DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Koala Habitat Information Base Technical Guide

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Cover photo: The koala (*Phascolarctos cinereus*) is an arboreal herbivorous marsupial native to Australia. John Turnbill/DPIE

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Contents

List of tables

List of figures

1. Overview of the Koala Habitat Information Base

Under the NSW Koala Strategy the Department of Planning, Industry and Environment has developed the first statewide Koala Habitat Information Base. This resource offers the best available spatial data on koala distribution, koala preferred trees and koala sightings for New South Wales (NSW).

The Koala Habitat Information Base will:

- provide information on koala locations and habitat corridors
- help to identify which trees to select for koala habitat restoration
- assist local conservation efforts such improving the management of threats and diseases
- help to inform reserve acquisition or private land conservation agreements
- inform future policy development to protect koalas.

It is an important resource to help government agencies, local councils and private land holders make decisions about koala conservation.

The Koala Habitat Information Base is not a regulatory instrument, meaning that the datasets do not categorise land for regulatory purposes. It does provide the best available scientific information to support decision makers, rehabilitators, land managers and community members involved in koala conservation.

The Koala Habitat Information Base delivers the following statewide datasets:

- a Koala Habitat Suitability Model
- a Koala Tree Index
- koala preferred-tree species models
- a Koala Likelihood Map and a Koala Likelihood Confidence Map
- a high-resolution map of tree cover and water bodies
- areas of regional koala significance
- all BioNet koala sightings.

These datasets spatially describe koala habitat and occupancy across NSW in different ways. This guide explains each dataset, how they were developed and indicates the types of questions the data can help answer.

2. Intent of this technical guide

This document provides summary information on the Koala Habitat Information Base. It can help determine which layers are the most relevant to users by explaining what each layer measures.

This guide:

- aims to help understanding of the datasets
- offers information on how to maximise the use and value of the information in the datasets
- provides information on how data for layers were developed to help with informed decision making
- aims to equip users with knowledge about which datasets can be used where, while also describing their limitations
- includes a technical appendix that records the lineage of key datasets.

3. Use conditions and disclaimer

The Koala Habitat Information Base datasets cover all of NSW. They reflect the accuracy and quality of the source datasets at the date of acquisition and for the time periods for which they are relevant.

Quality assurance has been conducted to ensure sound data management processes and appropriate analysis methods have been followed. Data inspection and validation have been conducted to ensure data consistency and completeness to the fullest extent possible.

4. Accessing the Koala Habitat Information Base

The Koala Habitat Information Base is comprised of datasets that are accessible through the our Sharing and Enabling Environmental Data (SEED) portal.

A user guide for SEED is available online.

5. Spatial data layers

There are six spatial layers in the Koala Habitat Information Base. Table 1 provides a summary of these layers and additional data contained in the Koala Habitat Information Base.

Table 1 Layers included in the Koala Habitat Information Base

Layers	Summary
The Koala Habitat Suitability Model	Provides a measure of koala habitat suitability at any location. The model predicts the likelihood of finding habitat that is ecologically similar to where koalas have been observed over the past 40 years.
The Koala Tree Index	Provides a measure of the probability of finding a tree species that koalas are known to prefer for food or shelter.
Koala Likelihood Map (1999–2018)	Predicts the likelihood of koalas occurring across a 10-square-kilometre grid covering NSW, based on available arboreal mammal records from the past 20 years.
Koala Likelihood Confidence Map (1999–2018)	Measures the confidence that can be placed in the koala likelihood estimate per grid cell.
The native vegetation of NSW	A high precision (5-metre scale) surface that discriminates between native tree cover, non-native vegetation, urban environments and water bodies.
Areas of regional koala significance (ARKS)	Regions mapped as having high known koala occurrence using analysis of koala observation densities.
Koala sightings	Koala (*Phascolarctos cinereus*) species sightings in NSW. Sightings are derived from the BioNet Species Sightings Data Web service. Records are updated daily.

5.1 Layer overview: Koala Habitat Suitability Model v1.0

Purpose	Scale
To measure koala habitat suitability at any location	Regional level

The Koala Habitat Suitability Model (KHSM) predicts the spatial distribution of potential koala habitat across NSW using a value between 0 and 1 (i.e. a higher value represents a higher probability that a specific location will contain habitat suitable for koalas). It is built from a predictive (MaxEnt) model, developed iteratively following a series of expert reviews. This dataset is delivered as a set of seven regional suitability models that show how koala habitat suitability varies at a regional scale. For example, the far western regional suitability model predicts the most westerly extent that koalas have the potential to occupy. Each suitability model provides an indication of where koalas have the potential to reside but are not necessarily currently occupied.

5.1.1 Layer development

Koala habitat

Koala habitat can be described differently at varying scales. Koalas interact with their environment at varying spatial scales from the site level (e.g. food, shelter and breeding needs) to broader landscape levels (based on their movement abilities and barriers to dispersal). The core drivers of habitat suitability can vary across these different scales. Food, shelter and breeding requirements are the key considerations at the individual site and tree scales, while the configuration of available habitat (e.g. the size, shape and degree of connectivity between habitat patches) and the physiological tolerances of animals themselves become increasingly important at a regional scale (McAlpine et al. 2006).

At a whole-of-range scale, climate is an important driver of koala range limits. Conversely, at a local scale, the ability of koalas to tolerate, avoid or detoxify plant secondary metabolites has a strong influence on animal health and fitness. Thus, nested within areas of suitable climate, a range of local-scale factors are likely to drive variations in habitat suitability, including what species of eucalypt occur where.

The habitat suitability models in the Koala Habitat Information Base predict the distribution and suitability of potential habitat in terms of a relationship between the environmental space defined by a full set of sites occupied by koalas, compared to what is available. It does this by relating the location of koala records to environmental factors such as vegetation, soil and topography. Figure 1 provides a simple summary of the modelling process.

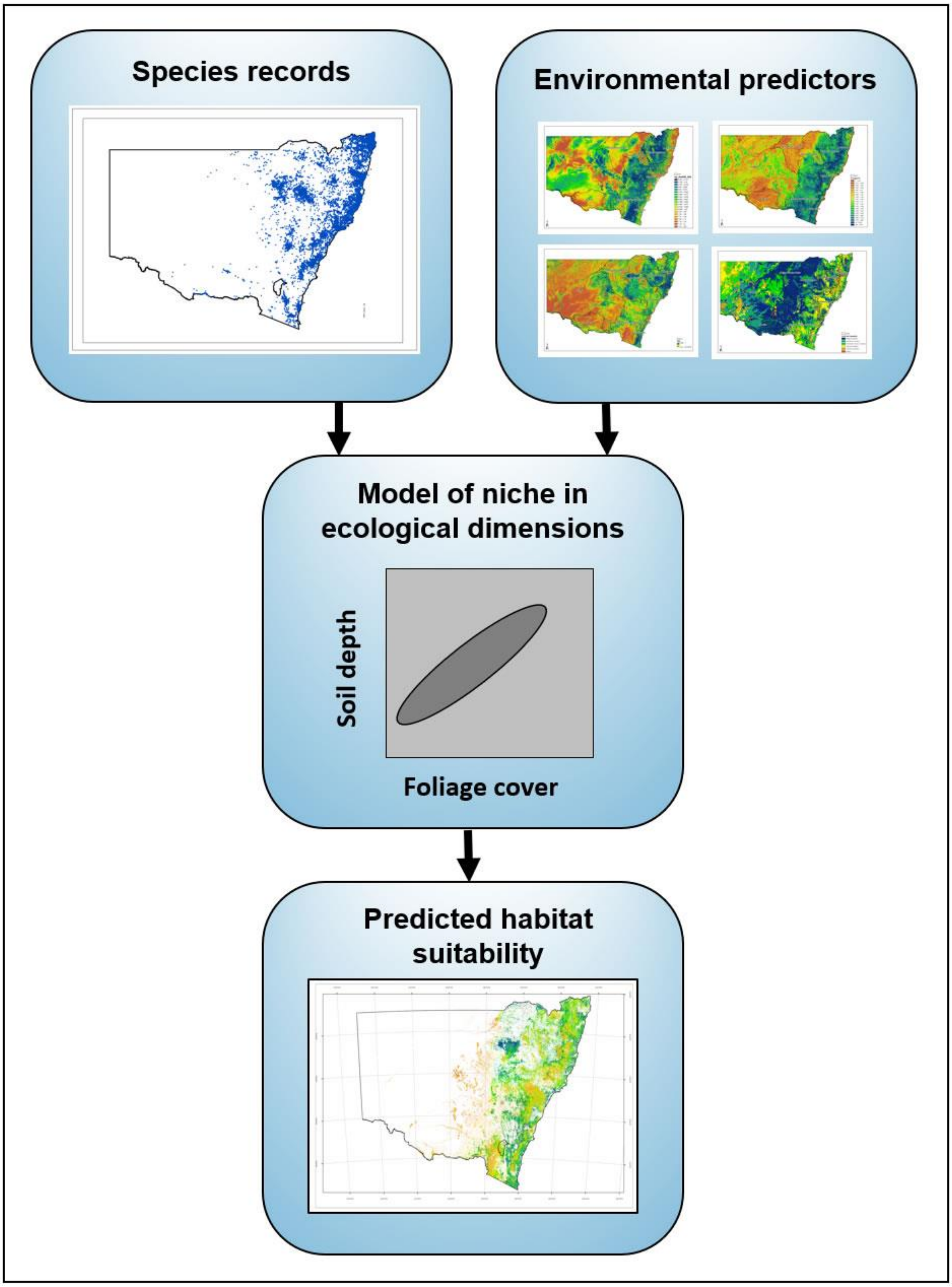


Figure 1 **A simple summary of the modelling process for koala habitat suitability**

The model type used (MaxEnt)

The MaxEnt model represents the realised-niche that koalas occupy and predicts this niche spatially across the landscape. It uses data on where koalas have been seen (presence data), and an algorithm that compares the locations of where animals have been found to all environments available in the study region. It defines these available environments by sampling a large number of points throughout the study area, which are referred to as background points. As such, the suitability score is relevant only to the predictors used in the model. The data layer provides a suitably score between 0 (unsuitable) and 1 (highly suitable) for every 30 x 30 metre pixel, allowing the user to identify areas of variable quality within any region.

The records of koala presence that help drive the model are primarily available in the form of 'opportunistic surveys'. This type of data is often referred to as 'presence-only' data. Data on koala sightings were sourced from NSW BioNet, the repository for biodiversity data products managed by the Department of Planning, Industry and Environment. These koala sightings have been collected over the past 40 years, providing just over 40,000 records for NSW. The records were spatially thinned per modelling region to address clustering of records by randomly subsampling single occurrences from each grid cell (Briscoe et al. 2016; Fourcade et al. 2014; Kramer–Schadt et al. 2013; Law et al. 2017). The process used to vet koala records is described in the Appendix.

To calculate the distribution of potential habitat, MaxEnt first calculates two probability densities (Figure 2). The probability density of the background points characterises the available environment within the study region, whereas the probability density of the presence points characterises the environment of where a species has been found. MaxEnt then calculates the ratio between these two probability densities, which gives the relative environmental suitability for presence of a species for each point in the study area.

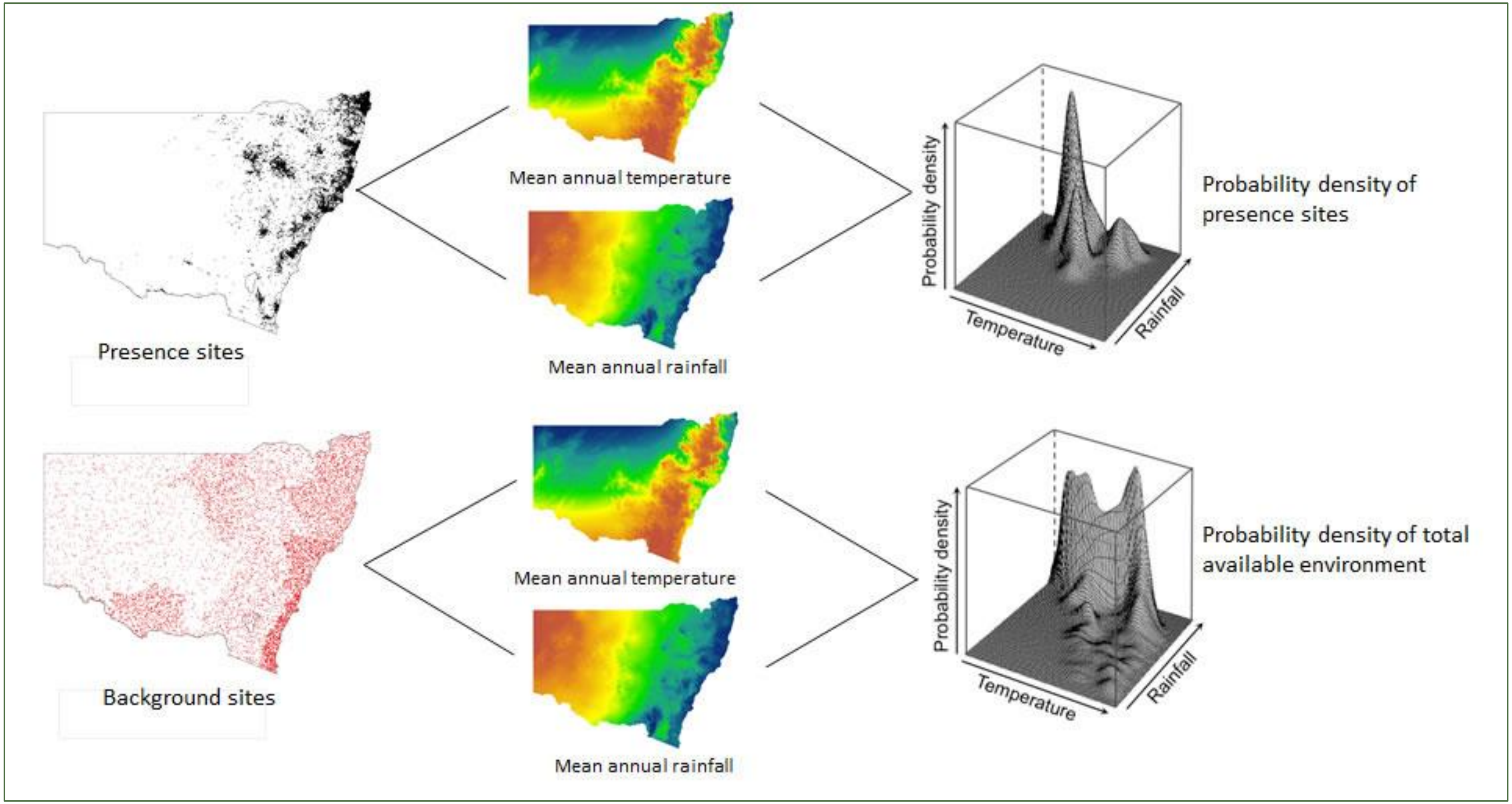


Figure 2 **This diagram represents how MaxEnt uses presence and background points to predict habitat (adapted from Elith et al. (2011) A statistical explanation of MaxEnt for ecologists. Diversity and Distributions, 17, 43–47)**

Splitting up the state

The KHSM was developed across nine koala modelling regions (Figure 3). This was important because the environmental drivers that dictate habitat suitability vary across NSW. For example, koala's prefer different tree species on the North Coast compared to the Southern Tablelands. By developing regional KHSMs that are independent of one another, users can consistently compare habitat suitability scores at any given location within a region.

The regions were defined by an agglomerative hierarchical cluster analysis of the turnover patterns of koala food and shelter species, where aggregation units were represented by local government areas (LGAs) on the coast and tablelands, and Interim Biogeographic Regionalisation of Australia (IBRA) subregions in western NSW. Tree species patterns are likely to best capture changes in habitat choice and food selection at a regional scale, where it is expected that the key drivers of habitat suitability are much the same within a region (where food choices are similar) but may differ between regions (different food choices).

Figure 4 provides an example of a detailed view within the KHSM, showing variation of suitability within an area.

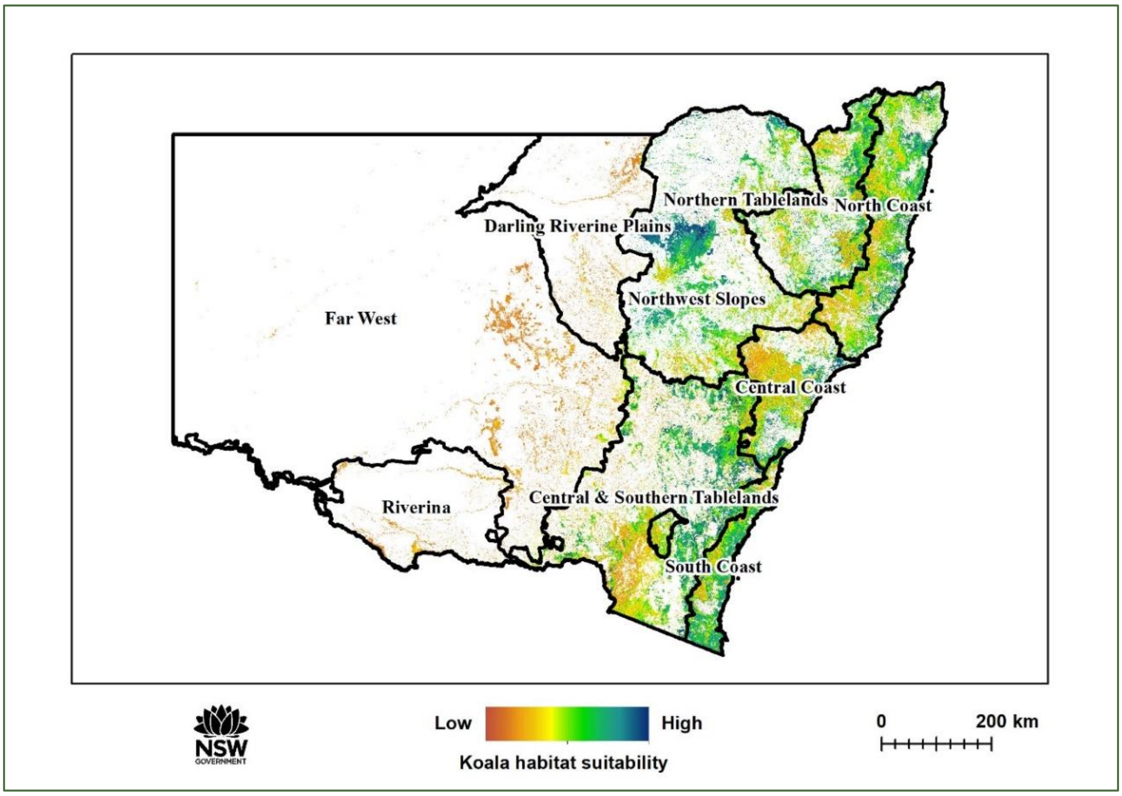


Figure 3 **Map showing the nine koala modelling regions and koala habitat suitability modelling**

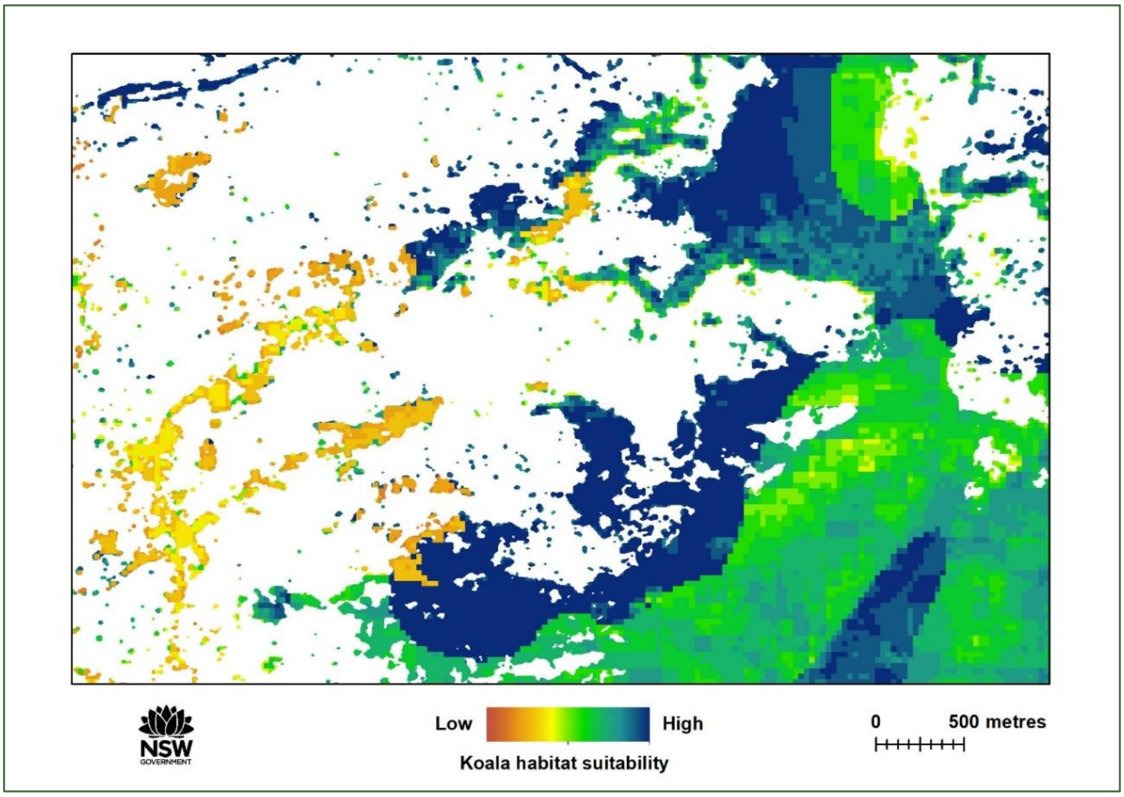


Figure 4 **A detailed view showing the results of koala habitat suitability modelling**

The western regions (Darling Riverina Plains, Far West and Riverina)

The three western-most regions of NSW lacked sufficient koala records to develop independent MaxEnt models. Instead, one model was developed to predict the western limit of koala habitat across these three regions using koala records sourced from Queensland, NSW and Victoria.

First, we ran a whole-of-range KHSM using a simple set of climate predictors. In the model, the western range limit for Koalas was driven by a mean maximum daily temperature threshold of 36ºC (for the warmest month) along with a 400-millimetre minimum annual rainfall threshold. The range of predictors were later expanded to include soil and a broader range of climatic drivers. This included annual temperature range, minimum temperature of the coldest period, annual actual evapotranspiration, minimum monthly water deficit, minimum monthly precipitation, soil bulk density and soil pH. Two versions of the complex whole-of-range model were prepared, one covering the three western-most koala monitoring regions (KMRs), the other also included the three central KMRs, which shows how habitat suitability changes from low-to-high across a full range of inland environments.

The central and eastern regions

The six central and eastern regions were considered broadly suitable for koalas from a climate perspective, and are likely to be affected more by local factors such as koala preferred tree species, soil type and topography. This assumption does not suggest that populations in these regions are unaffected by droughts and heatwaves, only that historically, koalas had the potential to occupy vast areas across each region. Some areas such as the Pilliga, which are modelled as potentially suitable, have undergone population decline in recent decades.

Whether the Pilliga population will ever recover is unknown. However, it is likely that some areas in western NSW modelled as potentially suitable (using koala records collected up to 40 years ago) may no longer be viable today. Thus, the KHSM cannot be used to predict koala occupancy, which is influenced not only by the ecological requirements and tolerances of a species, but also by events that have shaped the dynamics of populations in the past (i.e. disturbance from bushfires, vehicle strikes, disease and predation). Rather, the KHSM seeks to predict the suitability of potential koala habitat. The environmental predictors used in each region are described below.

Environmental predictors

A set of over 80 environmental predictors (drivers) were initially considered potentially relevant to koalas. However, many of these were correlated with one another to varying degrees, and we chose the simplest set possible that showed ecologically sensible response curves across the six central and eastern regions.

In each central and eastern region this combination of predictors best explained local variations in habitat suitability, while being least susceptible to biases associated with the collection of survey records. For example, far more koala surveys have occurred at low elevations (<500 metres) along the coast compared to adjacent hinterlands, and we didn't want the models to draw a direct link between survey intensity and habitat suitability.

The final selection of predictors was ultimately underpinned by our knowledge of the physiology and resource requirements of koalas, where we chose five predictors to represent the species' ecological niche. The driver with the greatest contribution in all six regional models is an index that reflects the probability of finding koala-preferred tree species across each region. This provides a critical habitat component in the model (see the Koala Tree Index section for more information).

The other drivers in the model include:

- a depth to bedrock soil layer
- a land soil capability index (used to distinguish high moderate and low fertility soils from very low soil fertility)
- cold air drainage (which attempts to capture the location of cold air pools in low-lying areas and is loosely correlated with depth to bedrock and topographic roughness)
- a remote sensed index of projected foliage cover based on SPOT5 satellite imagery. The list of predictors used and their response curves are further detailed in the Appendix.

Model confidence

The performance of the models was evaluated using 10-fold cross-validation. This is a process where predicted habitat suitability scores are tested against independent koala records that were not used to develop the models. The predictive power of models was generally high, with area under the curve (AUC) values over 0.7. In addition to model confidence, local koala experts were consulted about each draft model and asked to provide critical local review. This feedback was used to refine the models before release. This included a process to down-weight the Koala Tree Index in certain low-quality habitats identified by experts (see Appendix). In addition, our modelling methods and assumptions were reviewed by a panel of leading koala researchers.

For more information about the development of this layer

The Appendix contains further technical information, including product lineage, overall methods, predictor selections, regionalisation strategies and validation metrics.

