undertake actions in an approved Direct Benefit Management Plan (DBMP). A DBMP is a packaged investment that assists priority actions for particular prescribed environmental matters. However, the Policy provides that a DBMP cannot be used to offset a significant residual impact on koala habitat.

While making some allowance for koala habitat, this is a flawed approach for species conservation as the policy:

- Allows for full up-front financial settlement of environmental liabilities, and is essentially a tool to facilitate further land clearing;
- Is unlikely to result in any improvement in the status of any genetic unit of a species or ecosystem;
- Does not take into account limits to ecosystem loss;
- Assumes outcomes can be achieved, while no feasibility is undertaken; and
- Does not take into account koalas outside the SEQ region, or even within all of SEQ.

Offsets for koala habitat should only be imposed as conditions on development approvals as a last resort and not as an automatic licence to clear habitat.

5.3 COMMONWEALTH

There is only one law that affects the listing, assessment and conservation of the koala under the Commonwealth, the *Environmental Protection and Biodiversity Conservation Act 1999*. It, in turn, is the statutory basis for a number of guidelines and policies. This act specifies that oversight of our biodiversity needs to conform with international conventions and principles of ecologically sustainable development.

A New Commonwealth Environment Act

In 2012, the combined koala populations in Queensland, NSW and the ACT were listed as vulnerable under Section 178 of the *Environmental Protection and Biodiversity Conservation Act 1999*. The Scientific Committee also recommended that there should be a recovery plan, which was intended "... to commence following the expiration of the National Koala Conservation and Management Strategy in 2014".

As a nationally listed vulnerable population, the conservation of the koala population in eastern Australia must be a matter of national priority. Clearly, regulatory regimes and conservation measures adopted by the NSW and Queensland governments have failed to arrest the decline of the species. The Australian Government must take a leadership role where state governments have been either unable or unwilling, or both, to save the species from decline towards extinction.

However, as at 1 February 2019, no national recovery plan has been established. The National Koala Conservation and Management Strategy has long since expired, and the only Commonwealth direction is provided by the 2012 Approved Conservation Advice for *Phascolarctos cinereus*. Ongoing levels of species decline and habitat loss across the nation has highlighted severe deficiencies in the way the EPBC Act is designed and administered, as the 2016 Commonwealth State of the Environment Report states:

"The outlook for Australian biodiversity is generally poor, given the current overall poor status, deteriorating trends and increasing pressures. Our current investments in biodiversity management are not keeping pace with the scale and magnitude of current pressures. Resources for managing biodiversity and for limiting the impact of key pressures mostly appear inadequate to arrest the declining status of many species".

A good proportion of the current malaise in the ongoing decline of biodiversity in Australia can be attributed to a lack of adequate environmental assessment and compliance enforcement; lack of a land clearing trigger to enhance federal regulation of land clearing; lack of adherence to general principles, such as Ecologically Sustainable Development (ESD) and international conventions on biological and genetic diversity; poor recovery focus; little opportunity for public legal recourse and poor goal-setting and monitoring.

The EDO NSW and HSI (2018) have proposed a reform package that overhauls the current legislation and proposes a new Commonwealth Environment Act. Key elements of the Next Generation Biodiversity Laws proposed include:

1. A new Australian Environment Act that elevates environmental protection and biodiversity conservation as the primary object or aim of the act, with the

overarching objective, *"... to conserve and protect Australia's environment, its natural heritage and biological diversity including genes, species and ecosystems, its land and waters, and the life-supporting functions they provide".*

2. Duties on decision-makers to exercise their powers to achieve the act's aims, apply expanded principles of Ecologically Sustainable Development (ESD) and non-discretionary obligations to apply the tools in the act.

3. Strong institutions to steer proactive and evidence-based environmental policy advice, development, coordination, oversight and compliance activity. Two new statutory environmental authorities would be created, separate from the Department of Environment – a National Sustainability Commission (Sustainability Commission) and a National Environment Protection Authority (EPA).

4. New triggers for federal protection. In addition to the existing matters of national environmental significance, the National EPA will assess actions that significantly affect the following:

- The National Reserve System (terrestrial and marine protected areas);
- Ecosystems of National Importance, vulnerable ecological communities;
- Significant land clearing activities;
- Significant greenhouse gas emissions;
- Significant water resources (beyond coal and gas project impacts); and
- Powers to declare other matters of national environment significance.

5. A dual focus on protection and recovery of threatened species and ecological communities, and on landscape-scale conservation plans and programs.

6. Simpler, timely and accountable listing processes for nationally protected matters, backed by strengthened protections.

7. A new framework and emphasis on integrated, multi-sector bioregional plans to coordinate action, protect natural and cultural heritage places, achieve biodiversity goals and ensure ecologically sustainable development.

8. A National Ecosystems Assessment to holistically identify important natural assets, their status and the ecosystem services that nature provides to human society.

9. A national environmental data and monitoring program that links federal, state and territory data on biodiversity, strategic planning and environmental impact assessment to ensure strong biodiversity outcomes.

10. Strong public participation through greater community engagement, transparency and reasons for decisions.

11. Improved access to justice via merit review rights on decisions that affect the environment, open standing for the public to take breaches to court, protective costs orders for legal proceedings in the public interest, and a modern compliance and enforcement toolkit to deter misconduct and improve public trust.

12. Greater emphasis on Indigenous leadership, land management and biodiversity stewardship, including formal recognition of Indigenous Protected Areas to enable greater access to ongoing funding and legal protections.

13. A suite of international conservation protections to ensure Australian governments, companies, citizens and supply chains protect and support global biodiversity.

Similarly, environmental organisations in the Places You Love Alliance have called for (PYL 2017):

- The creation of truly national environment laws that genuinely protect Australia's natural and cultural heritage. The Federal Government must retain responsibility for current matters of national environmental significance and protect them effectively. National oversight must be expanded to land clearing, biodiversity and ecosystems, water resources, climate change, air pollution and protected areas.
- The establishment of an independent National Sustainability Commission to set national environmental standards and undertake strategic regional planning and report on national environmental performance. The commission would also develop enforceable national, regional, threat abatement and species level conservation plans.
- The establishment of an independent National Environmental Protection Authority that operates at arm's-length from government to conduct transparent environmental assessments and inquiries as well as undertake monitoring, compliance and enforcement actions.
- Guaranteed community rights and participation in environmental decision-making, including open standing provisions, open access to information about decision-making and environmental trends, review of decisions based on their merits, third-party enforcement provisions and protections for costs in the public interest.

Private land conservation

The IUCN recognises privately protected areas (**PPAs**) as an essential component in achieving the Convention on Biological Diversity (CBD) Aichi Biodiversity Target 11 regarding completing ecologically representative protected area networks around the world. It also encourages *"... the opportunity for voluntary contributions to conservation, complementing the role of governmental agencies, indigenous peoples and communities in caring for nature"* and, as such, recognises the importance of community ownership in biodiversity conservation.

While PPAs are known to be under-reported globally, in 2013 Australia had around 5,000 terrestrial properties that could be considered PPAs (covenants and land trust reserves), covering 8,913,000 ha. The 2017 National Private Land Conference (NPLC 2018) reported that the trend is for a *"... growing demand from landholders for some programs (such as establishing new conservation covenants on their lands) but for other others growth is slow or declining"*.

Under the National Reserve System Program landholders were sometimes offered an up-front payment and management assistance for conserving forest on their properties, with a clear understanding that they were formally contributing to the NRS. However, in Australia the majority of conservation covenants signed have not been established for the explicit purpose of contributing to or being incorporated into the NRS, nor have the majority of landholders expressly permitted their properties to be included.

Koala referral and assessment guidelines

As the submission on the Commonwealth referral guideline made by EDOs of Australia (2016) contends, as the laws are currently configured, the Draft Koala Assessment Guidelines, like the Significant Impact Guidelines, do not form part of the assessment and approval process under the EPBC Act. This should be corrected under the proposed new Environment Act.

The guidelines can be amended under a new act by using them as a trigger for determining significant impact. The guidelines also highlight another key deficiency of the EPBC Act – its failure to properly address cumulative impacts. Currently, there is no mechanism under the act to manage the many actions (such as private native forestry projects in NSW) that may individually fail to meet the significant impact test, but in combination are likely to significantly increase koala mortality and injury. These problems are compounded by forest operations undertaken in accordance with a Regional Forest Agreement not requiring additional approvals under Part 3 of the EPBC Act, irrespective of the adequacy of state provisions.

In addition, there are a number of key changes that need to be brought into law, including:

The definition of koala habitat contained in Section 5 should be based on the plant community present and the vegetation structure. A koala does not necessarily have to be present and should read:

"... any forest or woodland or scattered tree landscape containing species that are known koala food trees or shrubland with emergent food trees. This can include remnant and non-remnant vegetation in natural, agricultural and urban environments."

For the category 'Potential habitat (inland)', 'suitable habitat' in the guidelines is limited to 'riparian woodlands and forests (where koala food trees have reliable access to soil moisture)'. ANEDO submitted that this is too restrictive, as trees in non-riparian areas may have access to aquifers that provide adequate moisture in dry times:

"*Furthermore, research conducted by the NSW Office of Environment and Heritage indicates that much of the habitat sustaining the north-east Monaro koala population is rangelands, which is typified by less than 800 mm of average annual rainfall. Data suggests that some upper and mid-slope areas are used more frequently by koalas than riparian zones, even during dry periods.*" (ANEDO 2016)

It is recommended here that

- The definition of inland habitat should read 'woodlands, forests and scattered tree landscapes (where koalas have reliable access to soil moisture)';
- The definition of coastal habitat should read, 'cleared areas between isolated food/and or shelter trees on farm lands and suburban streetscapes and parks';
- Under primary threats – inland, 'vehicle strikes' should be added;
- Under primary threats – coastal, 'fire' should be added; and
- Under interim recovery objectives for both inland and coastal regions, 'mitigate or avoid vehicle strikes' should be added.

The Approved Conservation Advice for the 2012 listing outlines key research priorities. These knowledge gaps must be filled in order to ensure that sufficient data exists for proponents to make an informed decision regarding any referral. This includes:

- Develop landscape-scale population models, to provide a framework for the assessment of relative threat risk and management intervention cost-effectiveness;
- Identify and delineate key populations; and
- Determine the ability of inland koala populations to persist after, and recover from, drought, and evaluate the likely influence of climate change on these processes.

ANEDO (2016) submitted that the category 'habitat critical to the survival of the species' constitutes an inappropriately high threshold insofar as it does not reflect the definition of significant impact contained in the Significant Impact Guidelines (based on the definition developed by the courts). Specifically, the Significant Impact Guidelines state that "[a] 'significant impact' is an impact which is important, notable or of consequence, having regard to its context or intensity".

ANEDO also submitted that the legal definition of significant impact contemplates impacts other than those that may affect the survival of the species. For example, habitat fragmentation may undermine the size and resilience of a population without definitively affecting its long-term survival. In line with international covenants, any substantial loss of genetic diversity or loss of connectivity or available habitat of any population such that that population is placed at greater risk of extinction should be regarded as a significant impact under the new act.

The list of key threatening processes in Section 9 should be amended to include habitat loss and fragmentation (a key threat for the koala) as well as loss or fragmentation of refugia.

Sections 7, 8 and 9 of the Draft Koala Guidelines should be amended to include more specific commentary regarding the impacts of climate change on the koala, as well as examples of actions that may reduce the species' capacity to adapt to or gain access to climate refugia.

Bilateral Agreements

Both NSW and Queensland have undertaken Bilateral Agreements with the Commonwealth in relation to streamlining environmental assessment processes. The aim of these agreements, it was stated, was to eliminate duplication of process, cut green tape and specifically to speed up approval times for major projects.

However, a key issue was how well the Commonwealth and State legislation could be married. Initially the Commonwealth proposed two types of agreements with all the states:

- An Assessment Bilateral that commits the state governments to undertake an assessment of impact for matters of national environmental significance (MNES) through the state assessment process and provide clear recommendations and consideration of the legal requirements for decision-making under the EPBC Act. The agreement also extends to applications made as a major project under state planning laws, as well as development applications on key sites and infrastructure of state significance where the Minister for Planning is the consent authority.
- An Approval Bilateral that provides for accreditation of state processes for approval of proposed actions that would otherwise be assessed by the Australian Government for approval under the EPBC Act. Only one decision including conditions on approval is made by the state, accounting for both state matters and matters of national environmental significance.

While both NSW and Queensland have an Assessment Bilateral in place, only a notice of intention to develop an Approval Bilateral Agreement has been reached by the Commonwealth, because the bills were rejected in the Senate. In practice, however, the existing Bilateral Agreements have not resulted in quicker approval times, but rather have seen a rise in the number of questionable and disputed approvals by the Commonwealth. Key failures have been:

- A lack of a water trigger equivalent in the state approval processes has meant assessments of water resources by the states have not been adequate for Commonwealth sign-off;
- Some assessments provided for threatened species and communities (eg. the black-throated finch for the Carmichael Mine Project) have not met Commonwealth requirements; and
- Offset standards and tests of impact significance between the Commonwealth and the states are quite different.

Regional Forest Agreements (RFAs) are Bilateral Agreements that exempt all native forest logging operations on public and private lands from requiring additional approvals under Part 3 of the EPBC Act. In practice, this has enabled the Commonwealth to absolve itself of any responsibility for federally listed threatened species and ecosystems subject to forest native logging operations.

For example, following changes to the NSW IFOAs, on 3 April 2013 NSW conservation groups (Nature Conservation Council, Wilderness Society, North Coast Environment Council and the North East Forest Alliance) wrote a detailed submission to the then Federal Minister for Sustainability, Environment, Water, Population and Communities and the Minister for Agriculture, Fisheries and Forestry "to raise a number of complaints about the fulfilment of Commonwealth responsibilities for the implementation of the North East NSW Regional Forest Agreement and the provision of adequate protection for threatened species, threatened ecosystems and heritage values". This included examples of non-compliance with Commonwealth Recovery Plans.

The Parliamentary Secretary for Agriculture, Fisheries and Forestry refused to take any action, stating on 30 May 2013:

- *"The NSW FAs relate to operational forest management in NSW. Under these circumstances, the operational issues you have highlighted fall within the direct responsibility of the NSW Government and its agencies. I urge you to make your concerns known to the NSW Government".*

- While the RFAs required that "New South Wales undertakes to notify the Commonwealth within fourteen days of any amendment or termination of a Forest Agreement or amendment, suspension or revocation of any Integrated Forestry Operations Approval", this was not undertaken until after this complaint. "It was not until June 2013, NSW provided the Commonwealth with a bulk notification for amendments dated between December 2001 and March 2013 covering all four coastal IFOAs" (EPA 2017).

- It is apparent (section 2.3) that no meaningful protections for koalas have ever been provided in Private Native Forestry and that the recent changes to the IFOA for public native forest logging have significantly weakened protections for koalas, yet in November 2018 the Commonwealth agreed to extend the NSW RFAs indefinitely.

- The Commonwealth has also entered into a Memorandum of Understanding (MOU) with the states over a Common Assessment Method (CAM) for streamlining listing standards, bringing them into line with those used by the IUCN. However, the Commonwealth has not adopted the categories of data deficient and near threatened and so remains out of step with the scheme on the Red List. The last time the koala had an assessment by the IUCN was in 2009 and it is currently categorised as vulnerable. A new assessment of its Commonwealth status should be undertaken in light of new information on the decline of the koala in the past 10 years, and would need to be done Australia-wide.

- The adoption of this MOU has meant the endangered population category under the NSW BC Act cannot be used for those species already listed under another category of threatened. Similarly, any EPBC population listing under the CAM is done as a species and cannot be done if the species is currently listed as threatened.

- This issue could be addressed by:

The adoption of tests for significance of impact, which are to be undertaken at a population scale and given a trigger under the new act. The preservation of populations and genetic diversity should be the goal of any biodiversity conservation regime in order to be compliant with the international Convention of Biological Diversity (Article 8k), whereby governments are required to "… develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations".

- Strengthening the ability of states and the Commonwealth under the CAM to list any species occurring in their jurisdiction and populations as separate listings where the level of threat and extinction proneness exceeds existing conservation status currently assigned to that species, eg vulnerable listed species could also be listed concurrently where populations are endangered.

Offset Policy

The EPBC Act Offsets Policy and Offsets Assessment Guide were finalised and released in October 2012. Under them, offsets are not required for all approvals under the EPBC Act – only where residual, unavoidable impacts are considered to be significant.

The EPBC Act Offsets Policy states that conservation gain is the benefit that a direct offset delivers to the protected matter, which maintains or increases its viability or reduces any threats of damage, destruction or extinction. However, direct offsets may also include:

- The improvement and creation of new habitat through regeneration and rehabilitation activities across a landscape;
- Implementing feral animal control programs that reduce predation of a particular threatened species;
- Improving the population of a species through captive breeding and release programs; or
- Undertaking activities that improve the values of a heritage place or wetland of international importance, such as upstream management activities to improve estuarine water quality.

