VOLUNTEER EUROBODALLA KOALA PROJECT

REVIEW OF KOALA HABITAT SIGNIFICANCE OF BODALLA STATE FOREST

2021

Contents

Background

Around 9th October 2021, a Dalmeny resident reported seeing a koala in Compartment 3005, just north of Big Rock Road near the Princes Highway intersection. Koala-like scats were collected on 27th November 2021, due for near infra-red spectrometer analysis in 2022. Forestry Corporation NSW deployed audio devices, which produced no result.

On 3rd February 2020, shortly after the catastrophic wildfire, a Forestry Corporation NSW employee had reported seeing a koala in a burnt-out area of Bodalla State Forest.

The volunteer Eurobodalla Koala Project had been aware of reports by landholders at Eurobodalla Road and Waincourt Road, adjacent to Bodalla State Forest, of koalas on their properties, one just before the 2019-2020 wildfire, and an unsubstantiated rumour of koalas near the Potato Point Road.

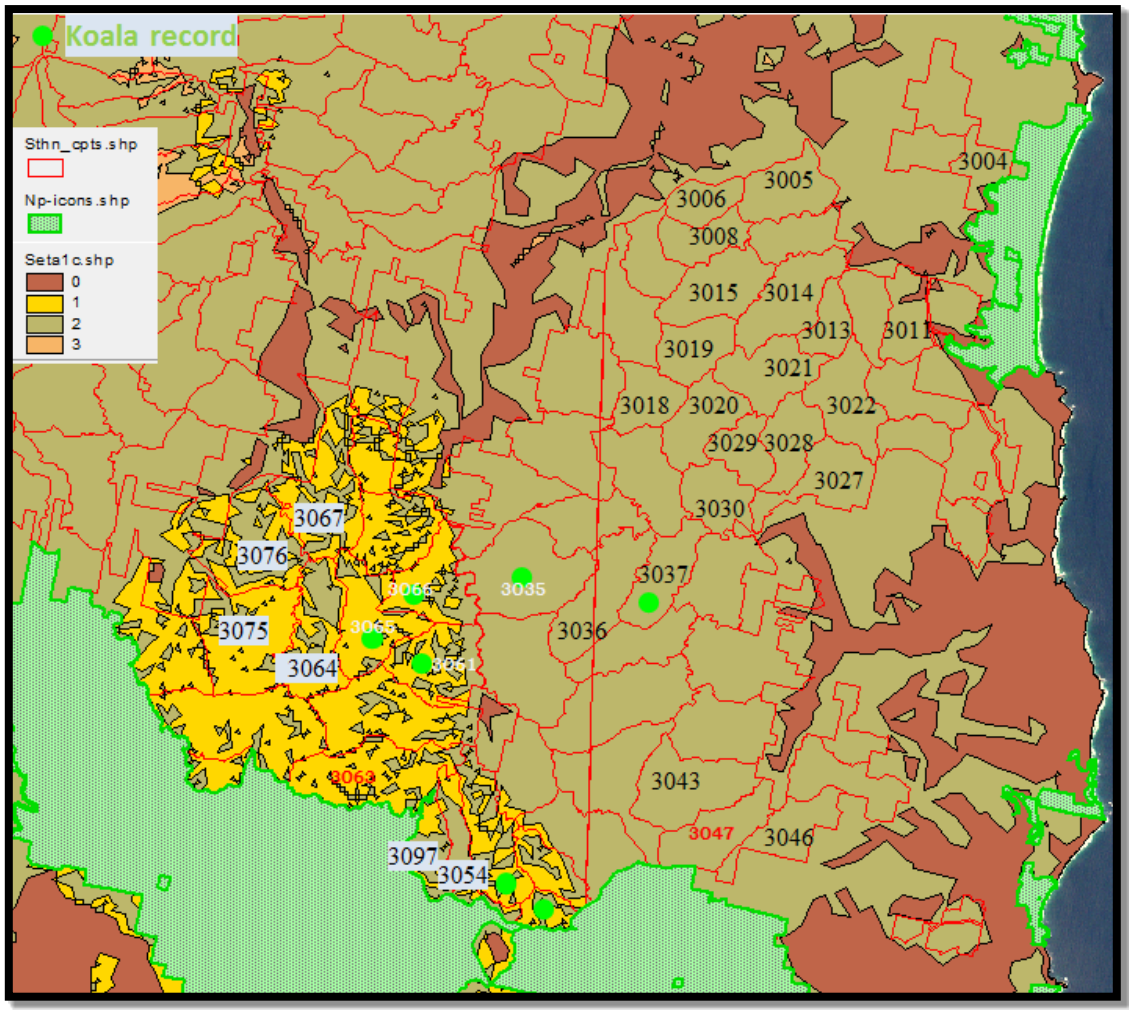
In June 2017, Port Macquarie Koala Hospital was reported to be caring for a koala called "Bodalla Bob", which had been run over by a car. Port Macquarie Hospital named its patients after their place of origin. (Was it one of ours? There is a Bodalla Street at Tullimbar, but that's nowhere near Port Macquarie either.)

There was an earlier report, circa April 2009, of koalas staying briefly in Red Gums on a property at Cheese Factory Road.

NSW Wildlife Atlas mapping (DECCW 2010) shows koala records within the border of Bodalla State Forest during:

- 1941-1970 (2 records)
- 1986-1995 (1 record)
- 1995-1998 (6 sightings in total in Logging Compartments listed as 0055, 0066, 84 and 3084 [one a female with a young on its back])
- 2001-2009 (5 records)

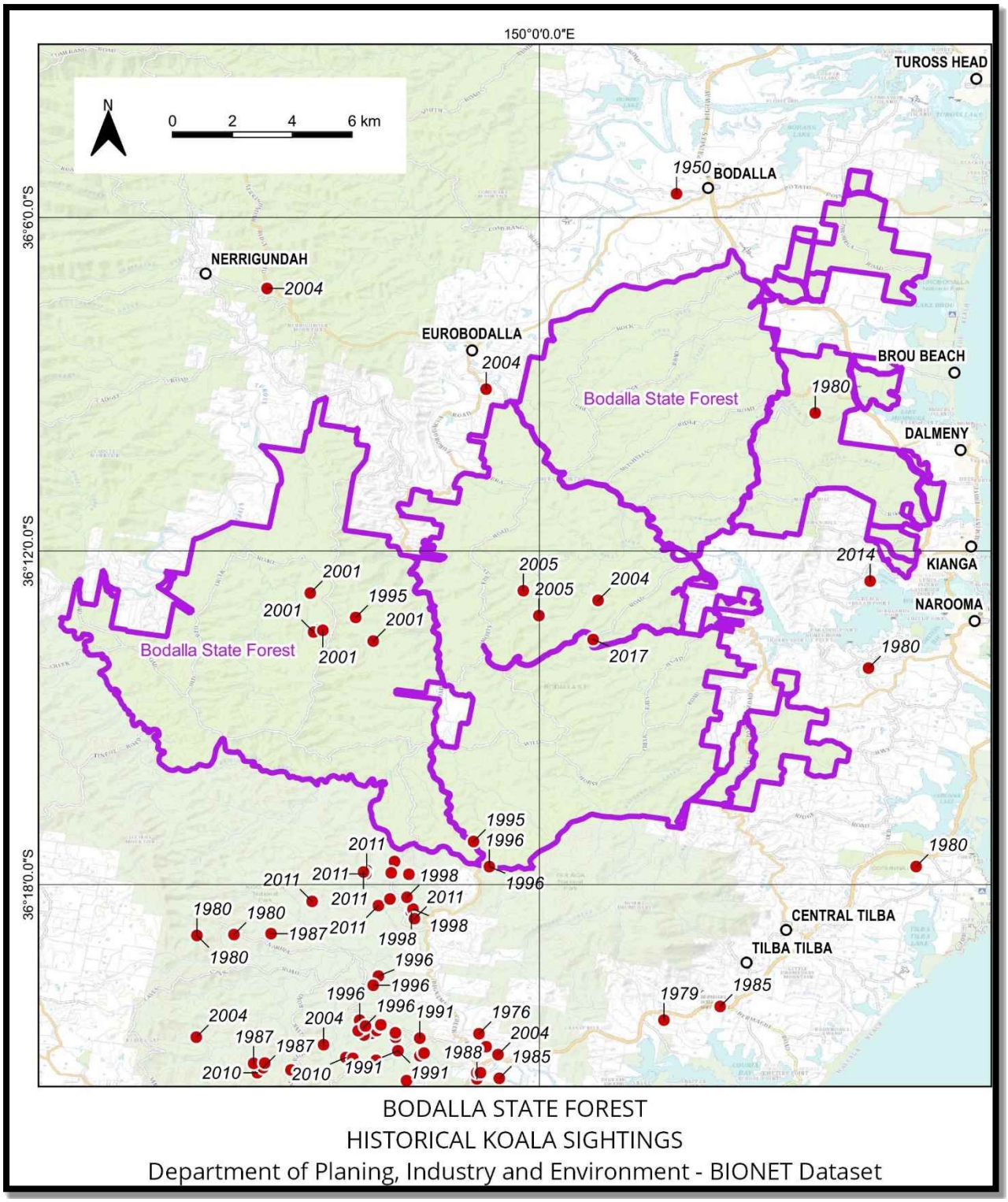
In May 2011, South East Forest Rescue sent a comprehensive submission to the Office of Environment and Heritage EPRG, citing core and intermediate koala habitat in Bodalla State Forest, and a total of 11 local koala records from the Wildlife Atlas (7 of which were in Bodalla State Forest Compartments), mapping them as follows:



Legend: 0=non koala habitat; 1=core, 2=intermediate, and 3=marginal koala habitat.

Forestry Corporation ecologists conducted surveys in 2012 but found no koala evidence in Bodalla State Forest.

Kooraban National Park, bordering the contemporary Bodalla State Forest, was established in January 2001. OEH surveys (2007-2011) estimated between 5 and 15 critically endangered koalas, probably related to the Bermagui population, were living around Sam's Ridge, in the National Park.



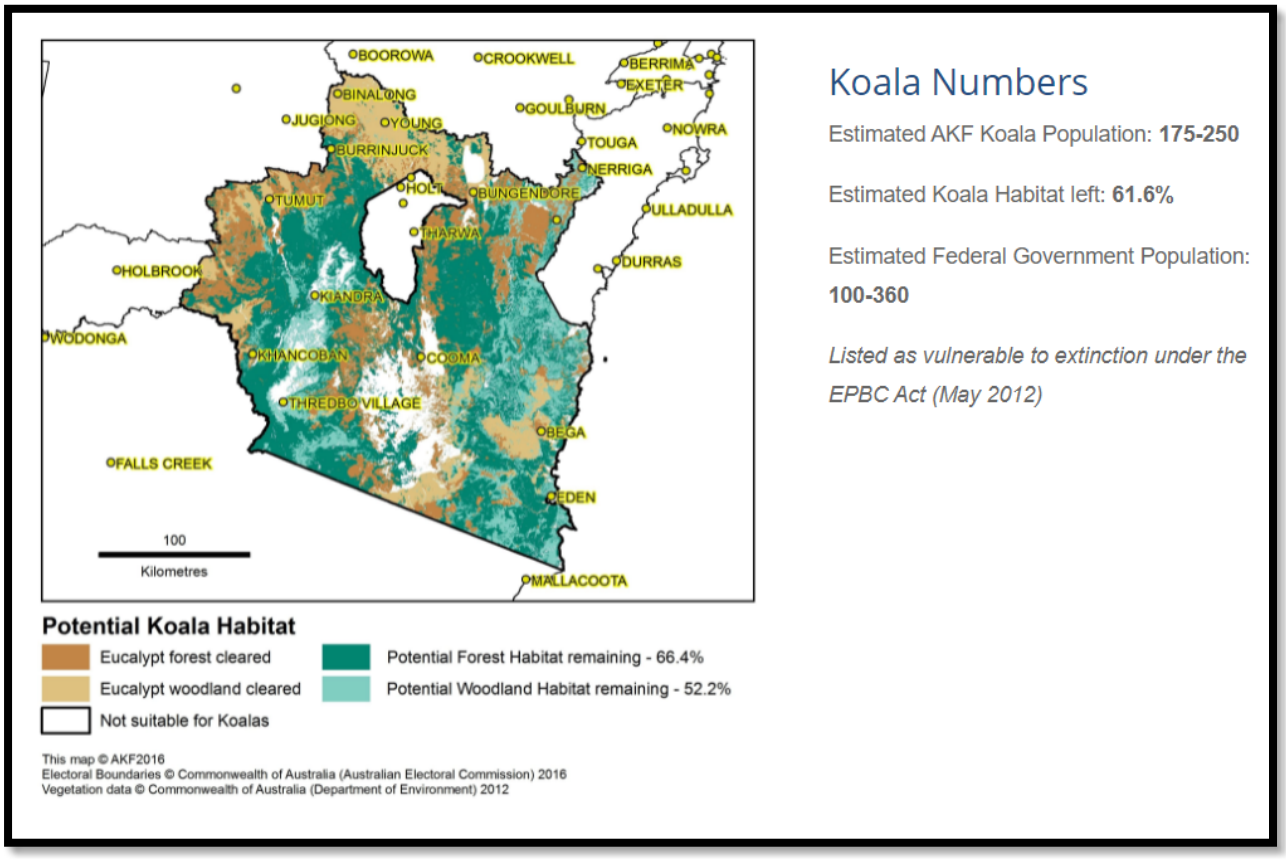
Basing its modeling on the then acknowledged koala browse species, the Eurobodalla Koala Project's pilot study (2013) postulated that Bodalla State Forest was an important component of a swathe of potential Eurobodalla koala habitat. The swathe stretched from the known low-density koala-populated forests at Bermagui and Kooraban National Park, to historical koala sites Nerrigundah and Wamban, with connections to Moruya State Forest

and Deua National Park. It was suggested koalas in a revival context might be able to disperse for breeding from Bermagui to Nerrigundah for example, if they could negotiate logging Compartment 3064 in their direct path, ridges and the Tuross River.

The Australian Koala Foundation issued a press release on 20th September 2021, reporting its research on national koala population decline over the previous few years. For the Eden-Monaro Electorate, the AKF Chairperson stated:

"Another electorate where half the bush was burnt in the summer of 2019 – 2020, but luckily most of the two known Koala populations escaped major harm. There may be about 50 in the Mumbulla, the Numeralla population appeared to be doing OK and 18 were rescued from the fires, but some must have perished. Sixty years ago there were many Koalas in this electorate, in an arc stretching from Dignams Creek near Cobargo to the Murrah State Forest near Bermagui, south to Tantawangalo State Forest, and north to Numeralla near Cooma. There may be quite a few Koalas between Numeralla and Queanbeyan, but no proper surveys have been done. Koalas are extinct in the Tantawangalo Forest and south of Eden. What happened in this electorate? The fur trade in the early 1900s, and millions and millions of trees shipped to Japan as woodchips to make cardboard since 1970, that's what. 'Cheap as chips' has a new meaning when it comes to Koalas in Eden-Monaro."

Australian Koala Foundation map (Eden-Monaro Electorate) September 2021



Koala Numbers

Estimated AKF Koala Population: **175-250**

Estimated Koala Habitat left: **61.6%**

Estimated Federal Government Population: **100-360**

Listed as vulnerable to extinction under the EPBC Act (May 2012)

Method

Readers are invited to criticize and contribute to this review.

[NOTE: Assertions are made about the importance of soil nutrients and topography to koala habitat potential. These are based on research from as long ago as the 1980's. Current research at the Australian National University is addressing the possibility that local soil nutrients are not necessarily correlated with koala tree species use. Similarly, ANU researchers are finding koalas using very steep country at Peak View, for example, where the animals might be found at the bottom of a cliff-like incline one day and at the top another day. Altitude is also included in habitat assumptions, based on historical koala records up to 1,000 metres. ANU researchers are now working with koalas in Kosciusko National Park, at 1,200+ metres.]

An underlying theoretical basis and methodology have been developed and progressively updated between 2012 and 2020 via three citizen science research initiatives available at www.eurokoalas.com, namely the Pilot Study, the Bendethera Report and the Wamban-Nerrigundah Study. The Revised Eurobodalla Koala Recovery Strategy 2021 and the East Lynne Carrying Capacity Study 2021 are also relevant. This report assumes readers are familiar with those documents, so it keeps referencing and some detail to a minimum, but they can be provided on request.

This review is mainly a desktop exercise, assembling already available material around a Bodalla State Forest koala perspective. Helpful ancillary maps, studies and information on locations beyond Bodalla State Forest are added.

To obtain a view of the multiple factors contributing to habitat quality within Bodalla State Forest, we have compared mapping and datasets sourced from NSW BioNet, including:

- historical koala sightings
- vegetation types
- topography
- watercourses
- geology
- soils
- fire history
- severity of the 2019-20 wildfire
- koala habitat suitability ratings, and
- the koala tree index.

Harvest Plans and logging history for individual compartments within Bodalla State Forest, vegetation types in the Forestry Corporation NSW GIS polygons and Eurobodalla Shire

Council endangered ecological communities lists and sensitivity biodiversity GIS maps, are also used.

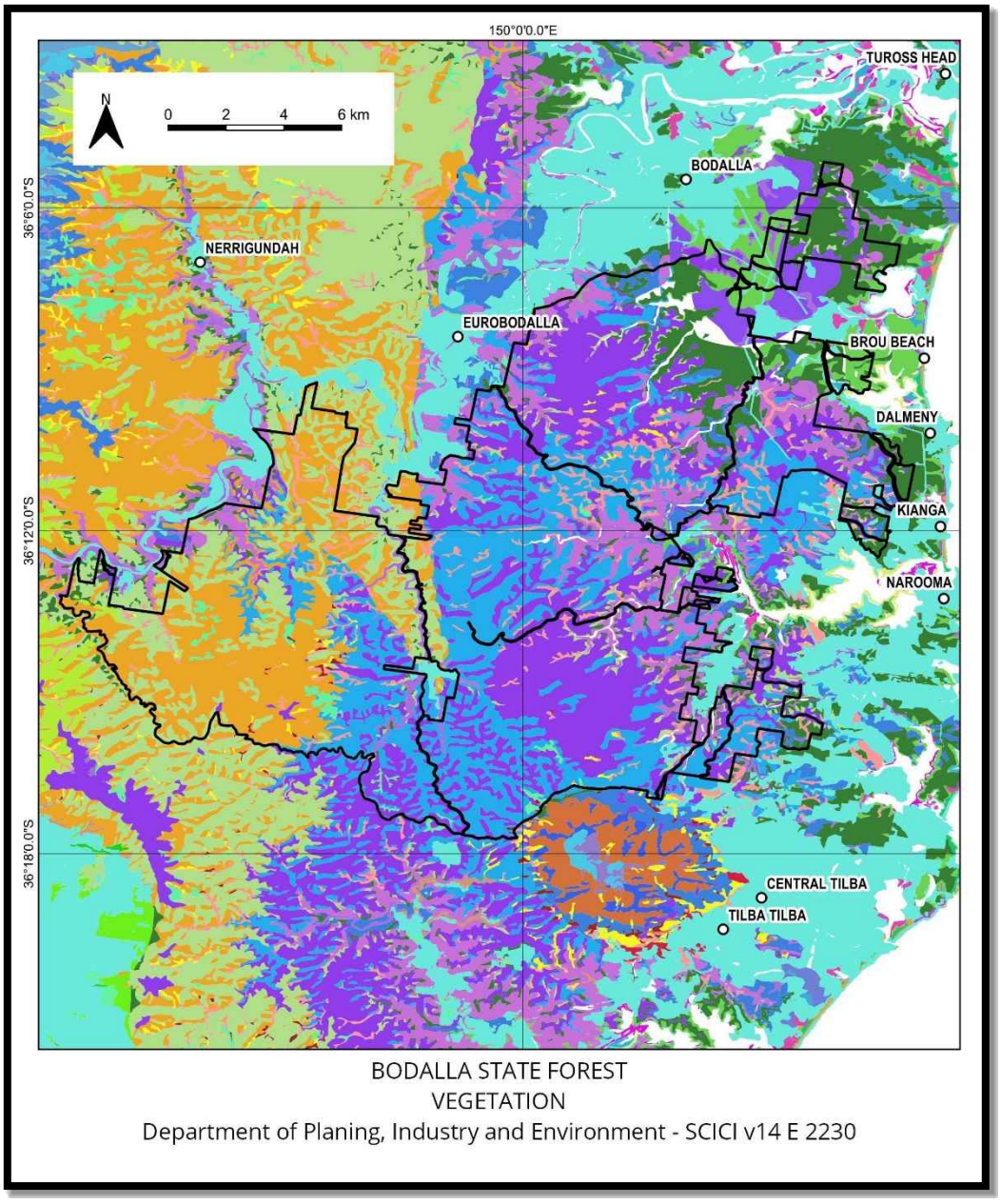
Connectivity (for breeding corridors) beyond Bodalla State Forest is considered.

Miscellaneous other habitat-related materials are canvassed, eg climate change projections.

NSW BioNet Maps

Our GIS volunteer has sourced multiple maps from NSW BioNet.

The ***SCIVI Vegetation Types*** (mapped here) can be searched for their indicative eucalypt species, plus other eucalypt species also occurring in that vegetation type. This helps estimate the potential quality of koala habitat, by cross-referencing with the NSW Review of Koala Tree Species Use, 2018.