5.2 Layer overview: Koala Tree Index v1.0

Purpose	Scale
To measure the probability of finding a tree species that a koala is known to use for food or shelter	Regional level

The Koala Tree Index (KTI) predicts the probability, using a value between 0 and 1, of finding a tree species that koalas are known to prefer for food or shelter at any location. This index is the most important predictor in all six regional KHSMs. Our assumption is that koalas can potentially use an area (for feeding or shelter) if any one of the tree species included in the index are present.

5.2.1 Layer development

The KTI represents the probability of at least one tree known to be used by koalas being present at a location. The index integrates the predicted spatial distributions of selected tree species by calculating for each grid cell every combination of species presences and absences (by multiplying together) and then summing the combinations. It can be thought of as the opposite of the probability that no suitable tree species occur. Figure 5 illustrates the KTI for each of the nine koala modelling regions. Figure 6 provides an example of a detailed view within the KTI, showing variation in probability of a tree species within an area.

Vegetation surveys used in this project were sourced from NSW BioNet. Vegetation-site data downloaded from BioNet provided more than 100,000 plots. The data were vetted for survey type, survey quality, floristic consistency and spatial accuracy. Full-floristic vegetation surveys from targeted 20 x 20 metre, or 0.4 hectare, quadrat sampling were used to provide presence–absence data for modelling the distribution of selected tree species. Models of individual tree species were built using boosted regression tree (BRT) modelling, a correlative species distribution model.

A review of koala tree use across NSW (OEH, 2018) compiled separate lists of relevant tree species for each koala management area (KMA) within NSW. Evidence of koala tree use was sourced from written reports, published research articles, and personal communications with local koala carers and experts. KMA lists were refined for each modelling region with further expert feedback obtained within each region. Each species was assigned a regional ranking indicating high use (feed trees), significant use (feed or shelter trees), and irregular or low use (feed or shelter trees).

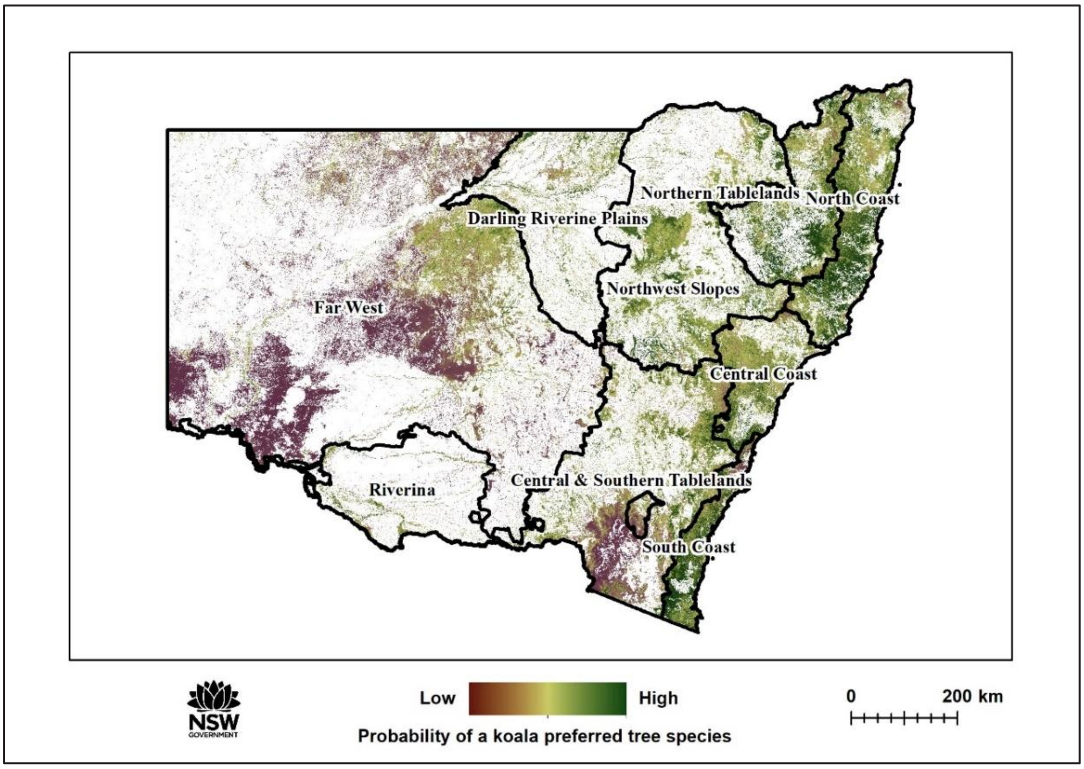


Figure 5 **State-wide map illustrating the Koala Tree Index v1.0 for each region**

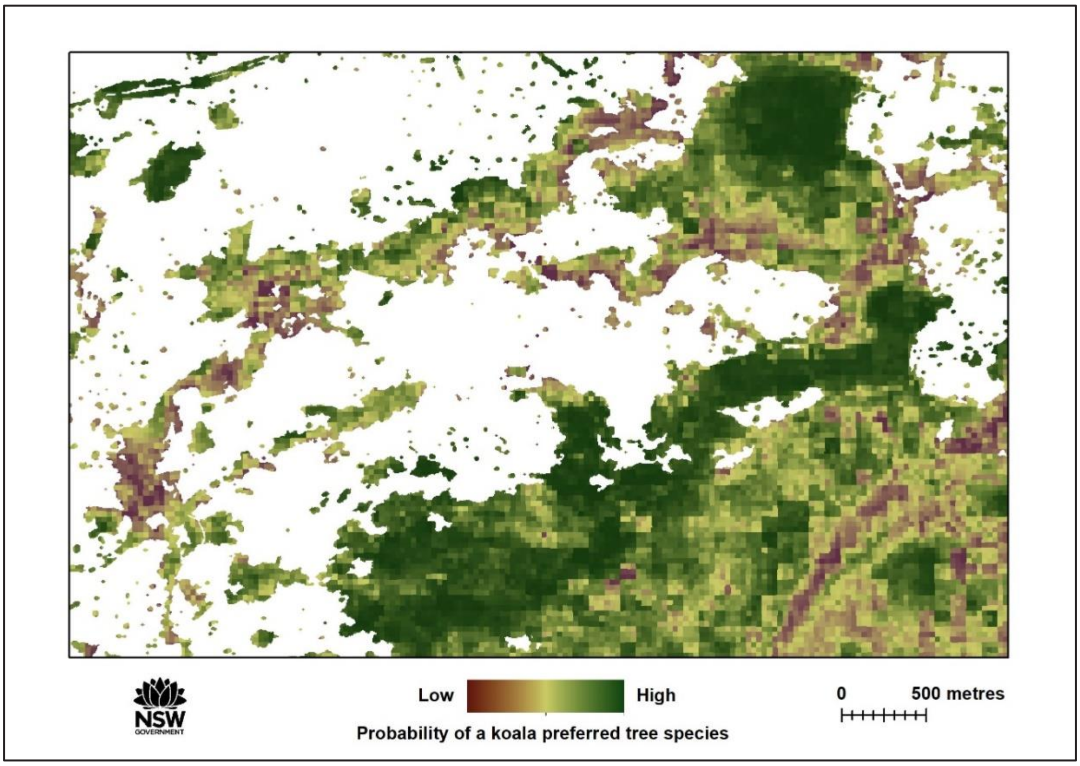


Figure 6 **A detailed view of the Koala Tree Index v1.0**

Not all listed tree species for a particular region were included in the KTI. Our aim was to target locations where known high-use food trees occur while ensuring that other listed species were adequately represented in the index. A step-wise process was implemented whereby high-use species (ranks 1 and 2) were automatically modelled and included in a preliminary index. This preliminary index was then analysed using predicted probability values at species occurrence sites, and association analysis to assess co-occurrence and possible model redundancy for species with similar distributions.

Additional species were added to the index after this stage. We recognised that adding many more species could lead to an over-prediction of habitat suitability, so the final choice of species came down to the simplest set that was supported and accepted by experts. All models were evaluated using performance metrics (AUC, deviance explained, response curves) and the predicted spatial distributions analysed by experts before inclusion in the final index.

The final list and ranking of tree species and those selected for inclusion in the KTI for each koala modelling region are listed in the Appendix. Individual tree species models for each region are also available on the SEED portal. More detailed information on modelling methods, input predictors, evaluation and validation metrics can be found in the Appendix.

For more information about the development of this layer

The final list, ranking and inclusion of tree species for each koala modelling region are listed in the Appendix along with technical information on the Koala Tree Index lineage, modelling method, predictor selections, evaluation and validation metrics.

5.3 Layer overview: Koala Likelihood Map

Purpose	Scale
To predict the likelihood of finding a koala in each 10-square-kilometre grid cell	Regional level

The Koala Likelihood Map (KLM) predicts the likelihood of finding a koala across a 10-square-kilometre grid covering NSW, based on available arboreal mammal records from the past 20 years (Predavec *et al.* 2015).

5.3.1 Layer development

The records used are of the koala and 8 species of other arboreal mammals within the glider (*Petauridae*), brushtail possum (*Phalangeridae*) and ringtail possum (*Pseudocheiridae)* families. The use of records for other arboreal species provide a measure of survey effort independent of koalas and allow identification of areas where other arboreal mammals have been recorded, but not koalas. Records are obtained from NSW BioNet and other independent sources. A filtering process is implemented to reduce some of the inherent biases in the atlas data.

Each grid cell is assigned a value for the likelihood of koalas (p) based on a binomial distribution with each record being a koala (K) or another arboreal mammal. The proportion of all records within a cell (N) (all subject species including koalas) that are koalas represents the likelihood: $p = K/N$

This provides the relative likelihood of koalas being recorded, with a value between 0 (no koalas) and 1; i.e. a higher value represents a higher relative likelihood.

Figure 7 illustrates koala likelihood results for the state based on data from January 1999 to August 2019, and generated in August 2019.

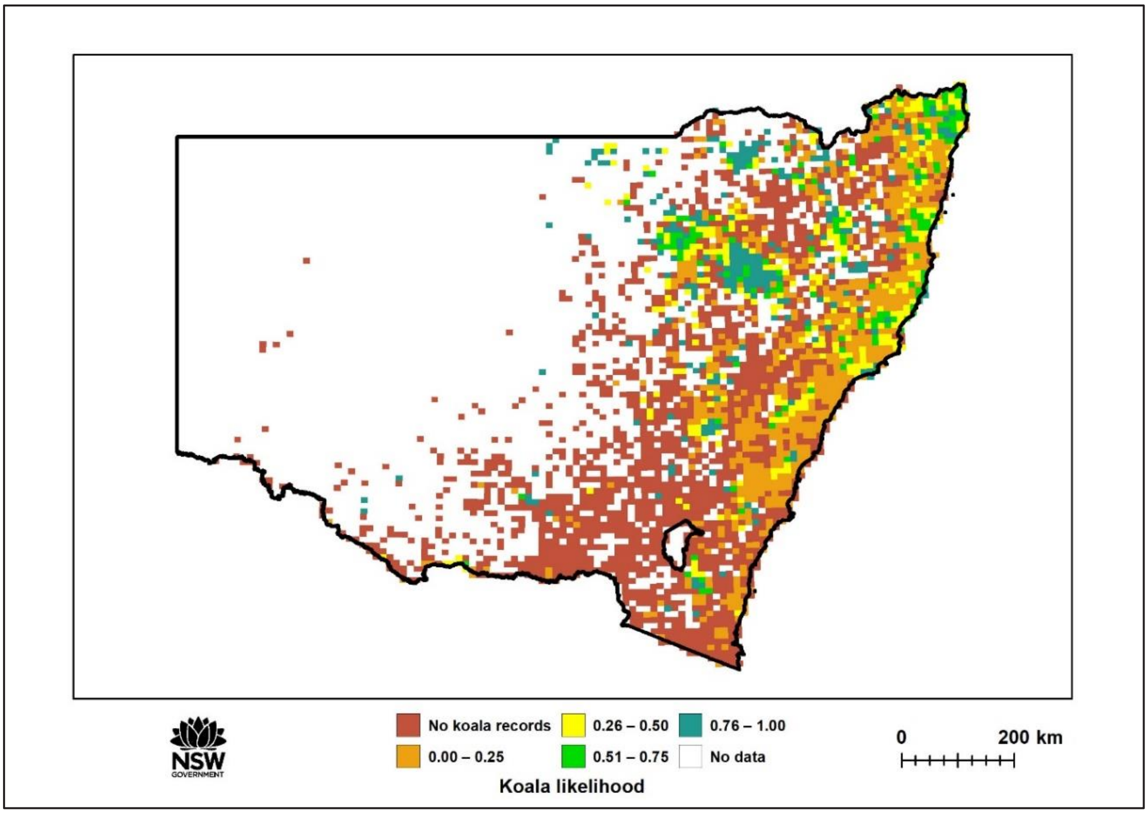


Figure 7 **Illustration of the Koala Likelihood Map (KLM) v2.0 (August 2019) likelihood layer**

In addition to the likelihood layer, the map also includes a confidence layer representing the relative confidence in the koala likelihood estimates (Figure 8). Each cell is assigned a relative confidence level (high, moderate or low) for *p* based on the exact 95% confidence interval.

The level of confidence is as important as the likelihood estimate because it indicates how confident we are in the likelihood of koala occurrence and whether more data should be obtained to increase our confidence.

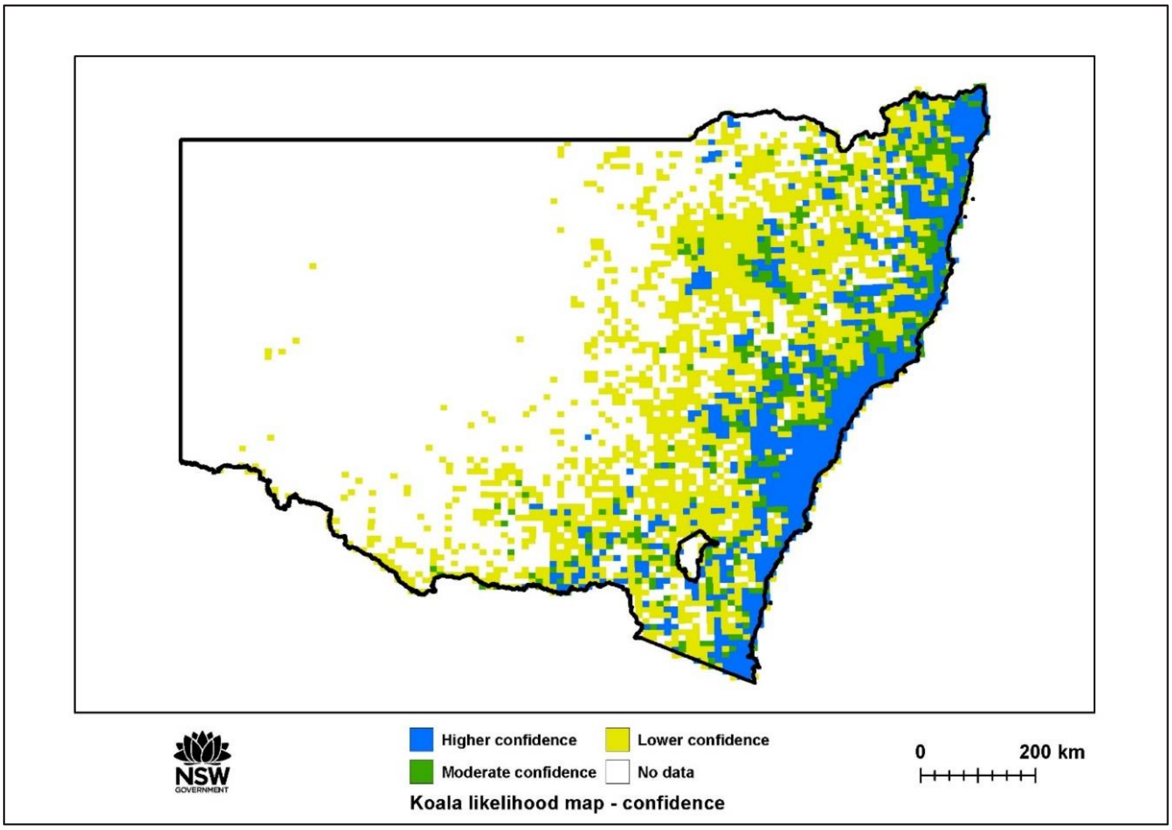


Figure 8 **Illustration of the Koala Likelihood Map (KLM) v2.0 (August 2019) confidence layer**

For more information about the development of this layer

Predavec M, Lunney D, Shannon I, Scotts D, Turbill J and Faulkner B 2015, Mapping the likelihood of koalas across New South Wales for use in private native forestry: developing a simple, species distribution model that deals with opportunistic data. Australian Mammalogy 37, 182–193.

5.4 Layer overview: The vegetation extent of NSW

Purpose	Scale
To discriminate tree cover and woodlands from other terrain elements	Local

This dataset combines the best available information on the extent of vegetation in NSW. This provides an important ecological map to identify tree cover from other terrain elements. It is mapped at a scale (5 metres) that individual tree crowns are delineated in addition to contiguous tree cover. It is based on the 2011, 5-metre NSW Woody Vegetation Extent (Fisher et al. 2016) with updates based on high-resolution imagery interpretation (Fisher et al. 2017). Candidate native grasslands have also been mapped using visual interpretation of high-resolution imagery (OEH, 2017). The layer also delineates softwood forest plantations and water bodies.

Figure 9 illustrates the updated extent of native vegetation across NSW. Figure 10 provides an example of a detailed view of native vegetation extent across NSW.

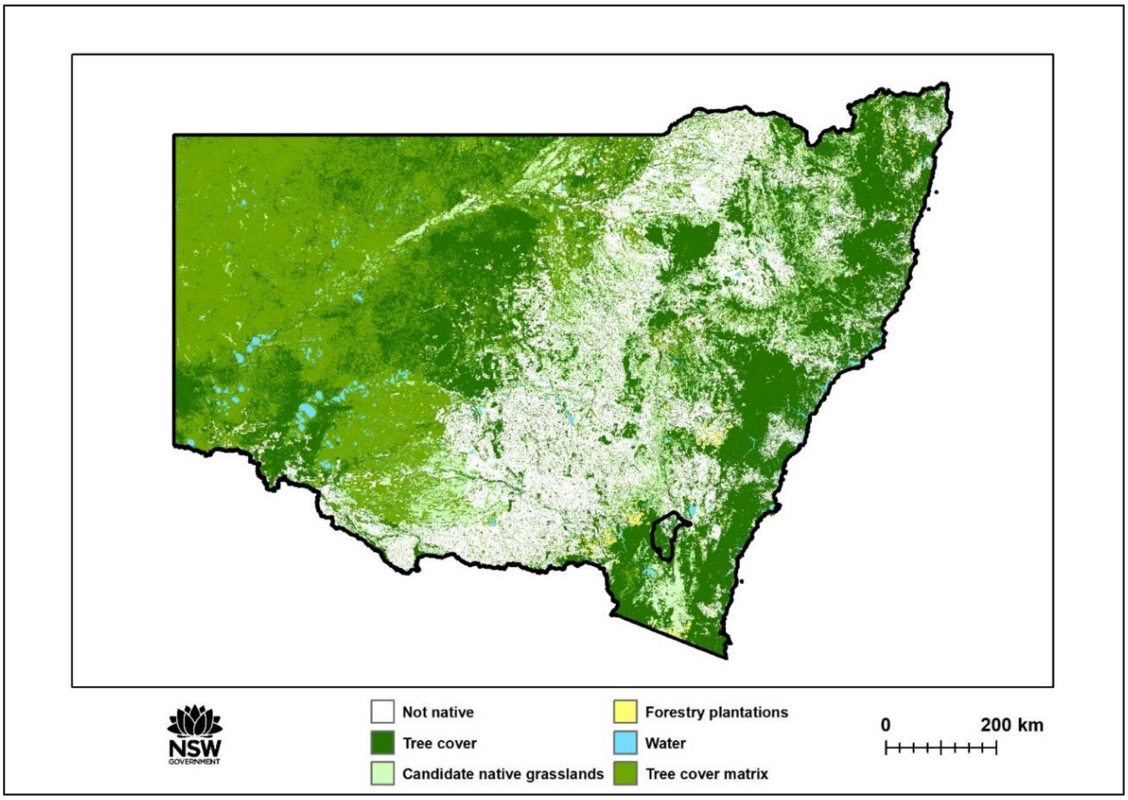


Figure 9 Map illustrating the extent of native vegetation across NSW (5-metre scale)

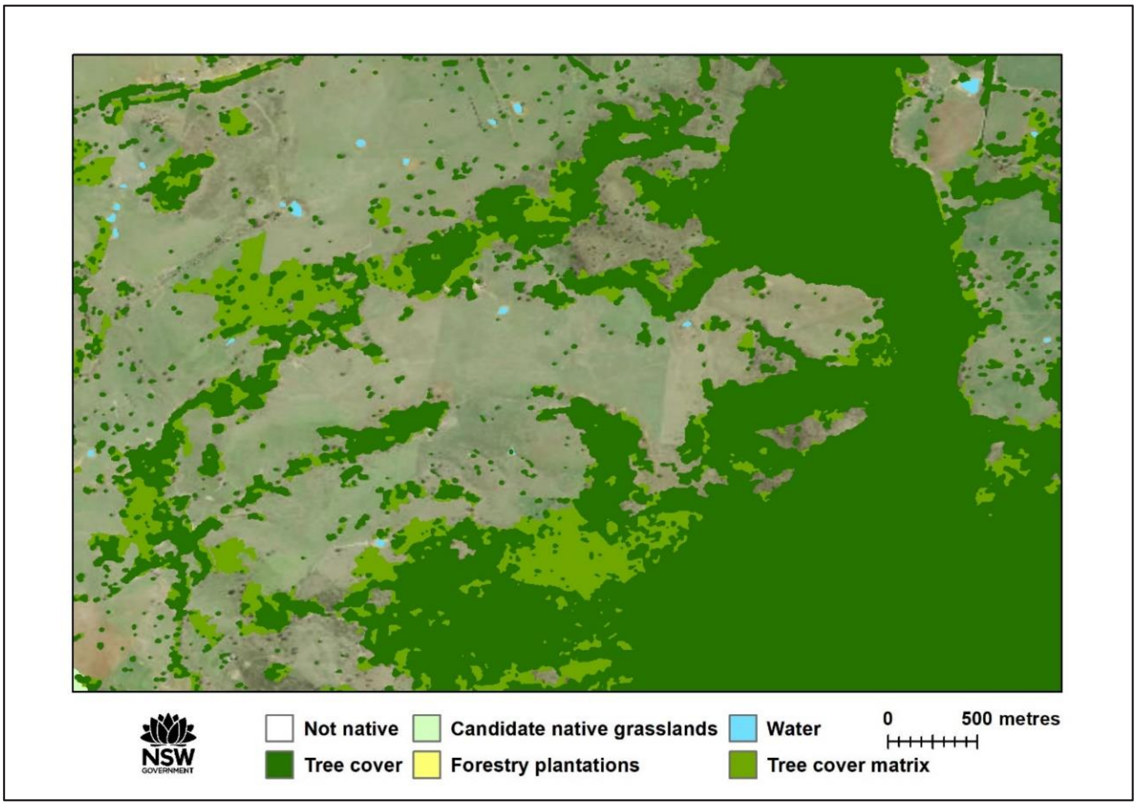


Figure 10 Detailed view of map illustrating the extent of native vegetation across NSW

Native vegetation extent was used to vet koala records (see Appendix) and apply a non-habitat mask to the KHSM (Table 2). While the KHSM predicts habitat suitability across the entire landscape, we recognise that areas mapped as 'not native', 'candidate native grasslands', 'forestry plantations' and 'water' provide none of the resources needed to sustain koala populations. Although they potentially offer value in terms of enabling animal movement and dispersal, they are essentially regarded as non-habitat and have been masked out of the final KHSM. Thus, it is only possible for koalas to occupy areas mapped as 'tree cover' and the associated 'tree cover matrix'. An unmasked (complete) KHSM is also available as a separate product.

Table 2 Categories in the NSW Vegetation Extent 5m Raster v1.2 dataset and their relationship to habitat/non-habitat

Pixel value	Type	Description	Potential koala habitat
0	Not native	Not native vegetation	No
1	Tree cover	Trees >2 metres in height	Yes
2	Candidate native grasslands	Potential native grassland visually assessed from a single data 50-centimetre aerial image	No
3	Forestry plantations	Softwood plantations	No
4	Water	All water bodies	No
5	Tree cover matrix	Non-woody gaps between native woodland trees	Yes

For more information about the development of this layer

NSW Office of Environment and Heritage (2017), The NSW State Vegetation Type Map: Methodology for a regional scale map of NSW plant community types, NSW Office of Environment and Heritage, Sydney, Australia.

5.5 Layer overview: Areas of regional koala significance

Purpose	Scale
To spatially define known koala population hotspots across NSW	State

Areas of regional koala significance (ARKS) use information on koala occurrence to identify key koala populations and management areas with potential for long-term viability. They also identify priority threats to key koala populations at the regional scale.

ARKS have been mapped across NSW using an original grid analysis resolution of 1 kilometre. The mapping has been designed to provide focus areas for the profiling and analysis of landscape values and threats acting on koala populations in NSW. The analysis was undertaken at a statewide scale and no attempt has been made to delineate fine-scale occupancy information.

A total of 48 ARKS were identified. The smallest was South West Rocks at around 400 hectares, and the largest was Bungonia (Illawarra) at 353,000 hectares (made up of five sub-areas). Altogether, 4,195,549 hectares (~42,000 square kilometres), or around 5% of NSW is mapped as being of significance for koalas.

A map of their locations is presented in Figure 11.