So, a direct offset may be satisfied by the use of ecosystem restoration activities, and species recovery actions not necessarily confined to the affected area. The uncertainty of outcomes for these types of actions should, at best, be regarded as questionable.

The Offsets Assessment Guide (OAG) data on the annual probability of extinction for different threatened species categories an attempt to show that "the more threatened a species or community is the larger the offset requirement". This principle accepts further loss of critically endangered and other threatened matters, and assumes that offset actions can find suitable areas for offset and does not take into account limits to ecosystem and habitat loss.

The OAG also allows, with respect to ecosystem restoration activities and species recovery actions outcomes, a reliability assessment using the best available science or, if not available, the proponents' best assessment of the likelihood of the outcome. Despite the lack of publicly available data on the success or otherwise of offsets such as landscape rehabilitation projects and wild-release and breeding programs, these assessments seem to be nearly always accepted by the Commonwealth, and lack of transparency in the reporting can give the public little assurance.

In many ways the current offset policy and OAG raises questions as to their adherence to the principles of ESD and the precautionary principle enshrined in the EPBC Act. A new Environment Act would ensure principles of ESD, genetic diversity and the precautionary principle are adhered to with any offset policy. The OAG, as it stands, should be rescinded until a better model is developed under a new offset policy.

Principles of ecologically sustainable development (Section 3A of the EPBC Act)

(a) decisionmaking processes should effectively integrate both longterm and shortterm economic, environmental, social and equitable considerations;

(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

(c) the principle of intergenerational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decisionmaking;

(e) improved valuation, pricing and incentive mechanisms should be promoted.

6. MANAGING KOALAS INTO THE FUTURE

6.1 MANAGEMENT PLANS

The future of koalas rests with how well we take actions now to ensure appropriate levels of knowledge, understand threats and develop tailored cross-tenure recovery actions and appropriate levels of funding. Requirements will vary from population to population. While an LGA-centred approach has been written into law, management plans must account for all populations and potential habitat in their jurisdiction.

Any management plan must at least identify the health of remaining koala populations, understand key threats, develop landscape-scale strategies to protect koala habitat, increase numbers of koala trees and facilitate dispersal by identifying key areas of habitat rehabilitation and linkages. Community groups, scientists, carer groups, conservation and land trust organisations and government agencies all have roles to play.

Below are two examples of management proposals, prepared through the co-operation of community groups, scientists, NGOs and government agencies to adequately address the key issues.

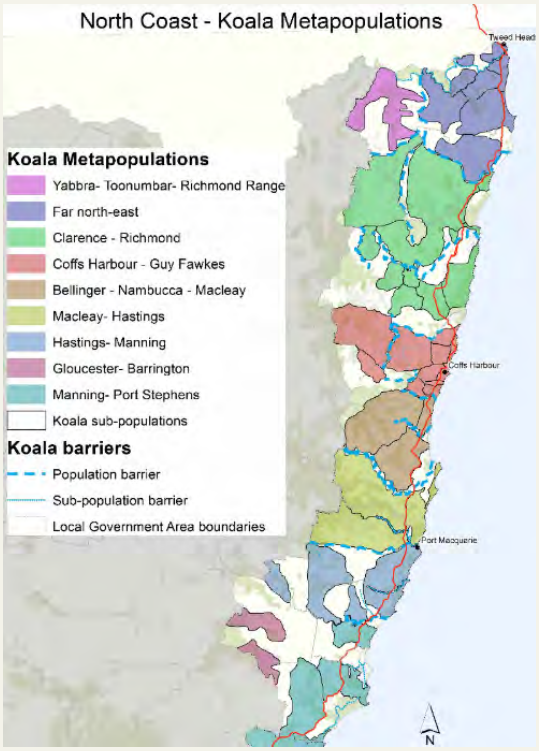
Great Koala National Park

There have been various koala conservation proposals in North East NSW, most have resulted from community-based surveys, assessments and analysis between 2012 and 2016. The proposed GKNP is the largest of these proposals. Several other smaller reserve proposals to protect important koala habitat and populations have been identified on the NSW coast north of the Hunter River, proposed by the National Parks Association of NSW (Available from https://npansw.org/wp-content/uploads/2018/03/50-Park-Proposals-NPA-31_1_2018.pdf) and their importance is supported by this habitat analysis.

This GKNP proposal was derived using community data and expert opinion from within the region and has focussed on describing and mapping the populations on the North Coast and hinterlands and areas of state forest that contain koala habitat and would be best included within the reserve system. The GKNP proposals are supported by the data presented in this report, with a high level of correspondence between WWF hubs and priority areas, data and analysis (Koala Hubs and Areas of Regional Koala Significance, ARKS) recently obtained from the NSW Office of Environment and Heritage, and by predictive habitat mapping from the Department of Primary Industries. Further, academic assessments of the impact of climate change on the distribution of koalas and their food tree species predicts North Coast and hinterland areas as being important for persistence (Adams-Hosking et al. 2012; Adams-Hosking et al. 2014).

The available data has been used to identify known priority areas for koala conservation both within and beyond the network of community reserve proposals – including identifying priority areas of public and private lands for immediate protection and areas for further assessment.

Figure 13. Populations in the GKNP



Conservation groups responded to community reports of dramatic declines in koala populations on the NSW North Coast by commencing, in 2012, a number of koala conservation assessments. Initial assessments were undertaken in five Local Government Areas on the upper mid-North Coast and hinterland areas (northern Kempsey, Nambucca, Bellingen, Coffs Harbour, Clarence Valley and Richmond Valley).

This project used koala habitat mapping, combined with collated koala locality records and local knowledge of koala ecology and key habitat, to derive a number of mapped outputs relevant to koala conservation assessment and planning in the region, including:

- Likely koala dispersal barriers;
- The identification of seven likely koala regional populations;
- Twenty-five likely koala sub-populations as focus areas for further targeted surveys, monitoring and research; and
- Three likely meta-populations (meta-populations being groupings of sub-populations that periodically exchange individuals):

1. The Coffs Harbour—Guy Fawkes metapopulation. This is centred on the Coffs Harbour, northern Bellingen and south-western Clarence Valley LGAs, and extends from the coastal plains at Coffs Harbour/Bongil Bongil National Park west through hinterland and escarpment forests to Guy Fawkes River National Park. This meta-population is considered to be of national significance as a koala core area. This same forest gradient has also been identified as significant in other conservation assessment and planning programs. It is clear that management programs need to be explored and promoted to ensure the long-term persistence of this critical forest area, where the Great Escarpment approaches the coast;

2. The Clarence—Richmond metapopulation is centred on the central and

northern Clarence Valley LGA and extends further north to the Richmond River valley, encompassing the Richmond Valley LGA, and;

3. The Bellinger—Nambucca—Macleay metapopulation, extending south and west from the southern Bellingen LGA to encompass the Nambucca LGA and the northern part of the Kempsey LGA to the Macleay River valley. This koala metapopulation is also considered to be nationally significant.

The initial proposal considered all public land with the above meta-population boundaries and would see 175,000 ha of public state forests added to existing protected areas to form a continuous 315,000 ha reserve of public land. The proposed GKNP adjoins World Heritage-listed reserves, including New England and Dorrigo national parks and the Guy Fawkes National Park, to form a proposed conservation complex of half a million hectares extending from the tablelands to the coast.

Further community-based koala conservation actions undertaken for the entire North Coast of NSW have informed a suite of additional proposed koala reserves between Port Stephens and the Queensland border and have been incorporated into a koala reserve network (Love and Sweeney 2015) and included in the NSW National Parks Association's "50 Parks Proposals" (National Parks Association of NSW 2018).

Figure 14. Original GKNP proposal (from NPA NSW 2018)

The community reserve proposals have some additional strengths compared to the hubs analysis. Hubs and other models of likelihood of occurrence are based primarily on koala records analysed for a measure of persistence. Therefore, by their nature, hubs are likely to be biased towards areas of greater survey effort and/or areas where more people live, and away from more remote hinterland areas and private land (the latter is typically under-surveyed). Using expert ecologist knowledge to analyse the landscape configuration, while incorporating knowledge of koala occurrence, habitats, distributions and population trends from local koala carers and conservationists, adds another layer to records-based analysis.

Modelled products will likely overlook areas of unsurveyed occupied habitat that need protection to achieve an adequate koala reserve system. There is therefore a

great need to undertake systematic regional surveys to identify all areas of resident populations to target for reservation if koalas are to achieve the protection required to halt their decline towards extinction. As shown by the more comprehensive assessment for the proposed Great Koala National Park, there is still a lot more to be done.

Proposed Sandy Creek National Park

In 2012, in the headwaters of the Richmond River south-west of Casino, the North East Forest Alliance (NEFA) found the Forestry Corporation illegally logging a Koala High Use Area (HUA) in Royal Camp State Forest, with four other Koala HUAs about to be logged (Pugh 2017c). The logging was stopped.

When the Forestry Corporation resumed logging in another part of the forest a few days later, NEFA found that they had logged another Koala HUA. The Environment Protection Authority (EPA) fined the Forestry Corporation $900 for logging 61 trees and constructing 405 m of snig tracks in just the first Koala HUA.

A year later, when the Forestry Corporation proposed logging in another part of the forest, claiming no koalas were present, NEFA found extensive Koala HUAs within the proposed logging area.

In 2013 NEFA (Pugh 2017c) proposed that Royal Camp State Forest and the nearby Carwong State Forest be made into the 2,100 ha Sandy Creek National Park because of a multitude of values, but primarily because of its demonstrated significant koala population.

A number of subsequent assessments undertaken for the NSW Government repeatedly verified the presence of a locally and regionally significant koala population. Most recently, a comparative EPA (2016) study found that 80% of Carwong and 58% of Royal Camp State Forest is utilised by koalas, concluding *"that habitat in Royal Camp and Carwong is source habitat, where reproduction exceeds mortality on average over time"*.

To date, the abundance of Koala HUAs has prevented the Forestry Corporation resuming logging. Despite the verified significance of these forests for koalas, they were omitted from the NSW Government's 2018 koala reserves, as the reserves were limited to unproductive forests.

The new Coastal IFOA removes the need to protect Koala HUAs, making these forests again available for logging, with the only requirement for koalas being to retain five koala food trees over 20 cm diameter per hectare. Such minimalist requirements will turn this source habitat into sink habitat.

Northern Tablelands Recovery Strategy

Unlike the North Coast, there are few opportunities to add public land to the reserve system on the Northern Tablelands and so conservation has to be private land-based. In this case, the strategy and subsequent Cool Koalas Project is a partnership between community and government actors. This strategy was prepared by local environmental consultancy Envirofactor (Hawes et al. 2016) for the Northern Tablelands Local Land Services (NT LLS) to promote recovery, avert any ongoing decline and minimise the risk of extinction of koalas within the Northern Tablelands region of NSW. It provides guidance for future research and survey activities as well as the strategic delivery of NT LLS on-ground incentives and Trees on Farms program. Within the 10-year life of the strategy, the objective is to:

- Improve baseline knowledge regarding koala distribution, abundance and ecology;
- Reduce threats to koala populations;
- Raise community awareness about koalas; and
- Enhance koala habitat and landscape connectivity on private land.

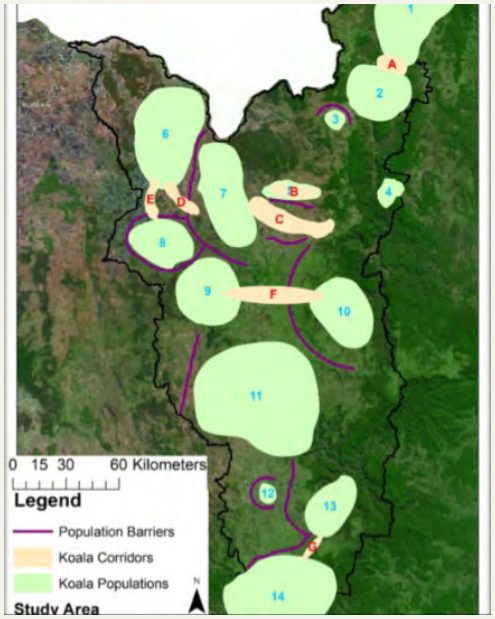


Figure 15. Key corridors and populations (Envirolink 2016)

The strategy is a synthesis of existing scientific knowledge, expert opinion and a community consultative process. A range of interest groups with knowledge, expertise and/or interest in koalas on the Northern Tablelands contributed to the consultative process, including university researchers, state and local government officers, koala carers, Landcare organisations, environmental consultants, environmental NGOs, land owners/managers and community groups/individuals. It identifies the knowledge gaps and, as far as possible, the issues known to threaten koalas, and seeks to achieve conservation of koala populations on the Northern Tablelands through implementation of recovery actions.

Strategy conclusions:

- Koala populations, movement corridors and/or movement barriers were identified based on existing koala records and local expert opinion. Due to the lack of records and their intrinsic biases, these were at best considered preliminary and an initial starting point for targeting data collection, survey effort and rehabilitation/replanting activities.
- Essential for the maintenance of existing koala populations is the protection and enhancement of mature, mixed age, woody vegetation that supports old-growth trees as well as the retention of old-growth paddock trees in close proximity to remnant patches and across agricultural landscapes.
- Koalas in the Northern Tablelands recovery strategy area utilise up to 38 indigenous tree species: 17 eucalypts are considered preferred food trees, 14 eucalypts occasional food trees and six species (predominantly non-eucalypts) are used for shade and shelter. This contrasts highly with the depauperate list of food trees under SEPP 44.

- The koala survey effort within the Northern Tablelands recovery strategy area has been limited both spatially and temporally as there have been few specific projects undertaken to restore koala habitat. Further surveys have been identified.
- Private land conservation will be critical to the protection and persistence of koala populations on the Northern Tablelands given the majority of current koala records occur on private land (Paull and Hughes, 2016).

Follow-on surveys

Initially, filling gaps in knowledge has involved surveys for koalas in areas where records are sparse, absent and/or historic, identifying tree species used by koalas and vegetation communities where koalas are found. The purpose has been to address data deficiencies, inform future habitat restoration projects and raise community awareness. The surveys undertaken to date (mainly using detection dogs, see below) have surveyed a total of 661 sites, of which koalas were identified at 216 (33%). Koalas observed during these surveys appeared healthy with no outward signs of Chlamydia.

2016: Cool Country Koala Project (North and South) – Northern Tablelands LLS. Systematic surveys undertaken in priority areas identified by the strategy. The northern project used detection dogs to survey 267 sites around Ashford, Inverell and Delungra (Cristescu and Frere 2017) while the southern project used scat surveys at 139 sites around Armidale/Uralla, Walcha and Nowendoc (Carr et al. 2017). Findings from these surveys identified koala presence at an additional 149 sites – 81 sites in the north and 68 sites in the south (30.3% and 49% of surveyed sites respectively). The results indicate a still healthy population in the Delungra region. These surveys confirm the strategy, finding that koalas use a much wider range of food trees on the Northern Tablelands and northwest slopes than indicated by SEPP 44 or other lists.

2017: OEH and North West Ecological Service. A targeted survey using detection dogs looked at 120 sites with previous koala records and/or likely koala habitat in the North West LLS region. Some 22 sites (18%) had koalas and/or scats present (Cristescu pers. comm. 2018).

2017 – Landcare/University of Sunshine Coast (USC). Using detection dogs, 40 sites in the Warialda, Delungra/Bingara area were surveyed, of which 17 sites (43%) had koalas present (Cristescu pers. comm. 2018), confirming the importance of this area for regional koalas.

2018 – NT LLS/USC. The preliminary findings of this most recent systematic survey of 116 sites in the Tenterfield and Glen Innes areas, using detection dogs, found 27 sites (23%) supported koalas (Cristescu pers. comm. 2018).

This initial round of surveys has provided important new information regarding the distribution and relative abundance of koalas in the NET. As further areas are surveyed, the baseline koala database for the region is increased. This will allow the selection of sites for ongoing monitoring and population profiling.

TREE-CLEARING FOR URBAN EXPANSION NEAR IPSWICH, SOUTHEAST QUEENSLAND, APRIL 2017. © SUPPLIED

6.2 WORLD HERITAGE LISTING

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Australia's eucalypts have been identified as being of outstanding universal value, and the koala as an outstanding example of a vertebrate species with an evolutionary dependence on eucalypts. While the Blue Mountains have been added to the World Heritage List, commitments to add eucalypt forests in northern and southern NSW remain unmet.