BODALLA STATE FOREST
VEGETATION
Department of Planing, Industry and Environment - SCICI v14 E 2230

Legend for SCIVI Vegetation Types Map

From largest to smallest, the SCIVI vegetation types in Bodalla State Forest appear as follows. (The red lettering rates the tree species' documented level of koala use as **H**igh, **S**ignificant, **I**rregular or **L**ow.)

Forest Type	***Positive Diagnostic Trees & Ratings***	***Others Occurring & Ratings***
n184 Clyde-Tuross Hinterland Forest	Cmac **I** Ebos **H** Emue **H** Esmithii **L**	Angflo **S** Cgumm **I** Eang Not rated Ebot **S** Ecyp **H** Eela **L** Eglo **H** Elon **H** Emaidenii **H** Epan **H** Esal x bot **S** Esie **S** Etri **H**
e32A Deua-Brogo Foothills Shrub Forest	Alit **L** Angflo **S** Eagg **I** Ebos **H** Econs **S** Eglo **H** Elon **H** Emue **H** Esie **S** Etri **H**	Angcost **L** Angsub **S** Cgumm **I** Cmac **I** Eang Not rated Ebot **S** Ecyp **H** E eugenoides **I** E fibrosa **S** E melliodora **H** Epan **H** Epil **H** E radiata **S** E smithii **L** Evim **I**
n183 South Coast Hinterland Wet Forest	Angflo **S** Ecyp **H** Efas **L** Elon **H** Emue **H** Esal x bot **S** E scias subsp. callisthma **S** E smithii **L**	Angcost **S** Eagg **I** Eang Not rated E baueriana **I** Ebos **H** Ebot **S** Eela **L** Eglo **H** E maidenii **H** E obliqua **S** Epan **H** Epil **H**

		Epip S E radiata S Esie S
p89 Batemans Bay Foothills Forest	Alit L Angcost S Angflo S Cgumm I Eagg I Econs S Eglo H Epan H Esie S	Cmac I E blaxlandii Not rated Ecyp H E fibrosa S Elon H Emue H Epil H Epip S E radiata S Esal x bot S E scias subsp. call S E smithii L E stenostoma Not rated Etri H
p90 Batemans Bay Cycad Forest	Alit L Cmac I Efibrosa S Eglo H Elon H Emue H Epan H Epil H	Angcost S Angflo S Cgumm I Eagg I Eang Not rated Ebos H Ebot S Econs S Eela L E eugenoides I E maidenii H Epip S E punctata I Esal x bot S E scias subsp. call S Esie S Etri H
e34 South East Coastal Gully Shrub Forest	Alit L Angflo S Ebau I Ebos H Ecyp H Eela L Eglo H Elon H Emue H	Cgumm I Cmac I Eagg I Eang Not rated Ebot S E maidenii H Epan H Epil H E radiata S Esal x bot S Esie S E smithii L Etere H

		Etri **H**
p40 Temperate Dry Rainforest	Ebot **S**	Angflo **S** Cmac **I** Ebau **S** Ebos **H** Ecyp **H** E deanei **S** Eela **L** E eugenoides **I** Efas **L** E fibrosa **S** Elon **H** E maidenii **H** Emue **H** Epan **H** Epil **H** E robusta **H** E sal x bot **S** E smithii **L** Etere **H**

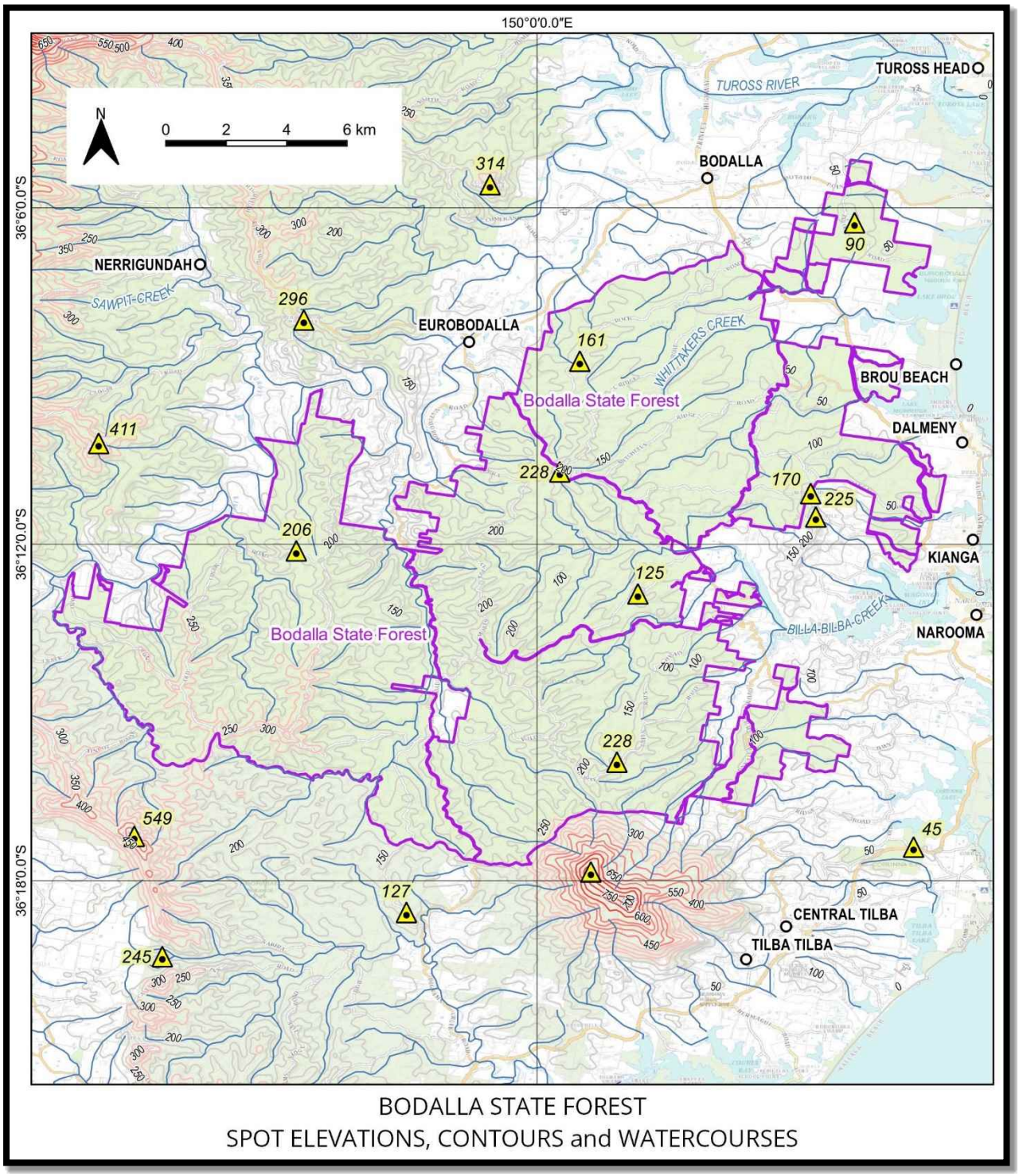
Alternative Biometric Descriptors

An alternative classification to SCIVI is available, but less often used. Here is an extract.

Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner	Yellow Stringybark (Eucalyptus muelleriana), Coast Grey Box (Eucalyptus bosistoana), Mountain Grey Gum (Eucalyptus cypellocarpa), White Stringybark (Eucalyptus globoidea)	Woollybutt (Eucalyptus longifolia)	**It occurs in steep gullies on the coastal range mainly between Merimbula and Narooma.**
Maiden's Gum - White Stringybark shrubby open forest on granitic foothills, southern South East Corner	Maiden's Gum (Eucalyptus maidenii), White Stringybark (Eucalyptus globoidea)	Coast Grey Box (Eucalyptus bosistoana), Blue Box (Eucalyptus baueriana), Yellow Stringybark (Eucalyptus muelleriana), River Peppermint (Eucalyptus elata)	**Occurs at 150-700 m elevation on steep to moderate, dry granitic slopes surrounding the Bega and Towamba valleys and further north between Mumbulla Mountain and Central Tilba.**
Mountain Grey Gum ferny tall moist forest on coastal ranges, southern South East Corner	Mountain Grey Gum (Eucalyptus cypellocarpa)	Yellow Stringybark (Eucalyptus muelleriana), River Peppermint (Eucalyptus elata)	**Widespread in gullies and moist sheltered slopes below 800 m elevation.**

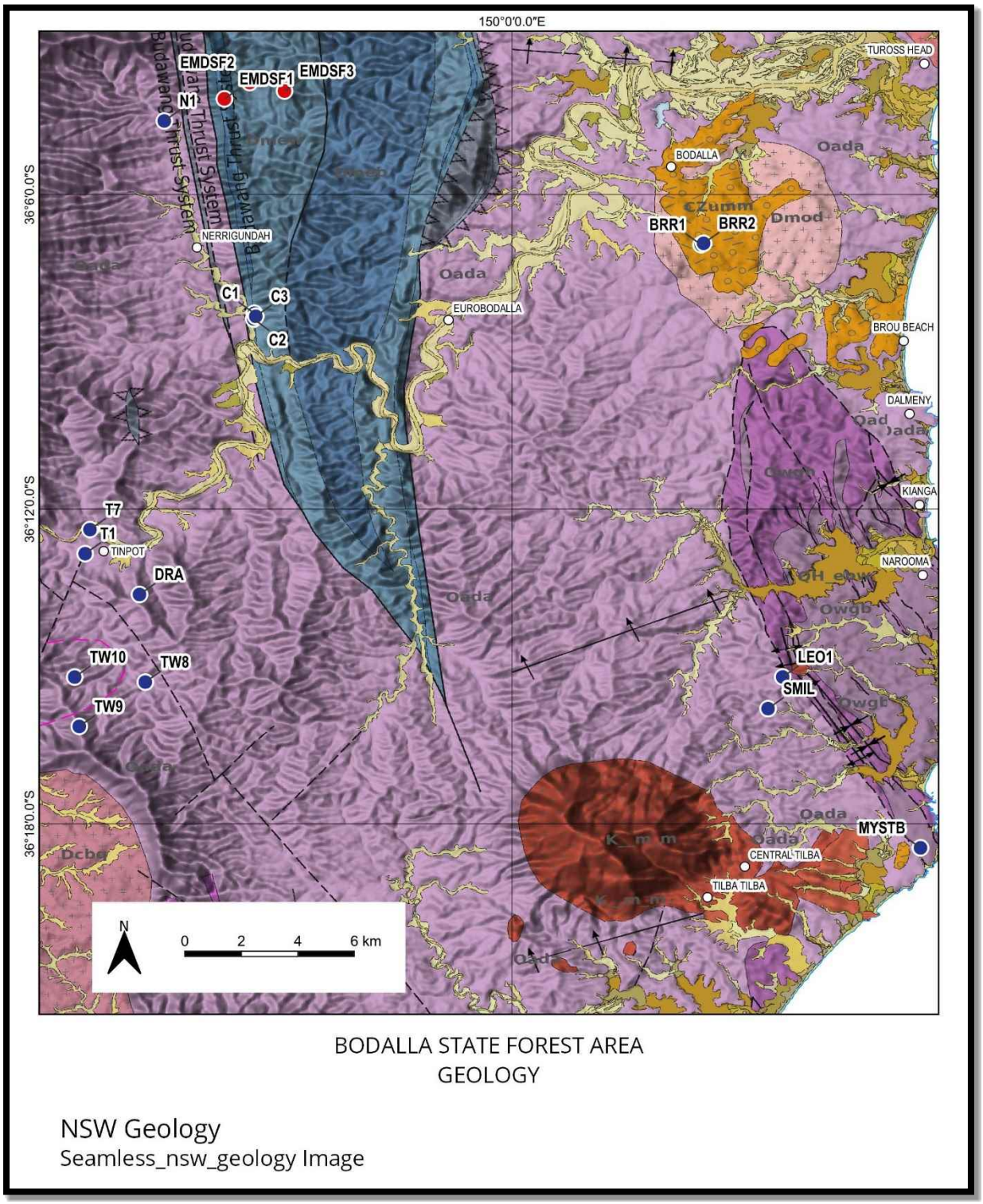
(Also see Forestry Corporation NSW GIS Mapping classifications, below).

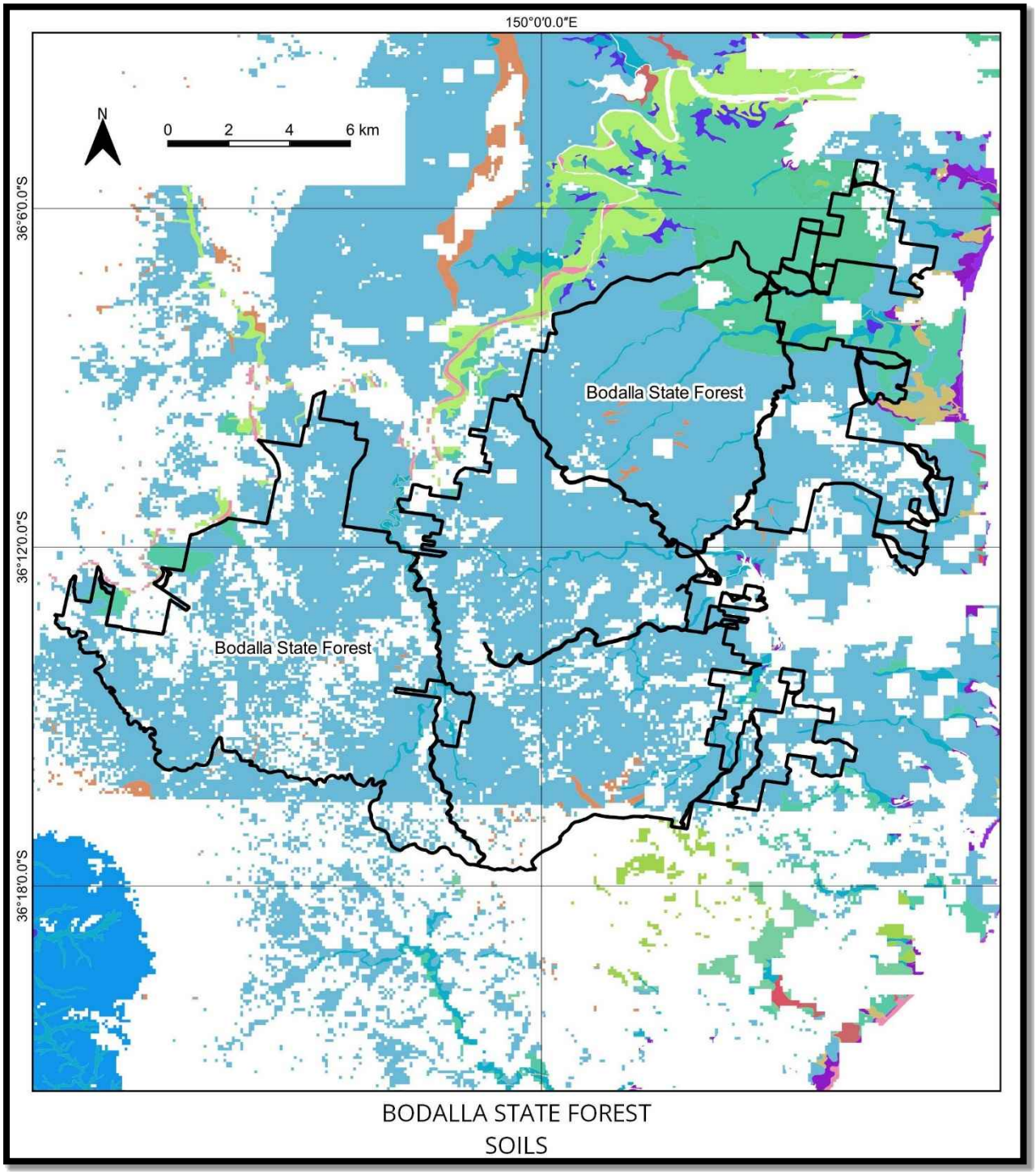
Topography and watercourses are crucial to koala habitat quality. The steeper the slopes and the further away fresh water sources are, the lower the potential habitat quality.



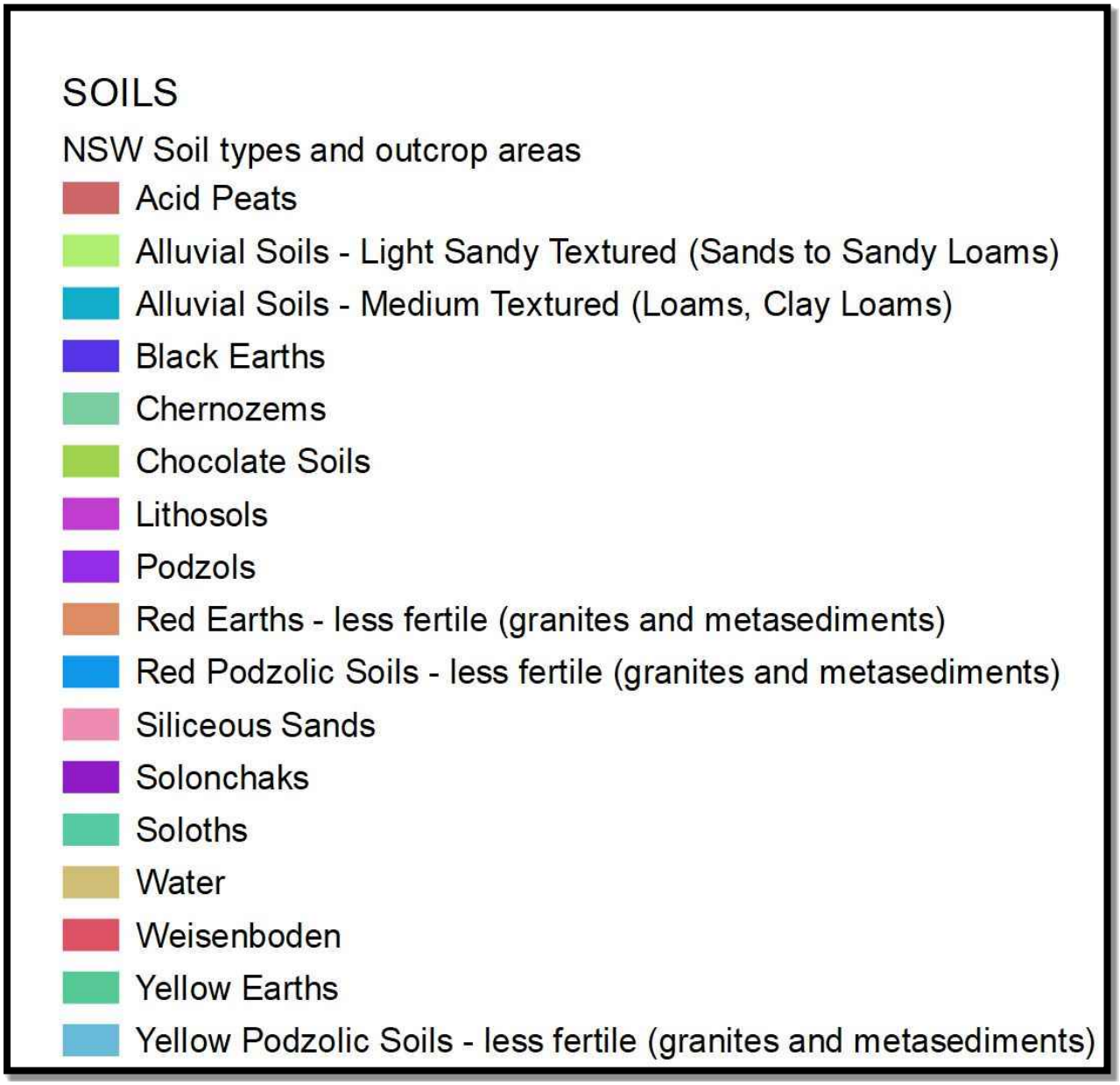
BODALLA STATE FOREST
SPOT ELEVATIONS, CONTOURS and WATERCOURSES

Geology and soils are also important to the nutrients in koala browse.