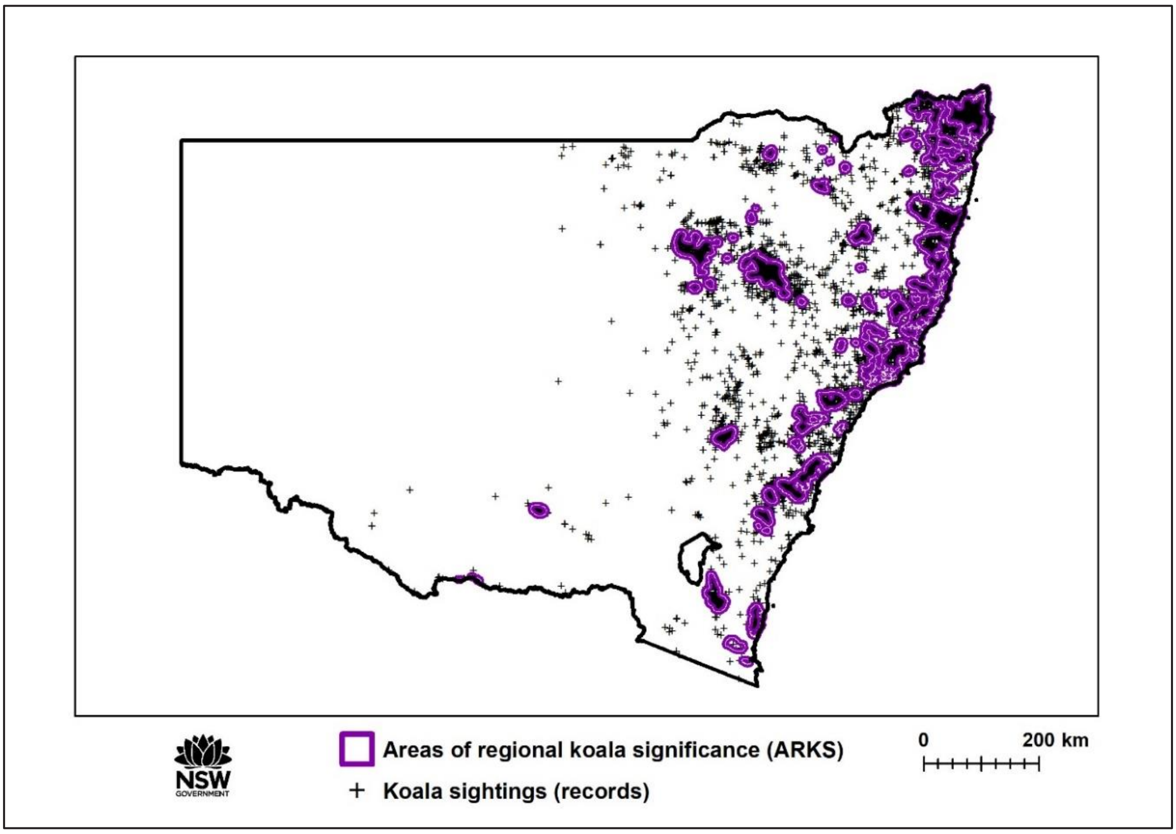


Figure 11 Areas of regional koala significance across NSW

For more information about the development of this layer

Department of Planning, Industry and Environment – Environment, Energy and Science (in 2019, Report: Framework for the spatial prioritisation of koala conservation actions in NSW. NSW Department of Planning, Industry and Environment, Sydney, Australia.

Or on SEED search for 'ARKS' for a link to the data and report.

5.6 Layer overview: Bionet koala sightings (records)

The NSW BioNet species sightings data collection includes flora and fauna records. Koala (*Phascolarctos cinereus*) species sightings in NSW are available on our SEED portal, derived from the NSW BioNet species sightings data records. Records reflect the locations that a koala has been observed and are updated daily. Figure 12 is a map of koala sightings across NSW from NSW BioNet.

A complete set of koala records used in the KHSMs is also available.

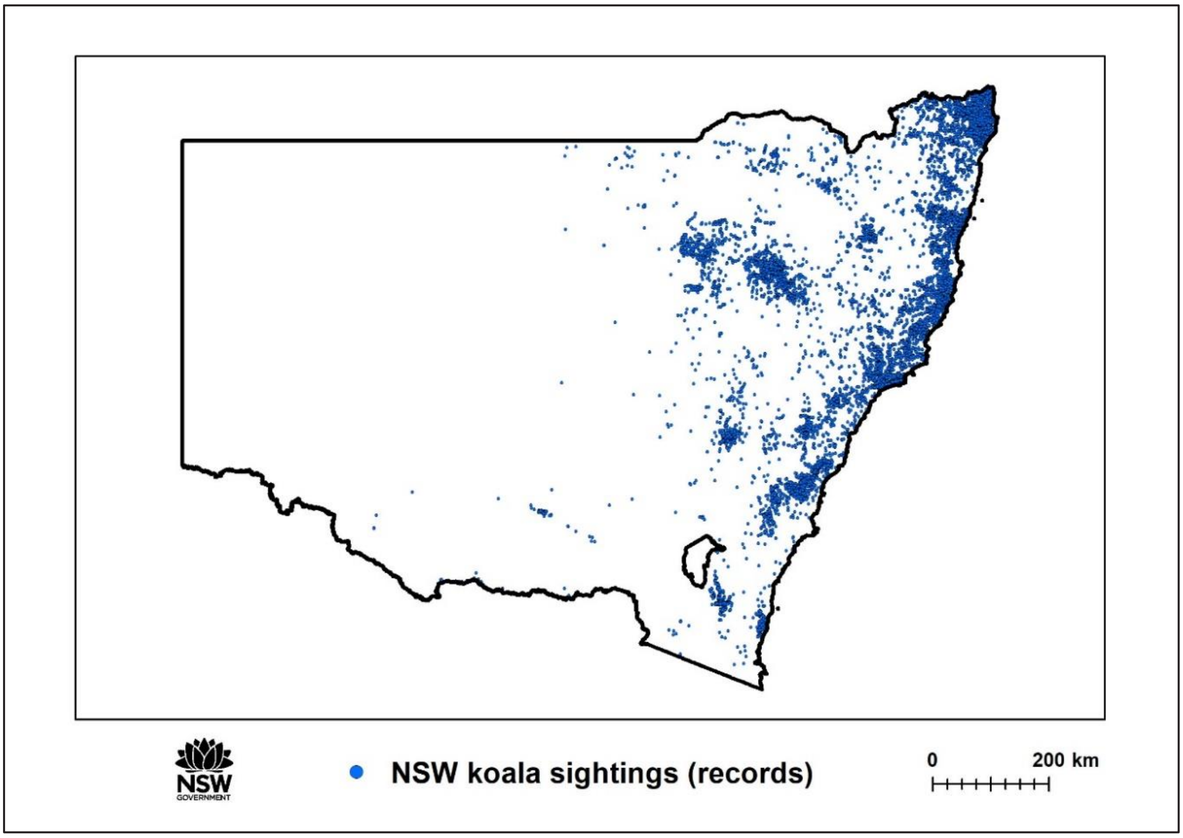


Figure 12 Map of data from NSW BioNet showing koala sightings across NSW

For more information about this layer

View koala sightings, derived from NSW BioNet records, on our data portal

6. Potential uses of the Koala Habitat Information Base

Table 3 summarises the types of questions datasets in the koala habitat information base can help answer and makes recommendations on which particular dataset or section of this document to consult.

Table 3 Questions the Koala Habitat Information Base could help answer

Potential questions	Dataset(s) to consult	Why this dataset?	Things to remember
Where is koala habitat in my region?	The Koala Habitat Suitability Model (KHSM)	This model will provide a relative measure of habitat suitability over any area within its region. Each cell records the suitability score on a scale from 0–1, with 1 being the highest suitability.	Although it provides a measure of suitability at every 30-metre pixel, most of the drivers behind the model have been generated at a coarser scale. The KHSM and KTSI are predictive models, and as such ground-truthing is required to verify the actual occurrence of tree species at any given site. The KHSM does not provide an indication of how likely you are to find a koala. The habitat may be highly suitable but there may be no koalas present. Thus, the KHSM is a measure of current and historic habitat, not occupancy. It also does not provide information on where the habitat is likely to persist under future climate scenarios. In some areas finer-scale koala habitat maps exist that may provide more detailed local information on koala habitat. However, due to the disparate methods applied across finer-scale maps the choice of using the KHSM or a local map should be made on a case-by-case basis.

Potential questions	Dataset(s) to consult	Why this dataset?	Things to remember
Where can I find trees in my region that koalas are likely to use, if present?	The Koala Tree Index (KTI)	This surface provides a probability at any location for how likely you are to find a tree species that koalas are known to prefer for food or shelter.	Although it provides a measure of suitability at every 30-metre pixel, the drivers behind the model (such as soil properties or vegetation information) may be generated at a coarser scale. The Appendix lists tree species you are likely to find in your region.
Am I likely to find a koala in my region?	The Koala Likelihood Map (KLM)	This broad-scale map provides an estimate of how likely you are to encounter a koala (relative to other areas within the same region) for every 10-square-kilometre grid cell across the state	Use the likelihood layer accompanied by the Koala Likelihood Map confidence layer. The confidence layer will indicate where more information (survey) is required to be confident in the likelihood score at each cell.
Where are the hotspots of persistent koala populations?	Areas of regional koala significance (ARKS)	This layer identifies key koala populations and management areas which have the potential for long-term viability. These are derived by assessing the density of known koala observations, as well as information about their habitat and the threats they face.	This surface is derived from koala presence records. That is, it references only the locations where koalas have been seen by observers. This means that there may be other hotspots in NSW that have not been identified. The KHSM can indicate where good koala habitat may be, even if nobody has visited the location.
Which trees are important for koalas in my region?	Appendix	This section provides ranked lists of tree species that are important for koalas for each of the nine model regions.	Lists of tree species are provided for each model region (Tables A.4–A.12).
Where is the best place to restore koala habitat and which tree species should I plant?	KHSM KLM The vegetation extent raster v1.2 Appendix	The KHSM will highlight areas of higher habitat suitability. Since it is clipped to a highly precise tree cover mask (5 metres), suitable habitat that may be disconnected (fragmented) from other suitable habitat is visible. These areas may provide suitable corridors for koala	Rankings for tree species in each region (see Appendix) indicate which tree species are important for koalas in your area. If restoring habitat using a selection of koala-preferred trees, vegetation communities of the local region should be used as a guide. This will ensure restoration of vegetation that suits koalas and the

Potential questions	Dataset(s) to consult	Why this dataset?	Things to remember
		movement. Combining this with the KLM (to identify areas where koalas have been recorded frequently in the past) will narrow down potential sites for restoring koala habitat at a local region scale.	surrounding native landscape. The State Vegetation Type Map provides an indication of vegetation communities in regional areas and may help with local assessments.

7. References

Briscoe NJ, Kearney MR, Taylor CA &and Wintle BA 2016, Unpacking the mechanisms captured by a correlative species distribution model to improve predictions of climate refugia. *Global Change Biology,* 22, 2425–2439.

Fisher A, Danaher T and Gill T 2017, Mapping trees in high resolution imagery across large areas using locally variable thresholds guided by medium resolution tree maps. *International Journal of Applied Earth Observation and Geoinformation,* 58, 86–96.

Fisher A, Day M, Gill T, Roff A, Danaher T and Flood N 2016, Large-area, high-resolution tree cover mapping with multi-temporal SPOT5 imagery, New South Wales, Australia. *Remote Sensing,* 8, 515.

Kramer‐Schadt S, Niedballa J, Pilgrim JD, Schröder B, Lindenborn J, Reinfelder V, Stillfried M, Heckmann I, Scharf AK and Augeri DM 2013, The importance of correcting for sampling bias in MaxEnt species distribution models. *Diversity and Distributions,* 19, 1366–1379.

Law B, Caccamo G, Roe P, Truskinger A, Brassil T, Gonsalves L, Mcconville A and Stanton M 2017, Development and field validation of a regional, management-scale habitat model: A koala *Phascolarctos cinereus* case study. *Ecology and Evolution*.

Lawley EF, Lewis MM and Ostendorf B 2011, Environmental zonation across the Australian arid region based on long-term vegetation dynamics. *Journal of Arid Environments,* 75, 576–585.

Lunney D, Crowther MS, Shannon I and Bryant JV 2009, Combining a map-based public survey with an estimation of site occupancy to determine the recent and changing distribution of the koala in New South Wales. *Wildlife Research,* 36, 262–273.

Morrone J 2009, *Evolutionary Biogeography: An Integrative Approach with Case Studies*, New York, Columbia University Press.

OEH 2017, The NSW State Vegetation Type Map: Methodology for a regional scale map of NSW plant community types. NSW Office of Environment and Heritage, Sydney, NSW.

OEH 2018. A review of koala tree use across New South Wales. NSW Office of Environment and Heritage, Sydney, NSW.

Predavec M, Lunney D, Shannon I, Scotts D, Turbill J and Faulkner B 2015, Mapping the likelihood of koalas across New South Wales for use in private native forestry: developing a simple, species distribution model that deals with opportunistic data. *Australian Mammalogy,* 37, 182–193.

Renner I W, Elith J, Baddeley A, Fithian W, Hastie T, Phillips SJ, Popovic G and Warton DI 2015, Point process models for presence-only analysis. *Methods in Ecology and Evolution,* 6, 366–379.

8. Appendix

This appendix outlines the development process and results for the Koala Habitat Suitability Model v1.0 (KHSM) and the Koala Tree Index v1.0 (KTI) as delivered in the Koala Habitat Information Base. This technical information is useful if you seek to understand how these datasets were created, the data that contributed to them and the ecological decisions made. Peer-reviewed papers that will provide more context on the to the ecological decisions made for the KHSM and KTI are in preparation.

The first tables in this appendix summarise the methods used for the KHSM and KTI. Subsequent tables and figures capture the availability of the koala records at the time of modelling followed by validation metrics such as area under the curve (AUC) scores. Detailed information about the predictors used in the KHSM and KTI models, as well as ranked lists of tree species for each koala modelling region, are also provided.

8.1 Koala Habitat Suitability Model v1.0 Technical Information

Table A.1 Koala Habitat Suitability Model

<table>
<tr><th>Title</th><th>Category</th><th>Description</th></tr>
<tr><td>Data</td><td>Koala records</td><td>
First, we grouped the 40,005 existing koala records into one of three time-periods (1999–2019, 1989–1998, 1979–1988) and three spatial accuracy classes (≤100 metres (m), >100 and ≤1000 m, >1000 m) shown here:
<table>
<tr><th></th><th colspan="4">Spatial accuracy</th></tr>
<tr><th>Time period</th><th><100 m</th><th>>100 and ≤1000 m</th><th>>1000 m</th><th>Total</th></tr>
<tr><td>1979–1988</td><td>9</td><td>2143</td><td>1899</td><td>4051</td></tr>
<tr><td>1989–1998</td><td>725</td><td>5378</td><td>138</td><td>6241</td></tr>
<tr><td>1999–2019</td><td>14,649</td><td>8781</td><td>6283</td><td>29,713</td></tr>
<tr><td>Total</td><td>15,383</td><td>16,302</td><td>8320</td><td>40,005</td></tr>
</table>
Approximately 74.3% of records were collected in the past 20 years, 15.6% between 1989 and 1998, and 10.1% between 1979 and 1988. Only 38.5% of records are assumed to have a spatial accuracy of less than 100 metres, 40.7% an accuracy between 100 m and 1 kilometre (km), and 20.7% of records greater than 1 km.
Most recent koala surveys have 100% of records with a <100 m spatial accuracy, while the three main Office of Environment and Heritage community surveys have 100% of records >1000m. These records are generally assumed to lie within 0-2 km of actual koala sightings. Other datasets such as wildlife rehabilitation database have highly variable spatial accuracies.
As part of our initial assessments, we ran three alternative sets of models in MaxEnt. The first set used all spatially accurate (≤100 m) records for the period 1999—2019. This set of records has the highest spatial bias, but also the highest confidence that koala records fall into areas of high-quality habitat. The second set includes records for the period 1999–2019. Records were drawn from all three spatial accuracy classes helped to reduce regional bias. This is important because often the only record available in an area had >1000 m spatial accuracy, and we did not wish to remove any significant
</td></tr>
</table>

<table>
<tr><th>Title</th><th>Category</th><th>Description</th></tr>
<tr><td></td><td></td><td>
sightings. However, by including these records, it is possible that many more records fall into lower quality habitat than the previous model. The third set of records covered all spatial accuracy classes and all time periods. We chose this because it captures the broadest and least biased set of records. However, by using records that are up to 40 years old, we increase the risk of including records from areas where koalas have become locally extinct. Having these three alternate sets of koala records allowed us to better understand how record accuracy and bias influence spatial predictions.
We used the full set of 40,004 records to develop our final MaxEnt models, but passed these through both a spatial vetting and thinning process as described in the categories in this table. For the whole-of-range model, we used 94,772 records from across NSW, Queensland and Victoria. Records from Queensland and Victoria were downloaded from NSW BioNet Atlas of Living Australia.
</td></tr>
<tr><td></td><td>Spatial vetting</td><td>
In addition to the selective inclusion/exclusion of records based on age and spatial accuracy, we also vetted koala records on a habitat basis. To do this we used two state-wide vegetation maps. These were the 5m Native Vegetation Extent (NVE) raster and a 5 m structural vegetation map based on vegetation photo patterns (VPP).
The Native Vegetation Extent layer was used to move koala records that did not fall into the Native Tree Cover class a distance of up to 350 m to the edge of the nearest tree crown or patch of wooded vegetation. We did this because we wanted to apply a non-habitat mask to the KHSMs. By moving records to areas that have a woody cover, we were able to include remote sensing predictors in the KHSM that distinguish cleared from non-cleared areas within the model itself.
This table shows the number of koala records in each class and the percentage of records with high-to-moderate (<10 0m) and low (>100 m) spatial accuracies.
<table>
<tr><th></th><th></th><th></th><th colspan="3">Spatial accuracy</th></tr>
<tr><th>Vegetation class</th><th>Total</th><th>% of total</th><th><100 m</th><th>>100 m</th><th>Difference</th></tr>
<tr><td>Tree cover</td><td>25,903</td><td>64.7</td><td>40.8%</td><td>59.2%</td><td>18.4%</td></tr>
<tr><td>Tree cover matrix</td><td>1244</td><td>3.1</td><td>38%</td><td>62%</td><td>24%</td></tr>
<tr><td>Not native</td><td>11,689</td><td>29.2</td><td>34.8%</td><td>65.2%</td><td>30.4%</td></tr>
<tr><td>Candidate native grasslands</td><td>563</td><td>1.4</td><td>22.4%</td><td>77.6%</td><td>55.2%</td></tr>
<tr><td>Water</td><td>345</td><td>0.9</td><td>25.8%</td><td>74.2%</td><td>48.4%</td></tr>
<tr><td>Forestry plantations</td><td>261</td><td>0.7</td><td>25.3%</td><td>74.7%</td><td>49.4%</td></tr>
<tr><td>Total</td><td>40,005</td><td>100%</td><td>–</td><td>–</td><td>–</td></tr>
</table>
About 68% of all records occur inside areas mapped as the native tree cover or native tree matrix, while the remaining 12,858 records fall into non-habitat classes. Records with moderate-to-high spatial accuracies are more likely to fall inside the tree cover and tree cover matrix (38–40.8%) classes compared to non-habitat classes (22.4–34.8%), while the opposite its true for low spatial accuracy records (59.2–62% vs 65.2–77.6%). On this basis, we felt it appropriate to move all 14,102 records in the non-habitat and tree cover matrix to the nearest tree cover polygon to ensure that all records used in the
</td></tr>
</table>

Title	Category	Description
		models sit underneath a scattered tree or a clump of trees inside a patch of woodland or forest. In terms of the 14,102 records, 55.7% fell within 25 m of a scattered tree or patch of woody vegetation. An additional 21.2% were within 50 m, 9.4% within 75 m and 5% with 100m. Of the 8.7% of records that were more than 100 m to the nearest Tree Cover polygon, 98.4% were within 250 m, 98.8% within 300 m, and 99% within 350 m. All 134 records that had to be moved > 350 m to the nearest Tree Cover polygon were excluded from the models. This table lists high-order VPP groups associated with potential koala habitat versus those we considered to be highly marginal or non-habitat.

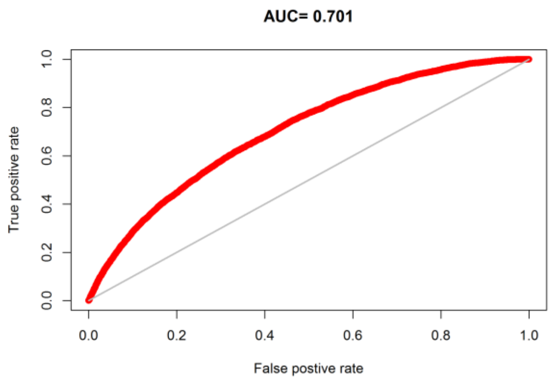
VPP group	Potential koala habitat	Number of koala records	Percentage of records
Non-native	yes	16,220	40.5
Dry sclerophyll forests and woodlands	yes	12,568	31.4
Wet sclerophyll forests	yes	3728	9.3
Floodplain forests	yes	2259	5.6
Native grasslands and grassy open woodlands	yes	1167	2.9%
Riparian forests	yes	1105	2.8%
Cypress pine woodlands	yes	10	0.0%
Rainforests	no	1947	4.9%
Heathlands, shrublands, mangroves and foredunes	no	709	1.8%
Non-woody wetlands and saltmarsh	no	248	0.6%
Belah and casuarina woodlands	no	23	0.1%
Acacia, mulga, brigalow and myall woodlands	no	12	0.0%
Unmapped	no	4	0.0%
Mallee	no	3	0.0%
Lignum, chenopods and low Shrublands	no	1	0.0%
Rocky outcrops	no	1	0.0%
Total		40,005	

Title	Category	Description
		% of records in potential habitat — **92.6%** **% of records in marginal or non-habitat** — **7.4%** Note that none of records in non-native VPP classes were excluded – as these are dealt with at finer scale using the Native Vegetation Extent layer. In contrast to the NVE layer the VPP the non-native class lumps sections of paddocks to non-native by segmentation, so isolated crowns get absorbed into these non-native segments. In total, 7.4% of records fell into poor quality habitat. We did not want to exclude these records, as many occur in the transition zone between different habitat types such as the margins of non-woody wetlands etc. We chose instead to include all records in the KHSM, but instead down-weight the values of the Koala Tree Index in areas mapped as marginal or inhospitable. We did this by dropping the KTI to the lowest probability of occurrence value in an effort to avoid over-predicting habitat suitability in obvious marginal habitats. This forced down weighting was necessary because the probability of occurrence values associated with the KTI tended to carry some level of bleed across distinct vegetation types. An alternative modelling approach (not run) to minimise over-prediction issues, would have been to remove koala records according to their distance to the nearest suitable VPP class. Allowing for the fact that transitions between vegetation types can be gradual, any record more than 100m to the nearest suitable VPP patch could have been removed from the models, and anything less than 100 m retained. Had this rule been applied, then we would have chosen not to down weight the KTI, as was done for this version of the KHSM. No spatial vetting or movement was applied to QLD or VIC records for the whole-of-range model.
	Dealing with bias	The simplest and most widely applied method of generating background points in MaxEnt is to take a random selection of the entire study area. However, datasets derived from opportunistic records (as opposed to planned surveys) often exhibit a strong geographic bias, with some areas being visited more often than others due to their accessibility or intrinsic interest. This unequal survey coverage of a species distribution is referred as sampling bias, sample selection bias or survey bias. Bias observations can (to some degree), lead to an over-representation of environmental conditions that reflect higher sampling effort. Thus, it is possible for a model to fit the environmental signal of the bias rather than that of the ecological niche, hindering model interpretation and application. This effect will depend on size of the study area, the spatial resolution of the predictors, and the number and spread of records – with bias becoming less of an issue as number of observations increase. Of greatest concern are artificial spatial clusters of observations, which violate the assumption of spatial independence. Various methods have been proposed to account for bias in HSMs. The spatial clustering of survey records is most commonly dealt with by randomly subsampling, extracting a single record from each cell across a larger grid (i.e. 500 m – 2 km) in order to reduce spatial aggregation. Below we describe the method used to spatial thin records. We created six datasets of increasing fewer, and more evenly spread sets of koala records, and ran a MaxEnt model on each using the same predictors.