In 1996, the Commonwealth of Australia and the state of New South Wales signed a Scoping Agreement for New South Wales Regional Forest Agreements, which committed them to undertake an assessment of World Heritage values of the forested areas of NSW. Instead, the Commonwealth established a World Heritage Expert Panel (CoA 1999) that identified a range of outstanding universal values in forested areas, including eucalypt-dominated vegetation, noting:

"Eucalyptus-dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency."

Within NSW, the best global expressions of eucalypt-dominated vegetation were identified as:

- The Moonee-Bindery area, including Guy Fawkes Wilderness Area, in north eastern NSW;
- Specified national parks in the sandstone area centred on the Blue Mountains of NSW; and
- Natural forest areas extending from the sea to the alps and inland slopes in south-eastern NSW.

The CoA (1999) considered "the koala (*Phascolarctos cinereus*) is an outstanding example of a vertebrate species with an evolutionary dependence on eucalypts".

As an outcome of its forest agreements, NSW agreed to further studies being undertaken by 1 April 2002 of eucalypt-dominated vegetation and religious beliefs embodied in the landscape (Aboriginal dreaming sites and bora grounds) in the forests of the dedicated reserve areas, for consideration of their protection and nomination for World Heritage listing.

While the Blue Mountains were subsequently added to the World Heritage list for their eucalypt values, the promised assessments of eucalypt forests in northern and southern NSW were never undertaken. A review of the World Heritage values of eucalypt forests in north-eastern NSW was undertaken for the National Parks Association (Cerese 2012).

In 2010, based purely on rainforest values, the NSW, Queensland and Commonwealth governments submitted a tentative list of 689,364 ha of national parks in north-eastern NSW and south-eastern Queensland to the World Heritage Centre for future nomination, as additions to the Gondwana Rainforests of Australia

World Heritage area. There has been no subsequent progress.

The new 2018 North East Regional Forest Agreement removes the requirements for a World Heritage assessment.

The proposed Great Koala National Park, in the Moonee-Bindery area, is within the identified World Heritage assessment area, adding weight to the significance of the nomination. WWF Priority Koala Habitat Areas fall substantially within this region, from the northern range to the southern.

6.3 ASSESSING AND MONITORING KOALA POPULATIONS

Role of Standard Population Monitoring Techniques and Citizen Science

When undertaking a local or regional Koala Management Plan, what are the best monitoring and management techniques for determining the status of a koala population? What methods are the most suitable for building citizen science and community involvement and what methods are best for scientific accuracy?

The following principles are important when surveying for koalas:

The following principles are important when surveying for koalas:

- **Measure koala density.** Measuring numbers of koalas in any given area is the basis of population density measurements. Use estimated spatial distributions of koala density and measures of uncertainty to prioritise locations for future surveys, in order to improve the effectiveness of monitoring and to increase improvement in density predictions over time. Always use appropriate survey design to explicitly deal with, and estimate, observation error.
- **Replication.** Design future survey locations and temporal replication with clear monitoring objectives in mind, with the understanding that no single monitoring design, of realistic size, is likely to be effective at simultaneously measuring spatial distributions and trends.
- **Data management.** Adopt a formal database structure that ensures data is recorded in a consistent manner, that no important data is missing from survey records, and that allows the dataset to be easily transformed into a format that facilitates statistical analysis.

When undertaking surveys to describe population densities and trends or just presence/absence, a number of techniques have been devised with varying degrees of success and reliability. Methods can be divided into either surveys for faecal pellets (generally to determine presence/absence and levels of activity) or surveys of koalas themselves (better for determining population density).

There have been attempts to describe population density using faecal pellets (Allen 2010), although reliability has been questioned (Cristescu et al. 2012; Woosnam-Merchez et al. 2012). A Regularised Grid-Based Spot Assessment Technique (RGBSAT) method (Biolink 2007a) has been recently used by OEH where survey sites were located at grid-line intersections at defined intervals (either 350 m, 500 m or 1

km). However, the chief issue here is a question of scale and density of sampling points relative to unsurveyed areas. The greater distance the sampling points from each other, the less likely that detection will be achieved, particularly for low-density populations, which is becoming more the norm with declining populations.

There is also the issue of surveys using human eye versus surveys using scat detection dogs. A 2015 study (Woosnam, pers. comm., 2018) tested the abilities of experienced humans in finding naturally deposited koala scat in various forest structures and ground layer complexities against a purpose-bred professional detection dog and its handler. This study found that in the easiest conditions (i.e. very open woodland with no understorey and little leaf litter), humans missed 50% of the scats when compared to the dog and handler team. In medium conditions (i.e. open forest with limited leaf litter and sparse shrubs), humans missed 92% of the scats. In hard conditions (i.e. closed forest with complex leaf litter and/or dense shrubs), humans missed 100% of the scats. Cristescu et al. (2015) demonstrated that even non-purpose-bred detection dogs are a more effective tool for the detection of koala scats than human vision.

Communities are encouraged to use the following scale-appropriate and effective techniques.

Presence/absence and distribution surveys

When trying to determine if koalas are present in an area, the best techniques sample as big an area as possible. Clearly, scat-detection dogs are the most efficient way of doing this due to the relatively larger area they can cover and the thoroughness of detection. If presence/absence is the chief aim of the survey, then intensive human scat surveys can achieve good results. In this case, the more people the better, in order to increase chances of detection. This approach is also a good tool for conducting citizen science, education and public participation. Allen (2010) demonstrated good strike rates using the sweep-search method, which uses several individuals intensively searching for scats over a specific area. Allen (2010) contends that this method does enable population trends to be monitored, as can line, belt or strip transects, although monitoring in this case would be indicative of levels of activity or occupancy rates rather than numbers of koalas per se.

However, the use of dogs is far better when investigating previously unsurveyed areas and when vegetation is complex (Cristescu et al. 2015). Dog surveys are generally timed, and specific areas are hard to delineate when the dog is allowed to run unleashed. Having a standardised search period (that excludes time taken to confirm scats by the dog handler) is therefore essential. Unleashed dogs are also suitable for restricted areas of bush with definitive boundaries. Leashed dogs are better if specific areal searches are preferred, but more time consuming.

Abundance, population density and trends

Deriving density and abundance estimates requires surveys that record individual koalas and an area that can be correlated with those observations. Transect counts (line or strip) are generally regarded as one of the best techniques for determining local koala density (Buckland et al. 2001; Dique et al. 2003) along with total counts (all of area searches). The techniques are described below.

Strip transects. Strip transects, with fixed boundaries, are established in bushland areas to sample a diversity of vegetation types across the landscape. Boundaries are fixed using survey pegs, with locations established using differential GPS. Each strip transect is typically 60 m wide, with five trained observers spaced 15 m apart walking a fixed bearing (using a sighting compass) and searching all trees for koalas with the aid of binoculars. All koalas observed are recorded, but koalas

detected outside the boundary of transects are not included in the analysis. Transects vary in length, depending on the site and terrain, but are typically 400 m long.

Line transects. The length of the line transects vary according to the site characteristics, such as the patch size, shape, forest structure and terrain, but are typically 800 m long. Each line transect is walked by two experienced observers using binoculars to assist in searching. One observer (the navigator) uses a compass to navigate the line, while the second observer is free to move a few metres either side of the line to optimise koala detection and avoid obscuring vegetation. Care should be taken to thoroughly search trees on or close to the transect line to ensure that the detection probability along the line is as close to one as possible (Buckland et al. 2001). When a koala is detected, it is recorded and the perpendicular distance from the line is measured to the point vertically below the koala with a 50 m measuring tape. Additional information relating to the GPS location, tree and koala is also recorded.

Total counts (all of area searches). This method is good for urban sites with a limited area, which can vary considerably, from yards and small areas of parkland or patches of bushland. Sites are systematically searched using teams of as many trained observers as necessary. When volunteers are used, care should be taken to ensure that each volunteer is paired with an experienced observer. Searches are undertaken of all individual trees, regardless of species. Access to individual properties is made (with the owner's permission), where possible, otherwise searching is done from the street using binoculars (Dique et al. 2004). All koalas observed are recorded.

Site selection and survey stratification. For peri-urban koala populations, Dique et al. (2004) potential koala habitat strata are derived from a Landsat image classification that discriminates forest, urban and grass land cover classes. This enables the study area to be stratified into four broad koala habitat strata consisting of: 1) Bushland habitat – forest land cover patches larger than 100 ha in the non-urban zone; 2) Remnant bushland habitat – smaller isolated forest land cover patches, generally 10–100 ha in the urban zone; 3) Urban habitat – suburban small-lot development and some small forest patches (usually less than 10 ha); and 4) Non-habitat – areas where koalas are generally not present, such as grass, rainforest and impervious surfaces (industrial, high development density urban areas, roads, parking areas, etc.).

Another approach is to use vegetation-type mapping where available to stratify sites. Care should be taken that mapping is accurate and does not exclude habitat types used by koalas. A cautious approach is recommended to ensure that vegetation types even with few or no recognised food tree species are sampled where possible. Ground-truthing is essential for any rigorous stratification of survey sites.

Issues with koala habitat maps

The majority of koala habitat maps produced to date have strong limitations to do with the limited accuracy of vegetation mapping and the presence of known food trees to indicate vegetation type preference. Key issues with this approach are:

- Existing lists of food trees are often not based on good scientific evidence. Species preferences can vary considerably from region to region. For most of these regions, confirmed tree species preference has not been determined. The only scientifically valid way of determining the diet of wild populations is to perform large-scale analysis of wild koalas' faecal pellets, however this has not been conducted at any significant scale to date.
- Koala food tree species lists are often based on the tree species under which koala

scats have been found. However, koalas may produce scats both while feeding and resting, and studies show poor correlation between roosting tree species and diet (Ellis et al. 2013; Marsh et al. 2013, Cristescu et al. 2011).

- While tree species are likely to be a factor in the diet preference of koalas, species may not be the main factor driving selection. In fact, recent research suggests that forage quality and palatability is also a key factor and may be driven by nutritional values such as available nitrogen, and that the nutritional value of a species can vary greatly from one landscape to the next (Moore et al. 2005; Stalenburg et al. 2014).

Given these constraints, mapping products have their role to play. As mapping technology continues to be refined, it will remain useful for planning and koala conservation outcomes. However, no mapping product is entirely accurate and, as such, mapping should only be used at broader planning levels, such as undertaken in this report. All mapping requires field verification before any planning decisions are made, a principle often ignored by developers and consent authorities that has resulted in bad planning decisions.

Genetic and Disease Profiling

Genetic and disease profiling are essential procedures to describe and assess the health of populations and form the backbone of the effective management and conservation of any species. Yet the genetic structure of koala populations is still largely poorly understood across most of eastern Australia.

Wedrowicz et al. (2013, 2016, 2017, 2018) developed a very powerful tool to enable the analysis of koala scats using microsatellite markers, a well proven genetic marker that does not require large volumes of samples in order to provide informative results on population structure. This method is very powerful and highly informative for conservation and management purposes as it provides crucial information on population structure, identifies genetically distinct populations, the genetic diversity of each population, migration rates between populations, as well as the prevalence of key pathogens. This basic information is crucial and urgently required across eastern Australia in order to understand which populations occur where, where the important corridors are, which populations need which specific management responses, and where further corridors need to be protected or established, etc. This critical information directs the limited resources available for conservation toward targeted measures for maximum effectiveness. Without this basic understanding of population structure, no broad-scale conservation plan or strategy will be effective.

As much as some state governments have recently invested in research for the use of SPNs (Single Nucleotide Polymorphisms) for koala genetic analysis, there are some critical limitations with SNPs for koala scat analysis. SNPs require vast amounts of samples from any given region (hence significant survey effort), and scats have to be extremely fresh, as demonstrated by Shultz et al. (2018), therefore severely restricting the choice of scats that can be sampled. Moreover, to date only relatively small SNP panels are currently available in one laboratory in Australia. Large SNP panels may be possible in the future, but are not yet available (Sheddon et al. 2018). SNPs for non-invasive koala genetic analysis are therefore still in the realm of research and development.

However, the method developed by Wedrowicz et al. is widely proven and demonstrated and has been used for several years in applied conservation projects. The scat collection method is simple and can be performed by anyone with minimal

training. This means that genetic information can be collected by virtually anyone, from ecology professionals to government officers, as well as members of the public. Several community groups have already successfully demonstrated their capability in collecting viable koala genetic material that was successfully tested. This opens the door to citizen-science projects that can provide useful and critically needed information to inform effective koala conservation.

Communities and governments are urged to support non-invasive genetic sampling projects or programs using the Wedrowicz et al. method to develop a standardised approach.

The use of fresh scats to provide disease profiles for populations is currently being developed. To date most sampling for disease profiling has occurred from tissue and samples from captured animals (Cristescu et al. 2011; Lee et al. 2010), which is in itself a stressful activity for the koala. Environmental stress can adversely affect population dynamics of animals and reduce resistance to disease (Davies et al. 2013). Chronic levels of stress can be identified through the measurement of glucocorticoid (GC) concentrations in faeces (Davies et al. 2013) and is a non-invasive method for monitoring stress in wildlife. It has been found that the sustained release of the adrenaline hormone ACTH results in elevated concentrations of cortisol metabolites such as glucocorticoid in faecal samples. The study identified the timing and concentrations of excretion of GC and therefore developed a non-invasive means of measuring stress in wild koalas through scats.

Disease detection procedures such as the measurement of the presence of bacteria and viruses within faecal pellets needs to be developed as a matter of priority to facilitate the development of koala population disease profiles that communities can gather using non-invasive means, and use in conjunction with genetic profiles.

KOALA SCATS ARE USED TO DETECT THE PRESENCE OF KOALAS DURING SURVEYS. IMAGE © DAVID PAULL.

7. REFERENCES

Adams-Hosking C. 2011. *Climate Change Adaptation Strategies for the Koala,* National Climate Change Adaptation Research Facility (NCCARF). Adaptation Case Study Series.

Adams-Hosking C., Moss, M., Rhodes, J.R., Grantham, H. and C. McAlpine. 2011. *Modelling the potential range of the koala at the Last Glacial Maximum: future conservation implications.* Australian Zoologist, Vol. 35, No. 4, pp. 983-990.

Adams-Hosking C., McAlpine C.A., Rhodes, J.R., Grantham, H.S. and P.T. Moss. 2012. *Modelling changes in the distribution of the critical food resources of a specialist folivore in response to climate change.* Diversity and Distributions 18:847-860.

Adams-Hosking C., McAlpine, C.A., Rhodes, J.R., Moss, P.T. and H.S. Grantham. 2014. *Prioritizing regions to conserve a specialist folivore: considering probability of occurrence, food resources, and climate change.* Conservation Letters:n/a-n/a.

Adams-Hosking, C., McBride, M.F., Baxter, G., Burgman, M., de Villiers, D., Kavanagh, R., Lawler, I., Lunney, D., Melzer, A., Menkhorst, P. and R. Molsher, *et al.* 2016. *Use of expert knowledge to elicit population trends for the koala (Phascolarctos cinereus).* Diversity and Distributions, 22(3), 249-262. doi: 10.1111/ddi.12400.

Allen, C. 2010. *Estimating koala numbers & assessing population trends in south eastern NSW.* Information prepared for the Threatened Species Scientific Committee to assist its assessment on the listing of the Koala as a threatened species under the EPBC Act. Department of Environment Climate Change and Water, February 2010.

Australian Broadcasting Corporation. 2017. *Murray Valley National Park: MP pushes for reversal to let loggers back in to red gum forest.* 6 November 2017. Available for viewing at https://www.abc.net.au/news/2017-11-03/push-for-murray-valley-national-park-reversal-to-let-loggers-in/9116854. Viewed 4 October 2018.

Australian Broadcasting Corporation. 2018. *Nearly half of Coomera koalas die after Gold Coast relocation.* Available for viewing at https://www.abc.net.au/news/2018-08-02/koalas-die-at-new-gold-coast-location/10065004 Viewed 9 December 2018.

Australian Network of Environmental Defender's Offices. 2014. Submission responding to Draft EPBC Act referral guidelines for the vulnerable koala *(Phasocolarctos cinereus)* in Queensland, New South Wales and the Australian Capital Territory.

Biodiversity Conservation Trust. 2018. *Working with landholders to protect koala habitat in Port Macquarie.* Available for viewing at https://www.bct.nsw.gov.au/news-stories/working-landholders-protect-koala-habitat-port-macquarie. Viewed 3 February 2018.

Biolink Ecological Consultants. 2007a. *The utility of regularised grid-based sampling for the purposes of identifying areas being utilized by koalas* Phascolarctos cinereus *in the South-east Forests of NSW – a Pilot Study.* Report to NSW Department of Environment and Climate Change.

Biolink Ecological Consultants. 2007b. *Conserving koalas in the Coomera-Pimpama Koala Habitat Area: a view to the future.* Final report prepared for Gold Coast City Council.

Biolink Ecological Consultants. 2013. *Port Macquarie-Hastings Koala Habitat & Population Assessment.* Unpublished report to Port Macquarie-Hastings Council.