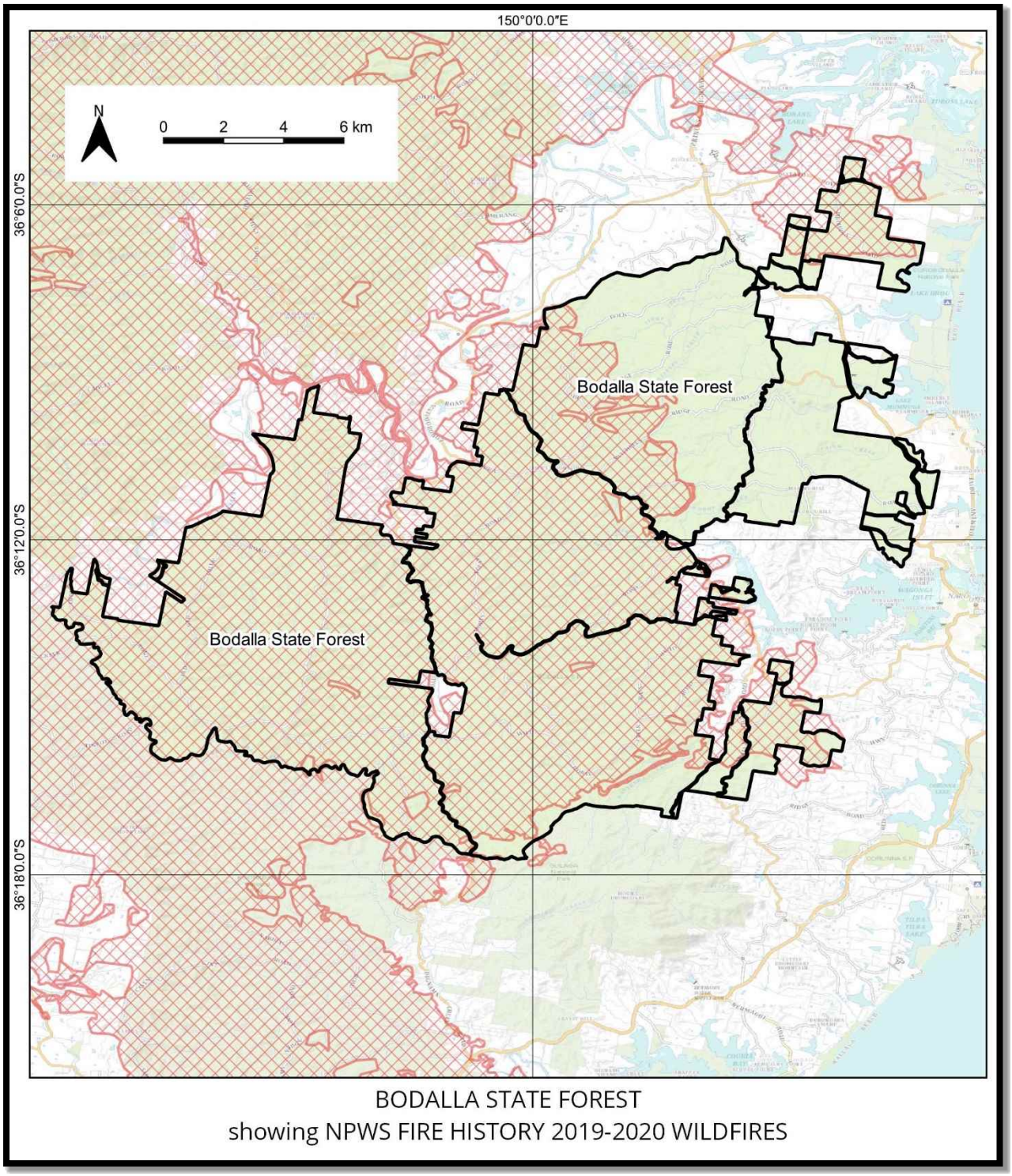


BODALLA STATE FOREST
SOILS

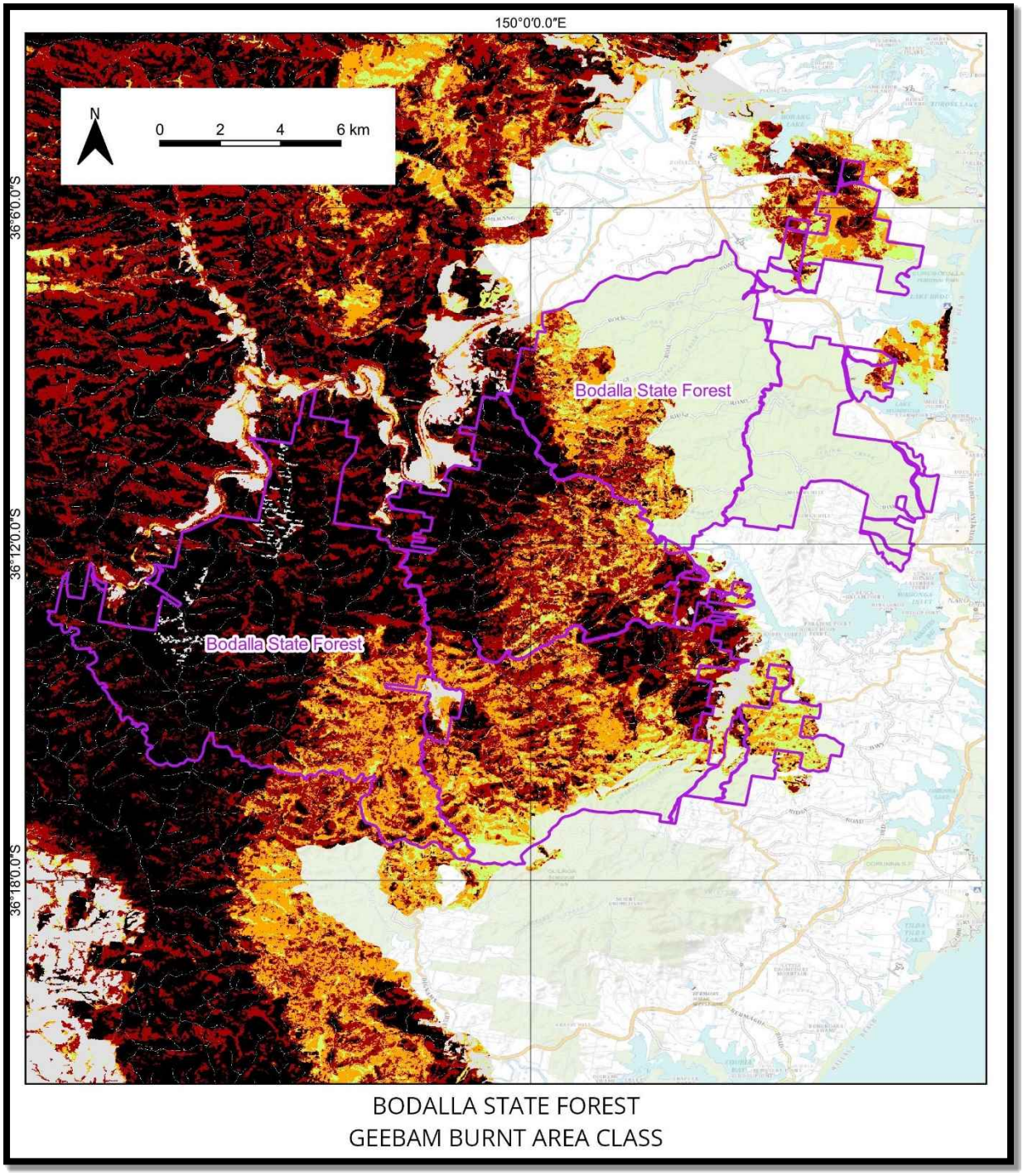


The “Yellow Podzolic Soils” predominate across most of Bodalla State Forest. Their nutrients are poor. Our previous research suggests this is one reason for the low density of the region’s koala population, however koalas persist on these soils in other places (eg Badja State Forest, on granite).

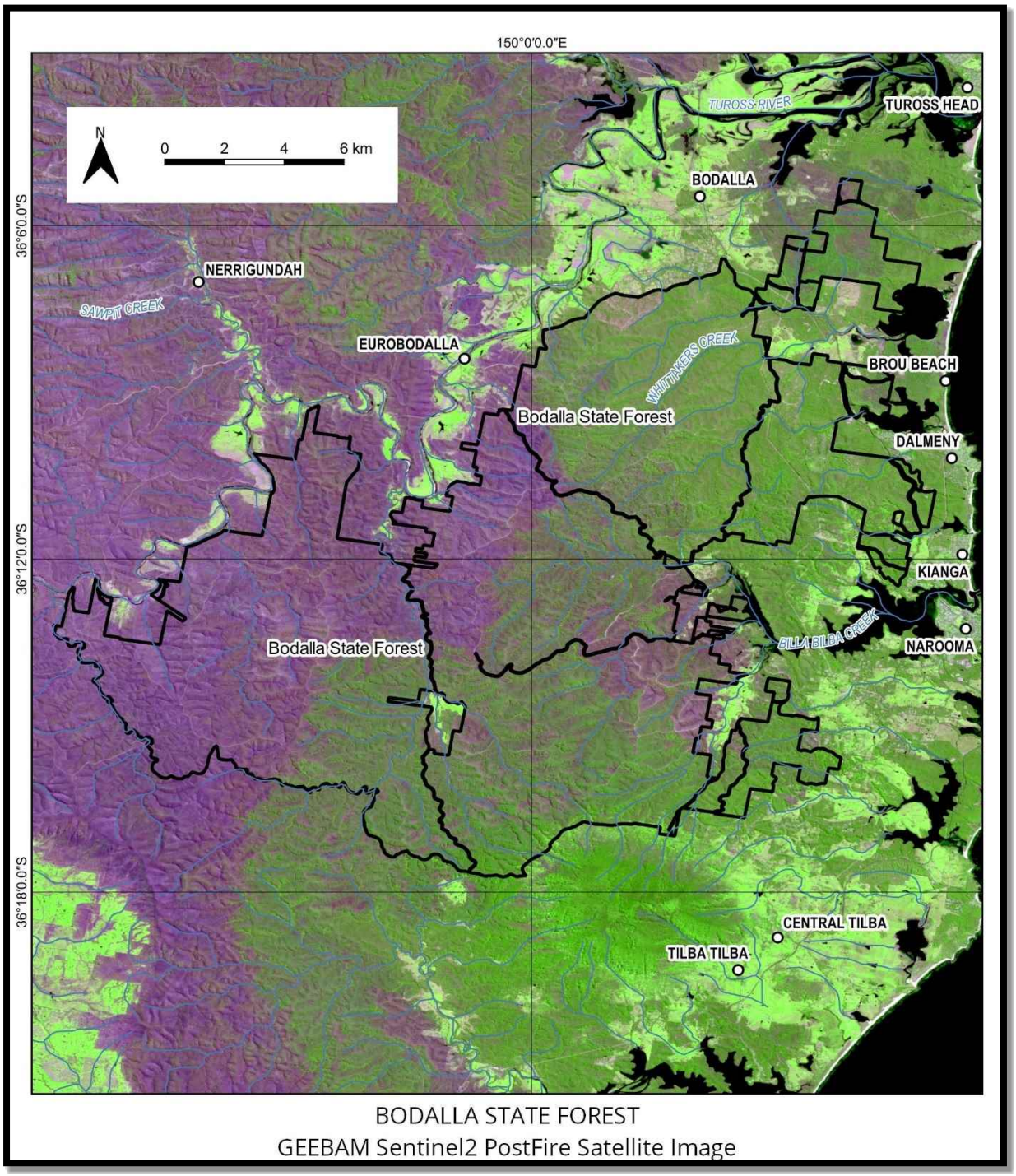
Fire, especially intense wildfire, has diminished the Eurobodalla koala population at particular historical points. The 2019-2020 wildfire was considered the most intense ever. Climate scientists predict increasing intensity and frequency of wildfire.



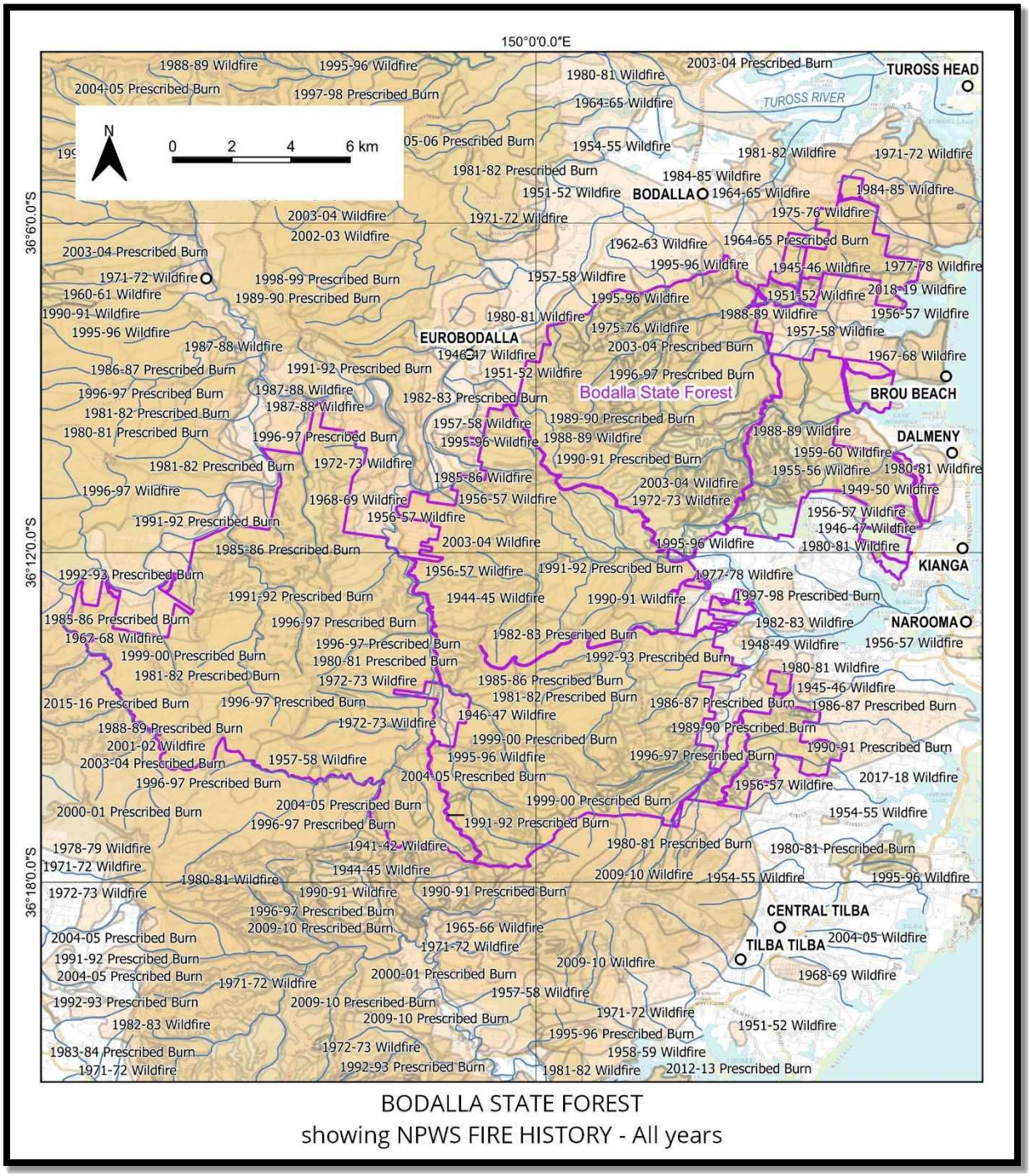
BODALLA STATE FOREST
showing NPWS FIRE HISTORY 2019-2020 WILDFIRES



BODALLA STATE FOREST
GEEBAM BURNT AREA CLASS



BODALLA STATE FOREST
GEEBAM Sentinel2 PostFire Satellite Image



BODALLA STATE FOREST
showing NPWS FIRE HISTORY - All years

Fire Impact

fire-and-the-environment-2019-20-summary-200108.pdf

The *NSW Fire and the Environment Summary for 2019-20* describes the fire impact, which needs to be applied as a weighting to our carrying capacity and habitat potential estimates. In the immediate short term, that's a 39% reduction. The "persistence of ecosystems" indicator seems to imply a long-term 4% reduction for our purposes.

- 39% reduction in ecological carrying capacity in the fire ground
- 39% reduction in ecological condition in the fire ground
- 4% reduction in ecosystem persistence in the fire ground

The **ecological carrying capacity** indicator shows the effectiveness of habitat at each location to support native species and ecosystems, considering its ecological condition and the effect of surrounding habitat loss and fragmentation on biological movement such as foraging, dispersal and migration. In 2013, 33% of the original ecological carrying capacity was estimated as remaining in New South Wales. In 2020, this decreased to 31%. Within the RFS fire ground, ecological carrying capacity decreased from 62% in 2013 to 38% in 2020, representing a 39% reduction. This assessment reflects the immediate effects post-fire on ecological carrying capacity. The effects of regeneration and regrowth will be captured in future assessments.

The **ecological condition** indicator shows the quality of terrestrial habitat at each location, estimating its intactness and naturalness without considering the indirect effects of surrounding habitat loss and fragmentation. In 2013, 44% of the original ecological condition in New South Wales was estimated as remaining. In 2020, this decreased to 42%. Within the RFS fire ground, ecological condition has decreased from 72% in 2013 to 44% in 2020, representing a 39% reduction. This assessment reflects the immediate effects post-fire on vegetation condition. The effects of regeneration and regrowth will be captured in future assessments.

The **persistence of ecosystems** indicator reflects the expected persistence of species diversity based on the proportion of habitat remaining in ecosystems, using a classification representing known and undiscovered species. This indicator is a metric for diversity across ecosystems, species and genetics. Plant species are used as a surrogate for all biodiversity. In 2013, 84% of the original diversity of NSW plants were estimated as likely to persist. In 2020, this decreased to 82%. In areas within the fire ground, the diversity of NSW plants likely to persist was reduced by 4%. This decline represents a loss of unique diversity. This is not equivalent to extinction of individual plant species. Field studies have demonstrated that floristic diversity can increase in a post-fire environment.

Extract from Draft National Koala Recovery Plan – Fire Extent

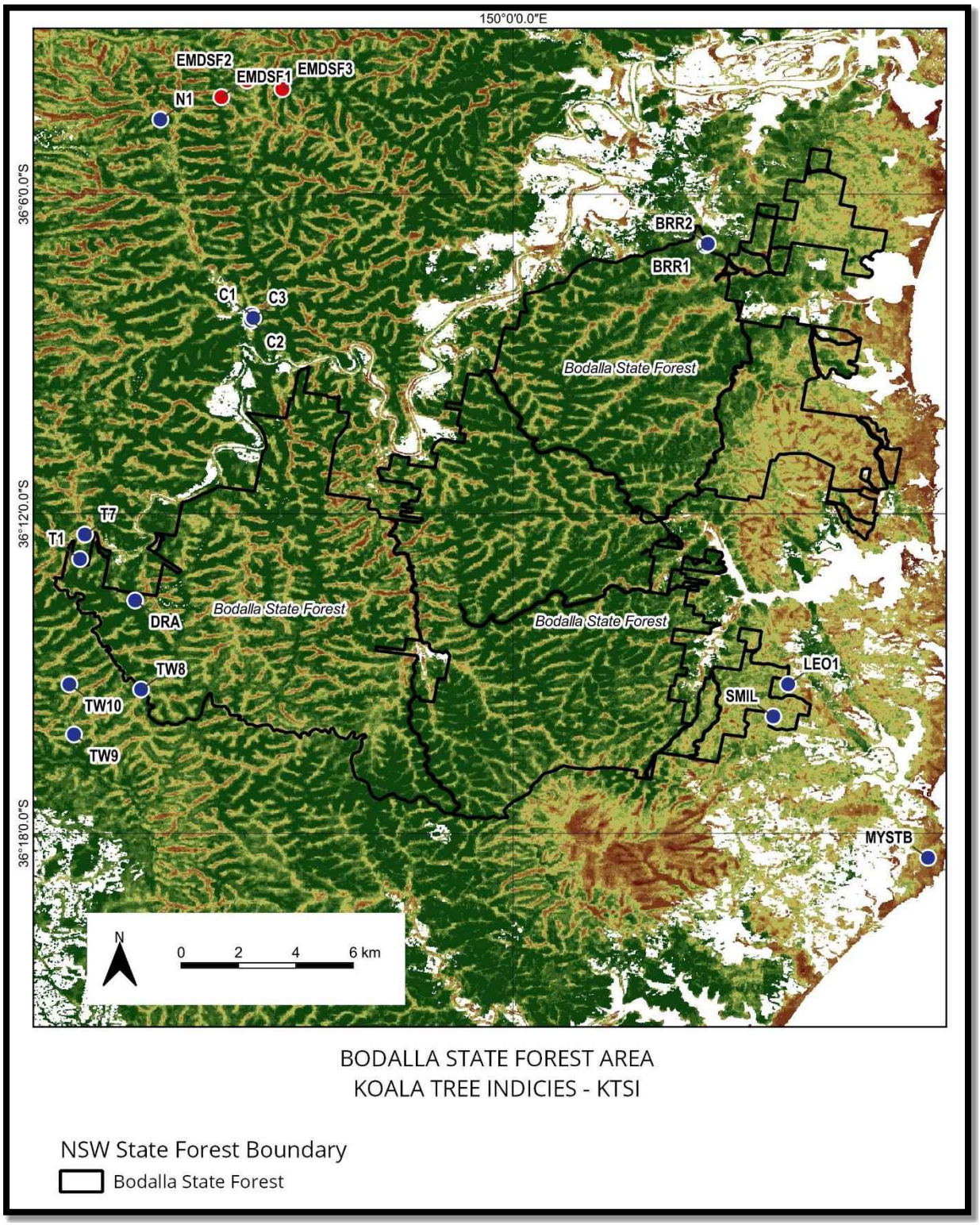
"The table…lists the area and proportion of land burned in the 2019/2020 bushfires within the area where the listed Koala and its habitat is known or likely to occur, by IBRA7 bioregion and by state/territory. Numbers for likely plus known koala distribution only are provided, excluding areas where koala may occur. Note: modelled distribution does not equate to Koala habitat (see section **Error! Reference source not found.** for further explanation). Numbers were generated using previous koala distribution mapping (2013). Source, DAWE 2021b."