Title	Category	Description
Model	Spatial thinning records	We randomly subsampled single occurrences from different sized grid cells (i.e. 220 m to 3.6 km) to give us a number of records we wanted to retain in six datasets. The different sized grid cells included 0.002, 0.004, 0.008, 0.016, 0.032 and 0.064 degrees. Next, we thinned a full set of records down to the same number of records we wanted to retain using a nearest-neighbour distance calculation. The process worked by identifying the shortest distance between two records then eliminating one of these records at random. The nearest-neighbour distances were then recalculated, and the process run x times to leave a given number of records. We compared the models thinned to different degrees, we found almost universally that thinning records at the 0.016 degree grid cell (~960 m x 960 m) level gave the least spatially biased predictions, while still maintaining a high performance in terms of area under the curve (AUC) results and the shape of the response curves.
	Decision on which predictors to include	For the regional models, we chose an initial subset of 85 state-wide 30 x 30 m predictors that are potentially relevant to koalas. These predictors were chosen with the notion that it was better to be inclusive, and to reduce the set further as part of the modelling process itself. To arrive at a final set of predictors, we ran multiple models, where we considered the proximal influence of the top-ranked predictors, where those most ecologically sensible were retained, and other closely related predictors removed. We ran this process across each of the six modelling regions before deciding on a single set of predictors that performed well in every region. The five final predictors selected for each region are listed in Tables 4, A.1–A.3 and described in Table A.5. Thus, while each region had its own unique KTI, all other predictors remained the same. For the whole-of-range KHSM, we chose to use a set of 9 second (~250 x 250 m) predictors. For our first model we chose two predictors, annual rainfall and average daily maximum temperature for the warmest month (January). These are the same two predictors used by Adams Hosking et. Al (2011) to develop a whole-of-range habitat suitability model for Koalas, the major difference being that they used 10 x 10 km grid cells, where as our models used 250 x 250 m. Our study identified the same key thresholds that appear to limit the most westerly distribution of Koalas, this being an upper mean maximum daily temperature of 36^{o}C, and a minimum 400 mm rainfall threshold. We later chose to expand this model to include a broader range of soil and climate variables including annual temperature range, minimum temperature of the coldest period, annual actual evapotranspiration, minimum monthly water deficit, minimum monthly precipitation, soil bulk density and soil pH. The whole-of-range model was clipped to the six central and western KMRs to show how habitat suitability changes from high to low across the full range of inland environments. The model does not include a KTI and should not be compared to the individual regional models.
Model Results	MaxEnt	MaxEnt can be thought of as a means of fitting a Poisson Point Process Model (PPPM), but some departures from the default software settings are required. Renner et al. (2015) provides some guidelines on what settings best mimic PPPM results. Following their recommendations, we used between 70,000 and 100,000 background points (depending on the size of the region), which are 7–10 times more than the recommended default settings. All maxent models were run using the package Dismo in R using our own customised scripts. MaxEnt has two key settings that can be changed by the user, both of which can have a profound effect on the model. The first of these relates to the feature class options which determine the flexibility of the modelled response,

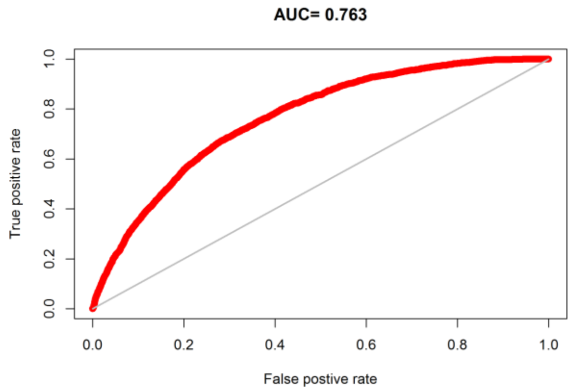
Title	Category	Description
		while the second is a regularisation multiplier, which is designed to prevent over-fitting of the models. The default setting for MaxEnt is to allow all feature types in a model (provided sample size is adequate), but we believe there's a strong case for developing simpler models that are easier to interpret ecologically, especially when it comes to wide-ranging animal species like koalas. We also have a preference for starting with simple models and adding complexity at a later stage if necessary. Simple models lower the risk of overfitting, but can also struggle when complex (such as multi-nodal) relationships exist. We chose to exclude threshold features from our MaxEnt models, which is considered best-practice where there is no ecologically valid reason for including them (Jane Elith, personal communication). Such reasons could be valid for plants that may be extremely sensitive to certain environmental conditions. We compared the results of running models with hinge and product (interaction) features with those that included linear, quadratic and product features. We found the results to be similar when we factored in the choice of a beta-multiplier. Left to its own devices, the numerical solver used by MaxEnt will attempt to fit training data exactly. To avoid overfitting a model, MaxEnt uses a 'regularization' parameter called the betamultiplier, which allows it to fit the data approximately. The larger the value of beta, the smoother the model MaxEnt produces. Regularisation can be thought of as a way of shrinking the coefficients (the betas) – that is penalising them in order to strike a balance between fit and complexity (prediction accuracy and generality). In choosing to develop ecologically simple models that characterise the niche of a wide-ranging and mobile species, we choose to use models with response curves fitted using linear, quadratic and product features, but we reduced the beta-multiplier from the default value (1) down to a range between 0.2 and 0.5, which gives MaxEnt just that little more flexibility when it comes to fitting complex relationships. You will notice that the response curves for all models are relatively simple, however the predictors themselves interact with one another in a complex way, and it's these interactions that drive variations in habitat suitability at both local and regional scales.
	Koala Habitat Suitability Model	MaxEnt produces a cloglog output raster which provides a relative measure of suitability for each grid cell between 0 and 1, with the average observation lying close to 0.5. Model performance is typically evaluated by a threshold-independent area under the receiver operating characteristic (ROC) curve. Results for each region and the importance of each predictor can be evaluated in the tables and figures of this Appendix.

North Coast



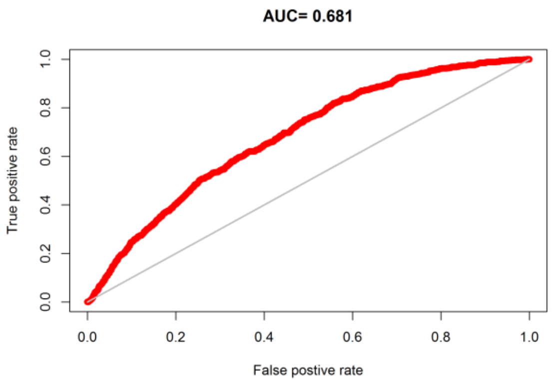
Average test AUC for 10-cross validation runs is 0.669, SD = 0.013

Central Coast



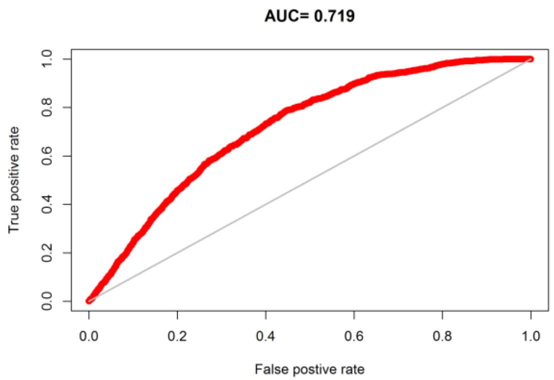
Average test AUC for 10-cross validation runs is 0.730, SD = 0.014

South Coast



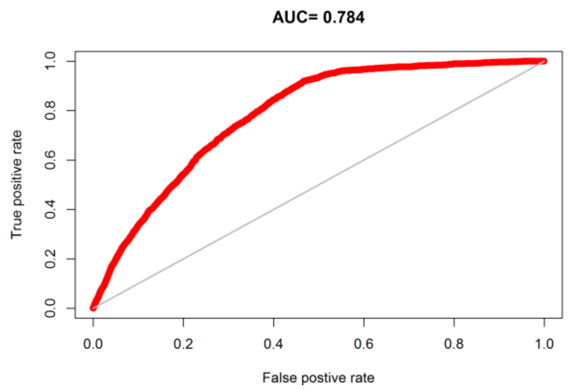
Average test AUC for 10-cross validation runs is 0.649, SD = 0.026

Northern Tablelands



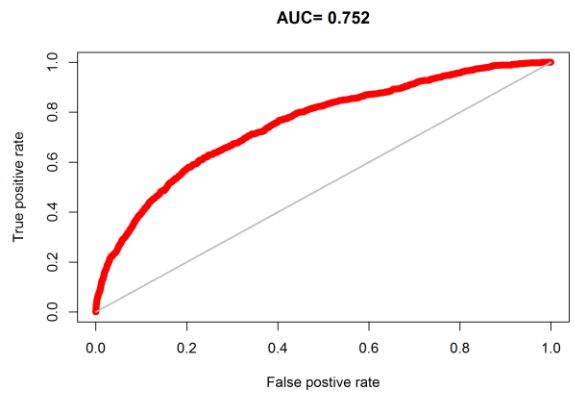
Average test AUC for 10-cross validation runs is 0.710, SD = 0.013

North West Slopes



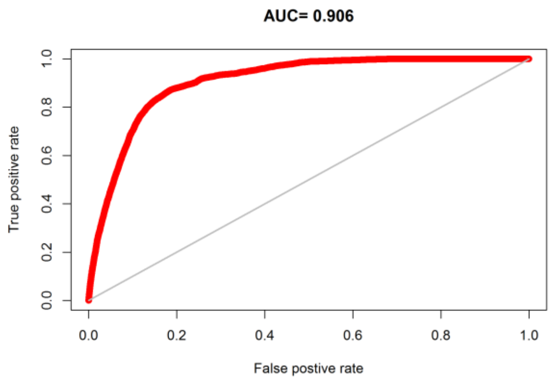
Average test AUC for 10-cross validation runs is 0.777, SD = 0.013

Central and Southern Tablelands



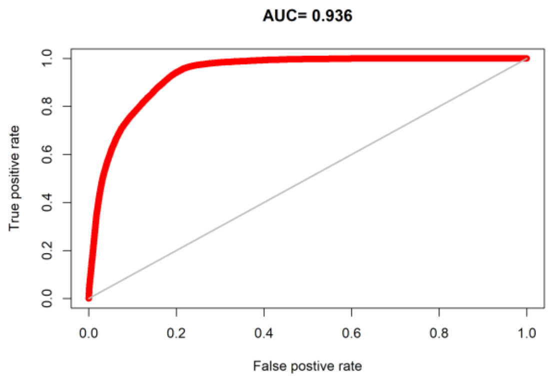
Average test AUC for 10-cross validation runs is 0.747, SD = 0.021

Simple whole-of-range



Average test AUC for 10-cross validation runs is 0.873, SD = 0.004

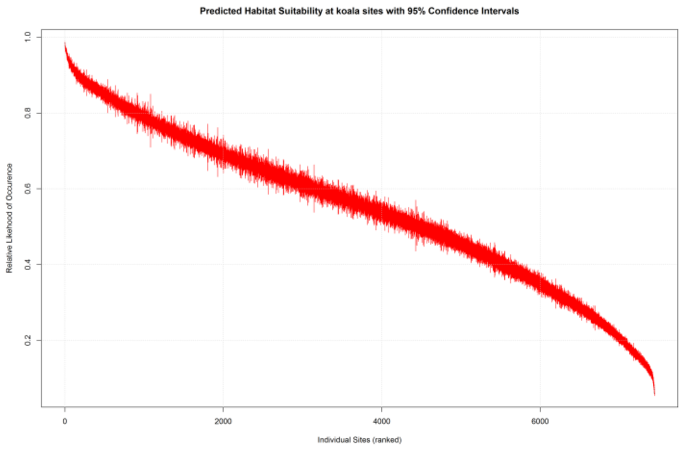
Complex whole-of-range



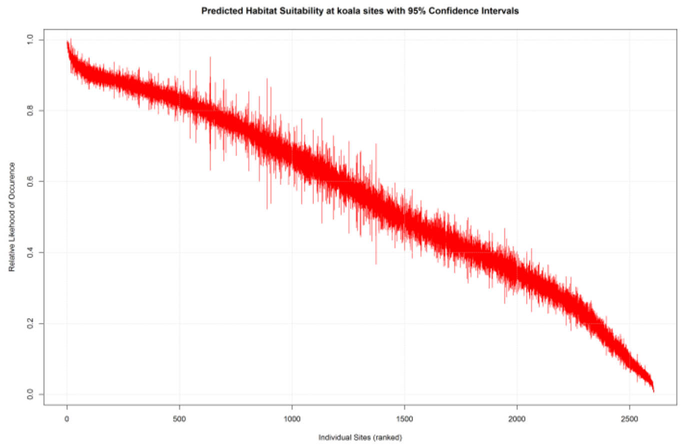
Average test AUC for 10-cross validation runs is 0.877, SD=0.005

Figure A.1 Receiver operating characteristic curves (red) for six regional MaxEnt models, including area under the curve (AUC) values for final model and hold-out test set (using 10-fold cross-validation). SD = standard deviation

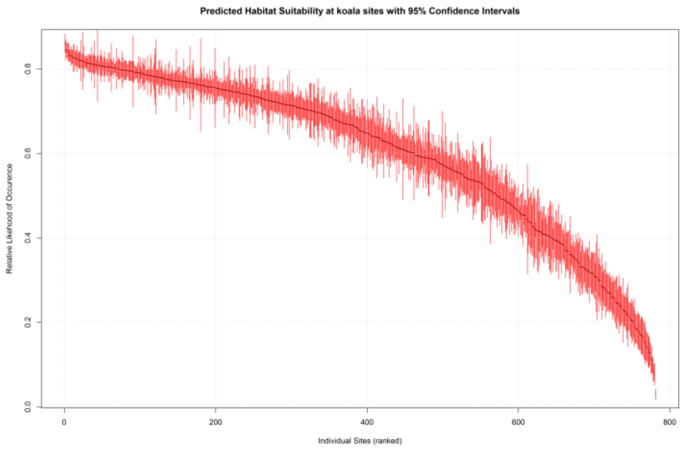
North Coast



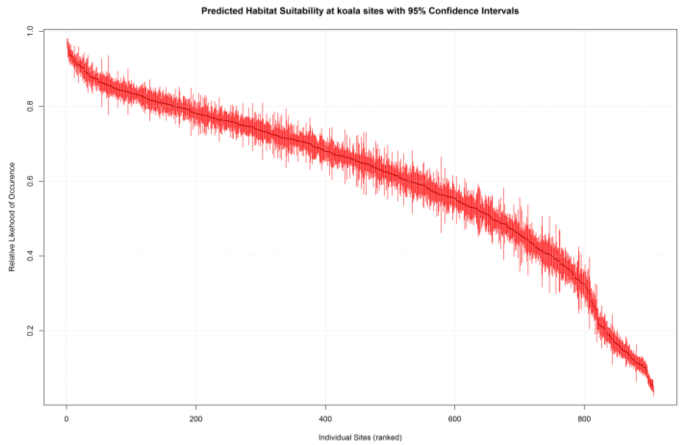
Central Coast



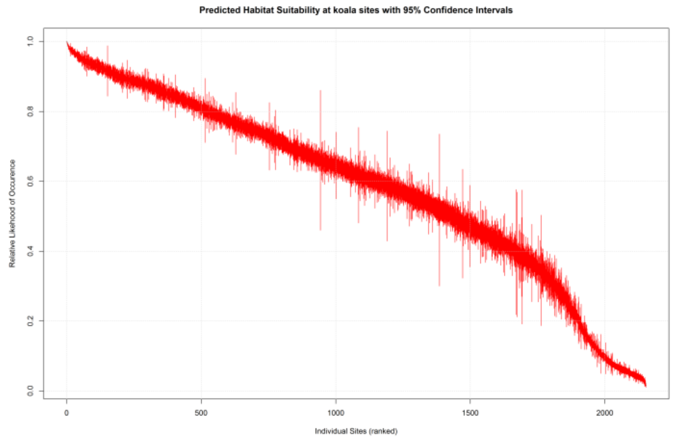
South Coast



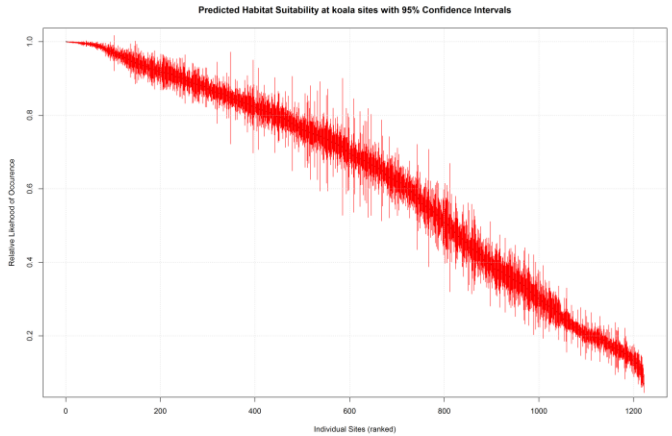
Northern Tablelands



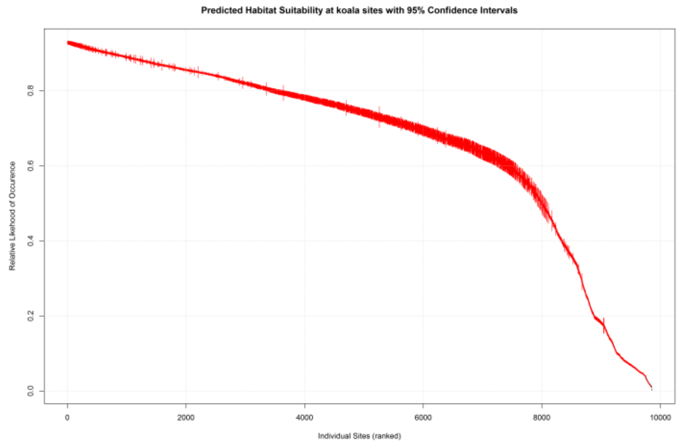
North West Slopes



Central and Southern Tablelands



Simple whole-of-range



Complex whole-of-range

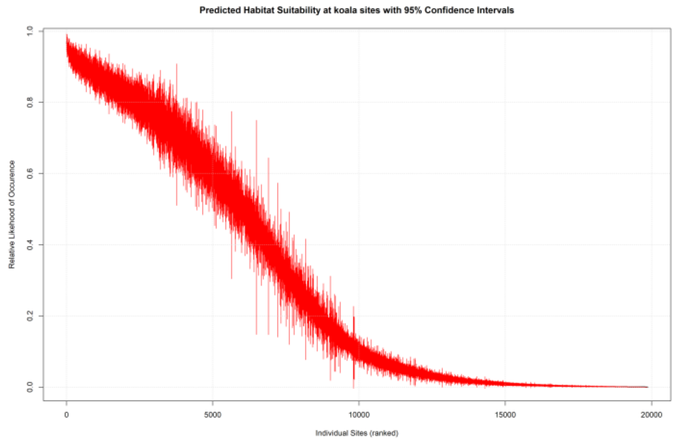


Figure A.2 Habitat suitability scores for koala records used in the Koala Habitat Suitability Model for each region. Scores are ranked from highest to lowest, with upper and lower 95% confidence limits based on 10-fold cross-validation.

Table A.2 Various thresholds calculated for each region with the Koala Habitat Suitability Model

Region	kappa	equal_sens_spec	spec_sens	prevalence	no_omission
North Coast	0.7838	0.5970	0.6107	0.0722	0.1103
Central Coast	0.8416	0.5377	0.5480	0.0366	0.0310
South Coast	0.7866	0.6406	0.5217	0.0041	0.0585
Northern Tablelands	0.7825	0.5911	0.5145	0.0118	0.0892
North West Slopes	0.8230	0.5269	0.3261	0.0208	0.0322
Central and Southern Tablelands	0.9260	0.4593	0.5537	0.0087	0.0714
Simple whole-of-range	0.6554	0.4195	0.3447	0.0898	0.0038
Complex whole-of-range	0.7206	0.5416	0.3919	0.1655	0.0073
Average	**0.8239**	**0.5588**	**0.5124**	**0.0257**	**0.0654**

Notes: kappa = the threshold at which kappa is highest ('max kappa'). The Kappa statistic is a metric that compares an observed accuracy with an expected accuracy (random chance); **equal_sens_spec =** equal sensitivity and specificity; **spec_sens =** the threshold at which the sum of the sensitivity (true positive rate) and specificity (true negative rate) is highest; **prevalence =** modelled prevalence is closest to observed prevalence; **no_omission =** the highest threshold at which there is no omission.

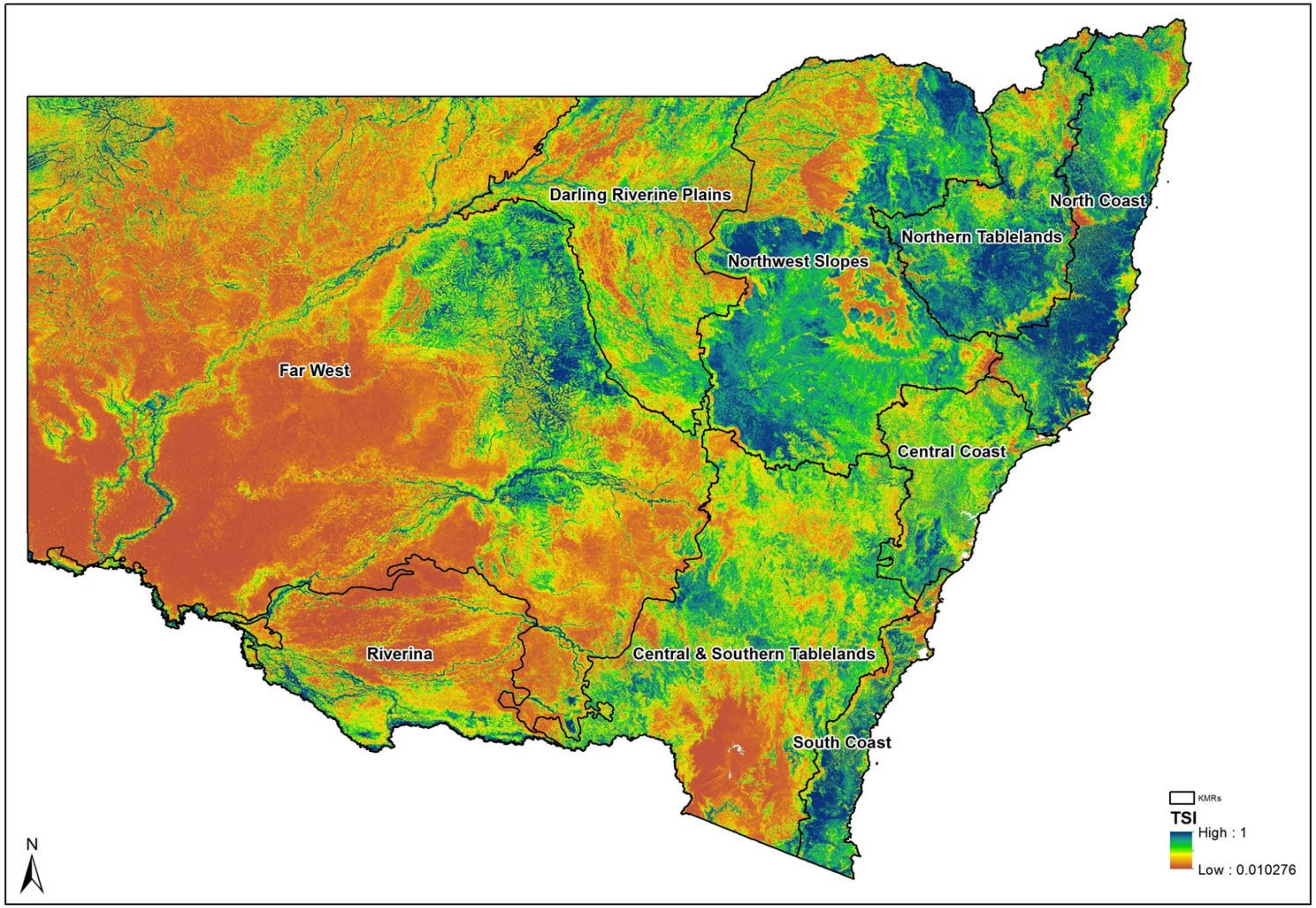
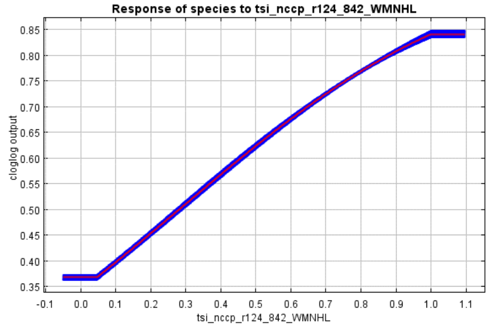


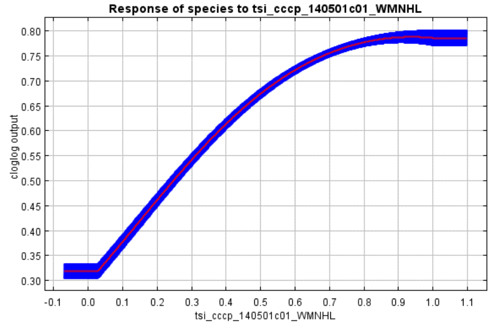
Figure A.3a Map showing the tree species index environmental predictor used in the Koala Habitat Suitability Model

North Coast



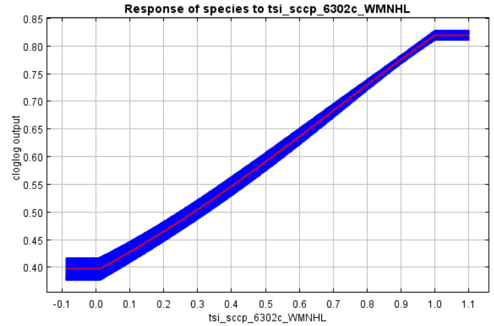
Percent Contribution=48.3%, Permutation Importance = 44.8%

Central Coast



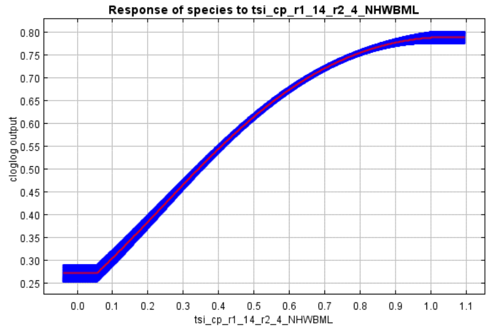
Percent Contribution=30.5%, Permutation Importance = 35.3%