Biolink Ecological Consultants. 2017. *East Coomera Koala Population Study 2017.* Prepared for the City of Gold Coast.

Bird, T., Kile, G.A. and F.D. Podger. 1975. *The eucalypt crown diebacks – a growing problem for forest managers.* Aust. For. 37: 173-187.

Blanch, S., Sweeney, O. and D. Pugh. 2018. *The NSW Koala Strategy: ineffective, inadequate and expensive. An assessment of the NSW Koala Strategy against Recommendations made in the Independent Review into decline of koalas in NSW.* Report produced by WWF-Australia, National Parks Association of NSW and North East Forest Alliance. Published by WWF-Australia, Sydney. 17 pages.

Briscoe, N.J., Kearney, M., Taylor C. and B. Wintle. 2016. *Unpacking the mechanisms captured by a correlative species distribution model to improve predictions of climate refugia.*

Buckland, S. T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and L. Thomas. 2001. *Introduction to Distance Sampling. Estimating Abundance of Biological Populations.* Oxford University Press, Oxford, UK.

Bull, J.W., Hardy, M. J., Moilanen, A. and A. Gordon. 2015. *Categories of flexibility in biodiversity offsetting, and their implications for conservation.* Biological Conservation 192, 522–532. DOI: 10.1016/j.biocon.2015.08.003 Bureau of Meteorology (2016). Retrieved 20th May, 2017, from http://www.bom.gov.au/weatherservices/about/heatwave-forecast.shtml.

Carr D.B., Lemon J.M. and A. Wilkie. 2017. *Cool Country Koala Project (South) – Final Project Report and Koala Management Plans – Armidale-Uralla, Walcha and Nowendoc. A report to Northern Tablelands Local Land Services*. Stringybark Ecological, Armidale, NSW.

Cerese, B. 2012. *The Eucalypt Forests of Northeast New South Wales. A preliminary Assessment and Documentation of their World Heritage Values*. National Parks Association. NPA Publications P/L, Newtown.

Climate Council. 2018. *Climate Change and Land Clearing: Risks and Opportunities in the Sunshine State*. 11pp. Available for download at https://www.climatecouncil.org.au/uploads/c1e786d5d0fe4c4bc1b91fc200cbaec8.pdf. Viewed 5 January 2018.

Commonwealth of Australia. 1999. *Comprehensive Regional Assessment, World Heritage Sub-theme: Eucalypt-dominated vegetation. Report of the Expert Workshop, Canberra, 8 & 9 March, 1999*. Commonwealth Government of Australia.

Cork, S. J. and Braithwaite, L. W. 1996. Resource availability, eucalypt chemical defences, and habitat quality for leaf-eating marsupials. In G Gordon (ed), *Koalas: Research for Management,* pp. 9–16. World Koala Research Inc, Brisbane.

Cristescu, R., Ellis, W., de Villiers, D., Lee, K., Woosnam-Merchez, O., Frere, C., Banks, P., Dique, D., Hodgkison, S., Carrick, H., Carter, D., Smith, P. and F. Carrick. 2011. *North Stradbroke Island: An island ark for Queensland's koala population?* Proceedings of the Royal Society of Queensland 117: 309-333.

Cristescu, R., Goethals, K., Banks, P.B., Carrick, F. and C. Frere. 2012. *Experimental Evaluation of Koala Scat Persistence and Detectability with Implications for Pellet-Based Fauna Census.* International Journal of Zoology, Volume 2012, Article ID 631856, 12 pages doi:10.1155/2012/631856.

Cristescu, R.H., Foley, E., Markula, A., Jackson, G., Jones, D. and C Frere. 2015. *Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management*. Scientific Reports 5: 8349.

Cristescu, R. and Frere, C. 2017. *Cool Country Koala Project 2016/2017 Northern Section-Final Report*. University of Sunshine Coast and Detection Dogs for Conservation.

Davies, N.A., Gillett, A., McAlpine, C., Seabrook, L., Baxter, G., Lunney, D. and A. Bradley. 2013. *The effect of ACTH upon faecal glucocorticoid excretion in the koala*. Journal of Endocrinology, 209. pp. 1-12.

DeGabriel, J.L., Moore, B.D., Shipley, L.A., Krockenberger, A.K., Wallis, I., Johnson, C.N. and W.J. Foley. 2009. *Inter-population differences in the tolerance of a marsupial folivore to plant secondary metabolites*. Oecologia 161(3): 539–548.

DeGabriel, J.L., Wallis, I.R., Moore, B.D. and W.J. Foley. 2008. *A simple, integrative assay to quantify nutritional quality of browses for herbivores*. Oecologia,156, 107–116.

Department of Environment and Climate Change (DECC). 2008. *Approved Recovery Plan for the Koala* (Phascolarctos cinereus). Department of Environment and Climate Change, Sydney, NSW.

Department of Environment and Science. 2018a. *Land cover change in Queensland Statewide Landcover and Trees Study Summary Report: 2016–17 and 2017–18*. Queensland Government, Brisbane, 4pp. Available for download at https://www.qld.gov.au/__data/assets/pdf_file/0031/91876/landcover-change-in-queensland-2016-17-and-2017-18.pdf. Viewed 5 February 2019.

Department of Environment and Science. 2018b. *Review of koala conservation measures and development of a new koala conservation strategy*. Queensland Government, Brisbane. Available for viewing at https://environment.des.qld.gov.au/wildlife/koalas/. Accessed 1 February 2019.

Department of Primary Industries. 2018. NSW *Regional Forest Agreements - Assessment of matters pertaining to renewal of Regional Forest Agreements*. NSW Department of Primary Industries.

Destination Southern Highlands. 2018. Southern Highlands koala conservation project talk for Threatened Species Day, 8 September 2018, Victoria Falls Visitors Centre. Available for viewing at https://www.southern-highlands.com.au/events/whats-on/southern-highlands-koala-conservation-project-talk-for-threatened-species-day. Viewed 5 February 2019.

Devictor, V. 2015. *When conservation challenges biodiversity offsetting*. Biological Conservation 192, 483–484. DOI: 10.1016/j.biocon.2015.09.032.

Dique, D. S., de Villiers, D. L. and H.J. Preece. 2003a. *Evaluation of line-transect sampling for estimating koala abundance in the Pine Rivers Shire, south-east Queensland*. Wildlife Research 30:127-133.

Dique, D. S., Penfold, G. C., Thompson, J., Leslie, R. S. and H.J. Preece. 2001. *Koala distribution and density: the accuracy and precision of koala surveys*. Pages 105-121 in Lyons, K., Melzer, A., Carrick, F. and D. Lamb (ed). *The Research and Management of Non-urban Koala Populations*. Koala Research Centre of Central Queensland, Central Queensland University, Rockhampton.

Dique, D. S., Preece, H. J. and D.L. de Villiers. 2003b. *Koalas in Pine Rivers Shire: distribution, abundance and management*. Queensland Parks and Wildlife Service Internal Report, Brisbane.

Dique, D. S., Preece, H. J., Thompson, J. and D.L. de Villiers. 2004. *Determining the distribution and abundance of a regional koala population in south-east Queensland for conservation management.* Wildlife Research 31, 109–117.

Drielsma, M., Manion G., Love, J., Williams, K. and T. Harwood. 2014. 3C *modelling for biodiversity management under future climate.* www.terranova.org.au: NSW Office of Environment and Heritage; 2014. csiro:EP1410001.

Dunlop, M. and Brown, P.R. 2008. *Implications of climate change for Australia's National Reserve System: A preliminary assessment.* Report to the Department of Climate Change, February 2008. Department of Climate Change, Canberra, Australia.

Ecological Australia. 2016. *Potential vegetation clearing under the equity code.* Online, available at: <https://bit.ly/2w1yKWp>

Ede, A., Hawes, W. and Hunter, J. 2016. *Koalas on the Northern Tablelands – Literature Review.* Report to the Northern Tablelands Local Land Services. The Envirofactor, Inverell.

Environmental Defenders Office NSW. 2016a. Submission on the Local Land Services Amendment Bill 2016.

Environmental Defenders Office NSW. 2016b. Submission on the Biodiversity Conservation Bill 2016.

Environmental Defenders Office NSW. 2016c. Technical submission on the Biodiversity Assessment Method and Mapping Method.

Environmental Defenders Office NSW. 2016d. Technical submission on the draft Offsets Payment Calculator.

Environmental Defenders Office NSW. 2016e. Submission on the NSW biodiversity and land management reforms: Draft regulations and products on public exhibition. Available for download at https://d3n8a8pro7vhmx.cloudfront.net/edonsw/pages/3974/attachments/original/1497580542/170615_EDO_NSW_Submission.pdf?1497580542. Viewed 1 January 2019.

Environmental Defenders Office NSW. 2018. Submission on the Draft Coastal Integrated Forestry Operations Approval. Available for viewing at https://d3n8a8pro7vhmx.cloudfront.net/edonsw/pages/6090/attachments/original/1548378693/190124_Submission_to_the_Private_Native_Forestry_Review_2018_-_EDO_NSW_submission.pdf?1548378693 . Viewed 18 December 2019.

Environmental Defenders Office NSW and Humane Society International Australia. 2018. *Next Generation Biodiversity Laws – Best practice elements for a new Commonwealth Environment Act.* Humane Society International Australia Ltd, Sydney. Available for viewing at https://www.edonsw.org.au/next_gen_biodiversity_laws. Accessed 7 December 2018.

Ellis, W., FitzGibbon, S., Melzer, A., Wilson, R.C., Johnston, S., Bercovitch, F., Dique, D. and F. Carrick. 2013. *Koala habitat use and population density: using field data to test the assumptions of ecological models.* Aust. Mamm. 35, 160–165.

Environmental Protection Authority (NSW). 2014. NSW EPA submission: Inquiry into the performance of the NSW Environment Protection Authority, General Purpose Standing Committee No. 5. NSW Environment Protection Authority.

Environmental Protection Authority (NSW). 2016. Koala Habitat Mapping Pilot: NSW State Forest Report. Environment Protection Authority. http://www.epa.nsw.gov.au/publications/forestagreements/koala-habitat-mapping-pilot-160038.htm

Environmental Protection Authority (NSW). 2017. NSW Regional Forest Agreements, A report on progress with implementation of the New South Wales Regional Forest Agreements' second and third five-yearly reviews. NSW Environment Protection Authority.

Environmental Protection Authority (NSW). 2018. *Remake of the Coastal Integrated Forestry Operations Approvals, Final Report, Threatened Species Expert Panel Review.* NSW Environment Protection Authority and Forestry Corporation of NSW.

Fisher, M., Cotsell, N., Scotts, D. and M. Cameron. 2014. *High Value Arboreal Habitats in the Coffs Harbour Local Government Area.* A joint project between the Office of Environment and Heritage and Coffs Harbour City Council, Coffs Harbour, New South Wales, Australia.

Fitzsimmons, P. 2017. Case Study 1 Australia's National Reserve System of public, private and indigenous protected areas. In the IUCN-WCPA's Best Practice Protected Area Guidelines Series No. 29: Guidelines for privately protected areas.

Forestry Corporation. 2015. FCNSW BMAD adaptive management trials: results summary. Forestry Corporation New South Wales.

Gold Coast Bulletin. 2017. *Gold Coast residents call for end to tree clearing as council koala plan on right track.* Available for viewing at https://www.goldcoastbulletin.com.au/technology/gold-coast-residents-call-for-end-to-tree-clearing-as-council-koala-plan-on-right-track/news-story/54795fac5a224a3836193729ab6a0777 Accessed 1 November 2018.

Gordon, G., Brown, S. and T. Pulsford. 1988. *A koala (Phascolarctos cinereus (Goldfuss) population crash during drought and heatwave conditions in south-western Queensland.* Austral Ecology 13, (4): 451-461.

Gordon, G., Hrdina, F. and R. Patterson. 2006. *Decline in the distribution of the Koala (Phascolarctos cinereus) in Queensland.* Australian Zoologist 33(3): 345-358.

Hansen B., Reich P., Lake P. S. and T. Cavagnaro. 2010. *Minimum width requirements for riparian zones to protect flowing waters and to conserve biodiversity: a review and recommendations. With application to the state of Victoria.* Report to the Office of Water, Department of Sustainability and Environment. http://www.ccmaknowledgebase.vic.gov.au/resources/RiparianBuffers_Report_Hansenetal2010.pdf

Hawes, W., Hunter, J., Lechner, A. and A. Ede. 2016. *Northern Tablelands Koala Recovery Strategy 2015-2025*. Report to the Northern Tablelands Local Land Services. The Envirofactor, Inverell.

Hunter Koala Protection Society. 2015. Nomination to the NSW Scientific Committee, the "Koala population in the Port Stephens LGA" as an "endangered population" under the Threatened Species Conservation Act 1995.

International Fund for Animal Welfare, Friends of the Koala and Save Ballina Koalas. 2016. Ballina Koala Plan: Joint Submission to the Minister for the Environment.

Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee 1997. *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia*. Department of Environment, Canberra.

Jurskis, V. and Walmsley, T. 2012. *Eucalypt ecosystems predisposed to chronic decline: estimated distribution in coastal New South Wales*. Bushfire Cooperative Research Centre.

Kendall, K. 2017. *Conserving Koala populations of the Southern section of the NSW north coast bioregion: Preliminary mapping of populations as a basis for further survey, research and planning*. Report compiled Kendall for the NSW National Parks Association.

Land and Property Information. 2013. NSW Foundation Spatial Data Framework. ISSN: 2202-7408.

Law, B.S., Caccamo, G., Wimmer, J., Truskinger, A., McConville, A., Brassil, T., Stanton, M. and L. Gonsalves. 2017. *A predictive habitat model for Koalas (Phascolarctos cinereus) in north-east New South Wales: Assessment and field validation*. NSW Department of Industry, Lands and Forestry.

Law, B.S., Brassil, T., Gonsalves, L., Roe, P., Truskinger, A. and A. McConville. 2018. *Passive acoustics and sound recognition provide new insights on status and resilience of an iconic endangered marsupial (koala Phascolarctos cinereus) to timber harvesting*. PL0S ONE 13(10): e0205075. https://doi.org/10.1371/journal. pone.0205075.

Lee, T., Zenger, K. R., Close, R.L., Jones, M. and D.N. Phalen. 2010. *Defining spatial genetic structure and management units for vulnerable koala (Phascolarctos cinereus) populations in the Sydney region, Australia*. Wildlife Research, 37 (2). pp. 156-165.

Love, A. and Sweeney, O. 2015. *A blueprint for a comprehensive reserve system for koalas (Phascolarctos cinereus) on the North Coast of New South Wales*. National Parks Association, Sydney.

Lunney, D., Gresser, S., O'Neill, L.E., Matthews, A. and J. Rhodes. (2007). *The impact of fire and dogs on koalas at Port Stephens, New South Wales, using population viability analysis*. Pacific Conservation Biology 13(3) 189-201.

Lunney, D., Stalenberg, E., Santika, T. and J.R. Rhodes. 2014. *Extinction in Eden: identifying the role of climate change in the decline of the koala in south-eastern NSW*. Wildlife Research, 41(1), pp.22-34.

Lunney, D., Predavec, M., Sonawane, I., Kavanagh, R., Barrott-Brown, G., Phillips, S., Callaghan, J., Mitchell, D., Parnaby, H., Paull, D. C., Shannon, I., Ellis, M., Price, O. and D. Milledge. 2017. *The remaining koalas (Phascolarctos cinereus) of the Pilliga forests, north-west New South Wales: Refugial persistence or a population on the road to extinction?* Pacific Conservation Biology, 23 (3), 277-294.

McAlpine, C. A., Callaghan, J., Lunney, D., Bowen, M. E., Rhodes, J. R., Mitchell, D.L. and H. Possingham. 2005. *Conserving South-East Queensland Koalas: How much habitat is enough?* In: Proceedings of the SEQ Biodiversity Conference. SEQ Biodiversity Conference 2004, Gatton, Queensland, (11-17). 30 June-2 July, 2004.

Maron, M., Bull, J. W., Evans, M. C. and A. Gordon. 2015. *Locking in loss: Baselines of decline in Australian biodiversity offset policies*. Biological Conservation 192, 504–512. DOI: 10.1016/j.biocon.2015.05.017.

Marsh, K.J., Moore, B.D. and W.J. Folley. 2013. *Continuous monitoring of feeding by koalas highlights diurnal differences in tree species*. Wildlife Research 40: 639-646.

Marsh, K.J., Saraf, I., Hocart, C.H., Youngentob, K., Singh, I.P. and W.J. Foley. *Occurrence and distribution of unsubstituted B-ring flavanones in Eucalyptus foliage*. Phytochemistry, 160, 31-39.