IBRA Region/ State	**Extent burned within known + likely koala distribution, ha (%)**	**Extent of known + likely koala distribution in region, ha**
NSW		
South East Corner	503976 (52%)	969,498

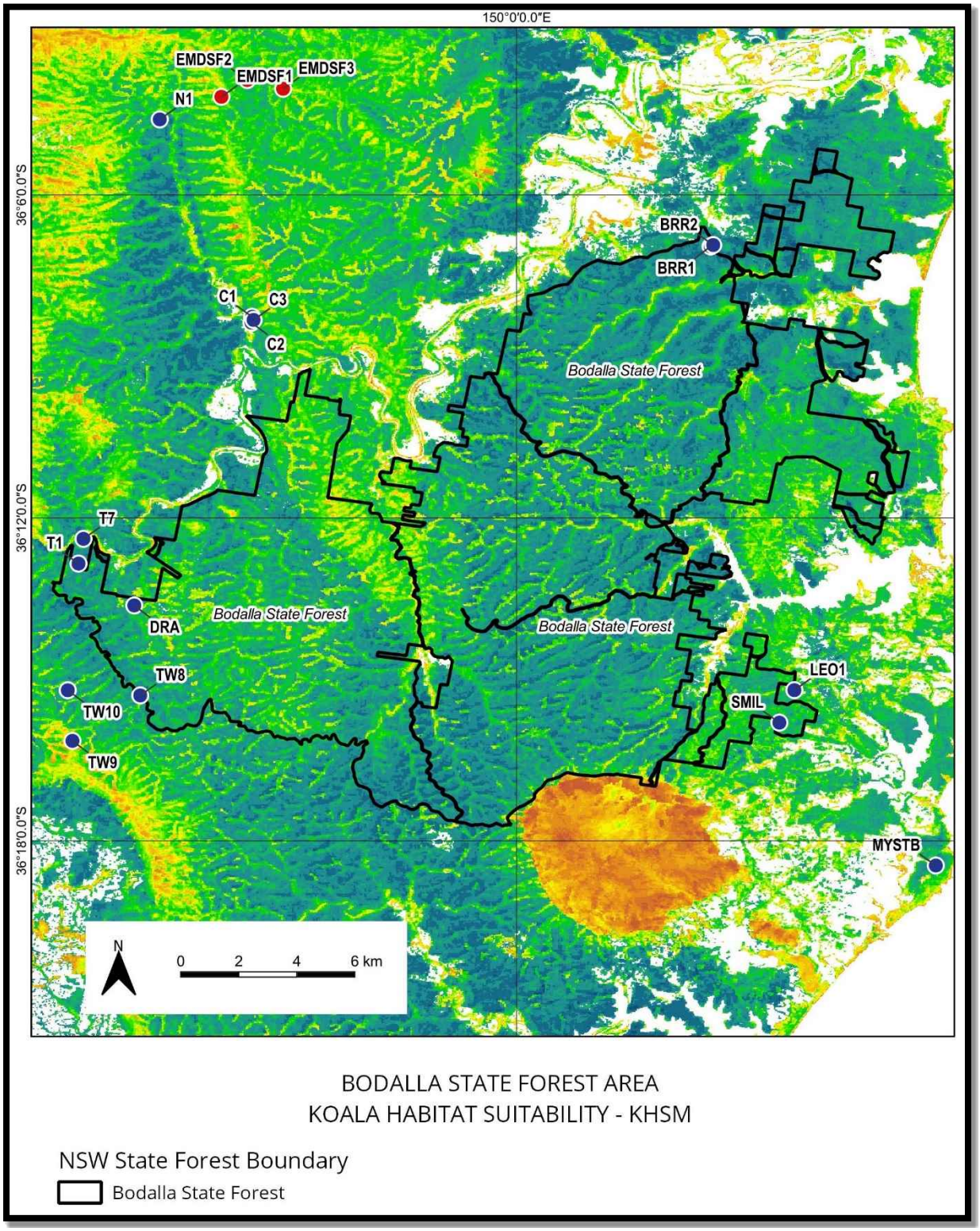
NSW Natural Resources Commission Report

The Cabinet-in-Confidence ***Final report – Coastal IFOA Operations post 2019/20 wildfires – June 2021***, leaked to the media on 25th November 2021, recommended harvesting in the Narooma management zone be suspended for 3 years from February 2020, because of the extreme risk to the area's recovery.

Also available on the NSW BioNet are modeled maps for ***koala-suitable trees, and koala habitat suitability***. Those for Bodalla State Forest are as follows:



Brown = highest suitability; Green = lowest suitability.



Blue = highest suitability; Yellow = lowest suitability.

Adjacent Endangered Ecological Communities

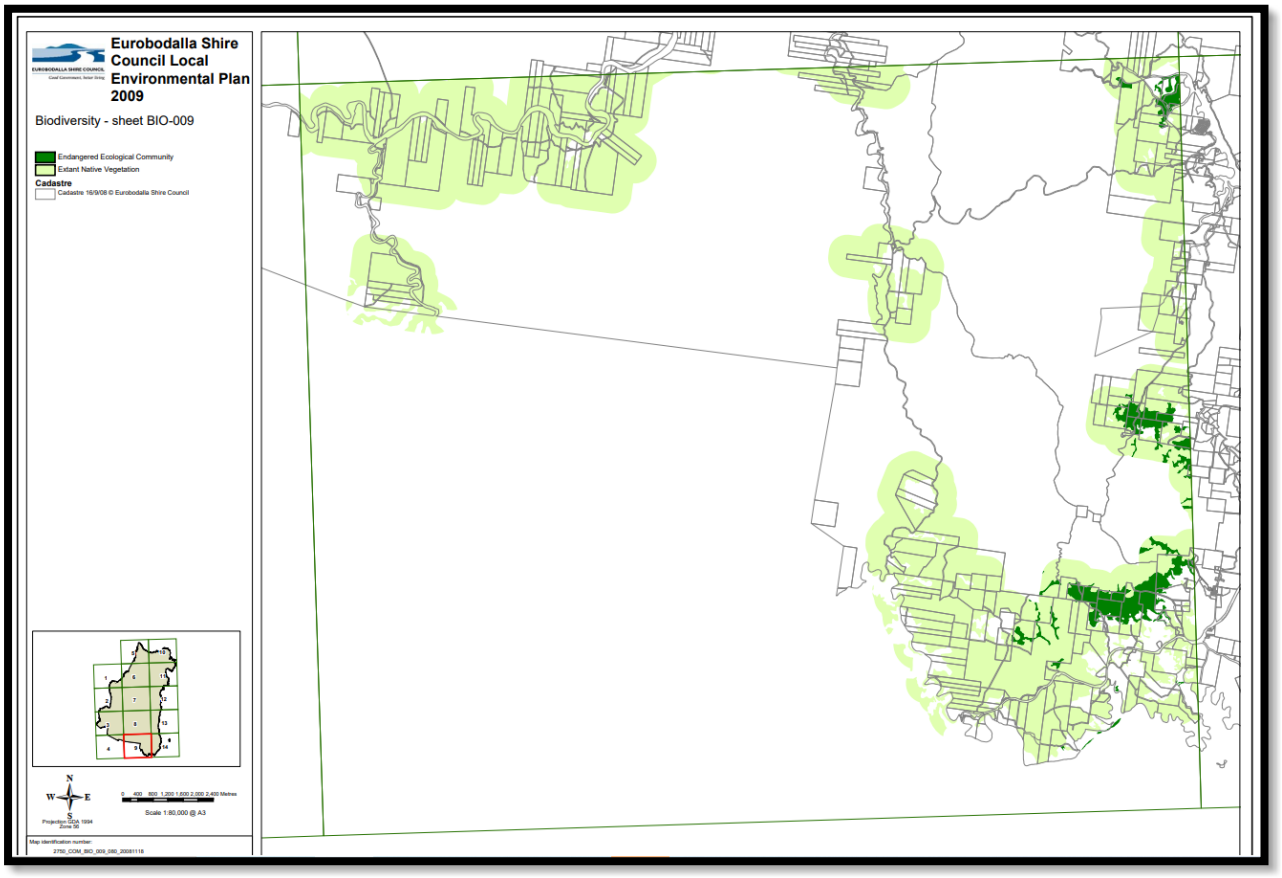
Eurobodalla Shire Council Endangered Ecological Communities
Survey and Mapping Report, 2007
https://www.yumpu.com/en/document/read/19492464/eurobodalla-endangered-ecological-communities-report-2007
Refer pp.12ff for details on communities and Appendix 1 for locations

Remnant Community Potentially Occurring in or near Bodalla State Forest	***Potential Koala Browse Species Associated with this Community***
Bega and Candelo Dry Grass Forests	• E tereticornis • E globoidea • Angophora floribunda
Brogo Wet Vine Forest	• E tereticornis • Angophora floribunda
Bangalay Sand Forest	• E botryoides • E pilularis
Swamp Oak Floodplain Forest	• E tereticornis • E botryoides • E longifolia
River-flat Eucalypt Forest on Coastal Floodplains	• E tereticornis • Angophora floribunda • E elata • E botryoides • E baueriana • E angophoroides • E globoidea • E muelleriana • E viminalis

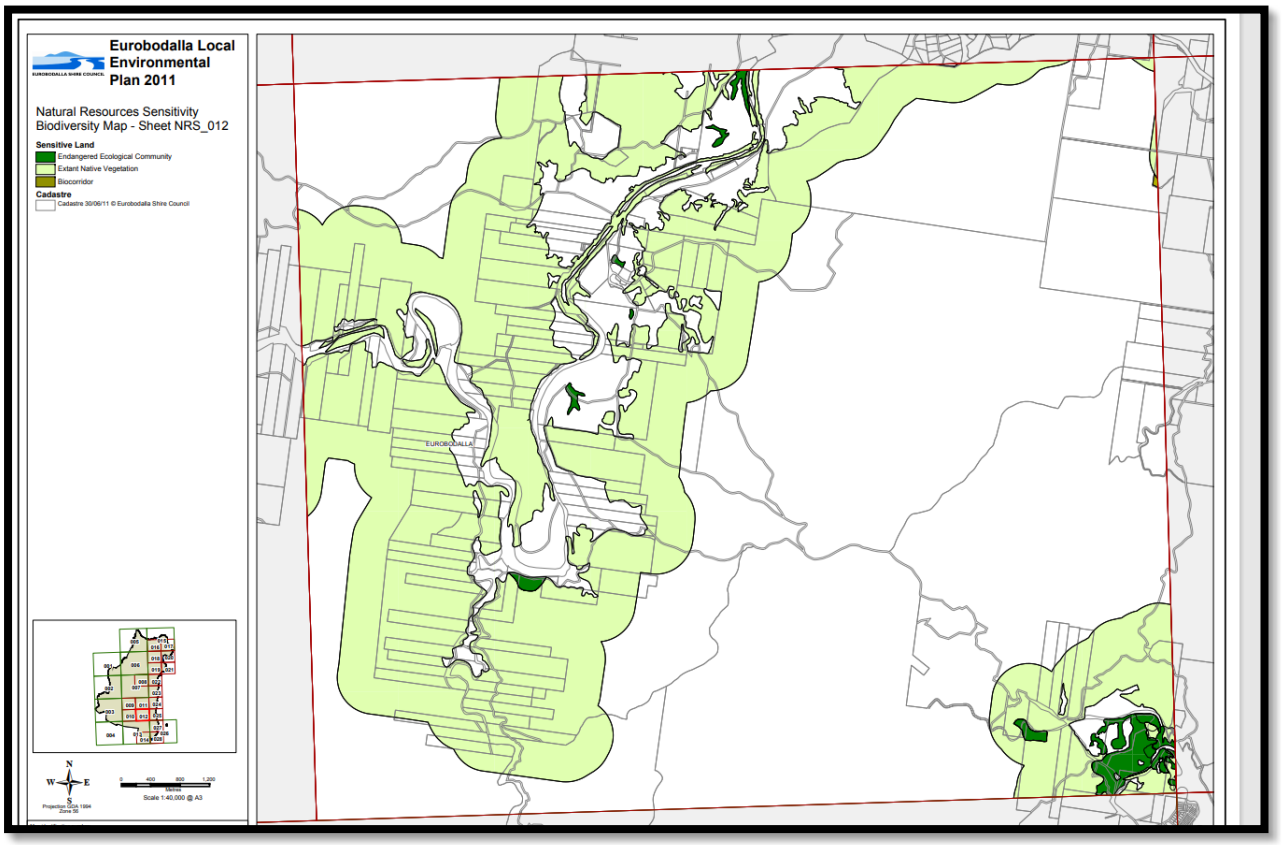
Eurobodalla Shire Council Local Environment Plan 2011 Sensitivity Biodiversity Maps