South Coast



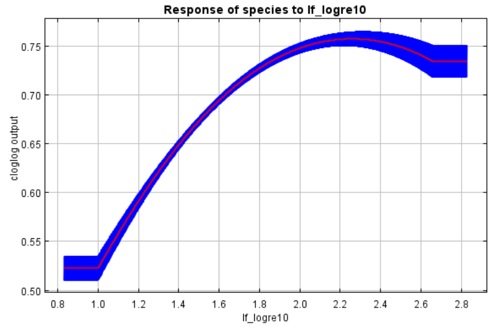
Percent Contribution=58.3%, Permutation Importance = 49.0%

Northern Tablelands



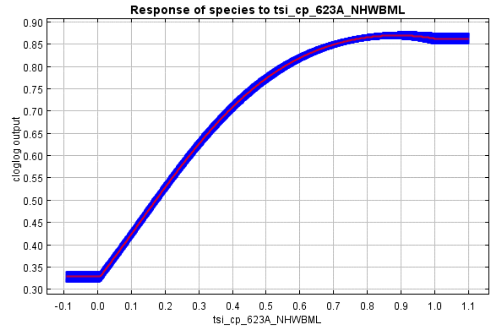
Percent Contribution=45.3%, Permutation Importance = 51.3%

North West Slopes



Percent Contribution=69.0%, Permutation Importance = 66.1%

Central and Southern Tablelands



Percent Contribution=66.7%, Permutation Importance = 46.8%

Figure A.3b Response curves for tree species index by region

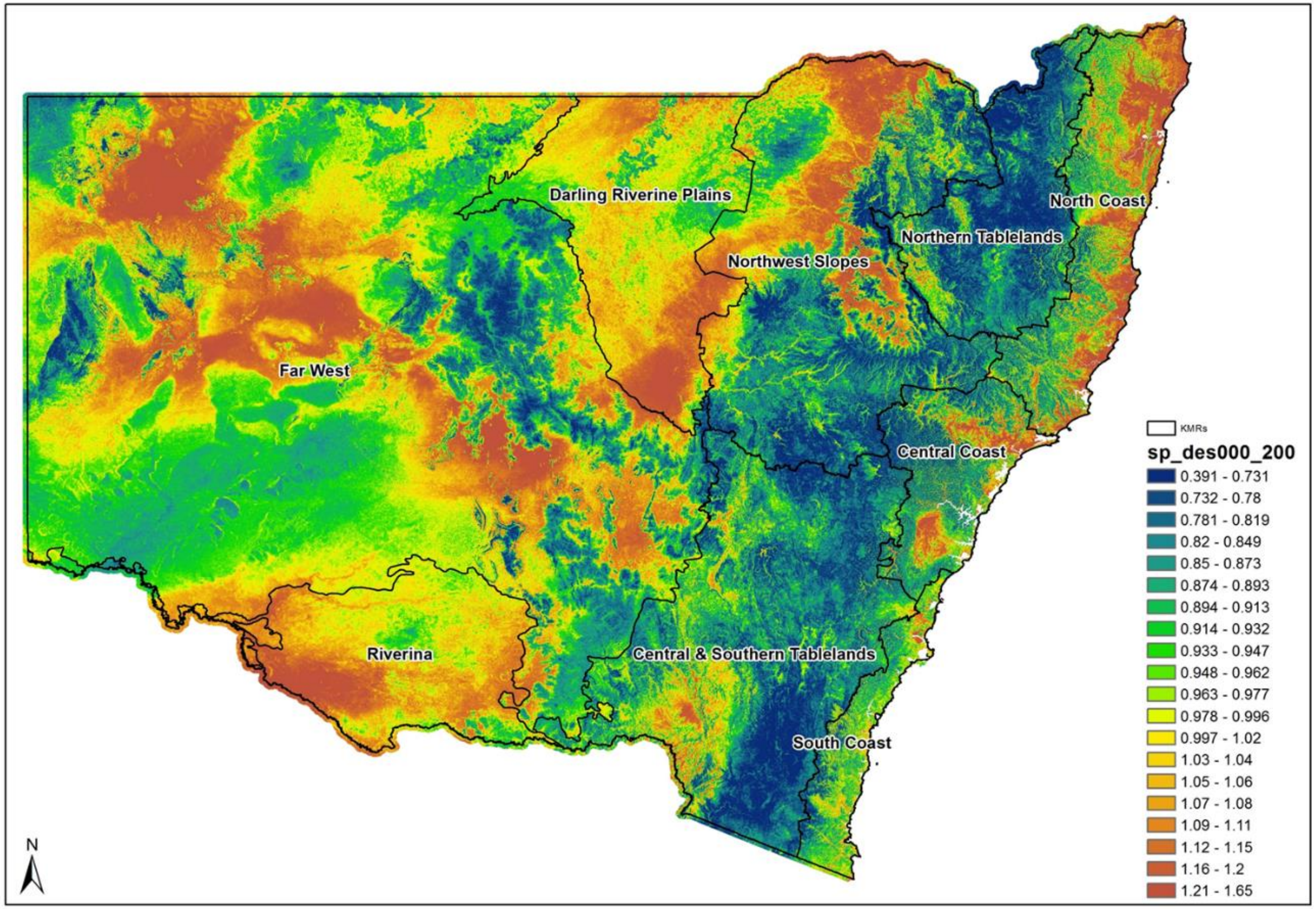


Figure A.4a Map showing the depth-to-bedrock environmental predictor used in the Koala Habitat Suitability Model

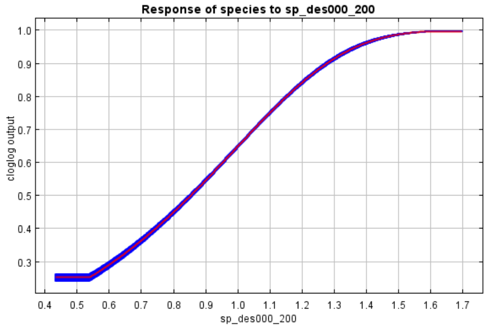
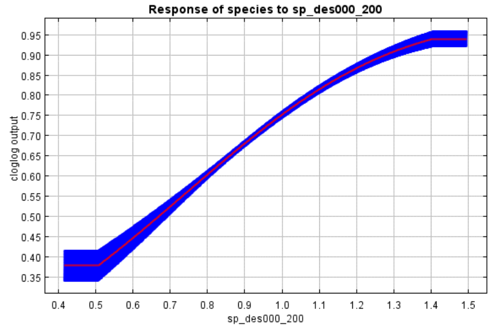
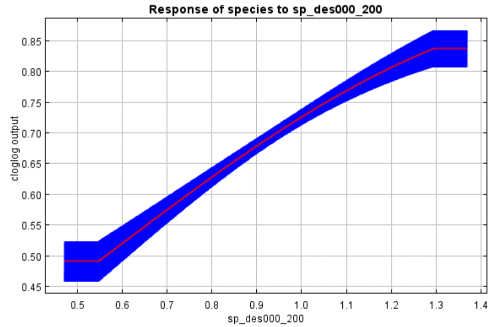
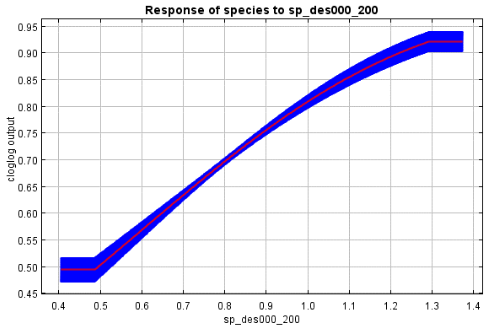
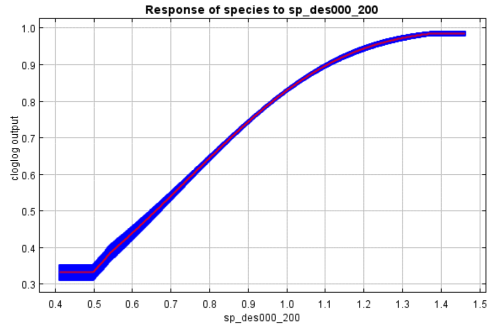
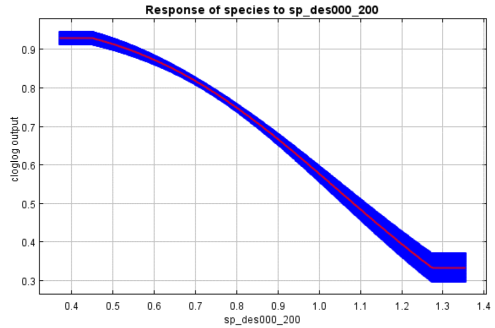
North Coast	Central Coast	South Coast
		
Percent Contribution=19.1%, Permutation Importance = 32.4%	Percent Contribution=15.2%, Permutation Importance = 15.4%	Percent Contribution=5.2%, Permutation Importance = 3.9%
Northern Tablelands	**North West Slopes**	**Central and Southern Tablelands**
		
Percent Contribution=7.2%, Permutation Importance = 5.5%	Percent Contribution=17.9%, Permutation Importance = 10.2%	Percent Contribution=5.1%, Permutation Importance = 10.5%

Figure A.4b Response curves for depth-to-bedrock by region

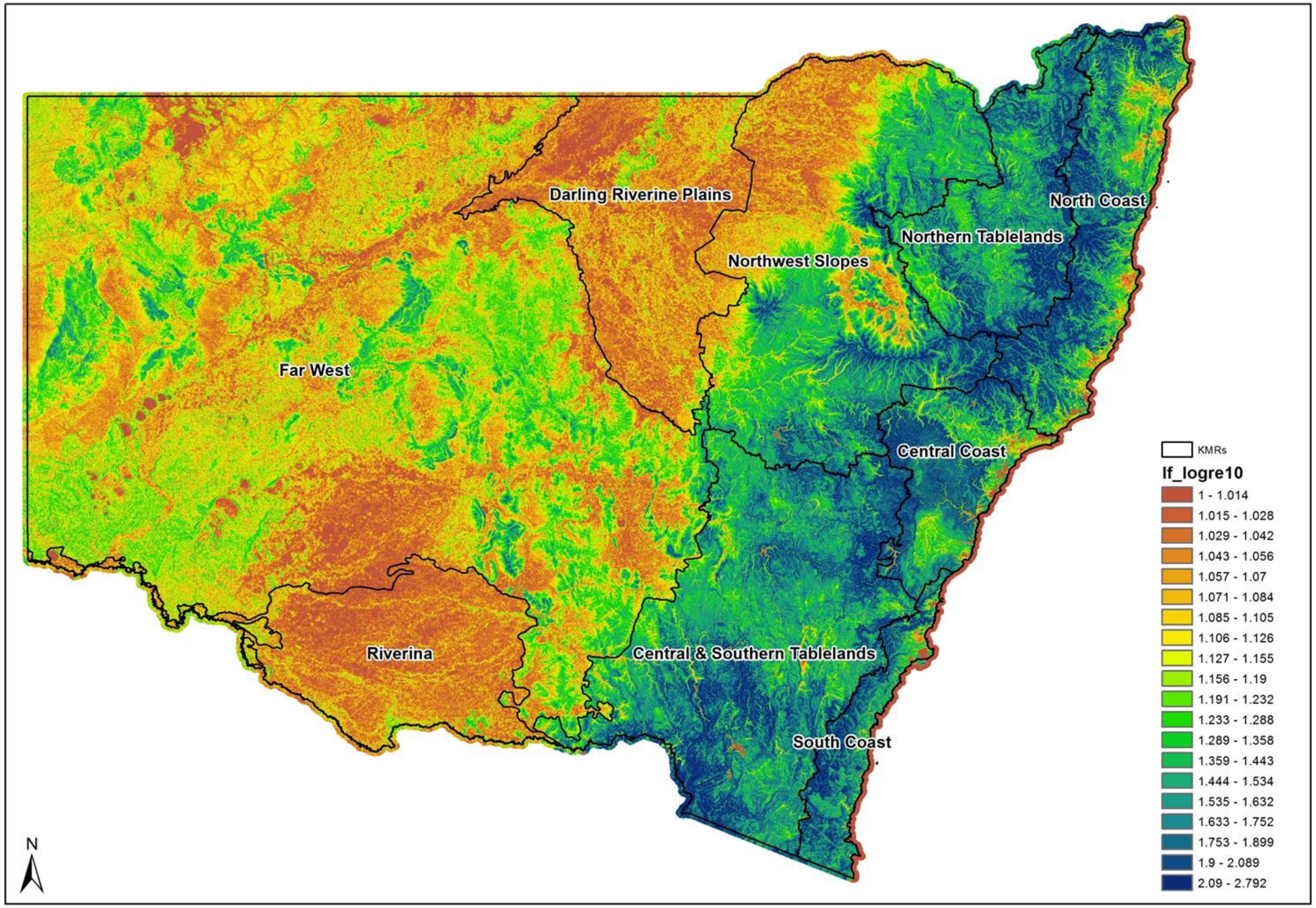
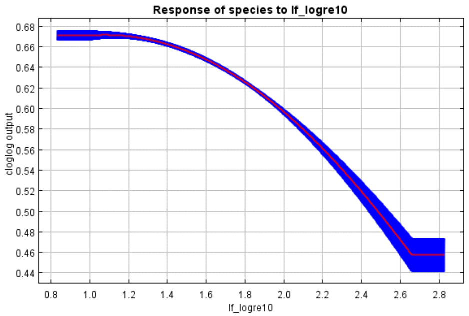


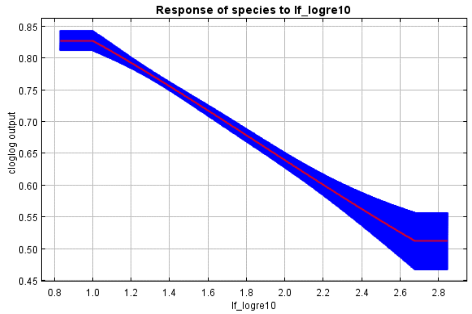
Figure A.5a Map showing the cold-air drainage environmental predictor used in the Koala Habitat Suitability Model

North Coast



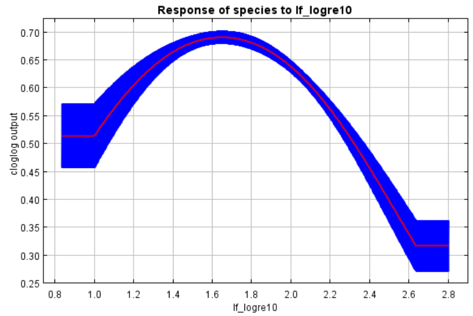
Percent Contribution=2.4%, Permutation Importance = 6.2%

Central Coast



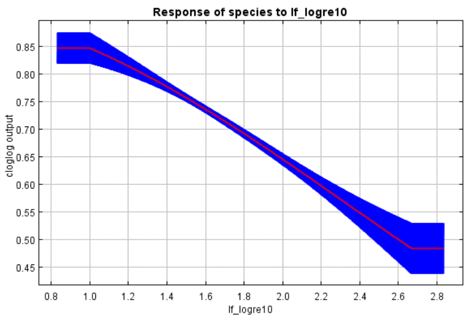
Percent Contribution=7.3%, Permutation Importance = 7.5%

South Coast



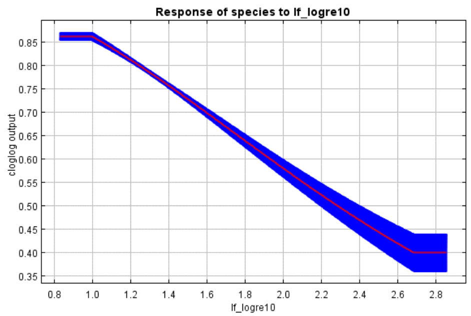
Percent Contribution=12.5%, Permutation Importance = 13.1%

Northern Tablelands



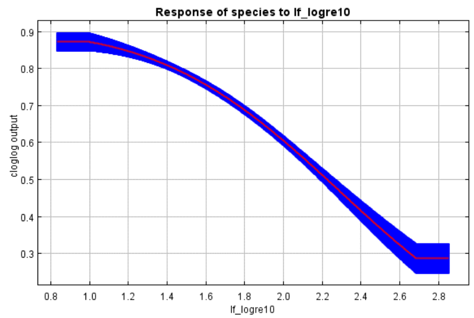
Percent Contribution=4.2%, Permutation Importance = 6.9%

North West Slopes



Percent Contribution=1.4%, Permutation Importance = 15.9%

Central and Southern Tablelands



Percent Contribution=3.7%, Permutation Importance = 8.9%

Figure A.5b Response curves for cold-air drainage environmental predictor by region

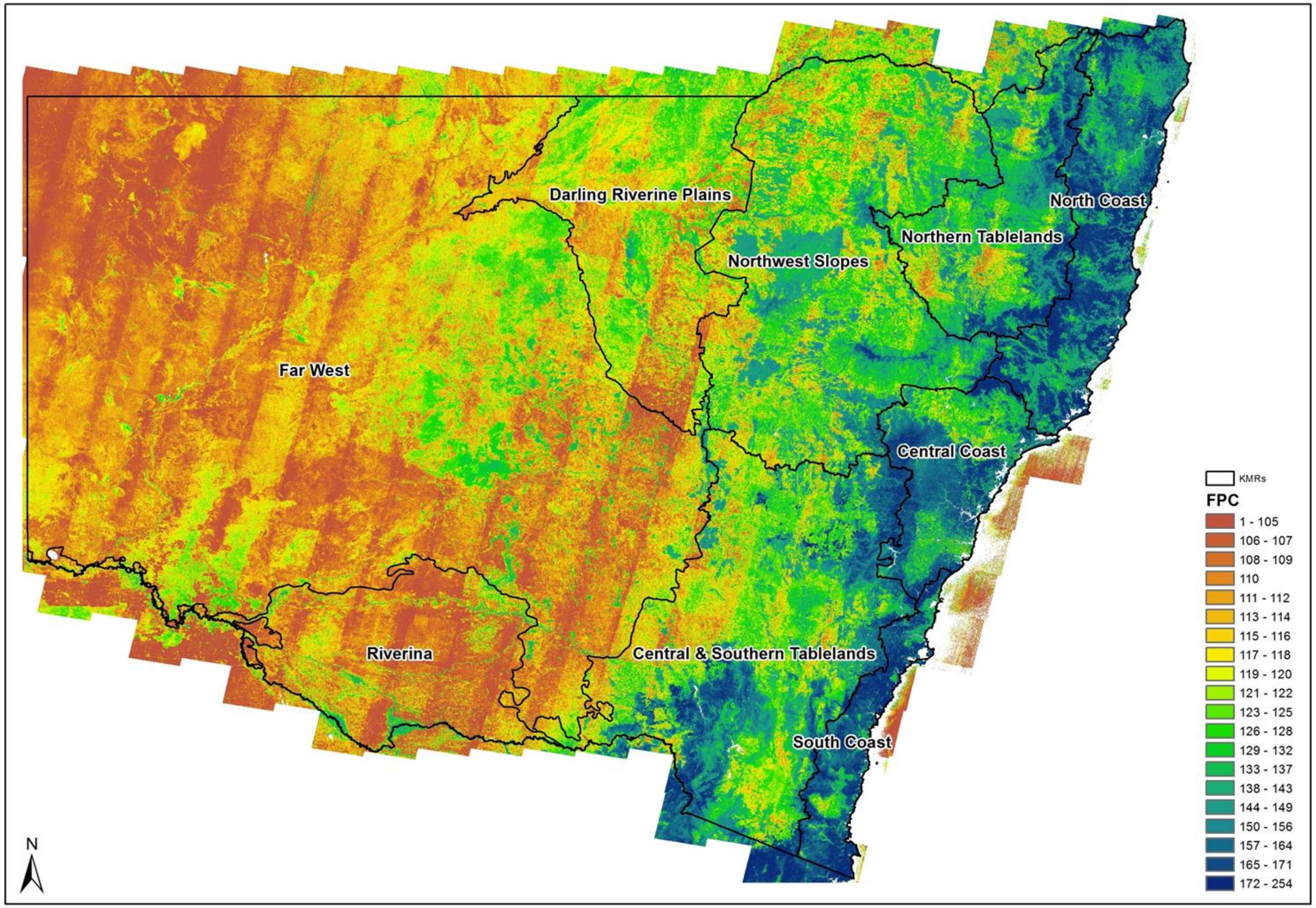


Figure A.6a Map of showing projected foliage cover environmental predictor used in the Koala Habitat Suitability Model

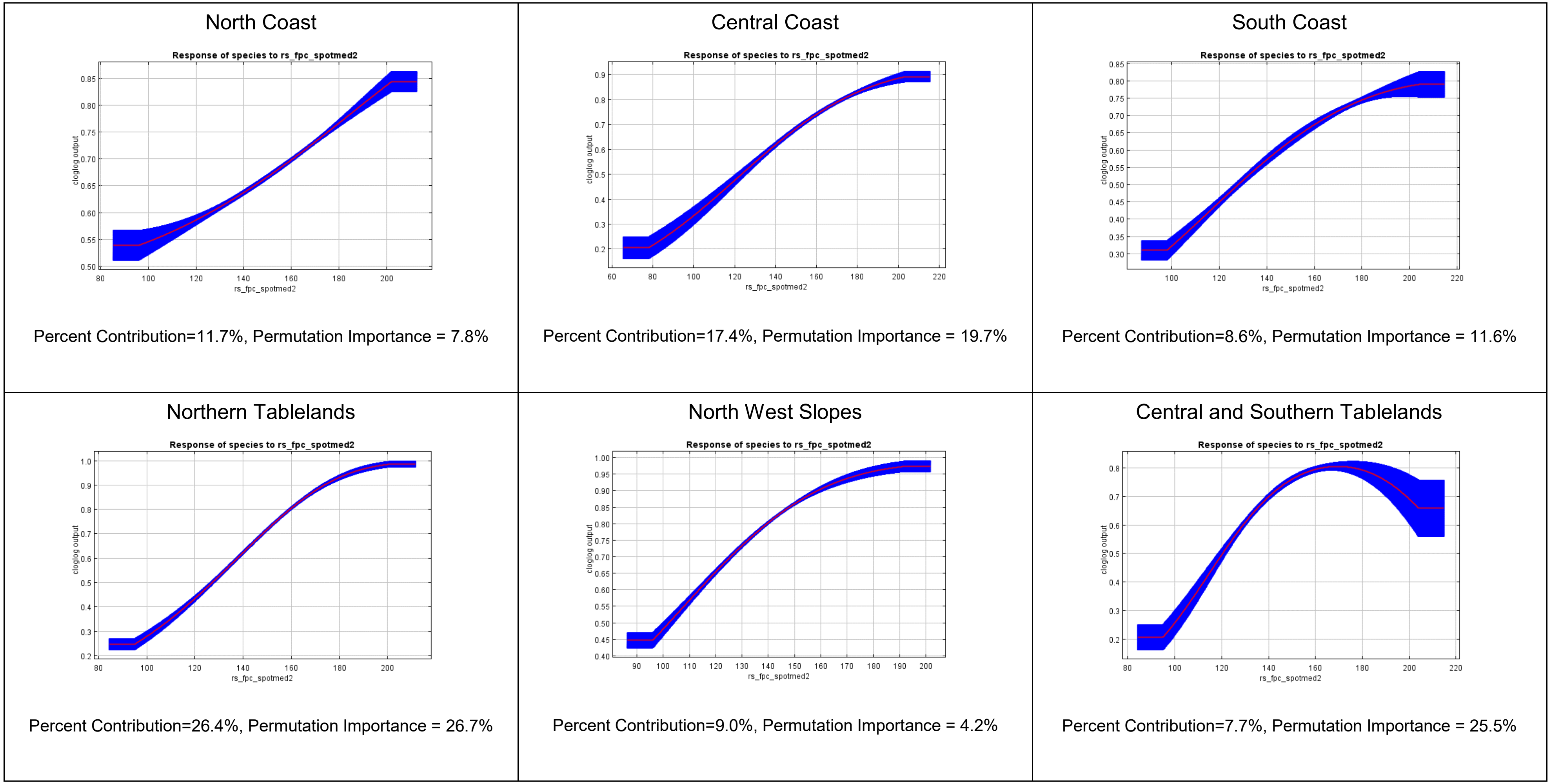


Figure A.6b Response curves for projected foliage cover by region

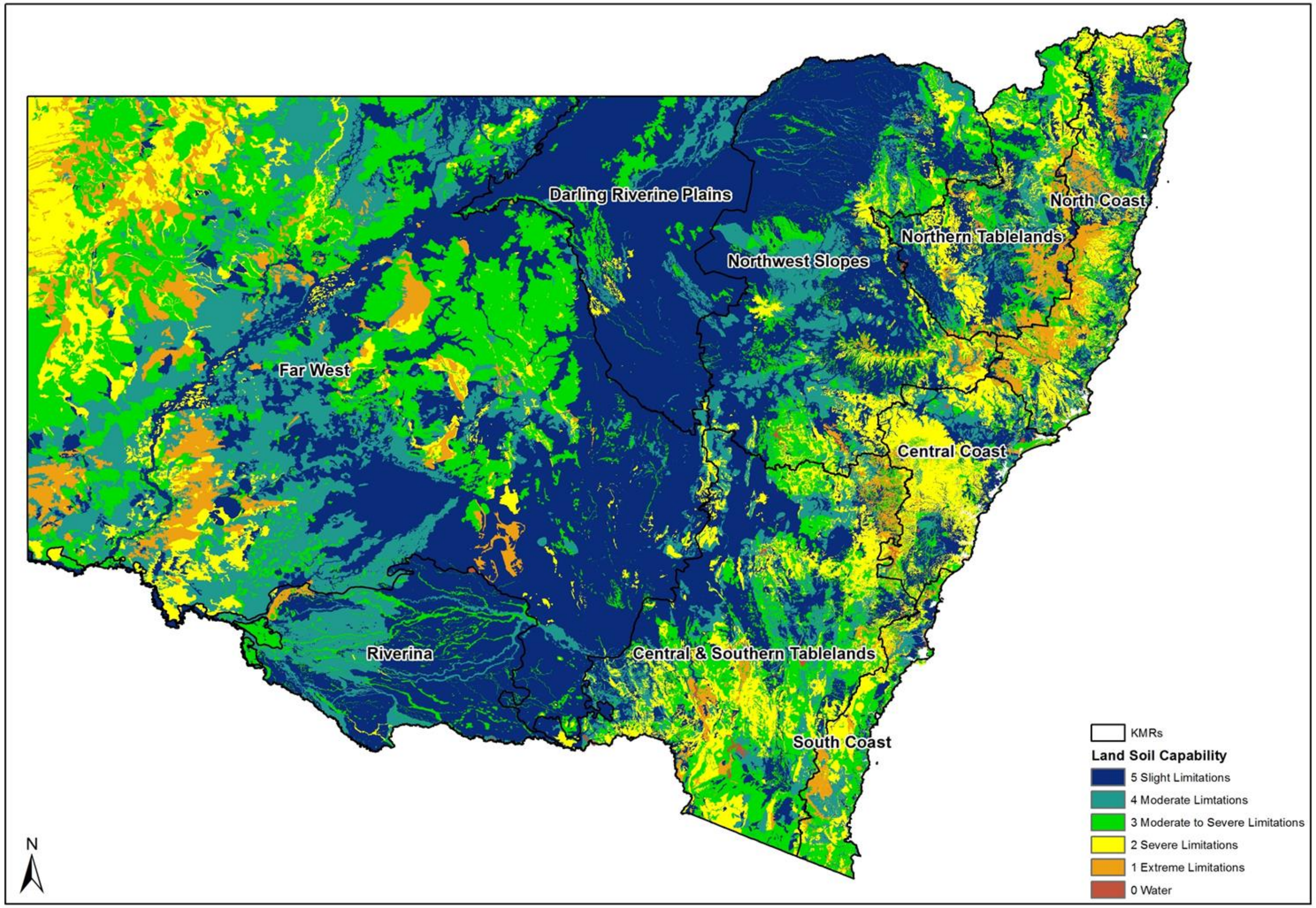


Figure A.7a Map showing projected land–soil capability used in the Koala Habitat Suitability Model