Melzer, A. 1995. *Aspects of the ecology of the koala, Phascolarctos cinereus (Goldfuss, 1817), in the subhumid woodlands of central Queensland*. PhD Thesis, School of Biological Sciences, The University of Queensland.

Moore, B. D. and Foley, W. J. 2000. *A review of feeding and diet selection in koalas (Phascolarctos cinereus).* Australian Journal of Zoology 48, 317–333.

Moore, B.D., Foley, W.J., Wallis, I.R., Cowling, A. and K.A. Handasyde. 2005. *Eucalyptus foliar chemistry explains selective feeding by koalas*. Biol Lett. 2005;1(1):64-7.

Moreno-Mateos, D., Maris, V., Béchet, A. and M. Curran. 2015. *The true loss caused by biodiversity offsets*. Biological Conservation 192, 552–559. DOI: 10.1016/j.biocon.2015.08.016.

National Parks Association of NSW. 2015. The Great Koala National Park. A proposal by NPA NSW and conservation groups of the NSW North Coast. Available for viewing at https://npansw.org/npa/campaigns/great-koala-national-park/the-great-koala-national-park-plan/. Viewed 28 November 2018.

National Private Land Conservation Conference. 2017. *Private land conservation in Australia – national trends and global developments, Session 3*. Visit http://plc-conference.org.au/sessions/private-land-conservation-in-australia-national-trends-and-global-developments/. Accessed 8 December 2018.

Natural Resources Council. 2016. Advice on Coastal Integrated Forestry Operations Approval remake. Natural Resources Commission.

Natural Resources Council. 2018. Supplementary Advice on Coastal Integrated Forestry Operations Approval Remake, Old Growth Forests and Rainforests - North Coast State Forests. Natural Resources Commission.

Natural Resource Management Ministerial Council. 2010. Australia's Biodiversity Conservation Strategy 2010-2030, Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Nature Conservation Council of NSW. 2018. Towards Zero Deforestation - A plan to end deforestation and excessive land clearing in NSW.

Niche Environment and Heritage. 2016. Ballina Koala Plan: Koala Population Viability Analysis of the proposed Pacific Highway Upgrade near Wardell, NSW. Prepared for NSW Roads and Maritime Services, January 2016.

NSW Chief Scientist and Engineer. 2016. Report of the Independent Review into the Decline of Koala Populations in Key Areas of NSW. December 2016.

Office of Environment and Heritage. 2017. Developing a NSW Koala Strategy. http://www.environment.nsw.gov.au/animals/nsw-koala-strategy.htm

Office of Environment and Heritage. 2018. Submission to the NSW Environmental Protection Agency on the Draft Coastal Integrated Forestry Operations Approval remake. NSW Office of Environment and Heritage Conservation and Regional Delivery Division North East Branch.

Office of Climate Change 2008. *Climate Change in Queensland, what the science is telling us*. Environmental Protection Agency, Brisbane.

Paull, D.C. and Hughes, B. 2016. *Proposal for a Western Woodlands Koala Park. Identification of Critical Conservation Lands. A landscape approach to preserving Koala populations in western New South Wales*. Report prepared for the Western Woodlands Alliance.

Places You Love Alliance. 2017. *A New Generation of Nature Laws*. Available for viewing at http://www.placesyoulove.org/australiawelove/naturelaws/. Accessed 5 February 2019.

Pugh, D. 2017c. Sandy Creek National Park Proposal. North East Forest Alliance, Revised March 2017. https://www.nefa.org.au/koalas.

Pugh, D. 2017b. North East Forest Alliance Submission to: Developing a NSW Koala Strategy, Proposed Priorities Action statement amendment, Draft koala habitat protection SEPP. https://www.nefa.org.au/koalas.

Pugh, D. 2017a. *Clearing Koalas Away in North East NSW*. North East Forest Alliance, July 2017. https://www.nefa.org.au/koalas.

Pugh, D. 2018. *OEH Koala Habitat Assessments are a Start for Meaningful Koala Conservation*. North East Forest Alliance, September 2018. https://www.nefa.org.au/koalas.

Pugh, D. 2018b. *Bell Miner Associated Dieback in the Border Ranges North and South Biodiversity Hotspot - NSW Section*. see https://www.nefa.org.au/logging_dieback

Pugh, D. 2018c. *A Review of North East NSW Timber Predictions and Yields from Public Forests Over the Past 20 Years*. see https://www.nefa.org.au/logging_industry

Queensland Conservation Council. 2018. MEDIA RELEASE: April 23, 2018.

Queensland Office of Climate Change. 2008. Review of the Queensland Government climate change strategy. Queensland Government.

Queensland Department of Science, Information Technology and Innovation. 2017. Land cover change in Queensland 2015–16: A Statewide Landcover and Trees Study (SLATS) report. DSITI, Brisbane.

Rennison, B. 2017. *Bioregional assessment of koala populations in NSW.* A report prepared for the Office of Environment and Heritage.

Renison, B. and Fisher, M. 2018. *Framework for the spatial prioritisation of koala conservation actions in NSW.* A report for the saving our species Iconic Koala Project. Office of Environment and Heritage.

Resource and Conservation Division. 1999. *Old-growth Forest Related Projects UNE/LNE CRA Regions*. Comprehensive Regional Assessments project number NA 28/EH. A report undertaken by the NSW National Parks and Wildlife Service for the NSW CRA/RFA Steering Committee. Forests Taskforce, Department of the Prime Minister and Cabinet, Canberra.

Rhodes, J. R., Beyer, H. L., Preece, H.J. and C.A. McAlpine. 2015. *South East Queensland Koala Population Modelling Study*. UniQuest, Brisbane, Australia.

Rhodes, J.R., Hood, A., Melzer, A. and A. Mucci. 2017. *Queensland Koala Expert Panel: A new direction for the conservation of koalas in Queensland.* A report to the Minister for Environment and Heritage Protection. Queensland Government, Brisbane.

Schultz, Q.J., Cristescu, R.H., Littleford-Colquhoun, J. D. and C. Frere. 2018. *Fresh is best: Accurate SNP genotyping from koala scats*. Ecology and Evolution 2017: 1-13.

Sheddon, J., Hogan, F. and C. Frere. 2018. *Genetic methods for Koala monitoring*. Presentation at the annual regional koala conservation meeting of South East Queensland local governments. November 2018.

Silver, M.J. and A.J. Carnegie. 2017. *An independent review of bell miner associated dieback*. Final report prepared for the Project Steering Committee: systematic review of bell miner associated dieback.

Spash, C. L. 2015. *Bulldozing biodiversity: The economics of offsets and trading-in nature.* Biological Conservation 192, 541–551. DOI: 10.1016/j.biocon.2015.07.037.

Stalenberg, E., Wallis, I.R., Cunningham, R.B., Allen, C. and W.J. Foley. 2014. *Nutritional Correlates of Koala Persistence in a Low-Density Population*. PLoS ONE 9(12): e113930. https://doi.org/10.1371/journal.pone.0113930.

State Forests of NSW. 2010. *Managing our Forests Sustainably: Forest Management Zoning in NSW State Forests.* Operational circular 99/10.

Steffen, W. and A. Dean. 2018. *Land Clearing and Climate Change: Risks and Opportunities in the Sunshine State.* Climate Council of Australia.

Stone, C. 2005. *Bell-miner-associated dieback at the tree crown scale: a multi-trophic process.* Australian Forestry 2005 Vol. 68 No. 4 pp. 237–241.

Stone, C., Spolc, D. and C.A. Urquhart. 1995. *Survey of Crown Dieback in Moist Hardwood Forests in the Central and Northern Regions of NSW State Forests (Psyllid/Bell Miner Research Programme).* Research Paper No. 28. Research Division, State forests of NSW. Sydney.

Sullivan, B.J., Baxter, G. S. and A.T. Lisle. 2003. *Low-density koala (Phascolarctos cinereus) populations in the mulgalands of south-west Queensland. III.* Broad-scale patterns of habitat use. Wildlife Research, 2003, 30, 583–591.

Threatened Species Scientific Committee. 2002. Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Threatened Species Scientific Committee. 2012. Approved Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (Koala Northern Designatable Unit).

Waller, E. 2018. *Independent review of the report on progress with the implementation of the New South Wales Regional Forest Agreements for the second and third five-yearly reviews 2004-2014*. A report to the Commonwealth of Australia and the State of New South Wales.

Wardell-Johnson G. and A.J.J. Lynch. 2005. *Landscape processes and eucalypt dieback associated with bell miner habitat in south-eastern Australia*. Australian Forestry 2005, Vol. 68 No. 4 pp. 242–250.

Wedrowicz F., Karsa M., Mosse, J. and F.E. Hogan. 2013. *Reliable genotyping of the koala (Phascolarctos cinereus) using DNA isolated from a single faecal pellet.* Molecular Ecology Resources 13(4): 634-641.

Wedrowicz, F., Saxton, T., Mosse, J., Wright, W. and F.E. Hogan. 2016. *A non-invasive tool for assessing pathogen prevalence in koala (Phascolarctos cinereus) populations: detection of Chlamydia pecorum and koala retrovirus (KoRV) DNA in genetic material sourced from scats*. Conservation Genetics Resources 8(4): 511-521.

Wedrowicz, F., Mosse, J., Wright, W. and F.E. Hogan. 2017. *Validating the use of non-invasively sourced DNA for population genetic studies using pedigree data*. Web Ecology (17): 9-18.

Wedrowicz, F., Mosse, J., Wright, W. and F.E. Hogan. 2018. *Genetic structure and diversity of the koala population in South Gippsland, Victoria: a remnant population of high conservation significance*. Conservation Genetics 19: 713-728.

Werner, P., Steffen, W. and A. Burbidge *et al.* 2009. *Ecological principles underpin a national approach to biodiversity conservation under climate change in Australia*. ESA Annual Meeting, Conference Organising Committee, USA.

Woosnam-Merchez, O., Cristescu, R., Dique, D., Ellis, W., Beeton, R., Simmonds, J. and F. Carrick. 2012. *What faecal pellet surveys can and cannot reveal about the ecology of koalas (Phascolarctos cinereus)*. Australian Zoologist 36(2), 192–200.

WWF Australia. 2018. Living Planet Report 2018. Available for viewing at https://www.wwf.org.au/knowledge-centre/living-planet-report#gs.ZHIXwfsv. Accessed 4 November 2018.

WWF-Australia. 2018. Koala extinction briefing NSW. A briefing prepared by WWF-Australia, Sydney. 8pp. Available for download at http://www.wwf.org.au/ArticleDocuments/351/pub-Koala-extinction-risk-NSW-28sept18.pdf.aspx . Viewed 10 December 2018.

WWF-Australia and Nature Conservation Council of NSW. 2018. *Bulldozing of bushland doubles around Moree and Collarenebri after safeguards repealed in NSW*. Report prepared for NSW Nature Conservation Council, Sydney. Available for download at https://www.wwf.org.au/news/news/2018/koala-habitat-destruction-triples-after-nsw-protection-axed#gs.cckcJwTb. Viewed 9 December 2018.

Youngentob, K.N., Renzullo, L.J., Held, A.A., Jia, X., Lindenmayer, D.B. and W. Foley. 2012. *Using imaging spectroscopy to estimate integrated measures of foliage nutritional quality*. Methods in Ecology and Evolution 2012, 3, 416–426.

8. APPENDICES

Appendix 1: State forest protection priorities

Identified koala reserves on state forests requiring urgent protection to stop further degradation of koala habitat and to allow for restoration of koala habitat.

State Forest Name	Area (ha)	Koala Records	Last koala Record	Med-high Modelled Koala Habitat	
	ha	sites	year	ha	%
South-Eastern Queensland Bioregion (NSW section)					
Bald Knob	1,668	60	2004	972	58
Beaury	2,665	42	2004	1,528	57
Bom Bom	886	3	2006	213	24
Braemar	2,024	10	2016	278	14
Bungabbee	1,097	6	1998	566	52
Camira	4,092	139	2014	1,250	31
Carwong	611	292	2015	401	66
Cherry Tree	1,615	33	2017	193	12
Cherry Tree West	307	13	2013	39	13
Divines	1,507	29	2015	469	31
Donaldson	2,378	48	2016	1381	58
Edinburgh Castle	948	7	2015	508	54
Ellangowan	909	1	2005	295	33
Gibberagee	1,886	24	1998	1092	58
Koreelah	691	49	2013	581	84
Mount Belmore	4,845	61	2016	587	12
Mount Lindesay	1,858	14	2014	539	29
Mount Marsh	1,183	62	2014	239	20
Richmond Range	5,547	43	2015	1,261	23
Royal Camp	1,887	246	2015	878	47
South Toonumbar	411	4	2004	191	46
Southgate	637	15	1998	549	86
Toonumbar	1,395	20	2006	321	23
Unumgar	3,320	27	2015	827	25
Woodenbong	287	19	2002	167	58
Yabbra	821	8	2014	424	52
NSW North Coast Bioregion					
Bagawa	5,540	120	2018	3,256	59
Ballengarra	4,262	20	2018	3,598	84
Bellangry	6,245	44	2017	3,270	52
Boambee	820	63	2016	627	76
Bril bril	2,187	36	2017	1,716	78
Broken Bago	3,877	20	2016	3,303	85
Buckra Bendinni	1,763	150	2016	909	52

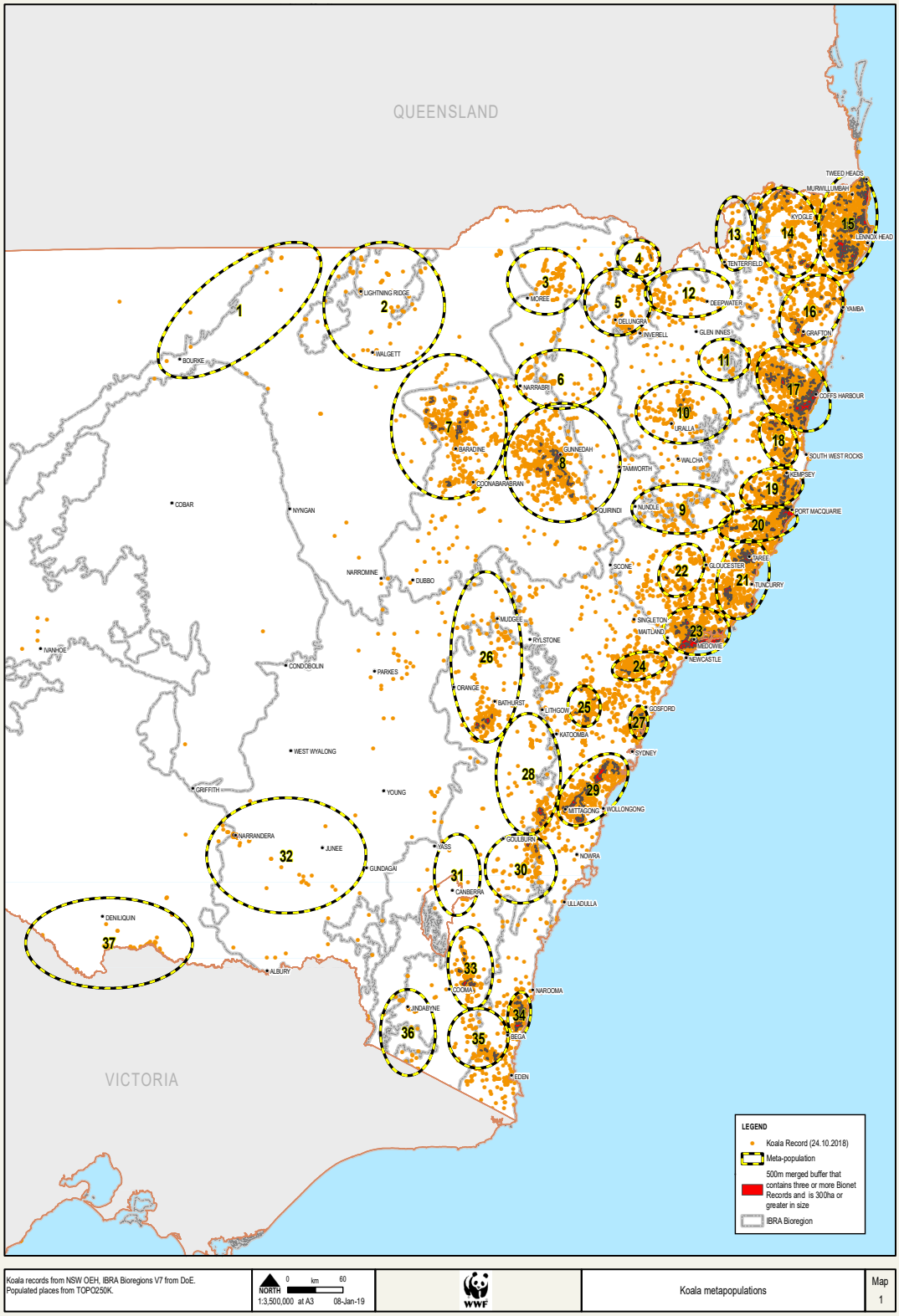
Bulahdelah	4,834	126	2016	2,311	48
Bulga	7,674	114	2017	5,334	70
Bulls Ground	1,713	12	2017	1,620	95
Burrawan	1,886	20	2016	1,840	98
Cairncross	2,615	69	2016	2,082	80
Chichester	5,357	201	2017	3,007	56
Clouds Creek	10,254	355	2018	7,521	73
Collombatti	3,017	20	2017	1,628	54
Comboyne	1,059	3	2015	883	83
Cowarra	1,716	34	2017	1,689	98
Dingo	2,267	8	2011	764	34
Ellis	5,531	130	2016	3,404	62
Fosterton	879	1	2004	516	59
Girard	6,722	74	2018	3,001	45
Gladstone	6,277	201	2018	3,445	55
Ingalba	3,300	113	2016	2,351	71
Irishman	1,610	41	2012	504	31
Johns River	90	1	2004	90	100
Kalateenee	1,347	8	2008	1,265	94
Kangaroo River	10,846	272	2016	5,969	55
Kendall	353	2	2006	330	94
Kerewong	2,921	28	2017	2,029	69
Kippara	286	1	1989	140	49
Kiwarrak	6,586	51	2018	5,174	79
Lansdowne	1,263	11	2018	991	78
Little Newry	147	18	2016	140	95
Lorne	2,439	23	2016	1,755	72
Lower Bucca	2,673	82	2013	2,340	88
Marengo	6,360	64	2014	2,809	44
Maria River	1,814	44	2017	1,790	99
Middle Brother	1,487	15	2016	1,184	80
Mistake	5,646	125	2018	2,044	36
Moonpar	1,500	16	2016	1,309	87
Mount Boss	5,498	36	2016	2,581	47
Myall River	2,364	16	2014	1,595	67
Nambucca	1,702	26	2018	1,636	96
Nana Creek	1,772	81	2016	1,075	61
Nerong	2,188	16	2016	2,141	98
Newry	3,639	98	2018	3,215	88
North Branch	715	5	2017	605	85
Nulla-five Day	276			102	37
Oakes	2,355	27	2016	1,024	43
Orara East	4,098	74	2018	2,918	71
Orara West	4,637	124	2017	2,984	64