Tinpot via Reg Murphy to Punkally

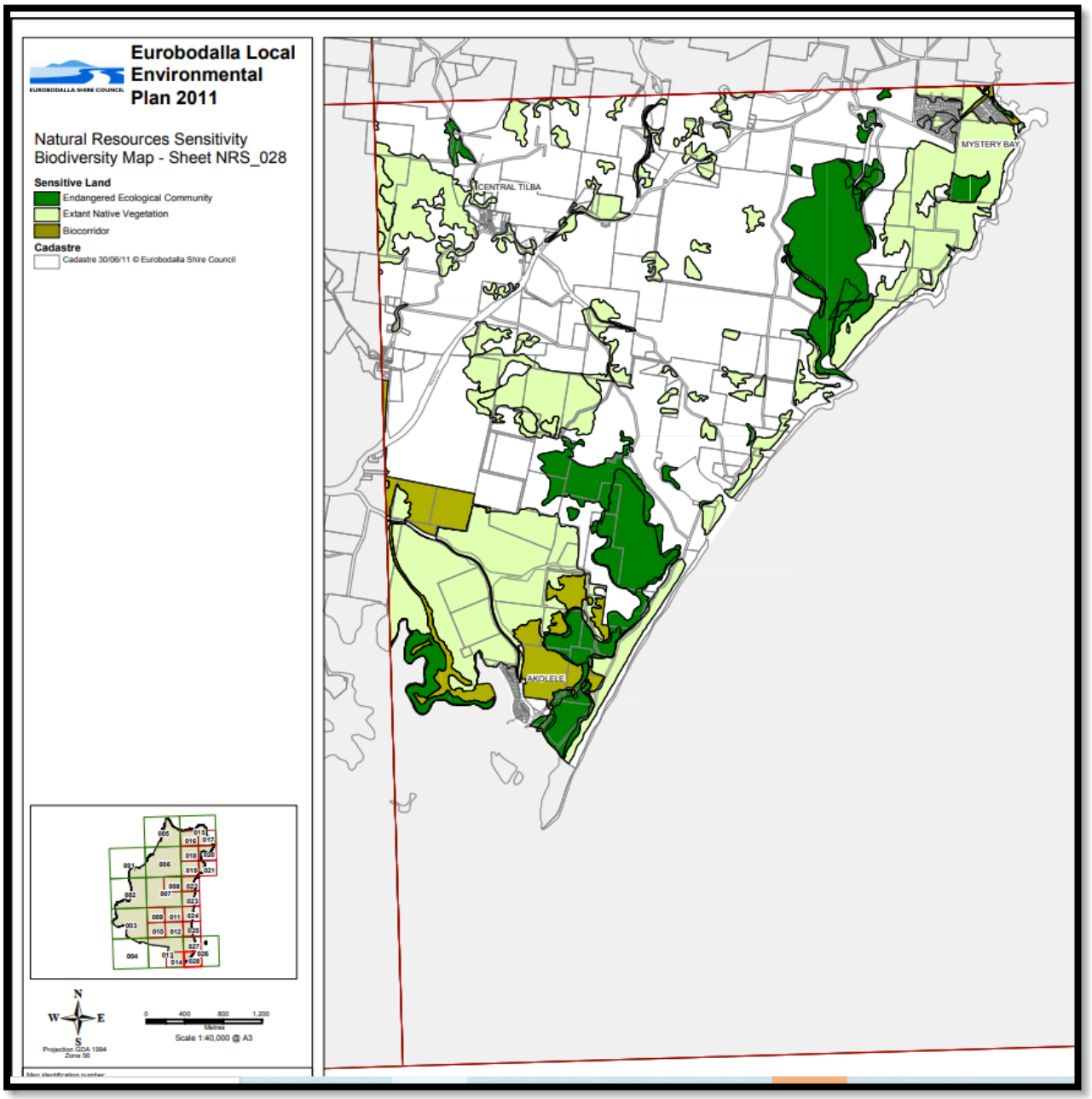
Tinpot to Corunna and Tilba



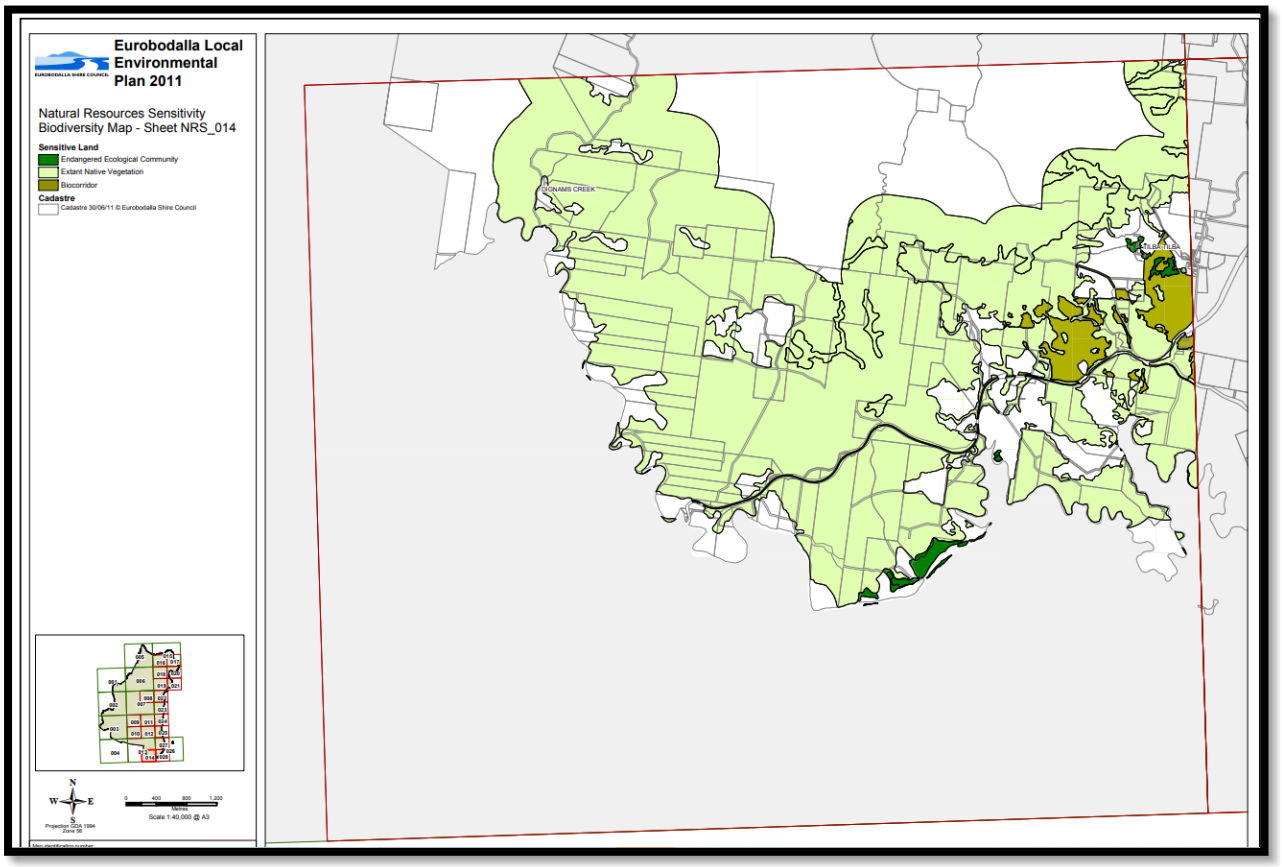
Eurobodalla and Wagonga



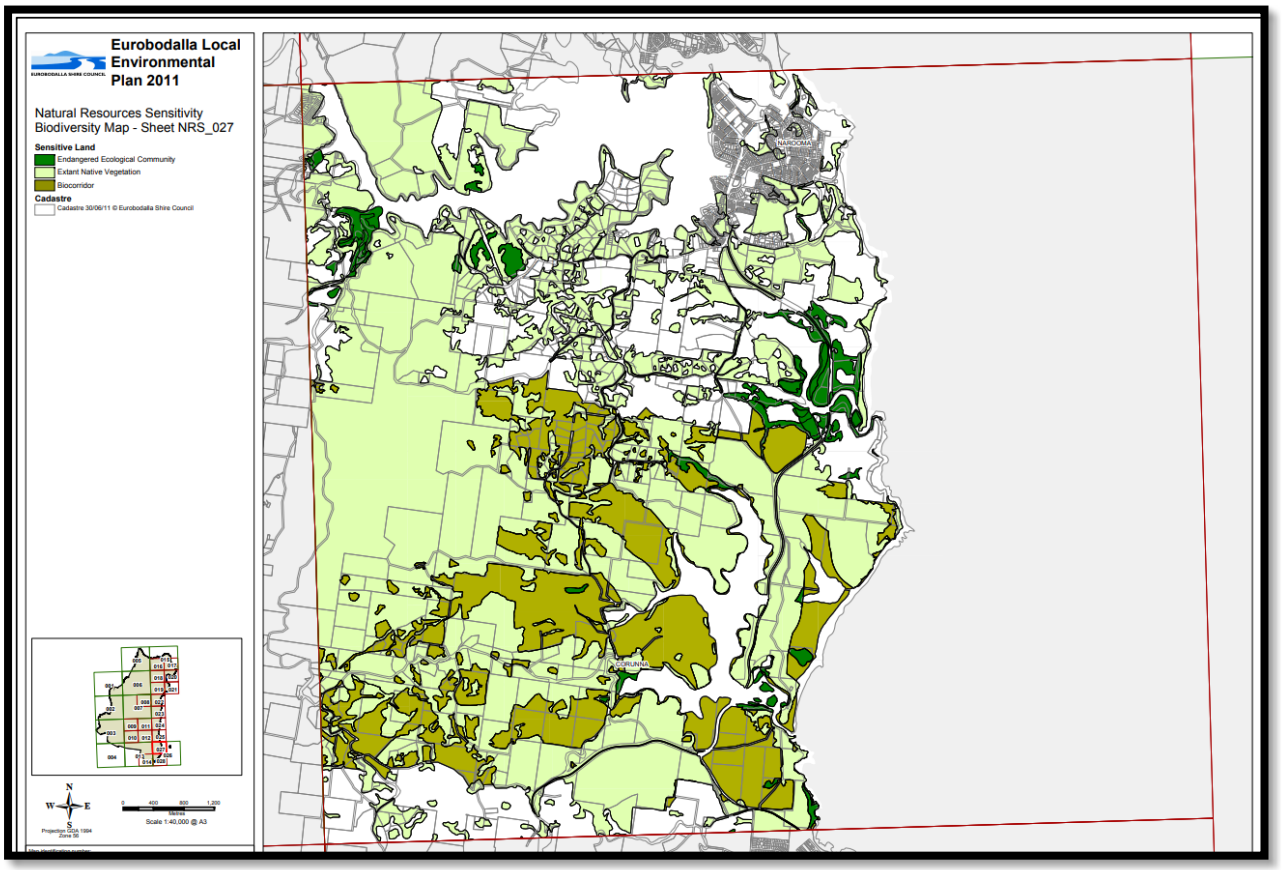
Central Tilba, Mystery Bay and Akolele



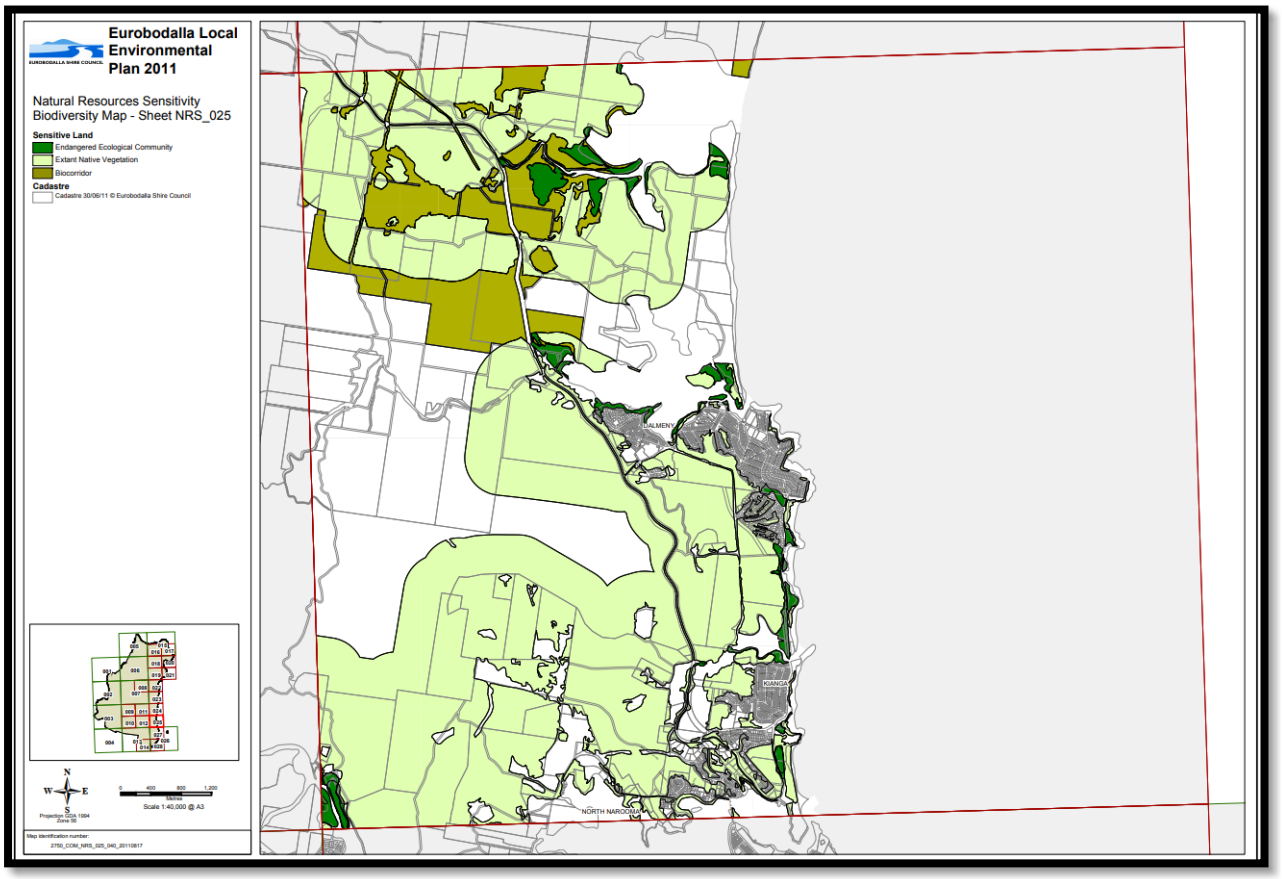
Dignams Creek to Tilba Tilba



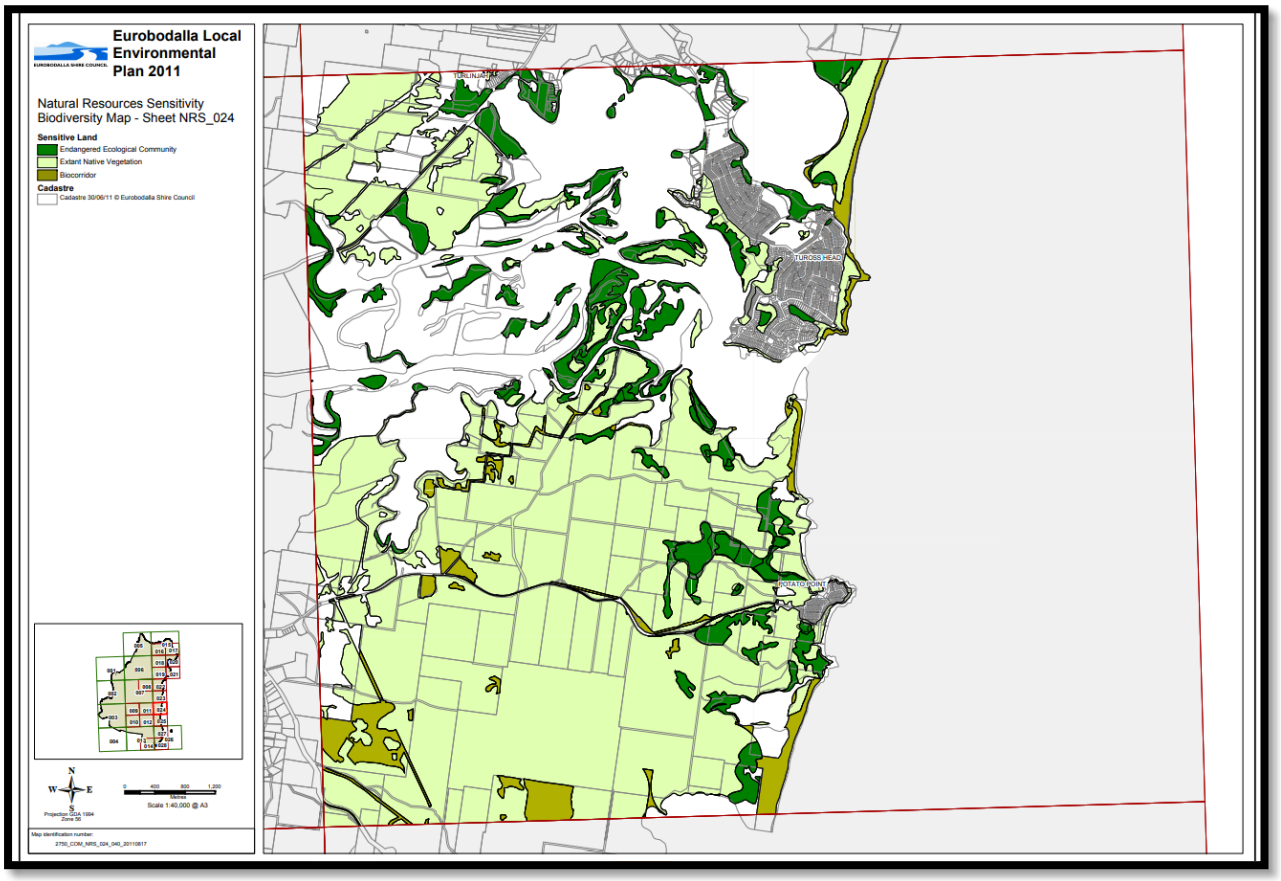
Narooma to Corunna



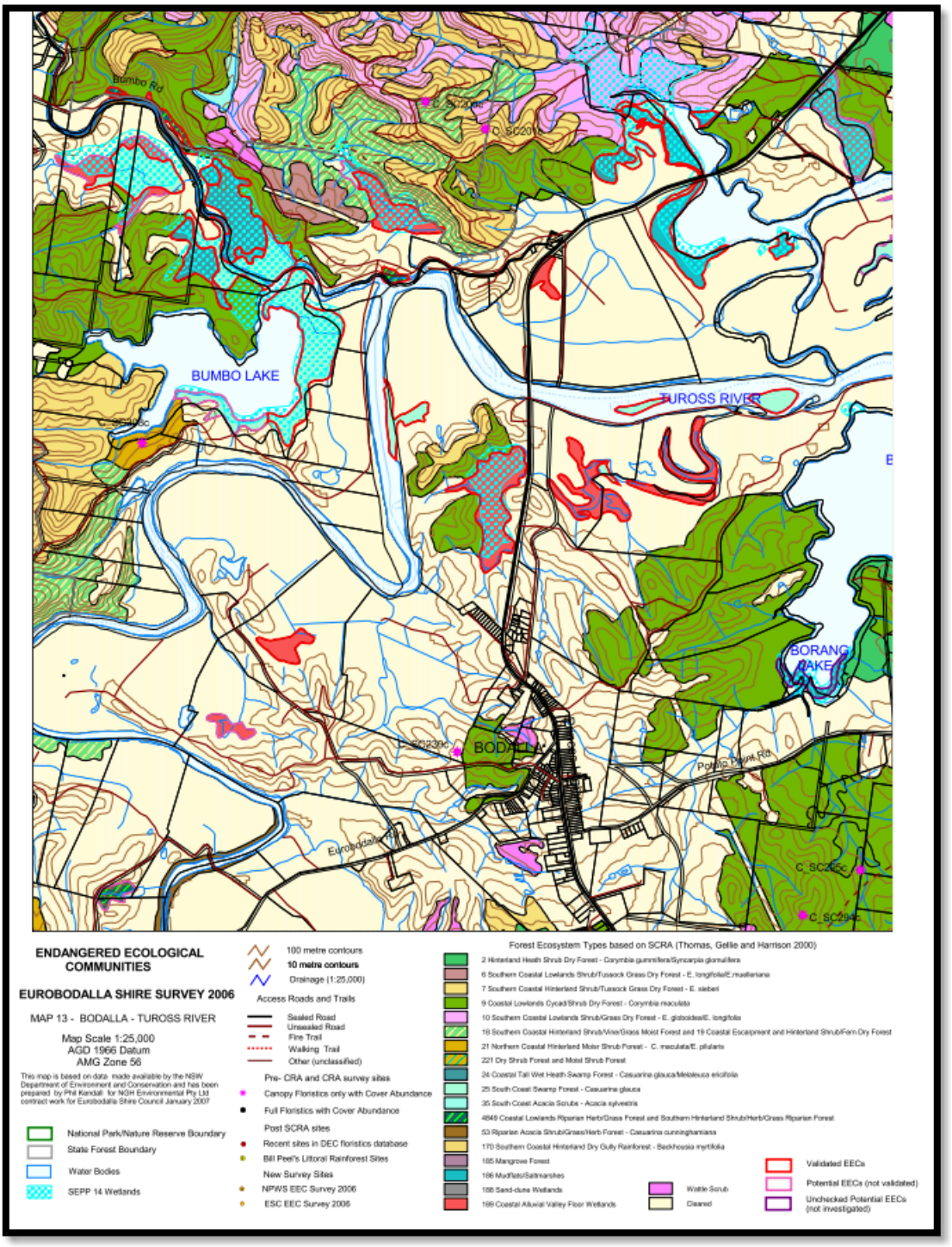
Dalmeny and Kianga



Tuross Estuary and Potato Point



Eurobodalla Shire Council Endangered Ecological Communities Map (Bodalla and Tuross River)



Forestry Corporation NSW GIS Mapping

The link is https://data-fcnsw.opendata.arcgis.com/datasets/nsw-forest-types?geometry=149.595%2C-36.288%2C150.638%2C-36.094

Bodalla State Forest appears as mostly General Management (Zone 4 - timber production with the full range of silvicultural operations).

There is one Special Protection Zone (Zone 1 – no timber harvesting) within the Bodalla SF footprint ("Silvestris" Flora Reserve, near F-Ridge Road, West of Wagonga Inlet).

At North Narooma there are Special Management Zones (Zone 2 – fauna corridors, high conservation value old growth and ecosystems, locations of key threatened fauna – no timber harvesting), plus a Non-Forestry Zone (Zone 7 – infrastructure).

Public users can move the cursor to any point on the map and bring up a table with that point's metadata, including a summary of its dominant eucalypt species.

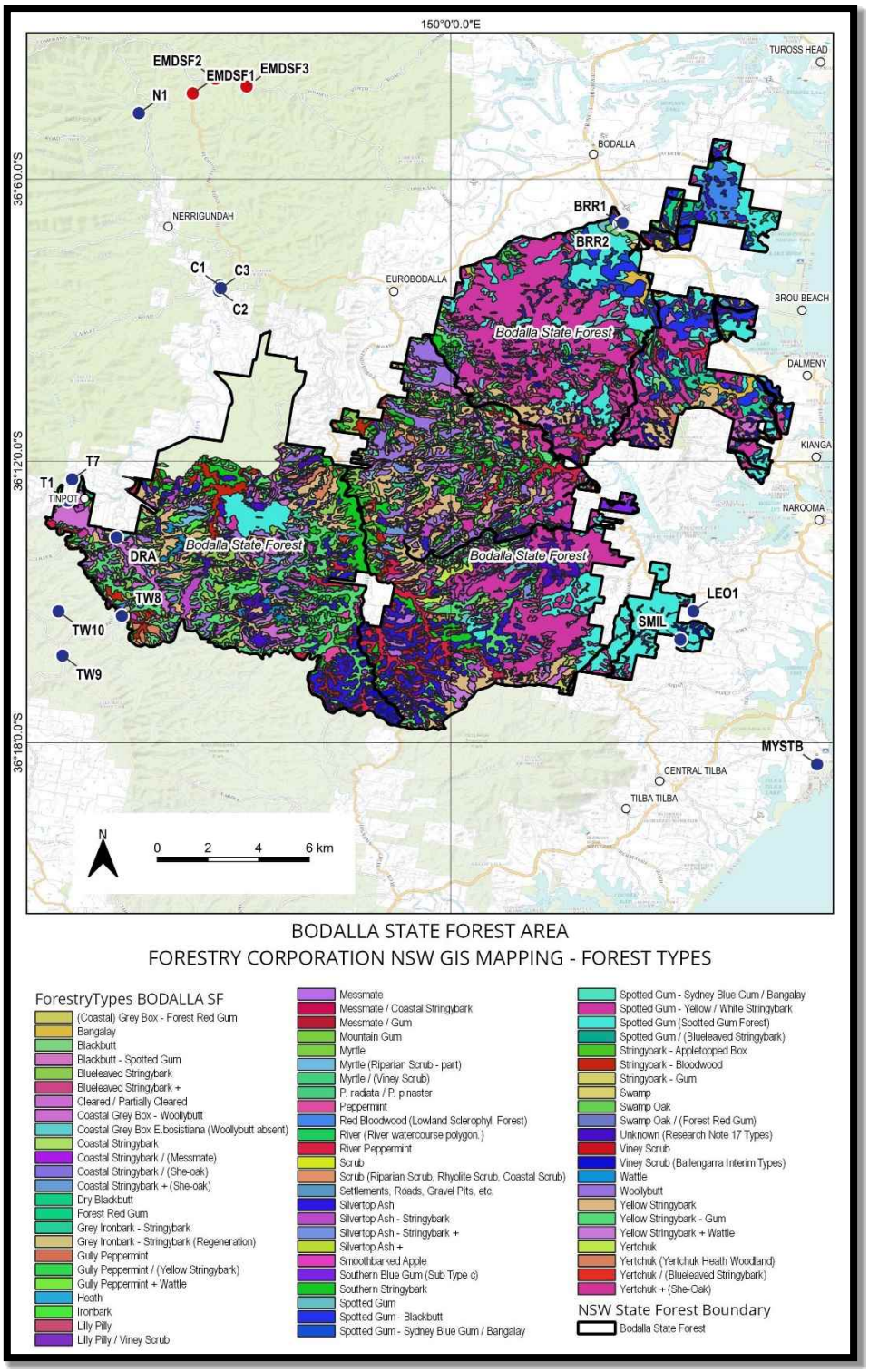
For example, a Forest Type 157 polygon displays the following table

NSW Forest Types	
OBJECTID	54351
UniqueID	158
ForestType	157
System	Research Note 17 Types
Description	Yellow Stringybark - Gum
Shape__Area	1061771.4765625
Shape__Length	26874.3429491462

The following is a structured selection of Forest Types and their eucalypt species from polygons across Bodalla State Forest, giving an overview of potential koala-use trees, rated according to the NSW Review of 2018.

In the table below, the koala-use ratings are for the South Coast KMA, unless otherwise specified. The latter is usually because data do not exist for the South Coast, so ratings for another KMA are used to suggest a possible best likelihood for our region. Ratings vary from region to region.

Pending a GIS version, initially a screen-shot was captured of the map at link https://data-fcnsw.opendata.arcgis.com/datasets/nsw-forest-types/explore?location=-36.199587%2C150.013682%2C12.00 then printed in hard copy.



A grid was drawn over the hard copy, using 12 vertical axes and 11 horizontal axes. This produced 60 intersection points, to be selected separately for their polygon and its forest type.

The 60 points were allocated to 3 sectors, as a check for broad geographic variations in forest type.

The Northern Sector is all of Bodalla State Forest north of a line between North Narooma and Kianga. Near the coast especially, this is the flatter country.
The South East Sector is below that line, extending westwards from the Wagonga Inlet and Gulaga precincts to the middle of Bodalla State Forest, in line with Eurobodalla.
The South West Sector extends further westwards to Tinpot and beyond, comprising more of the higher altitudes.

Northern Sector

Forest Type	*Description*	*Koala Rate of Use*
70	Spotted Gum	Irregular
112	Silvertop Ash	Significant
130	Red Bloodwood	Irregular
70	Spotted Gum	Irregular
70	Spotted Gum	Irregular
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
112	Silvertop Ash	Significant
70	Spotted Gum	Irregular
23	Myrtle	N/A
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
70	Spotted Gum	Irregular
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
63	Woollybutt	High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
23	Myrtle	N/A
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
37	Blackbutt	High (Central Coast)
26	Viney Scrub	N/A
121	Blue-leaved Stringybark	Irregular
102	Yertchuk	Significant
157	Yellow Stringybark-Gum	High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
75/112	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
169	Yellow Stringybark	High
166	River Peppermint	Low

South East Sector

Forest Type	*Description*	*Koala Rate of Use*
63/66r	Woollybutt	High
86/169	Coastal Grey Box-Woollybutt	High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
63/121	Woollybutt	High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
114	Silvertop Ash-Stringybark	Significant/High/Irregular
70/112	Spotted Gum	Irregular
169	Yellow Stringybark	High
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
157	Yellow Stringybark-Gum	High
70	Spotted Gum	Irregular
166	River Peppermint	Low
70	Spotted Gum	Irregular
75	Spotted Gum-Yellow/White Stringybark	Irregular-High/High
23	Myrtle	N/A
26	Viney Scrub	N/A

South West Sector

Forest Type	*Description*	*Koala Rate of Use*
126	Stringybark-Bloodwood	High/Irregular
123	Southern Stringybark/Northern Ironbark	Irregular/High
112	Silvertop Ash	Significant
132	Stringybark-Gum	Irregular/High
86b/169	Coastal Grey Box-Woollybutt	High
169	Yellow Stringybark	High
63	Woollybutt	High
70	Spotted Gum	Irregular
169	Yellow Stringybark	High
169	Yellow Stringybark	High
26	Viney Scrub	N/A
157	Yellow Stringybark-Gum	High
157	Yellow Stringybark-Gum	High
"Unknown"; adj to 123 & 112		

169	Yellow Stringybark	High
157	Yellow Stringybark-Gum	High
157	Yellow Stringybark-Gum	High
111/314	Peppermint	Low

Based on these forest types, we see the variation in species across the different polygons. Bodalla State Forest is large and covers a variety of topography. Spotted Gum plays a big role in the Northern Sector, with Stringybark and Woollybutt more frequent in the other sectors. “High and Significant Use” koala tree species are distributed throughout most polygons, either as a secondary species amongst others like Spotted Gum, or as dominant stands.