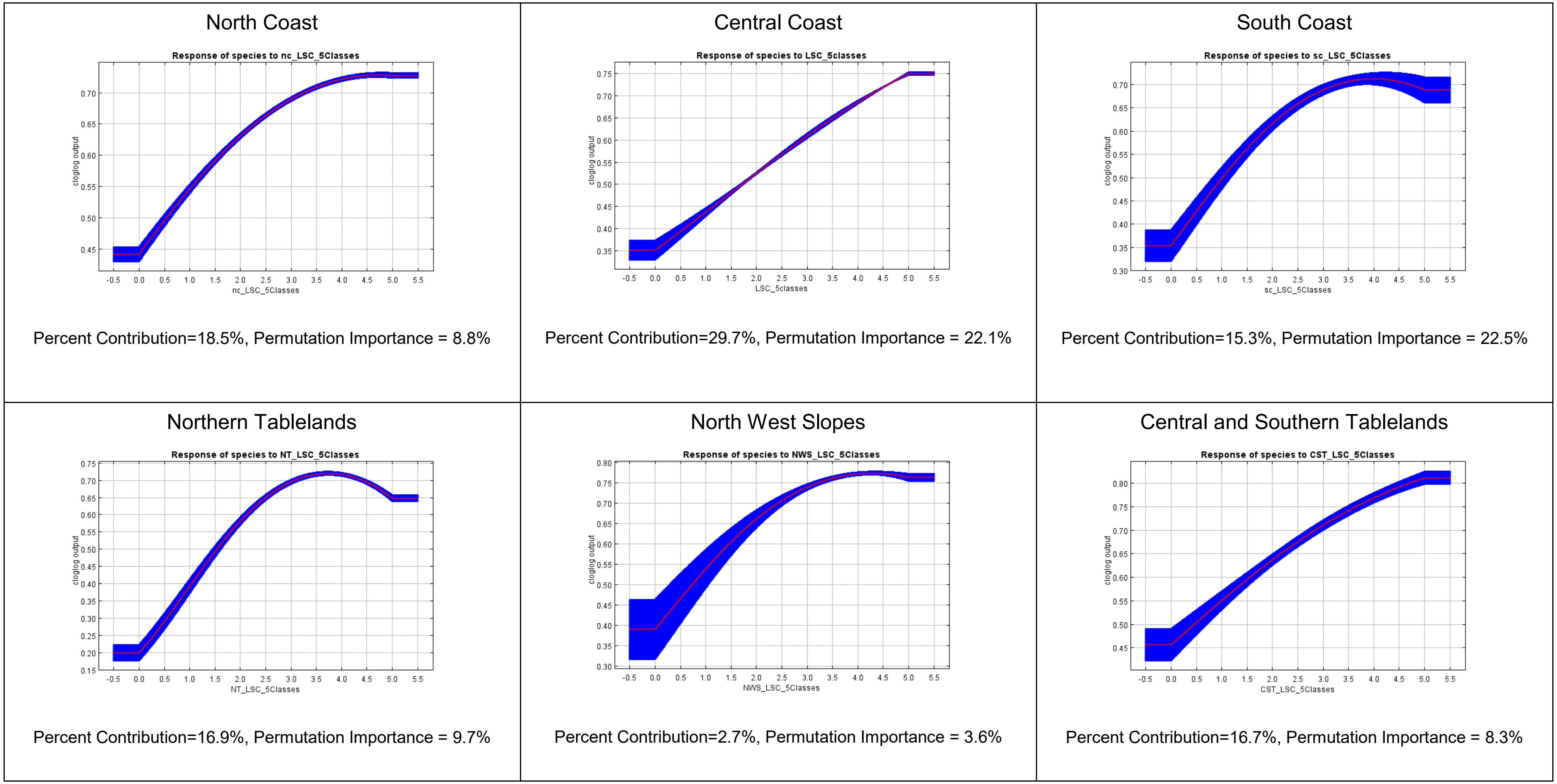
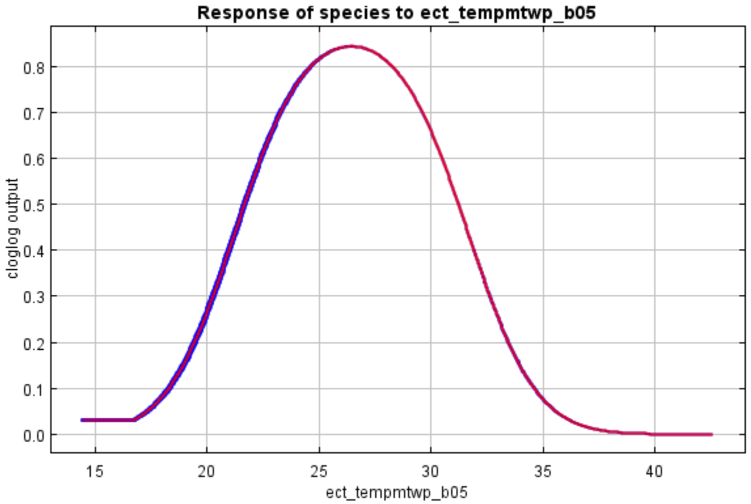


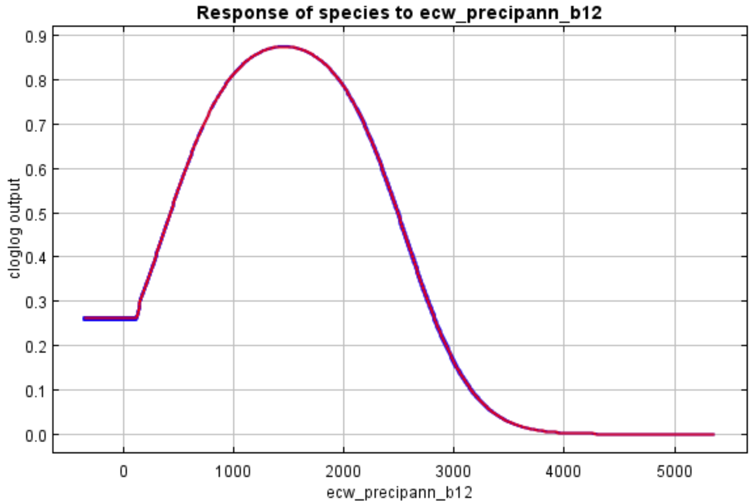
Figure A.7b Response curves for land–soil capability by region

Mean maximum daily temperature of the warmest period



Percent contribution = 93%, Permutation importance = 93.8%

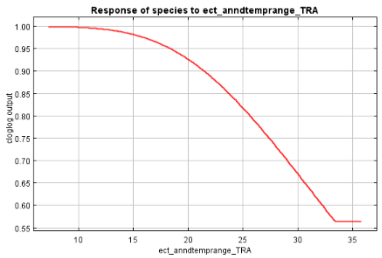
Annual rainfall



Percent contribution = 7%, Permutation importance = 6.2%

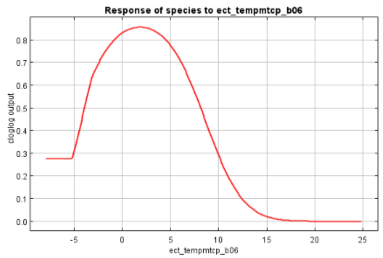
Figure A.8 Response curves for predictors in the simple whole-of-range Koala Habitat Suitability Model

Annual temperature range



Percent contribution = 5.2%, Permutation importance = 7.5%

Minimum temperature of the coldest period

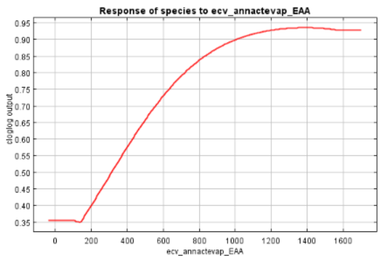


Percent contribution = 4.5%, Permutation importance = 49%

Maximum temperature of the warmest period

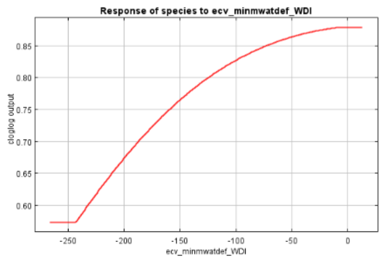
Percent contribution = 27.1%, Permutation importance = 1%

Annual actual evapotranspiration



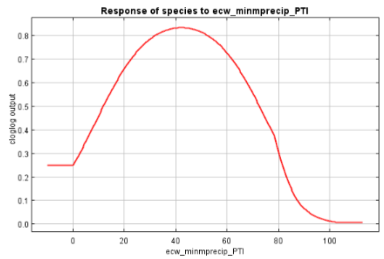
Percent contribution = 7.3%, Permutation importance = 9.3%

Minimum monthly water deficit



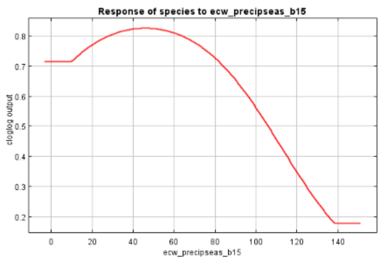
Percent contribution = 22.6%, Permutation importance =6%

Minimum monthly precipitation



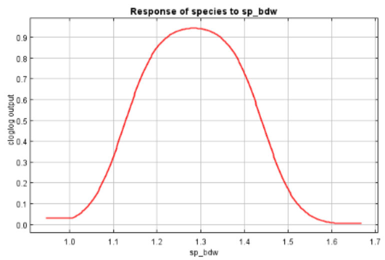
Percent contribution = 13.5%, Permutation importance = 11.6%

Precipitation seasonality



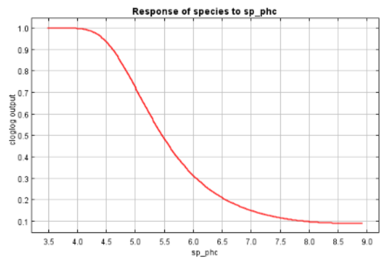
Percent contribution = 8.3%, Permutation importance = 14.8%

Soil bulk density



Percent contribution = 5.4%, Permutation importance = 0.2%

Soil pH



Percent contribution = 6.2%, Permutation importance = 0.6%

Figure A.9 Response curves for predictors in complex whole-of-range Koala Habitat Suitability Model

8.2 Koala Tree Index v1.0 Technical Information

Table A.3. Koala Tree Index and individual tree species models

Title	Category	Description
Data	Vegetation data	Vegetation plot data were downloaded from the NSW BioNet database. The data were vetted for survey type, survey quality, floristic consistency and spatial accuracy. Full-floristic vegetation surveys from targeted 20 x 20 metres (0.4 hectares) quadrat sampling were used to provided presence–absence data for modelling. Data for 123 species was extracted (as identified by OEH 2018 and further workshops and expert consultation to refine the list). Tables A.4 to A.12 show the species identified as important for regions in NSW, their ranking or use level and the number of presence–absence records per species. High- and significant-use species (Ranks 1 to 3) and a few low- or irregular-use species were selected for modelling, a total of 96 species. Presence records for these species were submitted to scrutiny at several workshops with expert botanists. Taxonomic issues were identified, and outlier or erroneous sites excluded.
	Environmental data	Spatial predictor layers representing environmental features form a core part of correlative species distribution models SDMs as they provide information characterising the locations associated with a species. Typical environmental covariates include abiotic factors such as climate (rainfall, temperature), terrain (elevation, slope), soil properties (clay, silt and sand content, available water capacity), and time-series remotely sensed indices (foliage projective cover (FPC), seasonal fractional cover (SFC)). For modelling purposes covariates were chosen which are relevant to describing (principally) eucalypt distributions, using ecological knowledge and results from previous studies modelling state-wide vegetation (SVTM). Spatial data layers are complete across NSW, gridded to 30-square-metre cell resolution, have a common projection and extent. An initial set of 32 potential predictors were trialled for this region. To minimise multicollinearity, highly correlated variables ($R > 0.8$) were excluded (the correlated predictor with the highest influence and most interpretable response retained), and a final set of 20 predictors were selected based on high model influence and meaningful response curves (Table A.13).
Model	Boosted regression tree (BRT)	For this study individual tree species models were built using boosted regression tree (BRT) implemented in R (R Core Team, 2017), using gbm and dismo packages (Elith et al. 2008; Hijmans et al. 2017; Ridgeway 2017). Each species model was optimised, for tree complexity and learning rate, holding bag fraction (0.75), initial tree size (500), incremental tree step size (50), maximum tree number (10,000), number of folds (10) constant. Models were evaluated using 10-fold cross-validation results (deviance explained, area under the receiver operating characteristic curve or area under the curve (AUC) and standard error), relative influence or importance of predictor variables, and response plot curves for ecological meaning. Individual species models were optimised by dropping the lowest contributing predictor(s) without affecting the predictive deviance computed from 10-fold cross-validation. The subsequent operational predictors selected for each region are listed in Tables A.14–A.20. Best-fit models for each species were predicted back into geographic space as continuous probability surfaces

Title	Category	Description
		ranging from low to high probability of occurrence (0–1), which were then analysed by expert ecologists who were familiar with the distributions of these tree species.
	Koala Tree Index	For koalas, suitable habitat from a vegetation point of view includes trees that they like to eat. Shade trees are important too, especially in inland areas of NSW; however without a food source an area cannot sustain koala populations. Modelled distributions of feed trees can be highly informative and useful as covariates for koala habitat modelling. Koalas show a preference for a large number of trees (OEH 2018) whose distributions may overlap or be mutually exclusive. An individual tree species may lack representation across the wider landscape with its realised niche occupying only a portion of the overall area. Combining individual tree distributions provides a single, state-wide layer of the probability of occurrence of trees suitable of koalas. From the modelled set of species (about 100), a subset was chosen to be included in a Koala Tree Index (KTI). Species were selected based on their use level (generally high use), accuracy of modelled distributions, and consideration of co-occurrence and spatial representation with other species. The list of species included in regional indices shows the Central Coast having the largest number of species included with 21 and Riverina the least with 5 (Table A.21). The index is calculated per grid cell by multiplying every combination of species presence and absence (cumulative probability) and then summing the combinations. It can be thought of as the compliment of the probability that no species occurs, or put another way, the likelihood of finding a koala-preferred tree at any location. Regional indices were merged to create a single seamless surface for NSW.
Results		Predictive power of the final species models was high with 10-fold cross-validation AUC values ranging from: • 0.96 for *E. nobilis* (standard error (SE) 0.002) to 0.85 (SE 0.006) for *E. tereticornis* for the North Coast (Table 22) • from 0.98 (SE 0.013) for *E. camaldulensis* to 0.83 (SE 0.061) *E. boistoana* for the Central Coast (Table 23) • 0.097 (SE 0.005) for *E. punctata* to 0.88 (SE 0.003) for *E. globoidea* for the South Coast (Table 24) • 0.98 (SE 0.003) for *E. camaldulensis* to 0.86 (se 0.006) for *E. viminalis* for the Central and Southern Tablelands (Table 25) • 0.98 (SEe 0.004) for *E. camaldulensis* to 0.85 (SE 0.011) for *E.laevopinea* for the Northern Tablelands (Table 26) • 0.99 SE 0.002) for *E. canaliculata* and *E. largiflorens* to 0.82 (SE 0.004) for *E. blakelyi* for the North West Slopes from 0 (Table 27) • 0.98 (SE 0.002) for *E. camaldulensis* to 0.90 (SE 0.004) for *E. chloroclada* for the western part of NSW (Table 28). Individual species models shared predictor variables but differing responses and relative importance to these variables resulted in different distributions. Independent field validation (n = 112) in the Central and Southern Tablelands koala modelling regions KMR identified areas of high tree suitability for koalas (KTI probability value of ≥ 0.6) as having an accuracy of 81%.

Table A.4. Koala tree use in the North Coast region. Initial list provided by the former Office of Environment and Heritage (OEH) 2018, subsequently modified to accommodate koala modelling region boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus biturbinata	**Grey gum**	**171**	**1**
Eucalyptus canaliculata	**Large-fruited grey gum**	**38**	**1**
Eucalyptus microcorys	**Tallowwood**	**1987**	**1**
Eucalyptus moluccana	**Grey box**	**267**	**1**
Eucalyptus propinqua	**Small-fruited grey gum**	**875**	**1**
Eucalyptus punctata	**Grey gum**	**57**	**1**
Eucalyptus robusta	**Swamp mahogany**	**376**	**1**
Eucalyptus tereticornis	**Forest red gum**	**690**	**1**
Eucalyptus amplifolia	Cabbage gum	102	2
Eucalyptus bancroftii	**Orange gum**	**60**	**2**
Eucalyptus glaucina	Slaty red gum	26	2
Eucalyptus grandis	**Flooded gum**	**431**	**2**
Eucalyptus *largeana*	Craven grey box	24	2
Eucalyptus resinifera	**Red mahogany**	**583**	**2**
Eucalyptus saligna	**Sydney blue gum**	**697**	**2**
Allocasuarina torulosa	Forest oak	2423	3
Corymbia maculata	Spotted gum	722	3
E. signata/E. racemosa	Scribbly gum/narrow-leaved scribbly gum	275	3
Eucalyptus acmenoides	White mahogany	690	3
Eucalyptus eugenioides	Narrow-leaved stringybark	238	3
Eucalyptus globoidea	White stringybark	172	3
Eucalyptus laevopinea	Silver-top stringybark	84	3
Eucalyptus seeana	Narrow-leaved red gum	103	3
Eucalyptus siderophloia	Grey ironbark	1135	3
Eucalyptus tindaliae	Stringybark	152	3
Angophora floribunda	Rough-barked apple	163	4
Corymbia gummifera	Red bloodwood	649	4
Corymbia henryi	Large-leaved spotted gum	234	4
Corymbia intermedia	Pink bloodwood	1589	4
Eucalyptus campanulata	New England blackbutt	365	4
Eucalyptus carnea	Thick-leaved mahogany	813	4
Eucalyptus crebra	Narrow-leaved ironbark	179	4
Eucalyptus fibrosa	Broad-leaved red ironbark	142	4
Eucalyptus nobilis	**Forest ribbon gum**	**33**	**4**

Scientific name	Common name	Number PA sites	Rank
Eucalyptus pilularis	Blackbutt	1113	4
Eucalyptus placita	Grey ironbark	22	4
Eucalyptus planchoniana	Bastard tallowwood	199	4
Eucalyptus psammitica	Bastard white mahogany	39	4
Eucalyptus rummeryi	Steel box	53	4
Eucalyptus scias	Large-fruited red mahogany	0	4
Eucalyptus umbra	Bastard white mahogany	138	4
Melaleuca quinquenervia	**Broad-leaved paperbark**	**874**	**4**

Notes: Species in bold are included in the Koala Tree Index. PA = presence–absence; Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.5. Koala tree use in the Central Coast region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus albens	**White box**	**35**	**1**
Eucalyptus blakelyi	**Blakely's red gum**	**58**	**1**
Eucalyptus bosistoana	**Coast grey box**	**6**	**1**
Eucalyptus canaliculata	**Large-fruited grey gum**	**134**	**1**
Eucalyptus cypellocarpa	**Monkey gum**	**30**	**1**
Eucalyptus longifolia	**Woollybutt**	**62**	**1**
Eucalyptus melliodora	**Yellow box**	**24**	**1**
Eucalyptus microcorys	**Tallowwood**	**48**	**1**
Eucalyptus moluccana	**Grey box**	**795**	**1**
Eucalyptus parramattensis	**Parramatta red gum**	**176**	**1**
Eucalyptus propinqua	**Small-fruited grey gum**	**72**	**1**
Eucalyptus punctata	**Grey gum**	**1839**	**1**
Eucalyptus robusta	**Swamp mahogany**	**372**	**1**
Eucalyptus tereticornis	**Forest red gum**	**960**	**1**
Eucalyptus beyeriana	Beyer's ironbark	120	2
Eucalyptus camaldulensis	**River red gum**	**3**	**2**
Eucalyptus deanei	**Mountain blue gum**	**319**	**2**
Eucalyptus globoidea	**White stringybark**	**500**	**2**
Eucalyptus grandis	Flooded gum	5	2
Eucalyptus largeana	Craven grey box	4	2
Eucalyptus paniculata	**Grey ironbark**	**382**	**2**
Eucalyptus quadrangulata	**White-topped box**	**17**	**2**

Scientific name	Common name	Number PA sites	Rank
Allocasuarina torulosa	Forest oak	1819	3
Angophora costata	Smooth-barked apple	2596	3
Corymbia eximia	Yellow bloodwood	533	3
Corymbia gummifera	**Red bloodwood**	**2588**	**3**
Eucalyptus botryoides	Bangalay	187	3
Eucalyptus crebra	Narrow-leaved ironbark	1208	3
Eucalyptus fibrosa	Broad-leaved red ironbark	1039	3
Eucalyptus oblonga	Stringybark	275	3
Eucalyptus pilularis	Blackbutt	761	3
Eucalyptus piperita	Sydney peppermint	1306	3
Eucalyptus resinifera	Red mahogany	431	3
Eucalyptus scias	Large-fruited red mahogany	63	3
Eucalyptus sclerophylla	Hard-leaved scribbly gum	245	3
Eucalyptus racemosa	Narrow-leaved scribbly gum	0	3
Eucalyptus saligna	Sydney blue gum	441	3
Eucalyptus signata	Scribbly gum	261	3
Eucalyptus viminalis	Ribbon gum	12	3
Syncarpia glomulifera	Turpentine	1767	3
Allocasuarina littoralis	Black she-oak	1767	4
Angophora bakeri	Narrow-leaved apple	588	4
Angophora floribunda	Rough-barked apple	1124	4
Casuarina glauca	Swamp oak	455	4
Corymbia maculata	Spotted gum	1260	4
Eucalyptus acmenoides	White mahogany	408	4
Eucalyptus agglomerata	Blue-leaved stringybark	318	4
Eucalyptus amplifolia	Cabbage gum	157	4
Eucalyptus camfieldii	Camfield's stringybark	23	4
Eucalyptus capitellata	Brown stringybark	365	4
Eucalyptus carnea	Thick-leaved mahogany	37	4
Eucalyptus consideniana	Yertchuk	52	4
Eucalyptus eugenioides	Narrow-leaved stringybark	471	4
Eucalyptus glaucina	Slaty red gum	20	4
Eucalyptus haemastoma	Broad-leaved scribbly gum	631	4
Eucalyptus imitans	Eucalyptus imitans	0	4
Eucalyptus macrorhyncha	Red stringybark	1	4
Eucalyptus michaeliana	Brittle gum	26	4
Eucalyptus siderophloia	Grey ironbark	213	4

Scientific name	Common name	Number PA sites	Rank
Eucalyptus sideroxylon	Mugga ironbark	37	4
Eucalyptus sieberi	Silvertop ash	286	4
Eucalyptus sparsifolia	Narrow-leaved stringybark	617	4
Eucalyptus squamosa	Scaly bark	79	4
Eucalyptus umbra	Bastard white mahogany	602	4
Melaleuca quinquenervia	**Broad-leaved paperbark**	**253**	**4**