Pappinbarra	315	1	2017	172	54
Pine Creek	1,124	153	2017	1,108	99
Queens Lake	687	4	2016	642	93
Roses Creek	421	3	2012	84	20
Scotchman	1,044	5	2016	980	94
Sheas Nob	3,057	22	2005	1,755	57
Tamban	7,334	77	2018	6,730	92
Tarkeeth	483	2	2006	374	77
Thumb Creek	231			83	36
Tuckers Knob	1,872	45	2016	1,499	80
Uffington	329	6	2014	262	80
Upsalls Creek	1,052	8	2017	532	51
Viewmont	597	4	2001	487	82
Wallaroo	3,595	45	2016	1,692	47
Wallingat	1,127	16	2016	694	62
Wang Wauk	8,022	224	2018	4,644	58
Way Way	492	3	1991	352	71
Wedding Bells	480	3	2002	399	83
Wild Cattle Creek	9,759	511	2018	8,154	84
Yarratt	2,395	26	2016	2,385	100
Yessabah	366	1	1990	179	49
Sydney Basin Bioregion					
Awaba	404	1	2006	*NA*	
Belanglo	2,080	99	2016	*NA*	
Heaton	154	1	2006	*NA*	
Jellore	992	3	2001	*NA*	
Olney	4,743	19	2006	*NA*	
Watagan	1,353	12	2005	*NA*	
South-East Corner Bioregion					
Bermagui	1,887	39	2011	*NA*	
Bodalla	1,180	5	1996	*NA*	
Gnupa	1,060	1	1986	*NA*	
Mumbulla	6,181	117	2016	*NA*	
Murrah	4,232	97	2012	*NA*	
Nullica	259			*NA*	
Tanja	866	5	2012	*NA*	
Yurammie	994	16	1999	*NA*	
South-Eastern Highlands Bioregion					
Cathcart	584			*NA*	
Tantawangalo	821	2	1991	*NA*	
Brigalow Belt South Bioregion					
Baradine	3,059	13	2003	*NA*	
Black Jack	197	2	2006	*NA*	
Breeza	1,361	6	2013	*NA*	

Coomore Creek	1,700	15	2014	*NA*	
Cumbil	7,658	162	2014	*NA*	
Doona	1,319	29	2012	*NA*	
Etoo	2,951	5	2002	*NA*	
Euligal	10,241	32	2014	*NA*	
Goran	498	19	2012	*NA*	
Merriwindi	2,637	10	2013	*NA*	
Minnon	2,415	11	2002	*NA*	
Pilliga East	4,417	21	2007	*NA*	
Pilliga West	18,563	126	2007	*NA*	
Quegobla	282			*NA*	
NSW South-Western Slopes Bioregion					
Narrandera	4	1	2006	*NA*	
Grand totals					
	341,75	6,542			

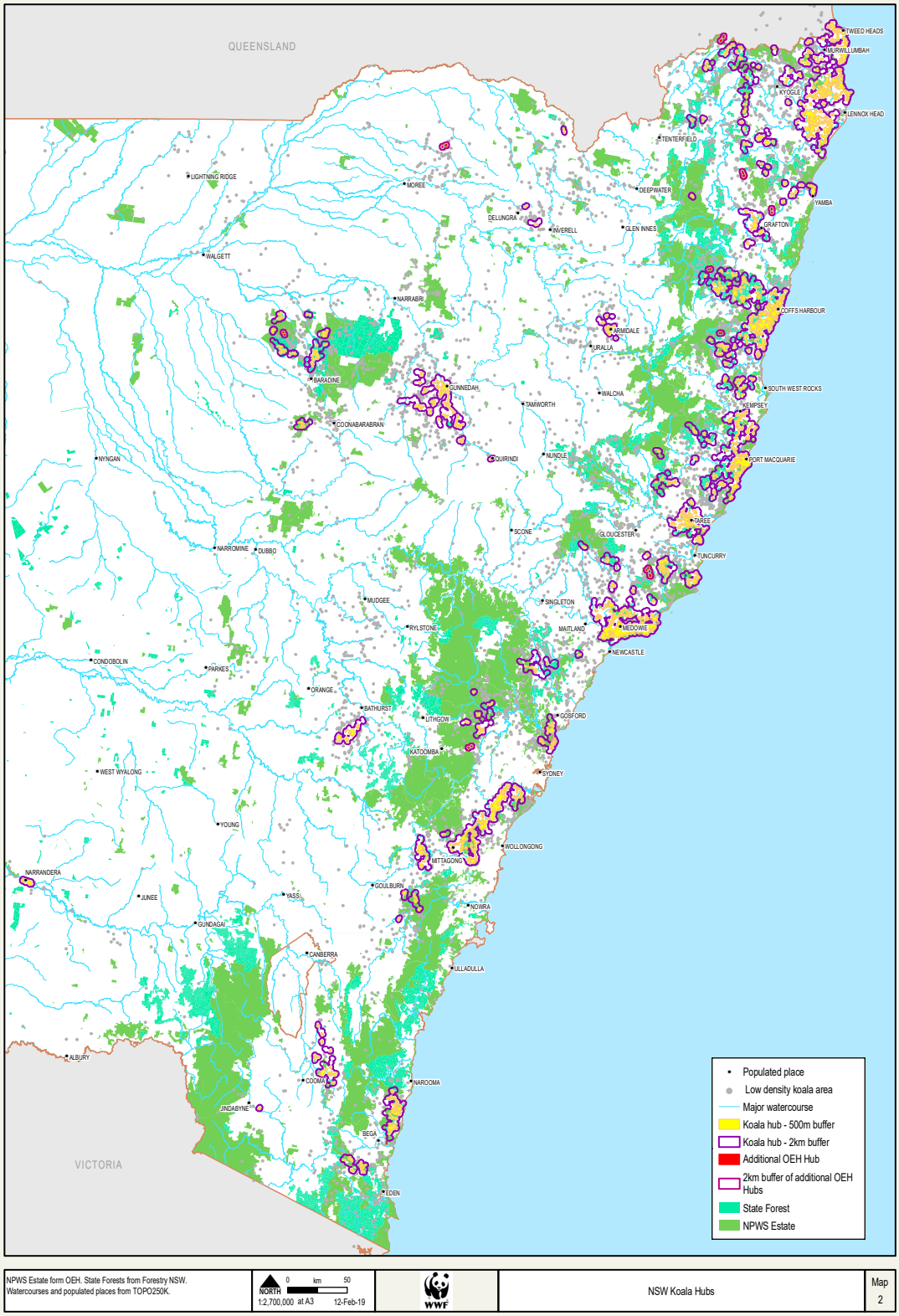
9. MAPS

Map 1. Koala metapopulations



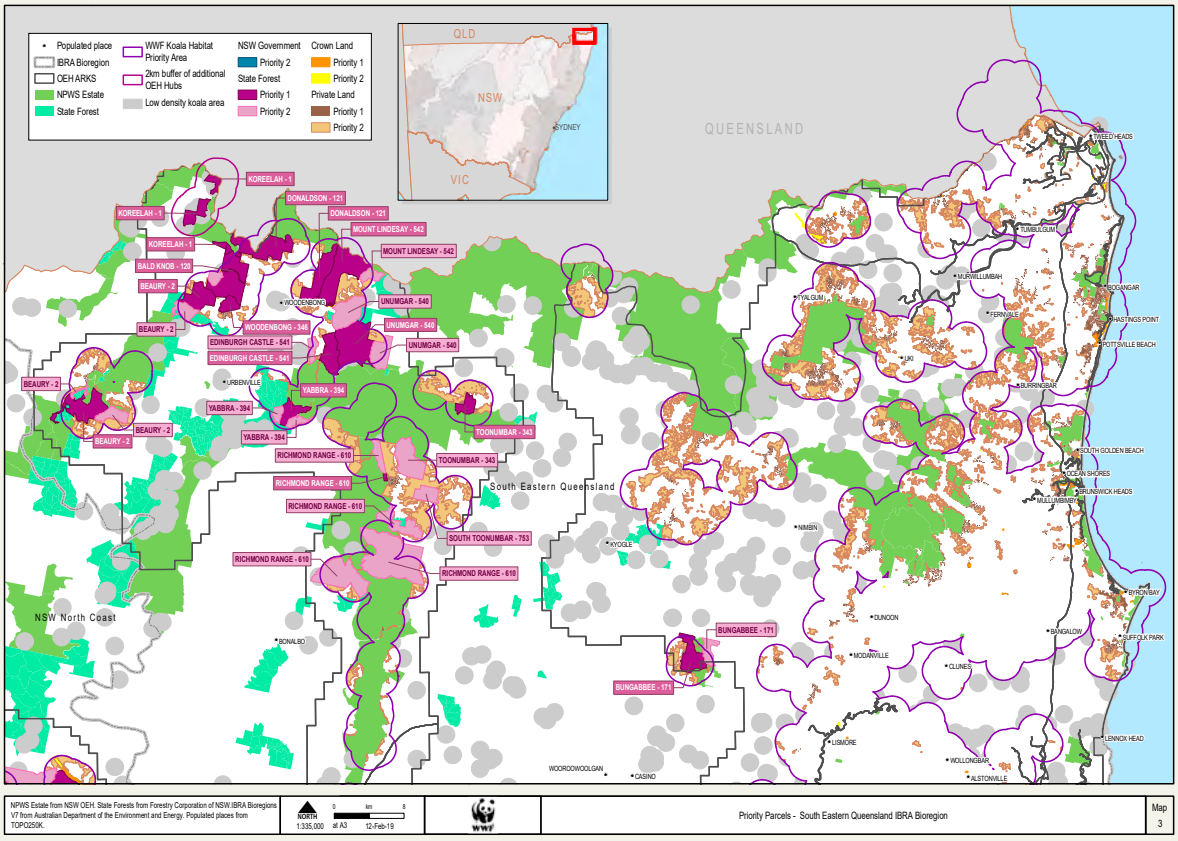
MAPS

Map 2. NSW Koala Hubs



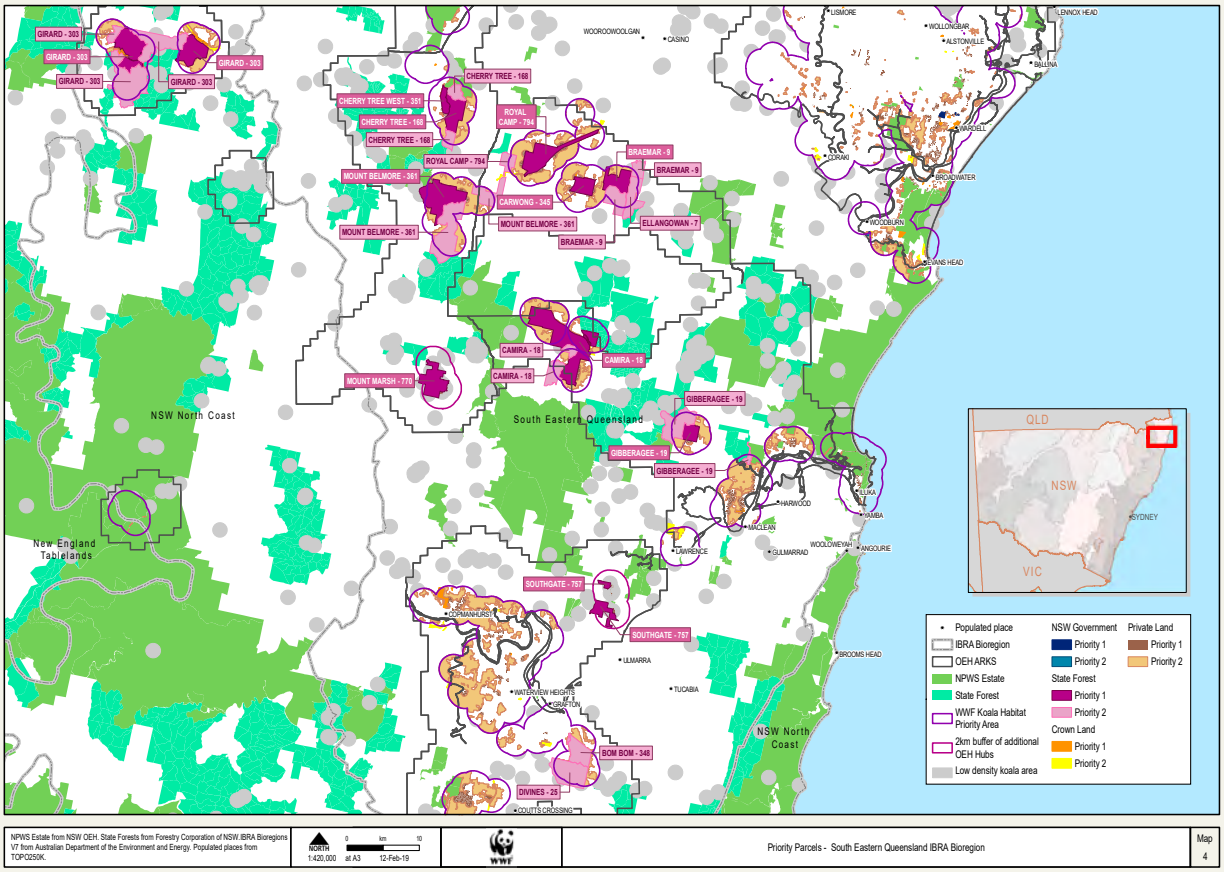
MAPS

Map 3. Priority Parcels - South East Queensland IBRA Bioregion (northern)