Extracts from Harvest Plans and Logging History
Relevant Koala Habitat Features by Compartment

The link is https://www.forestrycorporation.com.au/operations/harvest-plans/south-coast

The Eurobodalla Koala Project's focus is on the potential for low-density koala revival, evidence having pointed to a regional decline since the mid-20th Century and earlier. When studying these Harvest Plans, we are looking in particular for:

- Potential koala habitat patch size (eg home range areas and corridors – we find Compartment sizes tantalizingly close to South Coast home range sizes)
- Reserves, exclusion zones and other protections
- Eucalypt species, especially the proportion of high-use koala trees in the mix
- Types and intensity of historic and planned disturbance
- Steepness of slopes
- Recorded koala evidence

"Coastal Dry Forest" is often mentioned in these Harvest Plans. This is a catch-all definition for forest types that occur throughout coastal NSW, described as follows:
Dry coastal hardwoods are the most widely distributed forest communities in coastal NSW and stands comprise mosaics of different species. The most commonly occurring species are grey gum (Eucalyptus propinqua), grey ironbark (E. paniculata), coastal grey and steel box (E. moluccana, bosistoana, rummeryi), red/white mahogany (E. resinfera, E. acmenoides/umbra), stringybarks (E. globoidea, cameronii, sparsifolia) and smooth-barked apple (Angophora costata).

A somewhat modified list of eucalypts is more likely to be found in the Bodalla area Coastal Dry Forests (see Forest Type tables, above). For example, Red Ironbark (E tricarpa) occurs at Dalmeny near Compartment 3023, Silvertop Ash (E sieberi) is common a little higher up the hillsides, and Woollybutt (E longifolia) becomes more prominent at the southern Eurobodalla border.

As well as Grey Ironbark (Eucalyptus paniculata), these Harvest Plans often refer to "Ironbark (Eucalyptus sideroxylon)". This will be Eucalyptus tricarpa (the local subspecies of E sideroxylon), common name Red Ironbark, a high use koala tree on the south coast according to the NSW Review of 2018.

Cpt 3006A (Year 2019)
Wildlife Habitat Clump x1
Exclusion Zone x1
Species for Harvest Mix % (sawlog):

- Spotted Gum 74
- Yellow Stringybark 11

- White Stringybark 10
- Silvertop Ash 3
- Ironbark 2

History and Stand Condition:

The compartment was last harvested in 1964, with Timber Stand Improvement (TSI) in the early 2000's. The TSI was unsuccessful at encouraging enhanced growth of retained stems, with Spotted Gum coppice regenerating to compete and lock up the forest. As such, much of the compartment is dominated by relatively small diameter stems where growth has stagnated. The most likely way to generate more dynamic growth within the compartment to enhance future productive potential is to open up the site by harvesting merchantable stems and retaining the growers, ensuring retained average basal area of 10 m per hectare in the harvested area.

Koala scats, scratches or individuals listed under Known or Potential Habitat?

Yes

Cpt 3009 (Year 2013)

Probable EEC (River Flat Eucalypt Forest on Coastal Floodplains) x1

Exclusion Zone x2

Broad Forest Type (Y/A):

- Ash 1.7
- Coastal Dry Forest 32.8
- Coastal Moist Forest 79
- Non-Eucalypt Forest 4.3
- Non-Forest 2
- Spotted Gum 122.4
- TOTAL 242.1

Species Composition:

Overstorey dominated by –

- Spotted Gum (C maculata)
- Blackbutt (E pilularis)
- Yellow Stringybark (E muelleriana)
- Silvertop Ash (E sieberi)

Other species include –

- Ironbark (E sideroxylon)
- Bangalay (E botryoides)

History and Stand Condition:

Parts have undergone light and medium selective logging (targeting sawlogs and mining props) in 60s, 70s, 80s and 90s. Regular wildfire events since the 1960s, with all or part being burnt. In 1995, 1997, 2003 and 2007 hazard reduction burning over part of the unit. Area logged in 1992 is a mostly uneven aged, mostly fully stocked, highly variable over short distances, BA range 12-22sqm/ha. The stand is mostly mature with some advanced pole/small sawlog sizes and some clumps of sapling regrowth. Majority of this area contains

sufficient retained volume from the 1992 harvesting event to warrant another viable operation.
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3012 (Year 2018)
Exclusion Zones (River Flat Eucalypt Forest) x3
Forestry Type (YA) and Gross Area (Ha)
Coastal Dry Forest 113
Non-Forest 5
Rainforest 8
Spotted Gum 66
Yellow Stringybark – Gum 13
TOTAL 205
Species and Species Mix (Sawlog)
SG 27%
BBT 27%
YS 18%
STA 12%
IBK 10%
BAN 6%
History and Stand Condition:
The harvest area is predominately mature to over mature Spotted Gum, Blackbutt and Yellow Stringybark in predominately uneven-aged stands. Previous harvesting events have occurred in 1975/76 and 1999. The objective is to harvest commercially available trees (within BA removal limits) to create canopy openings and ensure mechanical disturbance creates a suitable seed bed for regeneration of the stands.
"Stringybark species, Ironbark and Spotted Gum are suitable E tree species present in these compartments."
"River-flat Eucalypt Forest TEC occurs in various locations within compartment 3012."
Slope %age
0-20 degrees 97
20-25 degrees 2
25-30 degrees 1
Koala scats, scratches or individuals listed under Known or Potential Habitat?
Adjacent to compartment

Cpt 3023 (Year 2018)
Version 1 (Version 2 is largely unchanged but no longer highlights the TEC)
Exclusion Zones
TEC River Flat Eucalypt Forest x1 (within stream exclusion zone)
Three main sections of the Compartment are excluded as Future Treatment Areas
Forestry Type (YA) and Gross Area (Ha)
Yellow Stringybark – Gum 30

Spotted Gum 159
Coastal Dry Forest 51
Rainforest 15
TOTAL 258
Species and Species Mix (Sawlog)
SG 60%
BG 40%
History and Stand Condition:
In 2008, this compartment was planned to be harvested under a two-cut regeneration harvest STS heavy regime, with the objective of producing sawlogs and creating canopy openings where appropriate for regeneration. The harvest area is predominately mature to over mature Spotted Gum, Stringybark and Ironbark, in predominately uneven-aged stands. The objective of this harvest is to harvest all commercially available trees to create canopy openings and ensure mechanical disturbance creates a suitable seed bed for regeneration of the stands.
Slope %age
0-20 degrees 73
20-25 degrees 20
25-30 degrees 7
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3024 (Year 2012)
Exclusion Zone x1 (Giant Burrowing Frog)
Forestry Type (Yield Association) and Gross Area (Ha)
Coastal Dry Forest 69.6
Non-Eucalypt Forest 17.6 (Rainforest)
Non-Forest 1.4
Spotted Gum 69
Yellow Stringybark – Gum 11.7
Overstorey dominated by Spotted Gum, Peppermint, Blackbutt and Stringybark, with Woollybutt and Grey Box.
History and Stand Condition:
The compartment has been subject to a number of harvest events ranging from highly selective targeting poles and mine props to intense targeting sawlogs.
The compartment is highly variable, with regrowth, mature and over-mature stands scattered throughout. Site quality and tree quality ranges from poor to good. Very poor quality over-mature dominants and areas of poor regeneration are scattered throughout the compartment.
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3025 (Year 2013)
Special Management Zones x5

High Conservation Value Old Growth Zones x3
Forest Types (RN17) and Gross Area (Ha)
Types -1 (2.0 Ha), -2 (3.0 Ha) and 235 (0.5 Ha) Unknown
Type 23 (1.3 Ha) Myrtle
Type 26 Viney Scrub (29.3 Ha)
Type 50 Bangalay (11.1 Ha)
Type 66 Grey Ironbark – Stringybark (40.6 Ha)
Type 70 Spotted Gum (56.3 Ha)
Type 75 Spotted Gum - Yellow/White Stringybark (51.1 Ha)
Type 76 Spotted Gum – Blackbutt (67.9 Ha)
Type 86 Coastal Grey Box – Woollybutt (54.8 Ha)
Type 166 River Peppermint (8.2 Ha)
Type 169 Yellow Stringybark (9.6 Ha)
Overstorey dominated by Spotted Gum, Ironbark, Stringybark, Coastal Grey Box, Woollybutt and Peppermint.
History and Stand Condition:
The majority of the resource unit was subject to Timber Stand Improvement treatment in 1955. The area west of Bells Ridge Road was harvested in 1983. The area east of Bells Ridge Road was harvested sometime prior to 1983.
Mature forest in very good timber condition with advanced growth and regrowth in very good condition (BA range 14-34 sqm/ha).
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3027 (Year 2015)
Exclusion Zones x3 (fauna) and x1 (Probable River Flat Eucalypt Forest on Coastal Floodplains)
Forest Types and Gross Area (Ha)
Types -2 To be assessed (4.1 Ha)
Type 14 Lilly Pilli (6.5 Ha)
Type 23 Myrtle (9.7 Ha)
Type 26 Viney Scrub (52.9 Ha)
Type 37 Dry Blackbutt (0.9 Ha)
Type 70 Spotted Gum (4.5 Ha)
Type 73 Spotted Gum – Sydney Blue Gum/Bangalay (0.8 Ha)
Type 75 Spotted Gum - Yellow/White Stringybark (141.3 Ha)
Type 86 Coastal Grey Box – Woollybutt (7.3 Ha)
Type 112 Silvertop Ash (0.8 Ha)
Type 121 Blue-leaved Stringybark (1.4 Ha)
Type 157 Yellow Stringybark – Gum (7.4 Ha)
Type 165 Gully Peppermint (10.3 Ha)
Type 166 River Peppermint (15.1 Ha)
Type 169 Yellow Stringybark (69.3 Ha)
Type 224 Scrub (0.2 Ha)

Type 231 Swamp (1.1 Ha)
Species composition described as “Spotted Gum, Blackbutt, Ironbark, Monkey Gum, Woollybutt, Yellow Stringybark, White Stringybark, Blue-leaved Stringybark, Sydney Peppermint and Silvertop Ash”.
History, Stand Structure and Condition
Previous logging 1984 (770 cubm), 1996 (700 cubm) and 2002 (3000 cubm).
The STS tract (160 ha) is a predominantly mature forest and will be harvested under a heavy and medium single tree selection (STS) regime. The objective within the 160ha harvest area for this operation (resource units 1 and 2) is to remove 45% and 35% of the basal area to create canopy openings for regeneration, whilst retaining and minimising damage to young regenerating stems, seed trees, habitat and recruitment trees. It is envisaged that the next harvesting operation in this compartment would be on average 30 years’ time
Ridge tops and upper slopes are not fully stocked and are comprised of even aged stands of mature and over mature trees remaining from last operation. Mid and lower slopes are fully stocked with even aged mature to over mature stands which have little future value growth potential.
Slope Classes (percentage of harvest area)
0-20 degrees 96.1%
20-25 degrees 3.7%
25-30 degrees 0.3%
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3047 (Year 2011)
No exclusion zones within compartment. Adjacent to National Park.
Yield Association Forest Types and Gross Area (Ha)
Coastal Moist Forest (11 Ha)
Spotted Gum (82 Ha)
Coastal Dry Forest (170 Ha)
Yellow Stringybark – Gum (58 Ha)
Rainforest (18 Ha)
Non-Eucalypt Forest (4 Ha)
History, Stand Structure and Condition
Previous logging 1980 (1031 cubm), 1983 (138 cubm), 1984 (12005 cubm) and 1986 (605 cubm).
The forest stand is typical of a dominant over-mature to mature defective structure due to successive highly selective logging events in the early to mid 1980s as well as a number of intense wildfires throughout the last century. Patches of advanced regrowth are evident along ridgetops associated with logging, fire, machinery disturbance and past TSI events.
The intent of this current planned event is to remove defective and larger commercial stems to create regeneration events across the majority of the net planned area in order to encourage a higher quality stand in future years. Where larger areas of advanced TSI regrowth exists, the intent will be to remove defective and larger commercial stems to release any future growers from present site occupancy competition.

Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3063 (Year 2008)
Net planned area 441 Ha.
No exclusion zones within compartment. Adjacent to Kooraban National Park.
Forest Types
Ash
Coastal dry Forest
Yellow Stringybark – Gum
Rainforest
Non-Eucalypt Forest
History, Stand Structure and Condition
Previous logging 1983 and 89 (303 cubm), 2000 (1455 cubm).
The stands are low to medium quality, predominantly a mature to overmature stand with patches of multi-aged regrowth.
Different post-harvest treatments of the logged gaps will be trialled to determine the optimum conditions for regeneration. Examples of such proposed treatments may include burning, heaping, planting, seeding, deep ripping and combinations thereof. Thinning silviculture may be used in other nominal gaps where even aged stands occur.
Koala scats, scratches or individuals listed under Known or Potential Habitat?
No

Cpt 3064 (Year 2012)
The northern half of the compartment (Resource Unit 2) is FMZ4 (not available to harvest this operation). Otherwise, there are no exclusion zones.
Forest Type (Y/A) and Gross Area (Ha)
Ash 82.4
Coastal Dry Forest 34.5
Non-Eucalypt Forest 13.7
Rainforest 4.5
Spotted Gum 93.6
Yellow Stringybark – Gum 207.2
History, Stand Structure and Condition
Previous logging 1963 (3000 cubm) and 2005 (3512 cubm).
Resource Unit 1 overstorey dominated by Stringybark, Woollybutt, Ash and Grey Box with Ironbark. Uneven aged, mature to overmature and moderately stocked (BA range 26-30 sqm/ha). These stands have limited further growth potential…condition described as poor to average, with the remnant overstorey in very poor timber condition, and advanced growth average and showing average vigour and form.
Resource Unit 2 overstorey dominated by Spotted Gum, Stringybark and Ash. This area was relatively lightly selectively logged in 2005. Highly variable uneven aged across the unit. Areas of more intensive logging are mostly stands of regeneration with scattered patches of overmature trees throughout them. Condition described as being average to good, with the

remnant overstorey in very poor timber condition, and regrowth and advanced growth showing good vigour and form.

Koala scats, scratches or individuals listed under Known or Potential Habitat?

Two koala records adjacent to Resource Unit 2. None within the compartment itself, but the adjacent ones are near enough to be visible on the compartment map.

Cpts 3007, 3008 and 3016 (Year 2013)

Several Small Possible Rainforest Zones and 20m buffers.

Cpt 3007: Gross Area 229.1 Ha; Net Harvestable Area 68.4 Ha

Cpt 3008: Gross Area 221.1 Ha; Net Harvestable Area 38.5 Ha

Cpt 3016: Gross Area 396.4 Ha; Net Harvestable Area 92.6 Ha

Total Gross Area 846.6 Ha; Total Net Harvestable Area 199.5 Ha

Forest Type (Y/A) and Gross Area (Ha)

Ash 58.5

Coastal Dry Forest 63

Coastal Moist Forest 8.7

Non-Forest 0.3

Rainforest 11.4

Spotted Gum 584

Yellow Stringybark – Gum 120.6

Overstorey dominated by Spotted Gum (Cmac), Blackbutt (Epil), Yellow Stringybark (Emue), and Silvertop Ash (Esie). Other species include Ironbark (Esid) and Bangalay (Ebot).

History, Stand Structure and Condition

Previous Logging:

Cpt 3007 – 1982 (4634 cubm), 1990 (113 cubm)

Cpt 3008 – 1965 (3034 cubm), 1980 (177 cubm), 1991 (5761 cubm)

Cpt 3016 – 1982 (12663 cubm)

Parts of the resource unit have undergone light and medium selective logging, targeting sawlogs and mining props in 60s, 80s and 90s. TSI was completed in the late 50s, 60s, 70s and 80s. The resource unit has had regular wildfire events since the 1960's, and HR burning since the 90s with all or part of the resource unit being burnt.

Mostly an uneven aged, mostly fully stocked, which is highly variable over short distances, BA range 12-22 sqm/ha. The stand is mostly mature with some advanced pole/small sawlog sizes and some clumps of sapling regrowth. Majority of this area contains sufficient retained volume from the 1990's harvesting event to warrant another viable operation.

Slope

Cpt 3007: 0-20 deg 96.3%; 20-25 deg 3.5%; 25-30 deg 0.1%

Cpt 3008: 0-20 deg 93.3%; 20-25 deg 6.5%; 25-30 deg 0.2%

Cpt 3016: 0-20 deg 79%; 20-25 deg 15.4%; 25-30 deg 4.4%

Koala scats, scratches or individuals listed under Known or Potential Habitat?

No

Cpts 3010 and 3011 (Year 2014)

Cpt 3010 Heavy Harvest at the northern end, around Brou Tip (Coastal Dry Forest). Remainder Medium Harvest (Spotted Gum).
Cpt 3011 mostly non-harvest (Spotted Gum etc).
Exclusion zones: Probable EEC River Flat Eucalypt Forest, Wetland, Flood Plain Forest and Owl Landscape. Mummaga Lake Walking Track and Bodalla Park Rest Area are within Cpt 3010.

Species Composition

Spotted Gum, Ironbark, Blackbutt, Yellow Stringybark, White Stringybark, Woollybutt, Bangalay and Silvertop Ash.

Forest Type (RN17) and Gross Area (Ha)

Type 23 Myrtle 1ha
Type 32 Swamp Oak 0.5ha
Type 50 Bangalay 3.4ha
Type 70 Spotted Gum 70.6ha
Type 73 Spotted Gum-Sydney Blue Gum/Bangalay 16.7ha
Type 75 Spotted Gum-Yellow/White Stringybark 52.1ha
Type 76 Spotted Gum-Blackbutt 61.4ha
Type 112 Silvertop Ash 15.3ha
Type 114 Silvertop Ash-Stringybark 6.4ha
Type 166 River Peppermint 9.8ha
Type 223 Heath 1.1ha
To be assessed/unknown 9.7ha

History, Stand Structure and Condition

Cpt 3010 gross area 184.8ha
Net harvest area 139.9ha (139.5ha harvested)
Pt 3011 gross area 247.8ha
Net harvest area 204.6ha (14.3ha harvested)
Total gross area 432.6ha
Total net harvest area 344.5ha (153.8ha total harvested)
Logging History: Cpt 3010 - 1963 @ 91cubm; 1998 @ 5500cubm. Cpt 3011 - 1972 @ 3000cubm; 2007-9 @ 9500cubm.
The STS tract (153.8) is a predominantly mixed aged mature and regrowth forest and will be harvested under a medium-heavy single tree selection (STS) regime. The objective within the 153.8 ha harvest area for this operation (resource unit 1, 2 & 3) is to remove 35% (in RU 2 and 3) and 45% in (in RU1) of the basal area to create canopy openings for regeneration, whilst retaining and minimising damage to young regenerating stems, seed trees, habitat and recruitment trees. It is envisaged that the next harvesting operation in this compartment would be on average 30 years' time.
Resource Units 1 & 2: Mixed aged stand comprising mature/over mature trees (which have reached growth potential) interspersed with regrowth stems.
Resource Unit 3: Single aged stand of mature/overmature trees (which have reach growth potential).

Slope Classes (percent of harvest area)

0-20 degrees: Cpt 3010 99.8%; Cpt 3011 100%

20-25 degrees: Cpt 3010 0.2%; Cpt 3011 0%
25-30 degrees: Cpt 3010 0%; Cpt 3011 0%
Koala records at the plot site, scats, scratches or individuals listed under Known or Potential Habitat?
Yes, Cpt 3011.

Analysis of Compartment Harvest Plan Features

Reserves, exclusion zones and other protections:
These are specified in some Compartments.
Potential EEC's (River Flat Eucalypt Forest, suited to koalas) are protected.

Historic Disturbance:
Wildfires and forestry operations are the main apparent modern disturbance.
Some locations are close to infrastructure (eg Brou Tip).

Slopes:
Within harvesting areas, slopes of 0-20 degrees (optimum for koalas) heavily dominate the percentages (1 x 73%, 1 x 79% and 5 x mid-to-high 90%s).

Water:
Creek lines are mapped across Compartments, and sometimes named.
The large nearby watercourse is the Tuross River, but it is flanked by private properties, mostly historically cleared for agriculture.

Koala Presence:
There are 5 koala records inside, or adjacent to, these 15 Compartments.
This contrasts favourably with the single record amongst the 17 East Lynne Compartments we studied concurrently for carrying capacity.

Patch Sizes, Eucalypt Species, Optimum Slopes and Koala Records (where listed):
The browse in the table below could be interpreted as follows:

- Spotted Gum only = low quality koala browse
- Spotted Gum dominant with High/Signif Koala Use Other Species = medium quality koala browse
- High/Signif Other Species only = high quality koala browse

The locations of koala records across the different Compartments suggests the animals were possibly using a mixture of each of these browse qualities.