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.6. Koala tree use in the South Coast region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus cypellocarpa	**Monkey gum**	**727**	**1**
Eucalyptus globoidea	**White stringybark**	**845**	**1**
Eucalyptus longifolia	**Woollybutt**	**317**	**1**
Eucalyptus maidenii	**Maiden's blue gum**	**172**	**1**
Eucalyptus punctata	**Grey gum**	**103**	**1**
Eucalyptus tereticornis	**Forest red gum**	**311**	**1**
Eucalyptus bosistoana	**Coast grey box**	**247**	**2**
Eucalyptus consideniana	Yertchuk	145	2
Eucalyptus eugenioides	**Narrow-leaved stringybark**	**118**	**2**
Eucalyptus tricarpa	**Mugga (red) ironbark**	**76**	**2**
Eucalyptus obliqua	Messmate	283	3
Eucalyptus saligna	Sydney blue gum	97	3
Allocasuarina littoralis	Black she-oak	1058	4
Angophora floribunda	Rough-barked apple	666	4
Corymbia gummifera	**Red bloodwood**	**736**	**4**
Corymbia maculata	Spotted gum	320	4
Eucalyptus agglomerata	Blue-leaved stringybark	353	4
Eucalyptus baueriana	Blue box	130	4
Eucalyptus elata	River peppermint	404	4
Eucalyptus fastigata	Brown barrel	296	4
Eucalyptus muelleriana	Yellow stringybark	588	4
Eucalyptus paniculata	Grey ironbark	257	4
Eucalyptus pilularis	Blackbutt	394	4
Eucalyptus piperita	Sydney peppermint	311	4
Eucalyptus sclerophylla	Hard-leaved scribbly gum	142	4

Scientific name	Common name	Number PA sites	Rank
Eucalyptus sieberi	Silvertop ash	852	4
Eucalyptus viminalis	**Ribbon gum**	**101**	**4**

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.7. Koala tree use in the Central and Southern Tablelands region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus albens	**White box**	**346**	**1**
Eucalyptus blakelyi	**Blakely's red gum**	**567**	**1**
Eucalyptus camaldulensis	**River red gum**	**19**	**1**
Eucalyptus cypellocarpa	**Monkey gum**	**490**	**1**
Eucalyptus mannifera	**Brittle gum**	**983**	**1**
Eucalyptus punctata	**Grey gum**	**606**	**1**
Eucalyptus tereticornis	**Forest red gum**	**207**	**1**
Eucalyptus viminalis	**Ribbon gum**	**927**	**1**
Eucalyptus globoidea	**White stringybark**	**342**	**2**
Eucalyptus rossii	**Inland scribbly gum**	**795**	**2**
Eucalyptus sclerophylla	**Hard-leaved scribbly gum**	**326**	**2**
Eucalyptus agglomerata	Blue-leaved stringybark	331	3
Eucalyptus bosistoana	Coast grey box	40	3
Eucalyptus bridgesiana	Apple box	792	3
Eucalyptus conica	Fuzzy box	3	3
Eucalyptus dalrympleana	Mountain gum	1124	3
Eucalyptus dealbata	Tumbledown red gum	129	3
Eucalyptus dives	Broad-leaved peppermint	1373	3
Eucalyptus elata	**River peppermint**	**146**	**3**
Eucalyptus eugenioides	Narrow-leaved stringybark	195	3
Eucalyptus goniocalyx	**Bundy**	**573**	**3**
Eucalyptus macrorhyncha	Red stringybark	1683	3
Eucalyptus maidenii	Maiden's blue gum	22	3
Eucalyptus melliodora	Yellow box	829	3
Eucalyptus microcarpa	Western grey box	72	3
Eucalyptus nortonii	Large-flowered bundy	285	3
Eucalyptus pauciflora	White Sally, snow gum	1231	3
Eucalyptus piperita	Sydney peppermint	762	3
Eucalyptus polyanthemos	Red box	537	3
Eucalyptus quadrangulata	White-topped box	42	3

Scientific name	Common name	Number PA sites	Rank
Eucalyptus radiata	**Narrow leaved peppermint**	**904**	**3**
Eucalyptus amplifolia	Cabbage gum	47	4
Eucalyptus fibrosa	Broad-leaved red ironbark	137	4
Eucalyptus obliqua	Messmate	204	4
Eucalyptus oblonga	Stringybark	70	4
Eucalyptus paniculata	Grey ironbark	21	4
Eucalyptus rubida	Candlebark	594	4
Eucalyptus sideroxylon	Mugga ironbark	156	4
Eucalyptus sieberi	Silvertop ash	859	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.8. Koala tree use in the Northern Tablelands region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus acaciiformis	**Wattle-leaved peppermint**	**111**	**1**
Eucalyptus albens	**White box**	**332**	**1**
Eucalyptus biturbinata	**Grey gum**	**224**	**1**
Eucalyptus blakelyi	**Blakely's red gum**	**514**	**1**
Eucalyptus camaldulensis	**River red gum**	**21**	**1**
Eucalyptus dalrympleana	**Mountain gum**	**301**	**1**
Eucalyptus dealbata	**Tumbledown red gum**	**334**	**1**
Eucalyptus melliodora	**Yellow box**	**642**	**1**
Eucalyptus microcorys	**Tallowwood**	**295**	**1**
Eucalyptus moluccana	**Grey box**	**200**	**1**
Eucalyptus nicholii	**Narrow-leaved black peppermint**	**27**	**1**
Eucalyptus pauciflora	**White Sally, snow gum**	**192**	**1**
Eucalyptus tereticornis	**Forest red gum**	**252**	**1**
Eucalyptus viminalis	**Ribbon gum**	**180**	**1**
Eucalyptus bridgesiana	Apple box	285	2
Eucalyptus brunnea	**Mountain blue gum**	**354**	**2**
Eucalyptus caliginosa	Broad-leaved stringybark	749	2
Eucalyptus laevopinea	**Silver-top stringybark**	**613**	**2**
Eucalyptus nobilis	**Forest ribbon gum**	**362**	**2**
Eucalyptus radiata	**Narrow leaved peppermint**	**381**	**2**
Eucalyptus stellulata	Black Sally	53	2
Eucalyptus youmanii	Youman's stringybark	177	2

Scientific name	Common name	Number PA sites	Rank
Angophora floribunda	Rough-barked apple	764	3
Angophora subvelutina	Broad-leaved apple	234	3
Eucalyptus amplifolia	Cabbage gum	41	3
Eucalyptus caleyi	Drooping ironbark	231	3
Eucalyptus macrorhyncha	Red stringybark	215	3
Eucalyptus nova-anglica	New England peppermint	126	3
Eucalyptus prava	Orange gum	444	3
Eucalyptus williamsiana	*Eucalyptus williamsiana*	74	3
Allocasuarina littoralis	Black she-oak	558	4
Callitris glaucophylla	White cypress pine	208	4
Eucalyptus campanulata	New England blackbutt	1114	4
Eucalyptus crebra	Narrow-leaved ironbark	107	4
Eucalyptus eugenioides	Narrow-leaved stringybark	159	4
Eucalyptus melanophloia	Silver-leaved ironbark	76	4
Eucalyptus michaeliana	Brittle gum	4	4
Eucalyptus obliqua	Messmate	481	4
Eucalyptus saligna	Sydney blue gum	381	4
Eucalyptus sideroxylon	Mugga ironbark	30	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.9. Koala tree use in the North West Slopes region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus albens	**White box**	**1497**	**1**
Eucalyptus blakelyi	**Blakely's red gum**	**922**	**1**
Eucalyptus camaldulensis	**River red gum**	**184**	**1**
Eucalyptus canaliculata	**Large-fruited grey gum**	**19**	**1**
Eucalyptus chloroclada	**Dirty gum**	**380**	**1**
Eucalyptus conica	**Fuzzy box**	**75**	**1**
Eucalyptus coolabah	**Coolibah**	**188**	**1**
Eucalyptus dealbata	**Tumbledown red gum**	**861**	**1**
Eucalyptus dwyeri	**Dwyer's red gum**	**402**	**1**
Eucalyptus exserta	Peppermint	4	1
Eucalyptus melliodora	**Yellow box**	**616**	**1**
Eucalyptus microcarpa	**Western grey box**	**144**	**1**

Scientific name	Common name	Number PA sites	Rank
Eucalyptus moluccana	**Grey box**	**270**	**1**
Eucalyptus parramattensis	Parramatta red gum	6	1
Eucalyptus pauciflora	**White Sally, snow gum**	**61**	**1**
Eucalyptus pilligaensis	**Narrow-leaved grey box**	**228**	**1**
Eucalyptus populnea	**Bimble box/poplar box**	**413**	**1**
Eucalyptus punctata	**Grey gum**	**253**	**1**
Eucalyptus crebra	**Narrow-leaved ironbark**	**1831**	**2**
Eucalyptus largiflorens	**Black box**	**26**	**2**
Eucalyptus melanophloia	Silver-leaved Ironbark	740	2
Eucalyptus prava	**Orange gum**	**211**	**2**
Angophora floribunda	Rough-barked apple	1520	3
Callitris glaucophylla	White cypress pine	2916	3
Eucalyptus caliginosa	Broad-leaved stringybark	13	3
Eucalyptus laevopinea	**Silver-top stringybark**	**344**	**3**
Eucalyptus macrorhyncha	Red stringybark	514	3
Eucalyptus sideroxylon	Mugga ironbark	236	3
Casuarina cristata	Belah	376	4
Eucalyptus bridgesiana	Apple box	100	4
Eucalyptus caleyi	Drooping ironbark	248	4
Eucalyptus dalrympleana	Mountain gum	92	4
Eucalyptus fibrosa	Broad-leaved red ironbark	470	4
Eucalyptus goniocalyx	Bundy	58	4
Eucalyptus mannifera	Brittle gum	22	4
Eucalyptus nobilis	Forest ribbon gum	103	4
Eucalyptus polyanthemos	Red box	53	4
Eucalyptus quadrangulata	White-topped box	13	4
Eucalyptus viminalis	Ribbon gum	108	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.10. Koala tree use in the Darling Riverine Plains region. Initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific Name	Common Name	Number PA sites	Rank
Eucalyptus camaldulensis	**River red gum**	**256**	**1**
Eucalyptus coolabah	**Coolibah**	**395**	**1**
Eucalyptus dealbata	**Tumbledown red gum**	**6**	**1**
Eucalyptus largiflorens	**Black box**	**284**	**1**
Eucalyptus melliodora	**Yellow box**	**20**	**1**
Eucalyptus populnea	**Bimble box/poplar box**	**532**	**1**
Eucalyptus conica	**Fuzzy box**	**4**	**2**
Eucalyptus dwyeri	**Dwyer's red gum**	**4**	**2**
Eucalyptus melanophloia	**Silver-leaved ironbark**	**12**	**2**
Eucalyptus microcarpa	**Western grey box**	**24**	**2**
Callitris glaucophylla	White cypress pine	257	3
Eucalyptus albens	White box	1	3
Eucalyptus chloroclada	Dirty gum	31	3
Eucalyptus crebra	Narrow-leaved ironbark	1	3
Eucalyptus pilligaensis	Narrow-leaved grey box	3	3
Eucalyptus sideroxylon	Mugga ironbark	2	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High us; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.11. Koala tree use in the Far West region. initial list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus camaldulensis	**River red gum**	**367**	**1**
Eucalyptus albens	**White box**	**46**	**2**
Eucalyptus blakelyi	**Blakely's red gum**	**44**	**2**
Eucalyptus coolabah	**Coolibah**	**131**	**2**
Eucalyptus dealbata	**Tumbledown red rum**	**33**	**2**
Eucalyptus largiflorens	**Black box**	**498**	**2**
Eucalyptus populnea	**Bimble box**	**862**	**2**
Callitris glaucophylla	White cypress pine	1635	3
Eucalyptus melanophloia	Silver-leaved ironbark	35	3
Eucalyptus melliodora	Yellow box	137	3
Eucalyptus microcarpa	Western grey box	412	3
Angophora floribunda	Rough-barked apple	0	4

Scientific name	Common name	Number PA sites	Rank
Casuarina cristata	Belah	192	4
Eucalyptus chloroclada	Dirty gum	5	4
Eucalyptus crebra	Narrow-leaved ironbark	0	4
Eucalyptus intertexta	Gum coolabah	422	4
Eucalyptus moluccana	Grey box	1	4
Eucalyptus pilligaensis	Narrow-leaved grey box	1	4
Eucalyptus sideroxylon	Mugga ironbark	232	4
Geijera parviflora	Wilga	920	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.12. Koala tree use in the Riverina region. Initial tree list provided by OEH 2018, subsequently modified to accommodate KMR boundaries and additional expert feedback.

Scientific name	Common name	Number PA sites	Rank
Eucalyptus camaldulensis	**River red gum**	**980**	**1**
Eucalyptus largiflorens	**Black box**	**498**	**2**
Eucalyptus melliodora	**Yellow box**	**84**	**2**
Eucalyptus microcarpa	**Western grey box**	**101**	**2**
Callitris glaucophylla	White cypress pine	167	3
Eucalyptus populnea	**Bimble box**	**7**	**3**
Casuarina cristata	Belah	8	4
Eucalyptus albens	White box	1	4
Eucalyptus intertexta	Gum coolibah	0	4

Notes: Species in bold are included in the Koala Tree Index. PA = presence-absence. Rank 1 = high preferred use; Rank 2 = High use; Rand 3 = Significant use; Rank 4 = Irregular or low use.

Table A.13. Environmental predictors used in tree species models.

Predictor variable	Predictor description	Original resolution	Reference/source
Climate			
radseas	Radiation of seasonality: coefficient of variation	1 sec	Xu T and Hutchinson M (2011). Generated by DPIE EES using 1 second SRTM v1.0 DEM
tempiso	Isothermality 2/7	1 sec	Xu T and Hutchinson M (2011). Generated by DPIE EES using 1 second SRTM v1.0 DEM
tempmtcp	Minimun temperature of coldest period (°C)	1 sec	Xu T and Hutchinson M (2011). Generated by DPIE EES using 1 second SRTM v1.0 DEM
precipdp	Precipitation of driest period (mm)	1 sec	Xu T and Hutchinson M (2011). Generated by DPIE EES using 1 second SRTM v1.0 DEM
Landform			
strmdstall	Euclidean distance to all streams (orders: 1 to 9) (metres)	30 metres	NSW Office of Water. DPIE EES
strmdstge6	Euclidean distance to sixth order streams and above (metres)	30 metres	NSW Office of Water. DPIE EES
exp315	Exposure to the north west (low = exposed (drier forests); high = sheltered (moister forests)).	1 sec	Ashcroft MB and Gollan JR (2012)
logre10	Cold air drainage	1 sec	Ashcroft MB and Gollan JR (2012)
rough0500	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 500-metre neighbourhood.	1 sec	derived from 1 second SRTM v1.0 Digital Elevation Model (GeoScience Australia)
tpi0250	Topographic position index using neighbourhood of 250-metre radius	1 sec	Derived from 1 second SRTM v1.0 Digital Elevation Model (GeoScience Australia)
tpi2000	Topographic position index using	1 sec	derived from 1 second SRTM v1.0 Digital

Predictor variable	Predictor description	Original resolution	Reference/source
	neighbourhood of 2000-metre radius		Elevation Model (GeoScience Australia)
Soil			
clay0_30	Clay content from 0 to 30-centimetre (cm) depths (%)	100 metres	Gray et al (2015)
sand0_30	Sand content from 0 to 30-cm depths (%)	100 metres	Gray et al (2015)
awc000_100pr	Available water capacity proportionally combined depths from 0 to 100 cm (%)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES
cly000_100pr	Clay content proportionally combined depths from 0 to 100 cm (%)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES.
des000_200	Depth of soil profile (A and B horizons) 0 to 200 cm depths	3 sec	Soil and Landscape Grid of Australia.
nto000_100pr	Total nitrogen proportionally combined depths from 0 to 100 cm (%)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES
phc000_100pr	pH (calcium chloride) proportionally combined depths from 0 to 100 cm (pHCa)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES
slt000_100pr	Silt content proportionally combined depths from 0 to 100 cm (%)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES
snd000_100pr	Sand content proportionally combined depths from 0 to 100 cm (%)	3 sec	Soil and Landscape Grid of Australia. Proportion derived by DPIE EES

Notes: All layers have a common projection, extent and resolution (30 x 30 metres). DEM = Digital Elevation Model; DPIE EES = Department of Planning, Industry and Environment – Environment, Energy and Science; SRTM = shuttle radar topography mission.

Table A.14. North Coast tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)																		
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**	**des000_200**	**sand0_30**
Eucalyptus bancroftii	0.93 (0.004)	0.07 (0.004)	6.2	11.4	3.7	18.7	2.0	6.3	3.7	3.5	10.0	1.9	1.6	2.7	6.1	6.1	4.9	4.4	7.0		
Eucalyptus biturbinata	0.91 (0.011)	0.22 (0.009)	12.0	7.5	11.4	6.3		7.5	4.3	6.8	3.6	5.8	5.4		4.7	5.1	15.0		4.6		
Eucalyptus canaliculata	0.95 (0.01)	0.05 (0.004)	16.9	16.3	11.9	16.1	5.1	3.9	5.5	4.5		4.5	2.9	1.8	5.6	3.1	1.0	1.1			
Eucalyptus grandis	0.88 (0.008)	0.4 (0.009)	6.6	7.7	9.1	8.1	4.9	4.7	3.1	5.4	5.4	3.8	5.6	2.6	3.4	4.7	3.3	16.9	4.8		
Eucalyptus microcorys	0.86 (0.003)	0.86 (0.008)	7.0	11.8	9.6	7.3	2.9	3.1	2.8	11.3	2.7	6.1	3.1	2.7	2.9	2.8	3.5	6.4	14.0		
Eucalyptus moluccana	0.94 (0.004)	0.22 (0.007)	13.0	9.7	9.6	18.8	2.8	4.3	2.2	2.8	3.7	3.6	3.1	3.4	3.9	6.9	6.5	2.6	3.2		
Eucalyptus nobilis	0.96 (0.002)	0.07 (0.002)	15.1	2.5	19.3	4.7		5.8	2.0	4.4	2.0	2.0	3.4	8.1	11.5	2.6	12.0		2.7	1.8	
Eucalyptus propinqua	0.88 (0.007)	0.56 (0.013)	11.9	13.8	10.8	6.8	4.0	3.7		5.6	5.2	6.0	3.4	2.9	5.0	5.0	3.4	5.5	7.0		
Eucalyptus punctata	0.93 (0.024)	0.07 (0.004)	20.0	12.2	6.5	9.0	3.2	7.2		6.0	7.0	7.1	3.2	3.2		2.4	5.0	4.3	3.8		
Eucalyptus resinifera	0.85 (0.009)	0.45 (0.009)	11.2	7.9	13.6	5.8	5.3	6.1		4.4	7.9		3.5		4.6	7.6	7.3	7.0	8.0		

	Model performance		Predictor relative contribution (%)																		
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**	**des000_200**	**sand0_30**
Eucalyptus robusta	0.93 (0.004)	0.28 (0.006)	8.3	5.0	9.8	11.9	5.1	6.2	2.1	16.8	7.1	2.7	4.8			5.1	7.3			4.7	3.2
Eucalyptus saligna	0.88 (0.003)	0.54 (0.006)	6.7	8.2	19.3	5.5		3.6	4.1	4.5	4.4	3.4	4.1	4.1	4.8	3.1	3.5	13.9	6.8		
Eucalyptus tereticornis	0.85 (0.006)	0.56 (0.006)	9.2	12.8	6.2	13.8	3.3	7.2	2.7	4.6	3.2	3.7	3.1	3.2	3.6	3.5	11.5	4.2	4.3		
Melaleuca quinquenervia	0.92 (0.004)	0.4 (0.008)	5.6	5.0	17.3	4.8		5.2	1.7	22.3	4.9	3.1	3.3			5.1	4.5			12.1	5.1

Notes: AUC = area under the curve; SE = standard error.

Table A.15. Central Coast tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)													
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**clay0_30**	**sand0_30**	**des000_200**
Corymbia gummifera	0.89 (0.002)	0.7 (0.007)	18.3	5.7	9.9	11.1	5.7	4.3	3.1	10.7	6.4	5.6	6.2	2.6	6.3	3.9
Eucalyptus albens	0.94 (0.012)	0.04 (0.002)	9.1	8.2	15.9	23.8	1.3	6.3	4.8	4.0	4.3	2.8	7.1	0.9	1.2	10.2
Eucalyptus blakelyi	0.96 (0.007)	0.05 (0.003)	16.3	7.9	13.1	11.0	7.7	7.5	3.2	7.9	6.7	2.3	7.2	2.5	0.7	6.0
Eucalyptus bosistoana	0.83 (0.061)	0.01 (0.002)	13.8	4.6	13.1	14.8	12.2	2.5	0.0	3.2	6.4	12.7	2.8	7.6	2.8	3.5
Eucalyptus camaldulensis	0.98 (0.013)	0.01 (0.002)	11.4	3.1	11.1	60.3	0.0	5.2	1.7	0.6	1.3	0.0	1.4	0.8	0.0	3.1
Eucalyptus canaliculata	0.96 (0.006)	0.09 (0.004)	34.3	6.6	10.0	9.9	5.1	3.8	4.5	1.9	6.2	4.5	2.1	1.6	3.0	6.4
Eucalyptus cypellocarpa	0.94 (0.028)	0.05 (0.004)	11.8	13.5	29.3	5.6	5.1	5.4	3.9	1.8	4.8	2.5	9.1	2.1	2.7	2.4
Eucalyptus deanei	0.94 (0.006)	0.17 (0.004)	12.3	5.7	10.6	6.5	5.4	7.1	9.0	3.9	6.8	10.1	10.4	1.7	5.8	4.8
Eucalyptus globoidea	0.88 (0.005)	0.28 (0.005)	12.4	7.9	13.6	12.2	5.5	5.2	4.6	5.4	12.2	4.9	5.1	1.8	4.1	5.2
Eucalyptus longifolia	0.94 (0.018)	0.05 (0.003)	14.4	13.2	7.2	8.6	5.4	12.3	1.4	6.7	12.0	3.9	3.2	3.5	3.1	5.0
Eucalyptus melliodora	0.92 (0.013)	0.04 (0.002)	10.2	14.7	18.4	14.2	5.4	7.6	2.5	8.4	2.8	1.7	9.1	1.2	1.1	2.9
Eucalyptus microcorys	0.96 (0.01)	0.05 (0.004)	27.1	11.6	11.0	16.7	3.3	6.8	3.2	3.0	3.6	4.4	1.7	1.8	2.8	2.9
Eucalyptus moluccana	0.93 (0.005)	0.32 (0.011)	14.8	17.1	9.8	14.6	3.8	5.3	4.4	2.9	5.3	2.3	4.1	8.3	3.8	3.5
Eucalyptus paniculata	0.86 (0.006)	0.24 (0.003)	10.2	7.1	13.4	10.9	6.7	8.9	4.2	5.6	7.8	6.8	4.3	4.1	4.5	5.5
Eucalyptus parramattensis	0.97 (0.005)	0.07 (0.005)	8.2	5.3	29.0	11.5	6.0	3.7	3.6	5.4	5.5	2.1	3.1	3.7	1.2	11.8
Eucalyptus propinqua	0.97 (0.004)	0.05 (0.002)	15.8	7.6	15.5	17.8	8.9	4.6	2.1	4.4	5.6	6.3	1.3	1.4	3.1	5.7
Eucalyptus punctata	0.85 (0.003)	0.68 (0.006)	11.0	7.5	8.2	19.4	4.3	7.5	4.1	9.4	6.6	5.4	4.5	2.2	3.6	6.4
Eucalyptus quadrangulata	0.97 (0.011)	0.03 (0.003)	33.5	3.6	7.5	5.2	3.9	13.4	1.9	3.6	9.9	8.8	2.2	1.4	3.8	1.3
Eucalyptus robusta	0.95 (0.004)	0.17 (0.005)	6.7	5.8	7.6	15.7	7.3	5.6	2.8	13.4	6.4	4.9	7.7	3.6	3.7	8.6

	Model performance		Predictor relative contribution (%)													
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**clay0_30**	**sand0_30**	**des000_200**
Eucalyptus tereticornis	0.9 (0.005)	0.42 (0.007)	13.6	15.9	7.8	11.2	4.6	6.5	3.2	4.9	5.8	3.6	4.8	9.2	3.3	5.8
Melaleuca quinquenervia	0.96 (0.003)	0.12 (0.003)	8.7	7.0	11.2	13.4	5.4	7.5	2.0	9.6	13.1	3.6	6.7	2.3	3.1	6.4

Notes: AUC = area under the curve; SE = standard error.

Table A.16. South Coast tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)													
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**clay0_30**	**sand0_30**	**des000_200**
Corymbia gummifera	0.93 (0.015)	0.55 (0.016)	12.8	4.8	22.4	7.3	2.5	4.2	5.9	7.8	7.1	3.9	5.2	3.0	7.8	5.3
Eucalyptus bosistoana	0.93 (0.005)	0.34 (0.011)	15.3	10.5	9.3	16.7	3.1	8.3	3.8	4.5	4.2	6.6	5.5	2.5	4.5	5.3
Eucalyptus cypellocarpa	0.91 (0.004)	0.61 (0.014)	15.8	7.0	27.3	7.3	3.5	4.8	4.0	4.3	3.3	5.6	4.2	2.7	5.8	4.4
Eucalyptus eugenioides	0.91 (0.009)	0.15 (0.004)	20.4	16.5	7.0	14.9	2.7	6.5	4.1	4.8	5.1	3.5	4.5	2.7	3.0	4.4
Eucalyptus globoidea	0.88 (0.003)	0.78 (0.009)	17.4	15.0	11.5	7.4	2.8	5.5	3.7	7.7	5.3	7.5	3.8	3.5	4.0	4.9
Eucalyptus longifolia	0.95 (0.002)	0.34 (0.006)	13.7	10.6	18.8	14.0	2.9	5.4	2.2	6.0	7.1	3.6	6.2	2.3	3.4	3.6
Eucalyptus maidenii	0.96 (0.005)	0.22 (0.01)	12.3	18.3	24.0	8.2	1.5	5.3	3.0	3.1	5.7	4.9	5.1	2.4	3.3	2.6
Eucalyptus punctata	0.97 (0.005)	0.13 (0.005)	19.9	19.9	9.7	9.7	1.8	7.7	4.3	4.4	3.8	2.3	4.1	3.8	5.2	3.4
Eucalyptus tereticornis	0.94 (0.003)	0.3 (0.006)	16.4	25.7	7.6	14.0	2.2	3.9	3.2	2.8	4.2	4.2	3.8	3.4	3.2	5.5
Eucalyptus tricarpa	0.97 (0.006)	0.14 (0.01)	12.9	9.2	21.2	12.0	2.8	10.0	2.9	2.9	3.9	4.8	7.5	2.2	2.8	4.9
Eucalyptus viminalis	0.95 (0.010)	0.25 (0.010)	6.9	5.1	23.0	8.7	2.2	5.0	2.6	24.1	5.0	2.7	4.1	4.8	2.5	3.3

Notes: AUC = area under the curve; SE = standard error.