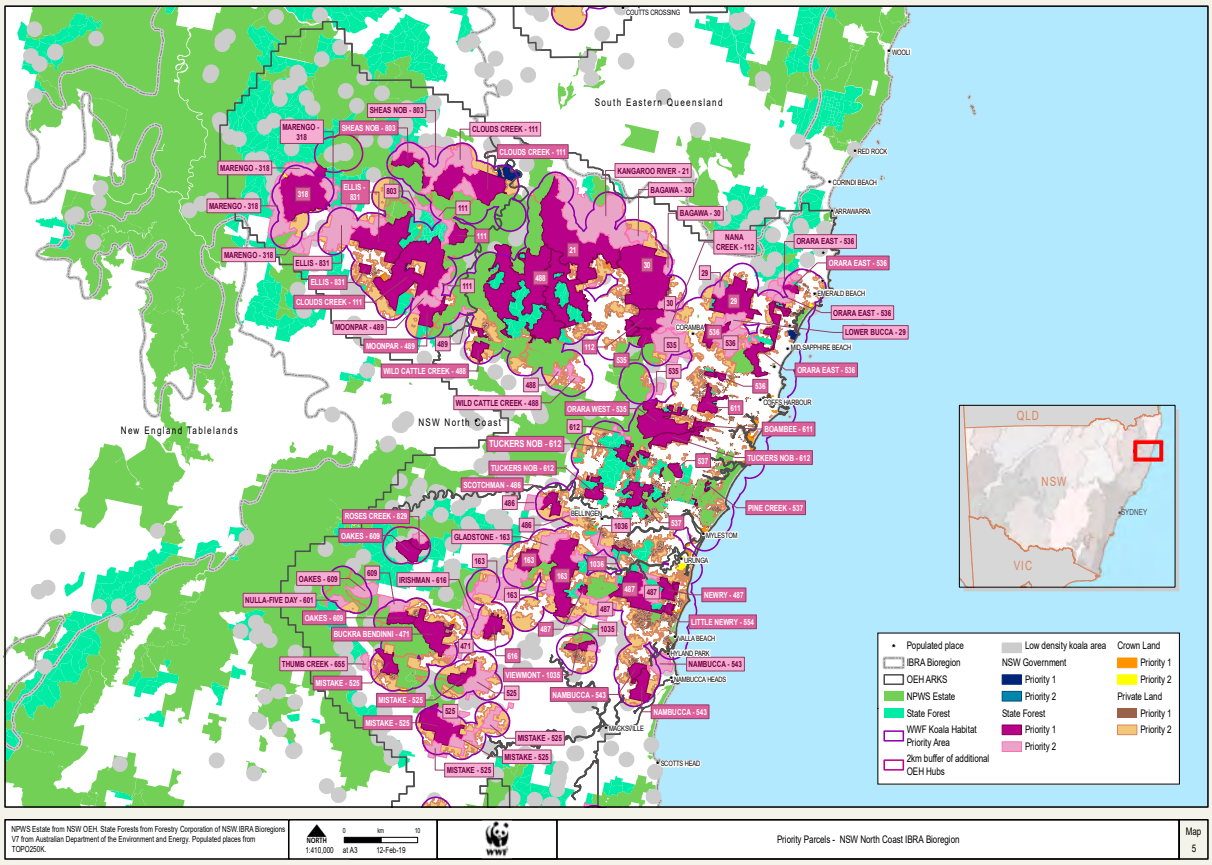
MAPS

Map 4. Priority Parcels - South East Queensland IBRA Bioregion (southern)



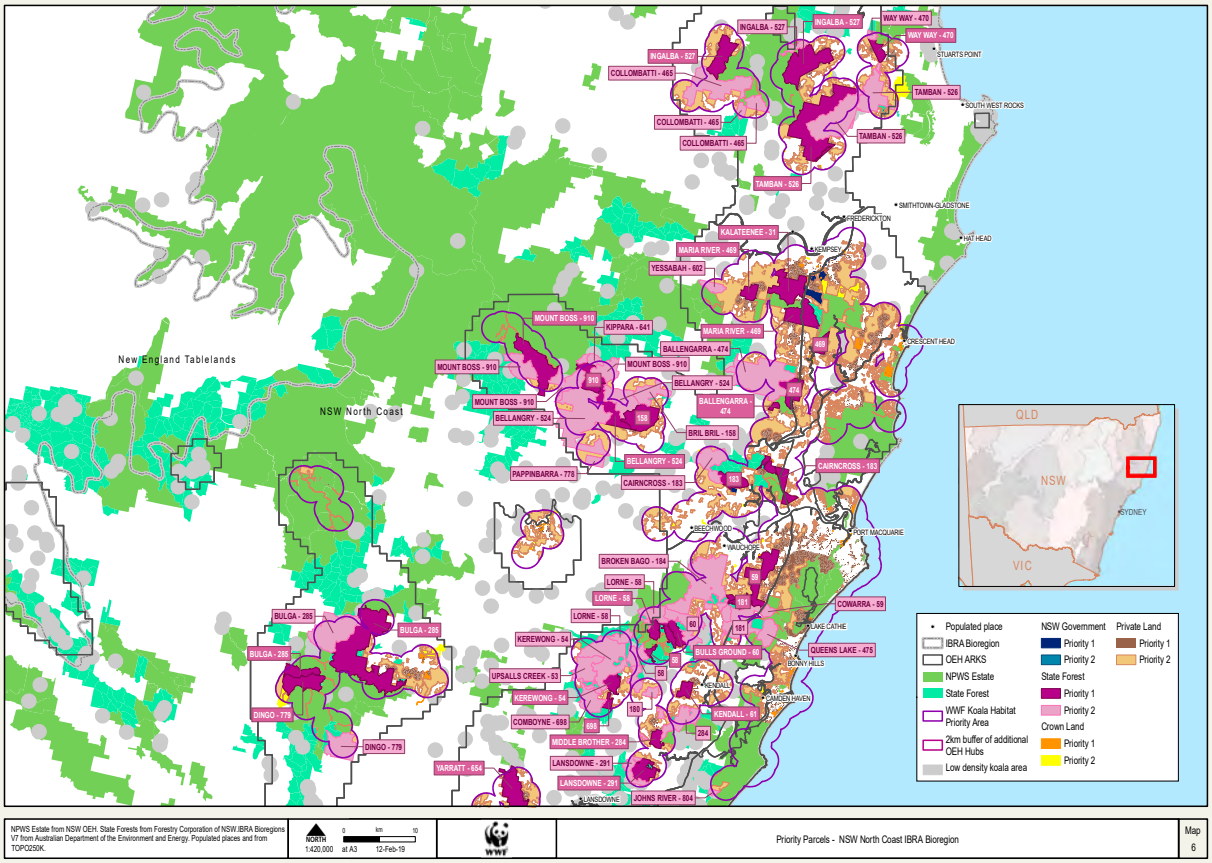
MAPS

Map 5. NSW North Coast IBRA Bioregion (northern)



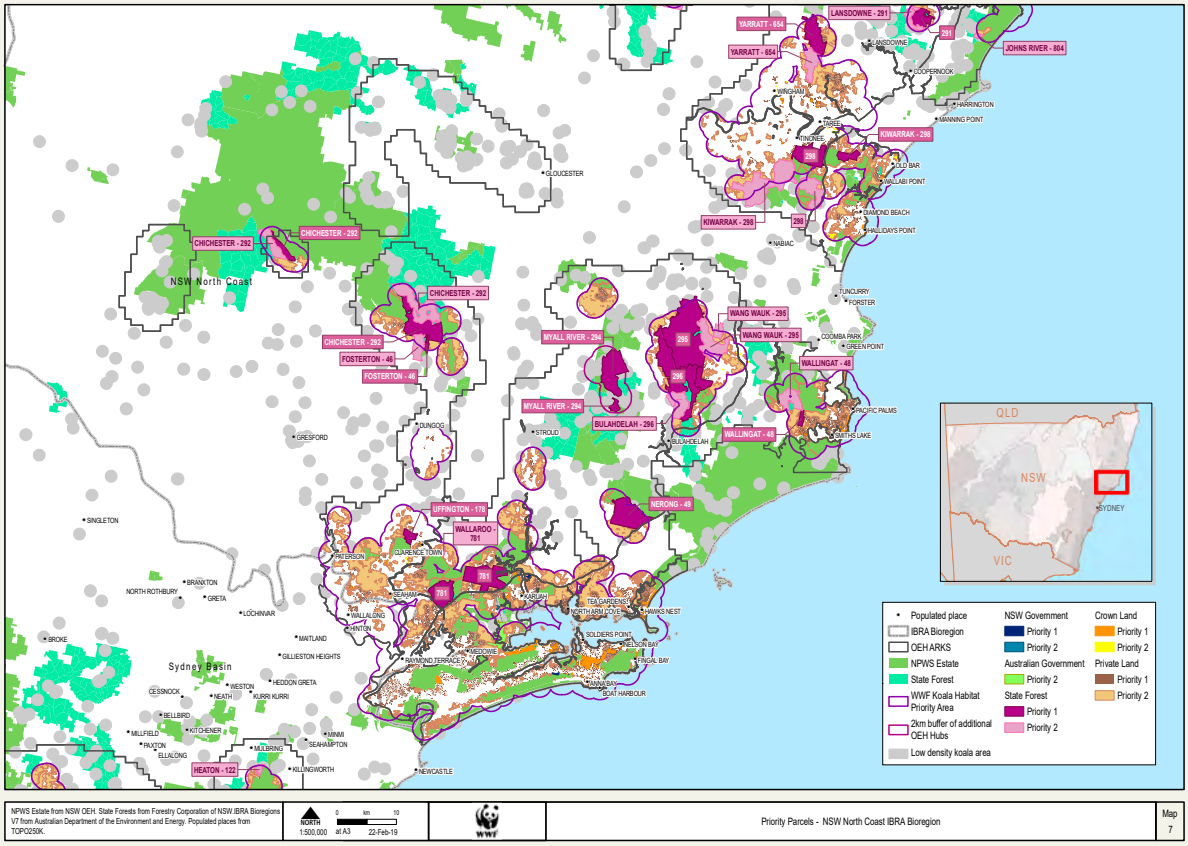
MAPS

Map 6. NSW North Coast IBRA Bioregion (central)



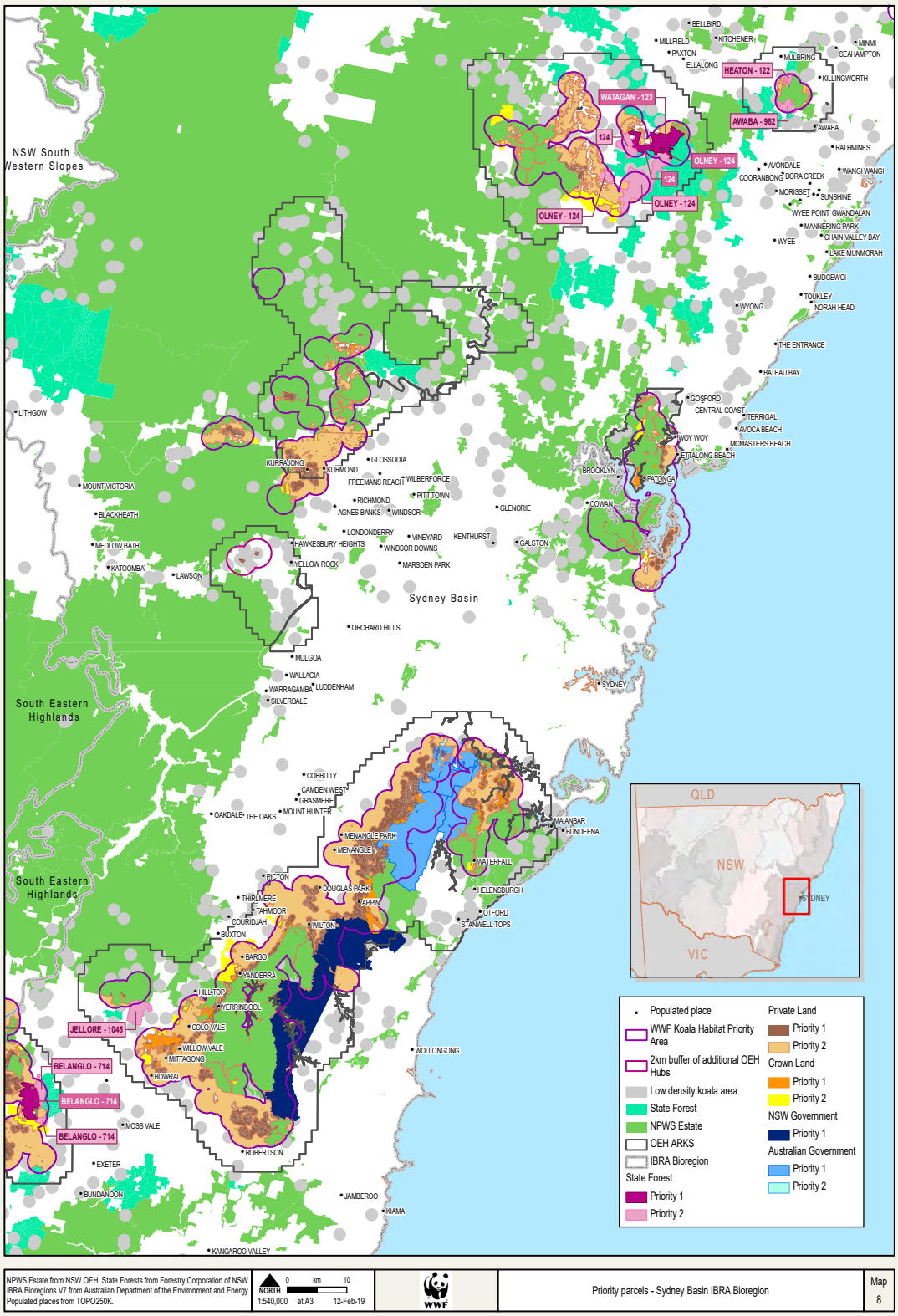
MAPS

Map 7. NSW North Coast IBRA Bioregion (southern)