Cpt Number	*Spotted Gum only (Ha)*	*Spotted Gum dominant with High/Signif Koala Use Other Species (Ha)*	*High/Signif Other Species only (Ha)*	*Percentage of slope 0-20 deg*	*Recorded Koala Evidence (#)*
3006A	**74**		**26**		**1**
3009	**122.4**	**79**	**34.61**		**0**
3012	**66**	**113**	**13**	**97%**	**1 adjacent**
3023	**159**	**51**	**30**	**73%**	**0**
3024	**69**	**69.6**	**11.7**		**0**
3025	**56.3**	**119**	**116.1**		**0**
3027	**4.5**	**142.1**	**87.1**	**96.1%**	**0**
3047	**82**	**181**	**58**		**0**
3063		**441**	*part of the 441?*		**0**
3064	**93.6**		**324.1**		**2 adjacent**
3007, 3008 & 3016	**584**	**150**	**179.1**	**3007: 96.3% 3008: 93.3% 3016: 79%**	**0**
3010 & 3011	**70.6**	**61.4**	**25.1**	**99.8%**	**1**
TOTALS	***1,381.4***	***1,407.1***	***904.81***		***5***

<u>Findings from Harvest Plans (Only) Analysis</u>

Totals in the table above suggest that, across these 15 Compartments, there are 904.81 Hectares of high-quality koala browse. At the conservative NSW South East home range estimate we have landed upon after consulting diverse research (350 Ha for a home range area) this eucalypt mix, on its own, would support 2.6 “breeding associations” (each with a dominant male, a breeding female and a few others).

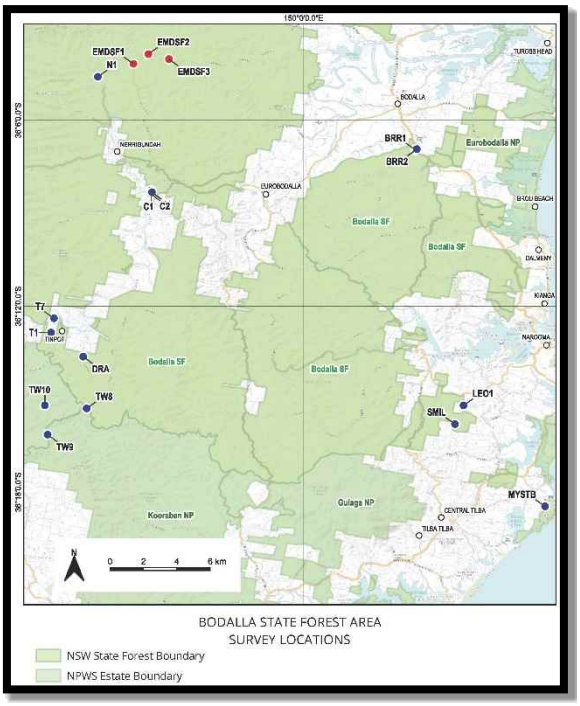
Across these Compartments, there are at least 2,311.91 Hectares of “medium-to-high quality koala browse”, on suitable slopes. Using the same home range estimate, this eucalypt mix would support 6.6 breeding associations (closest to the actual number of 5 koala records for these Cpts) [*cf East Lynne Carrying Capacity Study*].

Although ***n*** is small, these calculations are derivative and the Compartments are not all adjacent to each other, it seems not unreasonable to argue the sample of Compartments suggests a suitable koala habitat across the whole Bodalla State Forest, with likely potential home ranges around 350 Hectares each.

Plot Surveys

Eurobodalla Koala Project plot surveys in the vicinity of Bodalla State Forest have been undertaken at different times. Most were part of the Pilot Study, when checking for any evidence of a link between the small Kooraban National Park koala population and Tinpot/Wandella (suitable habitat features were found, but no definite scats). Three others were to follow up an unconfirmed koala sighting at Cadgee. One was in our program of advice to private landholders about the suitability of their properties as part of a local koala habitat landscape (the property, bordering Bodalla State Forest on Tebbs Road, was deemed suitable)**.**

The plot surveys also serve to build the Eurobodalla Koala Project database, are submitted to the NSW Government for its comprehensive database, and are useful as ground-truthing samples when considering the wider habitat in which they sit. Each plot contains 30 live trees of DBH 150mm and greater. Data for multiple habitat factors including tree species and sizes, soil, slope, aspect, shade and disturbance history, are collected on a spreadsheet adapted from the widely-used habitat and population estimation RGBSAT method.



Plot Number	*Location and Date*	*Species and # Found*	*Comments*
C1	Cadgee Bridge, Gulph Creek. 11/8/2012 & 5/9/2012. Unreliable sighting tree plus one other.	**Eela x2, on river flat.**	Reliable report of 1980's koalas on ridge opposite (Dampier SF). Report of koala in tree 2012 deemed unreliable.

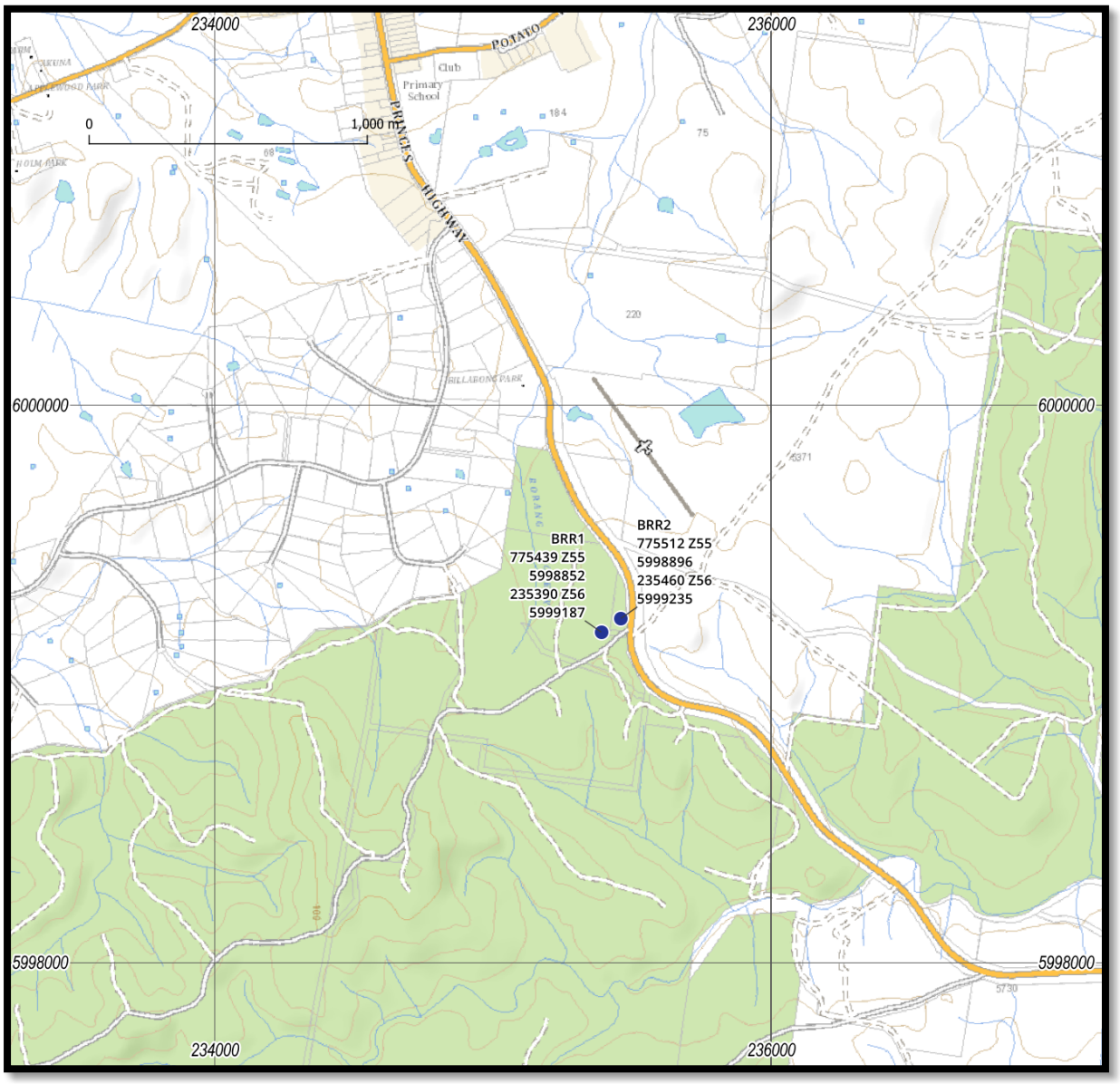
C2	Cadgee Bridge. 5/9/2012	**Angflo x3** **Eela x19** **Amea x2** **Emue x2** **Ebos x4**	
C3	Gulph Creek, East of Cadgee Bridge. 5/9/2012	**Angflo x10** **Alit x2** **Ebos x5** **Eela x12** **Cedar x1**	
T1	Tinpot. 21/3/2012	**Elon x9** **Esie x3** **Excup x1** **Emue x6** **Eglo x1** **Ecyp x3** **Angflo x3** **Acfal x3** **Eela x1**	Eang, Ebos & Etere adjacent to plot.
T2	Tinpot Flora Reserve. 28/3/2012	**Eglo x17** **Eagg x1** **Angflo x6** **Ebos x3** **Ebos/bau/mic x2** **Emue x1**	Stands of Etere on drive to plot.
T3	Tinpot, Kooraban NP adjacent to Reserve. 11/4/2012	**Ebos x6** **Elon x7** **Emue x1** **Acas x6** **Eagg x9** **Ebau x1**	Stressed large non-Stringy trees.
T4	Preserve Road, Tinpot, Kooraban NP. 12/9/2012	**Esie x5** **Eglo x14** **Eang x11**	Unidentified scratches and scats on plot Eangs & adjacent Eangs.
T7	Tinpot, near Tuross River. 4/4/2012	**Eela x18** **Ecyp x3** **Angflo x6** **Acas x1** **Emic x1** **Ebos x1**	Bandicoot digs & scats. Eucalypt ID difficulty: Eela/Esie/Ecyp/bos/mic.
TW8	Tinpot Road, Kooraban NP? 16/5/2012	**Emue x16** **Ebos x13** **Angflo x1**	Eucalypt ID difficulty: Ebos? Large Ecyp adjacent to plot. Some distressed trees.

TW9	Tinpot Road near Jeffers Road intersection. 16/5/2012	**Esie x21** **Ebos x3** **Eagg x6**	
TW10	South of Tinpot overlooking Wandella Creek off Red Creek Road. 23/5/2012	**Esie x16** **Eagg x9** **Etri x5**	Previous heavy disturbance: logging & fire. Distressed & dead trees. Casuarina & Acacia regrowth.
T11	Corner of Red Creek & Recoil Roads, Tinpot, Kooraban NP. 30/5/2012	**Eglo x7** **Eagg x3** **Ecyp x6** **Etri x6** **Acas x1** **Ebos x4** **Esie x3**	Eucalyptus ID difficulty. Scats collected but never identified: glider/BT & RT possum/koala? Disturbance: fire, logging & adjacent roadworks.
DRA	Darts Road, Kooraban NP (ex-Bodalla SF). 18/4/2012	**Ebos x12** **Emue x8** **Acacia sp x7** **Epan x1** **Elon x2**	Major disturbance: logging, soil disturbance, fire, wattle, weed.
LEO1	Tebbs Road, Narooma, adjacent to Bodalla SF. 22/10/2020	**Ebos x13** **Emue x3** **Cmac x9** **Acac x4** **Excup x1**	Ecyp & Eela near plot, closer to rainforest gully
BRR1	Big Rock Road, Cpt 3005. 27/11/2021	**Epil x13** **Cmac x1** **Cgumm? X8** **Banksia x1** **Alit x7**	Reported sighting follow-up; scats collected and sent for I.D.
BRR2	Big Rock Road, Cpt 3005. 27/11/2021	**Epil x10** **Alit x13** **Cgumm? X7**	Reported sighting follow-up; scats collected and sent for I.D.

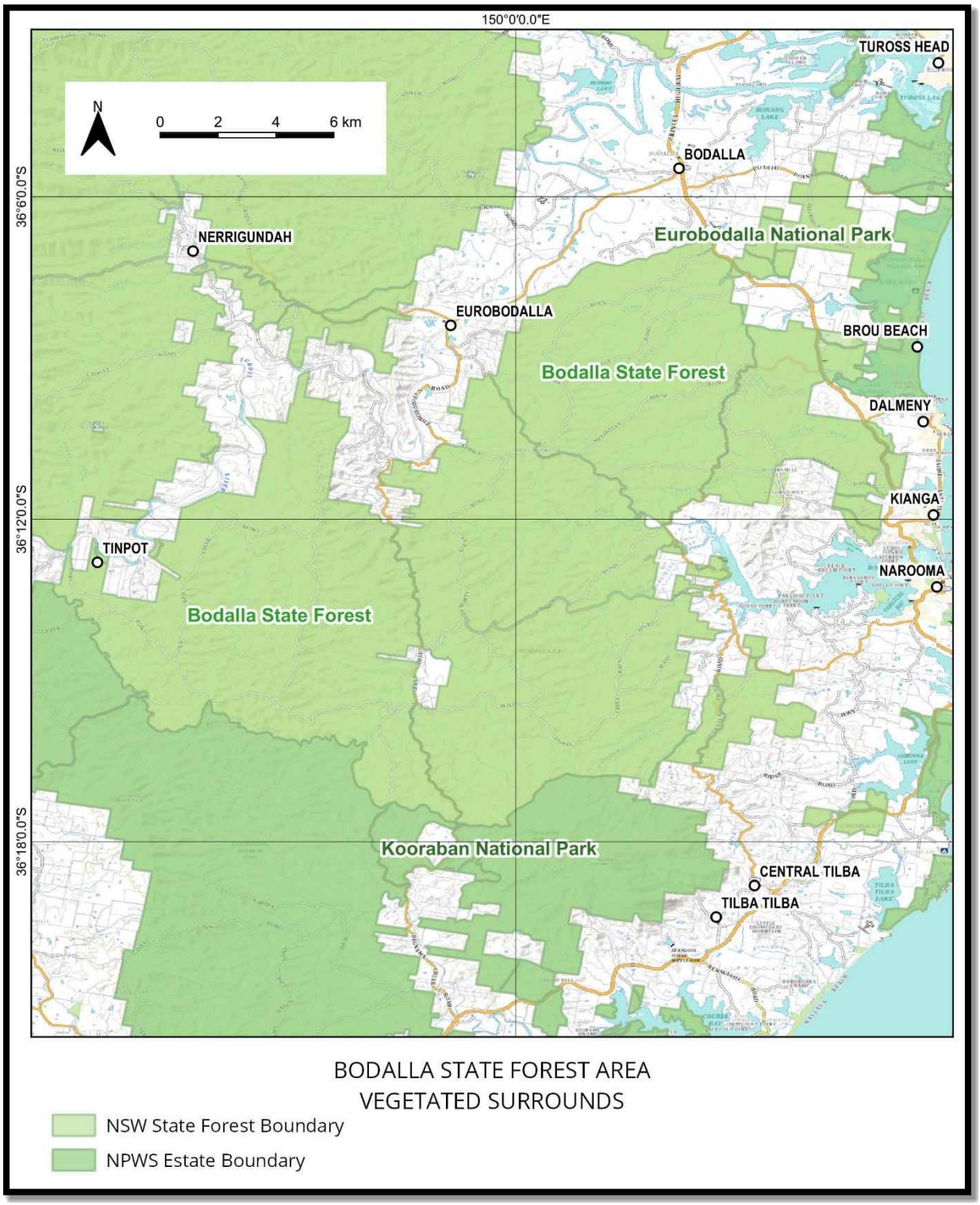
The tree species listed in the volunteer plot survey datasheets appear to match well with the listings in the associated Forestry Corporation GIS polygons and the Compartment Harvest Plans.

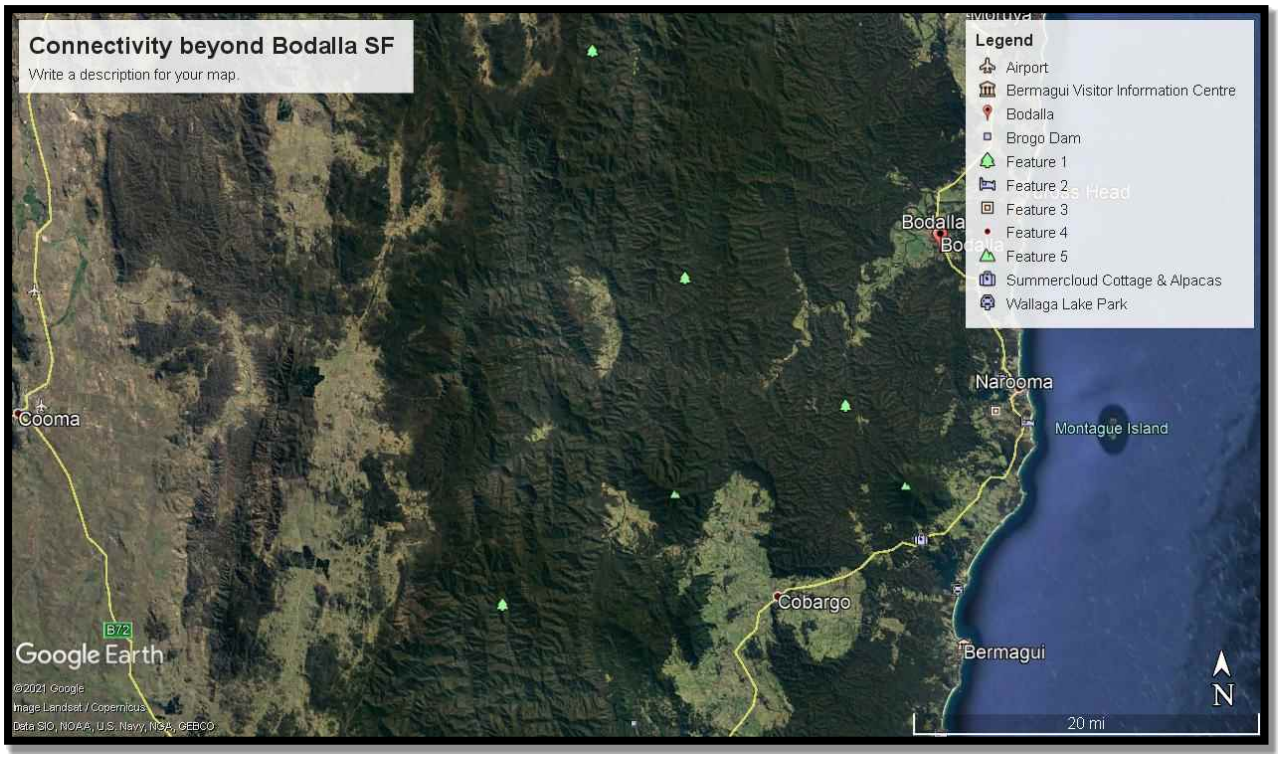
Despite the ruggedness of topography, these 16 plot surveys support the notion that the area is viable low density koala habitat because of the diversity, spread and number of High Use koala tree species (eg Elon, Ebos, Emue, Ecyp, Etri, Esie) and the proximity to good water. In addition, there is prior koala evidence nearby (ie Sam's Ridge, Kooraban NP OEH surveys 2007-11, the Cadgee 1980's report and the 2002-2009 Bodalla State Forest records).

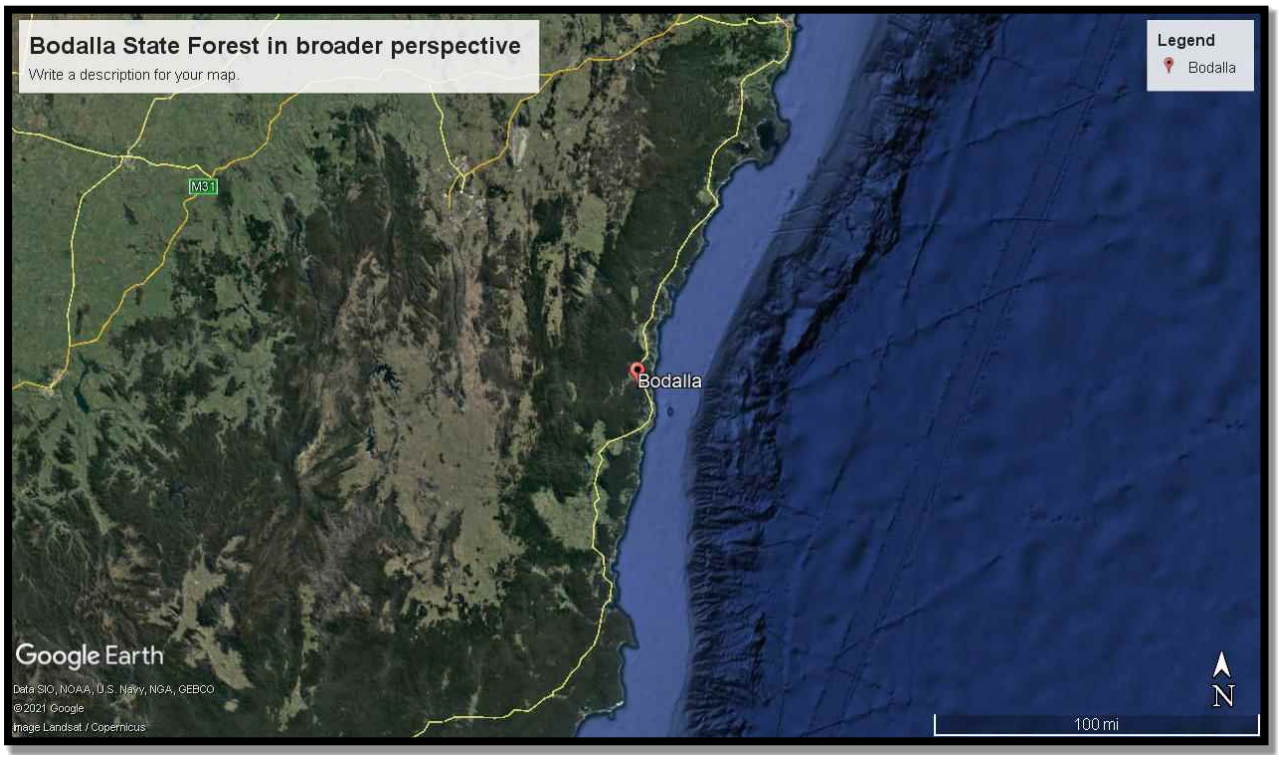
If the found scats are confirmed by ANU near infra-red spectrometer analysis in 2022, Plots BRR1 and BRR2 suggest continuing koala occupancy in Bodalla State Forest.