Table A.17. Central and Southern Tablelands tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model Performance		Predictor Relative Contribution (%)																	
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**rs_fpc**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus albens	0.96 (0.005)	0.15 (0.006)	15.8	7.4	11.6	6.6	2.6	5.0	2.5	4.7	2.4	1.5	2.2	4.0	7.3	2.6	2.5	14.0	4.8	2.5
Eucalyptus blakelyi	0.94 (0.006)	0.24 (0.007)	9.3	5.2	13.1	8.5	2.9	3.9	2.0	4.7	4.2	2.7	2.1	5.7	7.1	2.1	4.3	16.8	3.1	2.6
Eucalyptus camaldulensis	0.98 (0.003)	0.02 (0.003)	16.5	11.4	2.7	3.0	8.2	14.1	2.5	1.7	16.7	1.2	1.0	0.3	5.1	7.4	1.8	2.3	2.7	1.3
Eucalyptus cypellocarpa	0.94 (0.006)	0.27 (0.007)	14.6	15.0	9.4	4.4	1.9	3.0	3.4	3.3	2.6	2.6	2.6	19.1	2.2	2.2	4.2	3.3	3.0	3.3
Eucalyptus elata	0.93 (0.004)	0.13 (0.004)	10.9	10.4	9.2	6.2	5.2	4.4	3.2	3.1	2.3	3.3	5.0	9.1	4.4	3.0	4.4	6.8	4.2	5.0
Eucalyptus globoidea	0.94 (0.005)	0.21 (0.005)	13.2	14.3	12.3	7.4	2.0	2.6	4.1	3.1	4.5	3.2	3.2	4.2	2.4	2.1	5.3	10.3	3.6	2.1
Eucalyptus goniocalyx	0.93 (0.003)	0.25 (0.004)	12.6	8.3	10.0	13.3	2.3	3.3	4.4	5.0	2.3	2.3	3.2	6.3	4.1	2.1	2.8	10.3	4.3	3.3
Eucalyptus mannifera	0.89 (0.006)	0.41 (0.007)	10.9	7.1	14.5	7.3	2.5	5.2	1.9	3.2	5.1	2.7	4.0	8.4	3.3	3.4	4.5	9.2	2.9	3.9
Eucalyptus punctata	0.95 (0.005)	0.27 (0.005)	27.0	7.9	5.2	10.9	2.3	3.2	1.8	4.5	4.2	2.6	3.1	6.0	1.9	2.3	4.0	5.1	4.7	3.3
Eucalyptus radiata	0.9 (0.006)	0.38 (0.007)	13.9	9.1	13.0	6.8	1.8	3.2	2.3	4.0	3.5	2.1	2.1	10.1	2.2	3.9	2.8	13.4	3.1	2.8
Eucalyptus rossii	0.91 (0.005)	0.34 (0.005)	12.1	5.0	10.2	5.5	2.0	4.6	3.1	4.9	4.6	3.8	3.3	5.9	4.6	2.7	7.1	13.1	2.9	4.6

	Model Performance		Predictor Relative Contribution (%)																		
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**rs_fpc**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus sclerophylla	0.94 (0.003)	0.19 (0.003)	13.1	5.0	14.7	5.4	2.8	3.0	4.7	2.8	7.1	3.7	1.7	5.7	3.0	2.1	4.3	13.5	2.9	4.5
Eucalyptus tereticornis	0.95 (0.005)	0.13 (0.006)	15.9	9.4	7.8	12.1	2.6	3.3	3.2	2.8	8.1	2.9	5.4	9.6	2.7	1.5	1.8	3.6	4.5	2.8
Eucalyptus viminalis	0.86 (0.006)	0.45 (0.006)	8.8	7.1	17.6	5.0	3.9	3.8	3.4	5.1	3.2	3.2	5.4	6.7	3.7	4.8	5.4	4.8	3.6	4.5

Notes: AUC = area under the curve; SE = standard error.

Table A.18. Northern Tablelands tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus acaciiformis	0.96 (0.009)	0.13 (0.009)	11.1	3.0	7.9	8.5		4.8		12.5	5.7	3.4	10.3	3.4	2.5	5.5	12.4	5.6	3.3
Eucalyptus albens	0.96 (0.011)	0.28 (0.011)	8.5	2.6	2.6	3.9	2.2	5.1	1.9	4.5	2.7	2.9	3.7	3.2	2.9	2.5	44.9	1.9	4.2
Eucalyptus biturbinata	0.96 (0.006)	0.21 (0.007)	14.0	12.2	7.5	9.5		11.6	2.9	8.5	3.1	3.6	6.6		3.8	5.3	4.0	2.4	5.0
Eucalyptus blakelyi	0.9 (0.01)	0.5 (0.012)	11.7	6.6	8.6	7.0	3.7	4.3		8.2	7.5		4.5	4.0	3.3	10.1	13.3	3.9	3.2
Eucalyptus brunnea	0.95 (0.005)	0.24 (0.008)	26.2	9.6	6.4	5.1	3.9	5.9		5.4		4.7	3.8	3.4		6.1	7.0	6.8	5.6
Eucalyptus camaldulensis	0.98 (0.004)	0.03 (0.004)	2.2	2.8	5.3	11.8	1.2	15.1		8.0	11.4	1.3	3.4		1.1	1.2	30.1	4.4	0.7
Eucalyptus dalrympleana	0.9 (0.006)	0.35 (0.006)	7.7	6.6	17.3	6.5		7.8		9.2	6.7		6.6	3.3	3.5	7.7	7.1	5.4	4.7
Eucalyptus dealbata	0.94 (0.007)	0.32 (0.008)	13.1	4.2	6.1	5.8		4.6	3.0	6.2			4.3	10.6	9.9	3.8	18.4	3.6	6.2
Eucalyptus laevopinea	0.85 (0.011)	0.56 (0.011)	14.4	5.1	6.9	7.5	3.6	5.4	3.8	6.7	6.0	3.2	4.9	3.4	3.6	3.9	10.2	5.3	6.2
Eucalyptus melliodora	0.89 (0.008)	0.57 (0.01)	16.0	9.1	8.9	7.8		6.8		5.4	4.4	3.6	3.8	3.5	3.3	4.6	11.7	6.0	4.9
Eucalyptus microcorys	0.95 (0.009)	0.3 (0.01)	17.8	14.9	7.0	5.7		4.5	2.4	6.3	2.5	3.8	4.1	2.7	3.0	5.8	8.2	5.0	6.2

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus moluccana	0.93 (0.006)	0.23 (0.008)	10.0	11.3	10.1	12.4		6.0		4.8	5.7	4.5	4.4	5.6	4.6	3.6	8.5		8.5
Eucalyptus nicholii	0.93 (0.006)	0.04 (0.006)	9.0	40.5	10.9	10.7	0.6	1.7	0.9	2.3	2.7	0.5	3.8	0.9	1.4	2.3	1.7	2.3	8.0
Eucalyptus nobilis	0.95 (0.005)	0.27 (0.005)	9.9	6.6	13.1	22.2	2.3	4.8	2.2	3.1	2.6	2.8	3.9	2.6	3.5	2.8	10.7	4.0	2.9
Eucalyptus pauciflora	0.95 (0.005)	0.2 (0.004)	8.9	5.5	15.9	13.0	2.7	4.2	1.9	12.0	4.0	2.4	5.2		3.5	4.7	9.2	3.3	3.6
Eucalyptus radiata	0.93 (0.008)	0.33 (0.009)	12.0	4.8	11.1	8.8	3.3	5.5	2.6	4.9	5.1	4.0	4.5		3.1	4.5	17.3	4.3	4.2
Eucalyptus tereticornis	0.97 (0.004)	0.23 (0.004)	10.2	32.7	7.2	5.9	2.1	8.3	2.3	2.0	3.2	2.8	3.7	2.3	1.6	4.7	5.7	2.4	3.0
Eucalyptus viminalis	0.92 (0.011)	0.27 (0.013)	14.7	7.3	10.3	4.7	4.8	7.4	3.2	4.6	5.3	2.7	2.9	3.9	3.7	5.5	5.7	3.9	9.4

Notes: AUC = area under the curve; SE = standard error.

Table A.19. North Western Slopes tree model accuracies based on 10-fold cross-validation, and the relative importance of environmental predictors for species included in the Koala Tree Index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus albens	0.87 (0.007)	0.61 (0.006)	9.7	6.0	3.3	4.6	2.9	4.8	3.0	12.4	4.7	3.5	3.5	5.1	2.9	6.7	19.4		7.5
Eucalyptus blakelyi	0.82 (0.004)	0.5 (0.004)	9.3	4.9	6.9	8.2	7.2	6.5		12.5	4.9		10.9	3.7	5.1	5.0	5.3	4.6	4.8
Eucalyptus camaldulensis	0.94 (0.002)	0.11 (0.002)	4.3	6.3	8.6	8.7	7.3	25.5		12.1	6.1	2.3	4.5	1.5	2.6	3.5	3.9	2.9	
Eucalyptus canaliculata	0.99 (0.002)	0.03 (0.002)	2.1	8.1	42.4	15.5	0.7	1.5	4.1	2.1	1.3	1.2	0.9		1.8	3.5	6.5	8.2	
Eucalyptus chloroclada	0.88 (0.004)	0.24 (0.004)	11.9	4.1	7.2	4.6	6.6	6.9			10.4		3.9	8.3	4.5	4.2	6.4	10.1	10.9
Eucalyptus conica	0.91 (0.003)	0.07 (0.003)	9.0	14.3	3.1	6.2	8.7	5.3	0.7	8.4	4.0	2.7	7.8	5.8	7.6	5.6	7.3	2.4	1.2
Eucalyptus coolabah	0.99 (0.003)	0.07 (0.003)	5.3	3.7	29.5	18.2	4.4	8.3	1.8	2.8	2.2	1.9	2.3	4.8	3.0	3.8	2.4	3.5	2.2
Eucalyptus crebra	0.87 (0.004)	0.65 (0.005)	15.8	6.1	5.7	5.0	3.6	6.7	2.6	3.3	4.2	3.0	3.8	4.8	3.5	4.8	10.2	4.0	12.9
Eucalyptus dealbata	0.88 (0.007)	0.41 (0.008)	24.2	3.9	4.7	3.2		3.0		5.1	3.7	3.7	5.0	12.2	13.6	2.5	9.5	2.5	3.4
Eucalyptus dwyeri	0.89 (0.005)	0.25 (0.005)	13.1	5.4	6.2	7.0	4.7	5.5		5.9		7.4	5.6	4.5	5.3	5.7	7.4	6.5	9.7
Eucalyptus laevopinea	0.96 (0.006)	0.16 (0.006)	11.0	3.6	4.3	36.5	2.3	2.5	3.4	3.0	2.1	2.2	3.8	2.0	3.4	5.0	5.6	4.0	5.4

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus largiflorens	0.99 (0.002)	0.02 (0.002)	6.0	22.1	4.9	16.6		5.7		1.7	6.9	10.2	2.6	7.9	3.3		6.9	2.8	2.3
Eucalyptus melanophloia	0.93 (0.006)	0.31 (0.007)	32.9	8.3	3.8	4.8	2.6	4.6		5.3	5.4	2.7	2.7	3.1	2.7	1.8	10.2	6.8	2.4
Eucalyptus melliodora	0.86 (0.003)	0.37 (0.003)	9.7	6.8	6.6	9.7		9.1		8.8	5.0	5.7	10.0	5.1		5.3	6.3	6.3	5.4
Eucalyptus microcarpa	0.91 (0.005)	0.1 (0.005)	14.0	24.2	6.1	6.9	2.4	3.3		7.5	4.6		2.5	3.2	10.2	2.8	3.2	5.1	4.1
Eucalyptus moluccana	0.85 (0.004)	0.21 (0.004)	21.7	18.3	8.0	3.9	2.0	5.2	1.9	4.0	3.9	3.2	3.1	3.8	3.3	2.4	4.5	5.3	5.6
Eucalyptus pauciflora	0.99 (0.004)	0.04 (0.004)	1.0	1.4	48.2	12.9	1.6	1.7	1.1	6.6	1.7	0.8	2.4	1.9	3.7	2.4	6.3	4.0	2.3
Eucalyptus pilligaensis	0.93 (0.004)	0.14 (0.003)	8.7	5.6	10.6	6.1	8.6	2.4	2.0	4.2	15.3	1.4	1.6	4.1	3.2	3.6	9.7	5.5	7.3
Eucalyptus populnea	0.96 (0.004)	0.19 (0.005)	5.9	5.7	8.0	24.0	4.4	4.1		5.1	5.3	3.5	6.2	4.0	6.4		9.1	4.7	3.6
Eucalyptus prava	0.97 (0.004)	0.11 (0.003)	29.1	1.7	3.0	14.5		3.8		0.6	0.8	2.2		8.4	4.1	3.7	1.4	7.9	18.7
Eucalyptus punctata	0.97 (0.003)	0.13 (0.004)	26.6	20.0	5.8	2.1			2.8	6.0	1.7	5.0	3.3	3.7	2.7	2.8	8.8	6.9	1.9

Notes: AUC = area under the curve; SE = standard error.

Table A.20. Western tree model accuracies based on 10-fold cross validation, and the relative importance of environmental predictors for species included in the koala tree index. Predictor code names are described in Table 13.

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Callitris glaucophylla	0.96 (0.003)	0.3 (0.003)	9.4	7.3	9.4	8.3	2.0	5.5	1.1	1.6	2.0	1.1	1.7	2.3	2.0	2.2	37.4	2.5	4.1
Casuarina cristata	0.91 (0.002)	0.2 (0.002)	15.5	6.9	11.5	6.8	5.1	9.0	1.9	3.4	3.0	2.2	4.0	4.0	7.3	6.5	4.3	5.1	3.3
Eucalyptus albens	0.95 (0.002)	0.21 (0.002)	9.0	5.3	8.1	5.9	1.9	3.6	2.2	9.2	2.9	2.2	3.0	4.7	2.3	4.9	26.9	2.3	5.6
Eucalyptus blakelyi	0.92 (0.001)	0.24 (0.001)	10.0	4.4	16.1	5.8	3.9	3.9	1.9	7.9	3.9	1.8	4.8	4.2	3.0	5.9	15.8	3.4	3.3
Eucalyptus camaldulensis	0.98 (0.002)	0.13 (0.003)	10.1	4.0	5.9	8.4	3.4	25.8	1.2	3.7	14.1	1.2	2.4	1.5	3.2	4.7	6.8	2.2	1.5
Eucalyptus chloroclada	0.9 (0.004)	0.2 (0.004)	16.0	6.0	5.9	3.9	6.1	7.5	1.6	2.1	7.0	2.4	3.4	8.6	3.1	5.0	4.4	5.6	11.6
Eucalyptus conica	0.95 (0.001)	0.03 (0.001)	12.7	12.8	6.8	7.3	4.6	6.4	1.9	7.4	3.5	1.7	4.8	5.1	4.4	6.5	8.9	2.3	3.0
Eucalyptus coolabah	0.96 (0.005)	0.24 (0.006)	5.7	4.5	26.7	5.1	5.5	7.4	1.1	3.1	2.9	1.5	2.8	3.9	9.8	3.9	4.6	8.7	3.0
Eucalyptus crebra	0.94 (0.003)	0.29 (0.003)	23.8	5.8	7.1	12.8	2.3	4.0	1.9	2.6	3.1	2.2	2.6	4.0	2.3	3.0	14.5	2.9	5.1
Eucalyptus dealbata	0.95 (0.002)	0.15 (0.002)	18.1	3.3	13.3	3.4	1.4	2.1	1.9	4.4	2.5	2.4	3.6	9.7	6.6	3.6	17.4	2.5	4.0
Eucalyptus dwyeri	0.97 (0.002)	0.11 (0.002)	7.9	11.6	9.6	6.0	2.5	5.8	1.4	11.2	3.1	3.6	4.5	3.0	2.4	3.6	9.6	9.1	5.1

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus largiflorens	0.93 (0.003)	0.29 (0.004)	9.3	9.2	7.5	11.1	4.5	10.8	1.2	4.1	9.6	2.0	4.3	3.7	6.0	3.6	6.3	2.8	4.2
Eucalyptus melanophloia	0.96 (0.002)	0.15 (0.002)	26.9	5.7	10.4	6.1	2.7	4.9	1.6	5.1	3.3	2.0	2.6	4.5	2.0	2.8	12.7	4.4	2.3
Eucalyptus melliodora	0.92 (0.002)	0.22 (0.002)	9.5	4.6	19.3	6.7	2.4	5.1	2.5	5.1	3.8	2.9	4.8	5.2	2.6	5.1	12.7	3.9	3.9
Eucalyptus microcarpa	0.96 (0.003)	0.11 (0.003)	11.8	14.3	8.7	12.3	3.7	5.5	2.0	4.9	6.8	1.9	1.8	3.3	6.0	3.7	8.2	2.9	2.3
Eucalyptus pilligaensis	0.93 (0.006)	0.13 (0.006)	6.8	11.0	7.0	11.9	6.8	3.2	2.7	4.3	9.6	2.2	2.1	4.5	3.6	5.2	8.0	3.8	7.3
Eucalyptus populnea	0.94 (0.004)	0.31 (0.004)	14.9	14.4	8.7	13.9	3.5	4.6	1.2	3.6	3.9	1.9	4.2	2.6	2.7	3.3	10.2	3.8	2.4
Callitris glaucophylla	0.96 (0.003)	0.3 (0.003)	9.4	7.3	9.4	8.3	2.0	5.5	1.1	1.6	2.0	1.1	1.7	2.3	2.0	2.2	37.4	2.5	4.1
Casuarina cristata	0.91 (0.002)	0.2 (0.002)	15.5	6.9	11.5	6.8	5.1	9.0	1.9	3.4	3.0	2.2	4.0	4.0	7.3	6.5	4.3	5.1	3.3
Eucalyptus albens	0.95 (0.002)	0.21 (0.002)	9.0	5.3	8.1	5.9	1.9	3.6	2.2	9.2	2.9	2.2	3.0	4.7	2.3	4.9	26.9	2.3	5.6
Eucalyptus blakelyi	0.92 (0.001)	0.24 (0.001)	10.0	4.4	16.1	5.8	3.9	3.9	1.9	7.9	3.9	1.8	4.8	4.2	3.0	5.9	15.8	3.4	3.3
Eucalyptus camaldulensis	0.98 (0.002)	0.13 (0.003)	10.1	4.0	5.9	8.4	3.4	25.8	1.2	3.7	14.1	1.2	2.4	1.5	3.2	4.7	6.8	2.2	1.5
Eucalyptus chloroclada	0.9 (0.004)	0.2 (0.004)	16.0	6.0	5.9	3.9	6.1	7.5	1.6	2.1	7.0	2.4	3.4	8.6	3.1	5.0	4.4	5.6	11.6

	Model performance		Predictor relative contribution (%)																
Species	**AUC (SE)**	**Deviance explained (SE)**	**radseas**	**tempiso**	**tempmtcp**	**precipdp**	**strmdstall**	**strmdstge6**	**exp315**	**logre10**	**rough0500**	**tpi0250**	**tpi2000**	**awc000_100pr**	**cly000_100pr**	**nto000_100pr**	**phc000_100pr**	**slt000_100pr**	**snd000_100pr**
Eucalyptus conica	0.95 (0.001)	0.03 (0.001)	12.7	12.8	6.8	7.3	4.6	6.4	1.9	7.4	3.5	1.7	4.8	5.1	4.4	6.5	8.9	2.3	3.0
Eucalyptus coolabah	0.96 (0.005)	0.24 (0.006)	5.7	4.5	26.7	5.1	5.5	7.4	1.1	3.1	2.9	1.5	2.8	3.9	9.8	3.9	4.6	8.7	3.0
Eucalyptus crebra	0.94 (0.003)	0.29 (0.003)	23.8	5.8	7.1	12.8	2.3	4.0	1.9	2.6	3.1	2.2	2.6	4.0	2.3	3.0	14.5	2.9	5.1
Eucalyptus dealbata	0.95 (0.002)	0.15 (0.002)	18.1	3.3	13.3	3.4	1.4	2.1	1.9	4.4	2.5	2.4	3.6	9.7	6.6	3.6	17.4	2.5	4.0

Notes: AUC = area under the curve; SE = standard error.

Table A.21. Summary of all species included in regional Koala Tree Indices and the number of times each species was included in an index.

Species (listed alphabetically)	CC	CST	DRP	FW	NC	NT	NWS	Riv	SC	Number of times included in a regional index
Corymbia gummifera	1								1	2
Eucalyptus acaciiformis						1				1
Eucalyptus albens	1	1		1		1	1			5
Eucalyptus bancroftii					1					1
Eucalyptus biturbinata					1	1				2
Eucalyptus blakelyi	1	1		1		1	1			5
Eucalyptus bosistoana	1								1	2
Eucalyptus brunnea						1				1
Eucalyptus camaldulensis	1	1	1	1		1	1	1		7
Eucalyptus canaliculata	1				1		1			3
Eucalyptus chloroclada							1			1
Eucalyptus conica			1				1			2
Eucalyptus coolabah			1	1			1			3
Eucalyptus crebra							1			1
Eucalyptus cypellocarpa	1	1							1	3
Eucalyptus dalrympleana						1				1
Eucalyptus dealbata			1	1		1	1			4
Eucalyptus deanei	1									1
Eucalyptus dwyeri			1				1			2
Eucalyptus elata		1								1
Eucalyptus eugenioides									1	1

Species (listed alphabetically)	CC	CST	DRP	FW	NC	NT	NWS	Riv	SC	Number of times included in a regional index
Eucalyptus globoidea	1	1							1	3
Eucalyptus goniocalyx		1								1
Eucalyptus grandis					1					1
Eucalyptus laevopinea						1	1			2
Eucalyptus largiflorens			1	1			1	1		4
Eucalyptus longifolia	1								1	2
Eucalyptus maidenii									1	1
Eucalyptus mannifera		1								1
Eucalyptus melanophloia			1							1
Eucalyptus melliodora	1		1			1	1	1		5
Eucalyptus microcarpa			1				1	1		3
Eucalyptus microcorys	1				1	1				3
Eucalyptus moluccana	1				1	1	1			4
Eucalyptus nicholii						1				1
Eucalyptus nobilis					1	1				2
Eucalyptus paniculata	1									1
Eucalyptus parramattensis	1									1
Eucalyptus pauciflora						1	1			2
Eucalyptus pilligaensis							1			1
Eucalyptus populnea			1	1			1	1		4
Eucalyptus prava							1			1
Eucalyptus propinqua	1				1					2

Species (listed alphabetically)	CC	CST	DRP	FW	NC	NT	NWS	Riv	SC	Number of times included in a regional index
Eucalyptus punctata	1	1			1		1		1	5
Eucalyptus quadrangulata	1									1
Eucalyptus radiata		1				1				2
Eucalyptus resinifera					1					1
Eucalyptus robusta	1				1					2
Eucalyptus rossii		1								1
Eucalyptus saligna					1					1
Eucalyptus sclerophylla		1								1
Eucalyptus tereticornis	1	1			1	1			1	5
Eucalyptus tricarpa									1	1
Eucalyptus viminalis		1				1			1	3
Melaleuca quinquenervia	1				1					2
Total	21	14	10	7	14	18	20	5	11	

Notes: CC = Central Coast, CST = Central and Southern Tablelands, DRP = Darling Riverina Plains, FW = Far West, NC = North Coast, NT = Northern Tablelands, NWS = North West Slopes, Riv = Riverina, SC = South Coast.

8.3 References

Ashcroft MB and Gollan JR 2012, Fine-resolution (25 m) topoclimatic grids of near-surface (5 cm) extreme temperatures and humidities across various habitats in a large (200 x 300 km) and diverse region. *International Journal of Climatology*. 32, 2134–2148.

Elith J, Leathwick JR and Hastie T 2008, A working guide to boosted regression trees. *Journal of Animal Ecology,* 77, 802–813.

Gray JM, Bishop TFA, and Yang X 2015, Pragmatic models for the prediction and digital mapping of soil properties in eastern Australia. *Soil research,* 53, 24–42.

Hijmans RJ, Phillips S, Leathwick J and Elith J 2017, dismo: species distribution modeling. R package version 1.1–4. https://CRAN.R-project.org/package=dismo

Ridgeway R (with contributions from others) 2017, gbm: Generalized boosted regression models. R package version 2.1.3.https://CRAN.R-project.org/package=gbm

Xu T and Hutchinson MF 2013, New developments and applications in the ANUCLIM spatial climatic and bioclimatic modelling package. *Environmental Modelling & Software*. 40, 267–279.