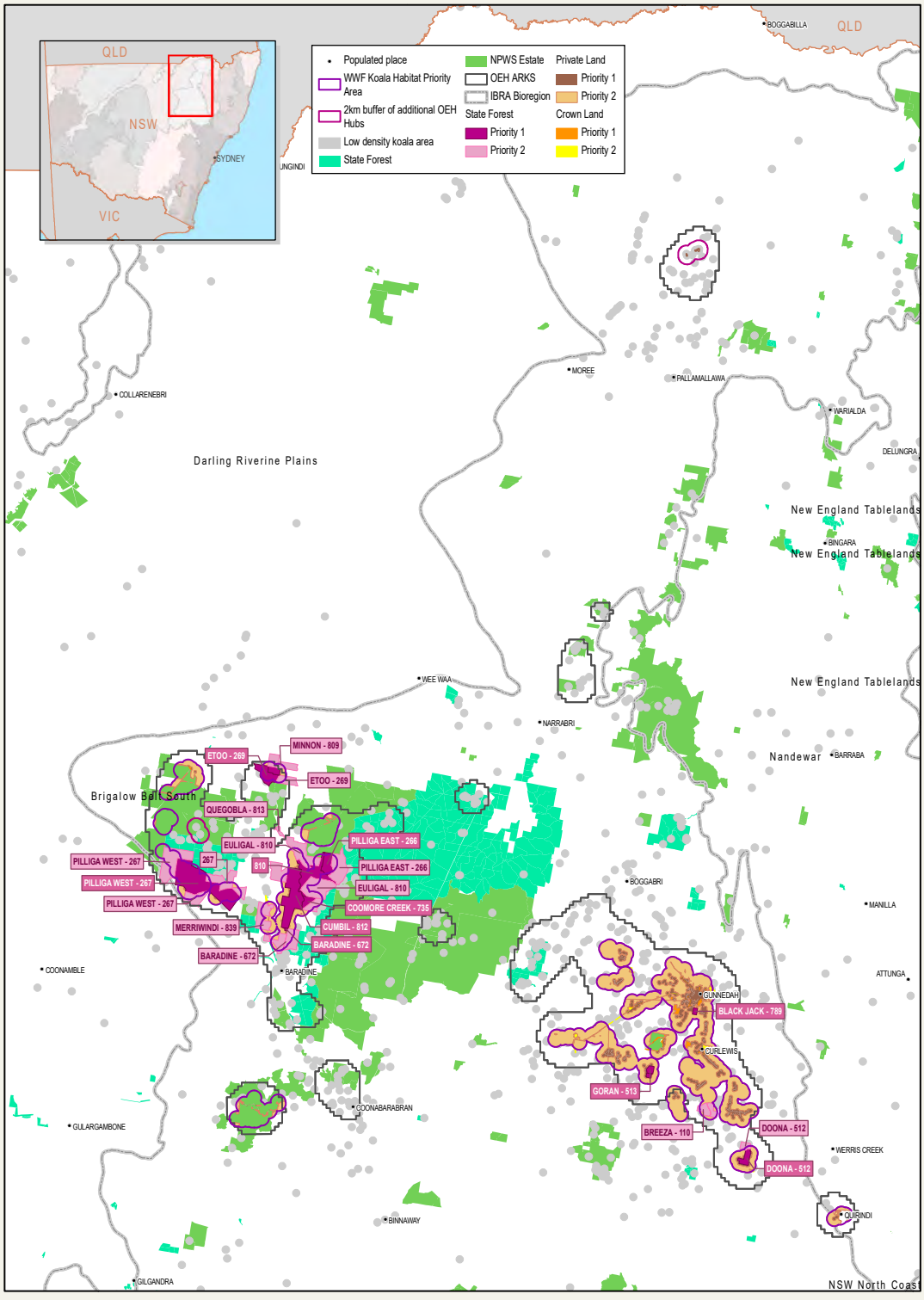
MAPS

Map 8. Sydney Basin IBRA Bioregion



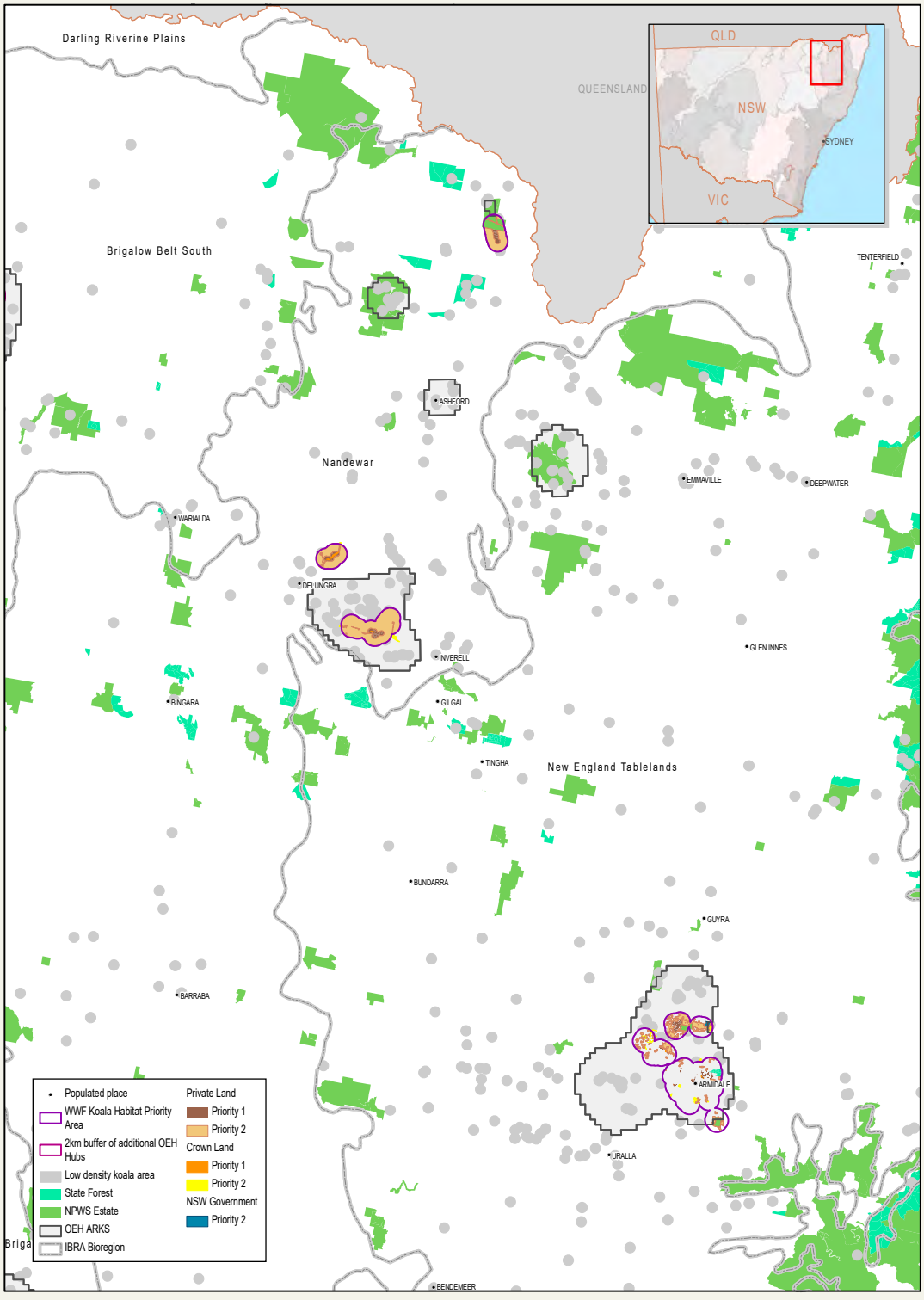
MAPS

Map 9. Darling Riverine Plains and Brigalow Belt South IBRA Bioregions



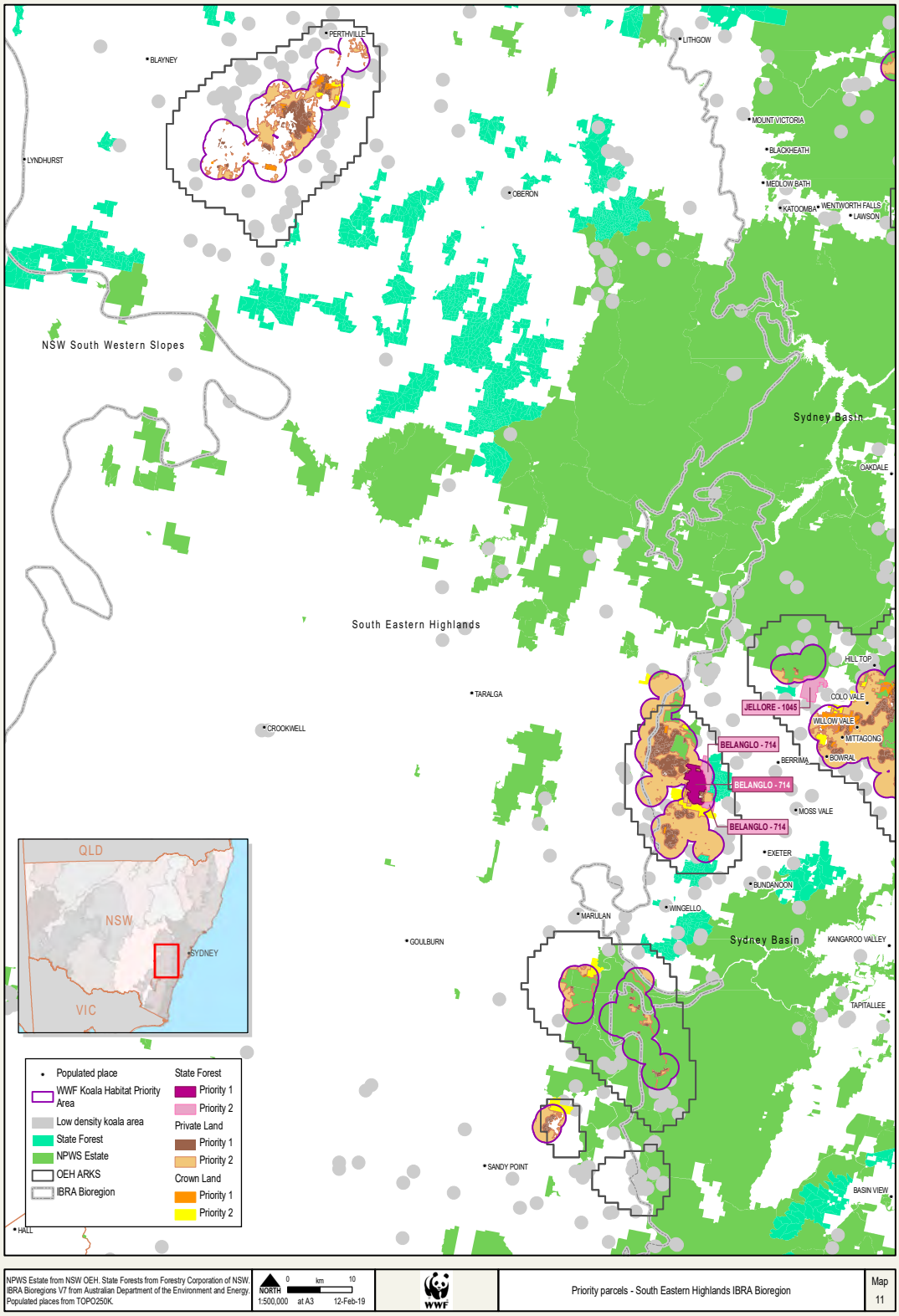
MAPS

Map 10. New England Tablelands and Nandewar IBRA Bioregions



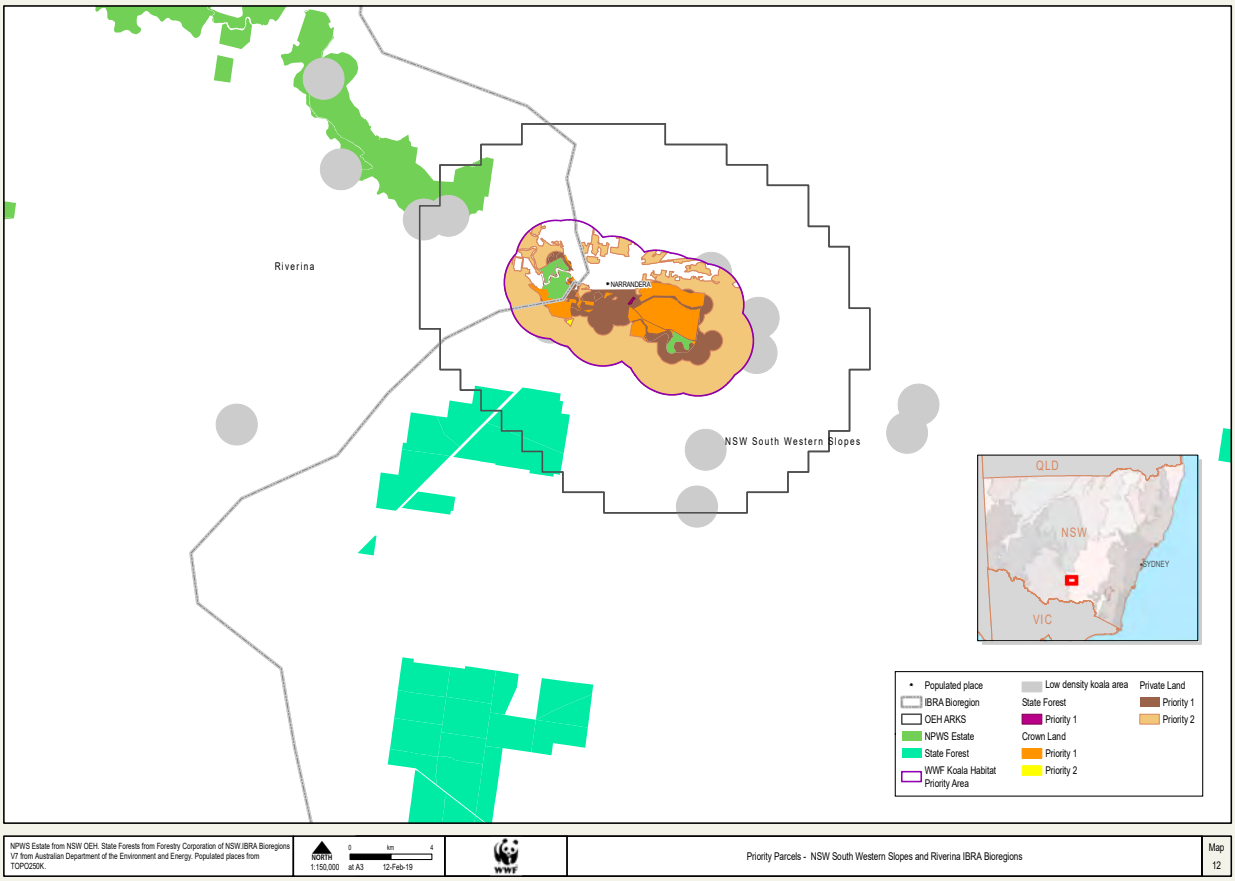
MAPS

Map 11. South Eastern Highlands IBRA Bioregion



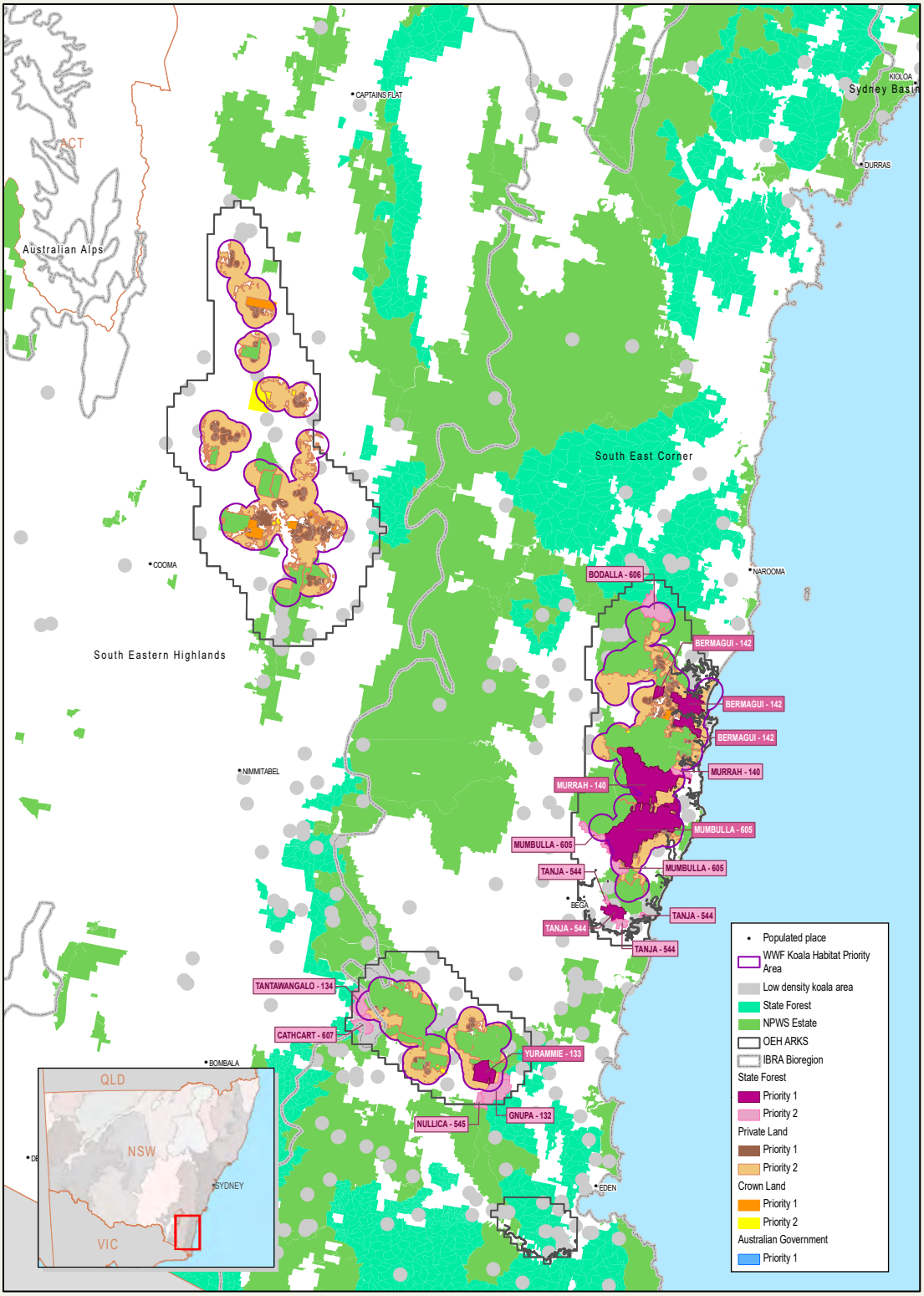
MAPS

Map 12. NSW South Western Slopes and Riverina IBRA Bioregions



MAPS

Map 13. South Eastern Highlands and South East Corner IBRA Bioregions



NPWS Estate from NSW OEH. State Forests from Forestry Corporation of NSW. IBRA Bioregions V7 from Australian Department of the Environment and Energy. Populated places from TOPO250K.

NORTH 0 km 10 1:500,000 at A3 12-Feb-19

WWF

Priority parcels - South Eastern Highland and South East Corner IBRA Bioregions

Map 13

Koalas in NSW and QLD need urgent protection.

TREE-CLEARING

WWF-Australia campaigns alongside farmers, industry and local and state governments to help see excessive tree-clearing in Queensland and New South Wales significantly reduced.

KOALAS

WWF-Australia is working to protect koalas and their habitat. We're urging the NSW Government to introduce strong laws to stop excessive tree-clearing and give our native wildlife a chance to thrive.

SPECIES

WWF focusses on bringing some of our most-loved Aussie wildlife species, including the black-flanked rock-wallaby, green turtle, quokka, and koala, back from the brink of extinction.

EARTH HOUR

WWF works together with millions of people in over 180 countries participating in Earth Hour - a symbolic gesture to show the need for stronger climate action.

CLIMATE

WWF-Australia works with businesses, governments and communities to accelerate the solutions and speed up Australia's transition to zero carbon pollution – ensuring Australia does its fair share and supports those most vulnerable to the impacts of climate change.

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

wwf.org.au

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