Connectivity







These images demonstrate the critical role State Forest tenure plays in occupying and linking remnant vegetated connectivity across and beyond the Eurobodalla.

From Bodalla State Forest, connectivity extends to Bermagui, Dampier, Badja, Deua, Moruya State Forest and further on. To the south are Coolagolite and Tanja, and to the north are the

Southern Shoalhaven and Palerang regions. Scattered records of koala presence are located in all these areas.

Low-density koala home ranges in the NSW South East can be as large as 350 hectares, and breeding dispersal distances can be up to 50 kilometres, hence the need for such an extensive, safely connected, landscape-scale habitat with an even more widespread metapopulation.

The Eurobodalla Koala Project's 2020 Wamban-Nerrigundah study (https://eurokoalas.files.wordpress.com/2021/03/report_wamban-nerrigundah-project_gilmore-electorate.docx.pdf) highlighted the need for preserving the remnant forests on this scale. The low number of koala sightings in the NSW South East is a function of the best habitat, on alluvial soils with gentle slopes, having been cleared for agriculture long ago. Koalas have had to adapt to the more rugged, less fertile areas mainly occupied by State Forests and National Parks.

From a koala population revival perspective, even if private landholders can be encouraged to revegetate, at least in the interim koala survival depends upon State Forests. In the long term, breeding corridors between the best habitat will still need to pass through State Forests.

Other Materials

Extract from Draft National Koala Recovery Plan – Habitat

"Within the geographic range of the Koala (**Error! Reference source not found.**), Koala habitat is influenced by the availability and nutritional quality of food trees, presence of suitable resting trees and microclimates, age structure of habitat, history, and barriers to dispersal. These differ regionally because they are strongly influenced by local climatic and landform attributes.

While precise requirements vary regionally, Koala habitat can be considered in terms of the following multi-scale resource requirements in space and time:

- the selection by Koalas of individual trees for food and shelter and other resources within their home range (sections **Error! Reference source not found.** & **Error! Reference source not found.**);
- patch size, form and context of home ranges within the landscape, including patches of forest, riparian, linear and roadside vegetation associations, open ground, corridors and scattered paddock trees used for breeding or dispersal (sections **Error! Reference source not found.** & **Error! Reference source not found.**);
- at larger scales, the regional landscape in which a metapopulation exists; and
- the geographic range of the Koala (section **Error! Reference source not found.**)."

Extract from Draft National Koala Recovery Plan – Population Decline

"A synthesis of surveys between 1949 and 1987 indicate that the distribution of the Koalas has contracted significantly in NSW, notably in the north-western and southern margins (Phillips 1990; Reed, Lunney & Walker 1990). These contractions have continued in recent years (McAlpine et al. 2015). Localised declines in the distribution of Koalas have been noted in coastal areas that are subject to high anthropogenic pressure (McAlpine et al. 2015). Some areas have seen localised, though possibly temporary, expansions (Ellis et al. 2017; Lunney et al. 2009, 2012)."

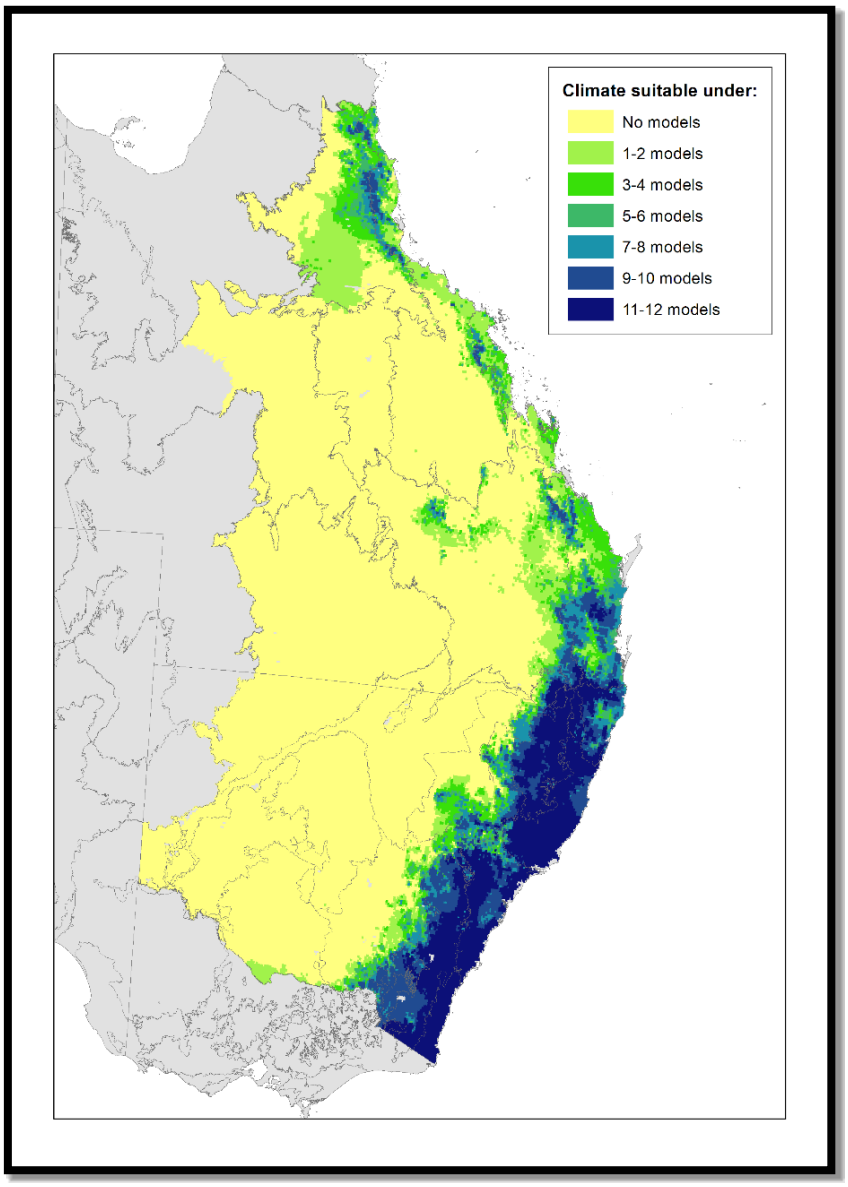
Extract from Draft National Koala Recovery Plan – Predicted Habitat Loss Under Climate Change

"Estimates represent the change in area that was climatically suitable for Koala based on conditions for the period 1961-1990 (Hoskings) 1991-2009 (Briscoe), and compared to the area that is expected to be climatically suitable for Koala in 2030, 2050 and 2070, within areas where koalas or their habitat are 'known' or 'likely' to occur (DAWE 2021). Estimates are summarised for IBRA7 bioregions (DoTE 2012). Negative values indicate a gain in climatically suitable area. Methods follow Table B.

Table A. Estimated changes to Koala distribution due to climate change under a high global-emissions scenario (A1FI or RCP8.5), summarised across 13 models of Koala distribution for the years 2030, 2050 and 2070."

Bioregion	Median % loss by 2030 (min, max)	Median % loss by 2070 (min, max)	Median % loss by 2070 (min, max)	Number of models predicting this bioregion to historically hold < 1000ha of climatically suitable for koalas
New South Wales				
South East Corner	0 (0, 0.2)	0 (0, 1.2)	0 (0, 8.7)	

Extract from Draft National Koala Recovery Plan – Predicted Suitability of Habitat Under High Emissions Scenario

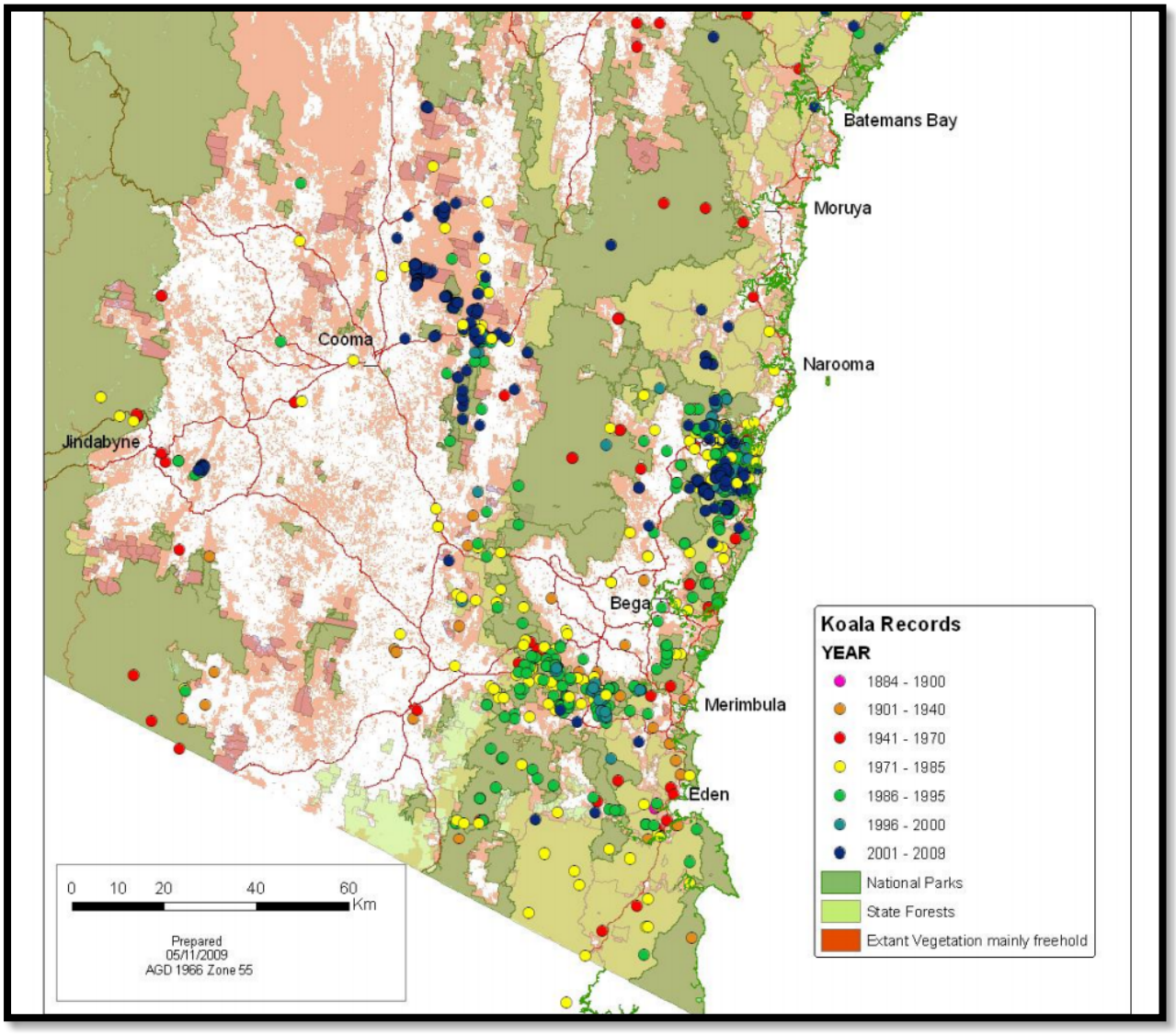


"Figure 1 Predicted Koala distribution in 2070 under a high global emissions scenario (RCP8.5) considering the impacts of climate-change driven changes to droughts and heatwaves on koalas. Colour indicates the degree of certainty that a given area will be climatically suitable for Koalas, indicated by the number of models out of a maximum of 12 that predict that area will be climatically suitable. Blue indicates high confidence that an area will be suitable for Koalas. Yellow indicates high confidence that an area will be unsuitable for Koalas. Data from Briscoe et al. (2016)."

Heather Gow-Carey Thesis, 2012

This study focuses on the Bega Valley LGA, but scopes as far north as Gulaga Mountain and Kooraban National Park. The analysis of browse species and habitat size and configurations, is therefore relevant to Bodalla State Forest.

Gow-Carey's map displays koala records in Bodalla State Forest and their spatial relationship to others in the region



"While several localised studies across this region have sought to determine the most utilised tree species, few have investigated actual tree species preferences. Furthermore, there have not been any successful attempts to map and quantify the extent of suitable koala habitat. This study seeks to address this knowledge gap."

"The study site is approximately 71 000 ha located between 150º 13'E, 36º 30'S and 149º 87'E 36º 64'S on the Far South Coast of New South Wales. This area covers a number of National Parks, State Forest and private land including sections of Kooraban, Gulaga,

Wallaga Lake, Biamanga, Mimosa Rocks National Parks; Bermagui, Mumbulla and Murrah State Forests; and Bermagui Nature Reserve (Figure 2.1)."

"Nutrient rich fluvial sediments and alluvial deposits are found along the river and creek flats of the region (Tozer et al. 2010). The topography varies from coastal flats and narrow floodplains to hilly areas with the peak of Mumbulla Mountain reaching an altitude of 773 m in the south and Gulaga (Mount Dromedary) reaching 806 m in the north."

"Before European settlement, the vegetation of the lowland slopes was largely tall open forests of spotted gum (Eucalyptus maculata), forest red gum (E. tereticornis), and woollybutt (E. longifolia), with a moderately dense sclerophyllous understorey (Lunney & Leary 1988). A large proportion of these regions were cleared for farming, and consequently the remaining dry open sclerophyll forest is restricted to the rugged, less fertile areas often associated with the Ordovician meta-sediments. These forests are dominated by silver-top ash (E. sieberi), yellow stringybark (E. muelleriana), blue-leaved stringybark (E. agglomerata), white stringybark (E. globoidea), along with rough-barked tree (Angophora floribunda) and woollybutt (E. longifolia). These vegetation communities are often found with a rather open understory of acacia and black she-oak (Allocasuarina littoralis). Restricted areas of temperate rainforest occur on the lowland zones along with moist sclerophyll found throughout the study area at higher altitudes and in moist valleys (State Forests 1994). Extensive logging operations have been in process since European Settlement in 1830 with a well established industry by the 1860's, supplying timber to the Sydney colonies (Lunney & Leary 1988). This has resulted in less than 10% of the lowland zone having scattered tree cover (Brooks 1994). The remaining forested areas are increasingly regrowth due to the continued logging of the Murrah, Mumbulla and Bermagui State Forests. The region also has an extensive history of drought, bushfire and prescribed burns (State Forests 1994; Lunney & Leary 1988)."

"…studies have shown that the numbers and density of koalas has remained low throughout the region with the current population confined to less fertile and rugged terrain, located across NSW State Forests, National Park and also small sections of private land (Jurskis et al. 2001; Allen 2010). It is estimated that in the forests to the north-east of Bega, no more than 42 individual koalas remain (Allen 2010). The continuing decline of habitat quality throughout the study area is apparent 'because of multiple factors including extensive canopy dieback, clearing due to rural-residential development and commercial forest harvesting' (NSW Scientific Committee (2007), cited in Allen 2010 p.18). This in turn has resulted in limited connectivity between the two known koala populations located in Kooraban National Park and those in the Bermagui/Mumbulla region, with anecdotal evidence suggesting that the link may have been severed in the past 10-15 years (Allen 2010). This study is focussed on these populations between Dignams Creek and Tathra, with the analysis of habitat quality being the primary outcome."

Tree Usage by Koalas - Results

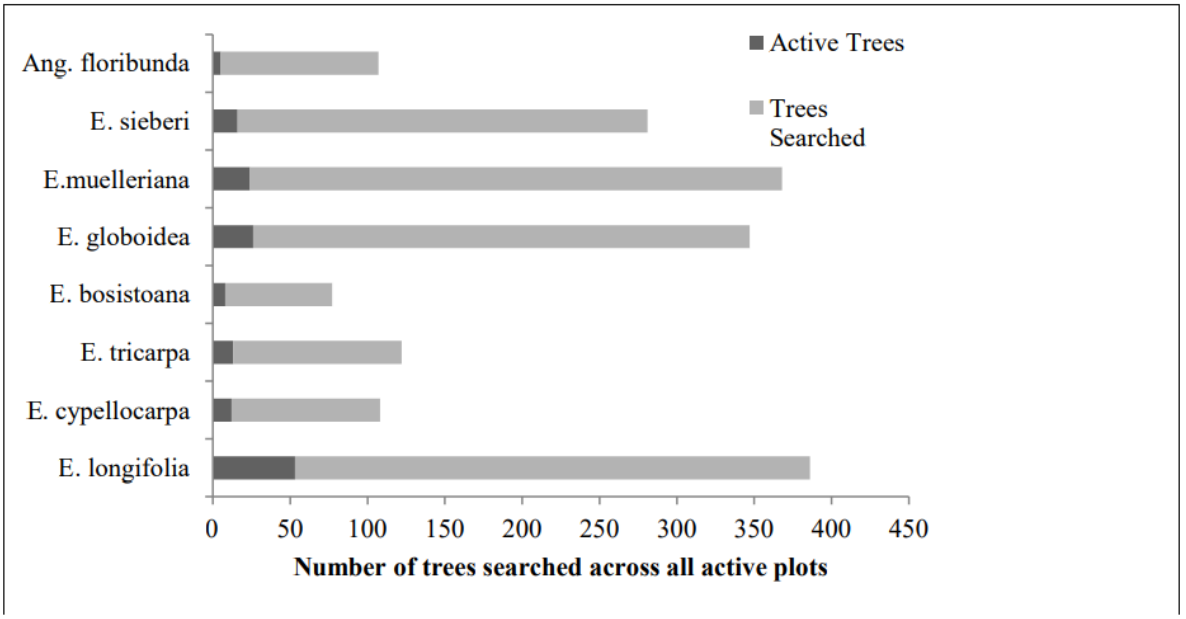


Figure 3.1: Proportion of trees in the main data set that were searched during the RGB-SAT surveys that had evidence of koalas compared to trees of the same species where no evidence was found.

"The overall rankings for both the analysis of strike rates and the use versus availability analysis are outlined in Table 3.6. For both methods of analysis, the rankings of the first five species are identical, with the use versus availability analysis refining only the ranks of the lowest three species (Eucalyptus muelleriana, Angophora floribunda and E. sieberi). The final ranking was used to delineate species based on the criteria in Table 3.1. Primary species included E. longifolia, E. cypellocarpa and E. tricarpa. Secondary species were revealed as E. bosistoana and E. globoidea and E. muelleriana, while E. sieberi and Angophora floribunda are classed as supplementary species."

An analysis of auxiliary species was also undertaken, but these did not satisfy Gow-Carey's criteria for inclusion in her 3-tiered priority ranking. Nevertheless, they had "strike rates", namely E consideniana, Acacia falciformis, Exocarpus cupressiformis, E botryoides, C gummifera, E agglomorata, Allocasuarina littoralis and Acacia spp.

The study then went on to cover predictive habitat modelling (with other factors included, eg soils), patch metrics, landscape analysis, road fragmentation etc.

Comparative Occupancy Rates, Tree Species, Tree Girth and Fire Impact: Friends of the Earth report re their Won Wron State Forest and Mullungdung State Forest (Victoria) Surveys, May 2021

"…the results…suggest that koala populations in Won Wron are very low, it would be ambitious to say that there are 50 koalas within a forest area of 6700ha…..

Friends of the Earth Melbourne has just completed its latest Strzelecki koala survey report for 2020/21. Surveys for the year concentrated in previously unsurveyed forests east of the Strzelecki's, mainly at Won Wron State Forest and Mullungdung State Forest. Results suggest that koala numbers could be up to ten times less in these forests, than the best remaining koala habitat in the Strzelecki Ranges.

The koalas in the Strzeleckis/South Gippsland regions could hold the key for the long term survival of the animal throughout Victoria and South Australia. As few as 2000 Strzelecki koalas may remain.

Key findings suggest that in 30,000 hectares of native forest stretching from Holey Plains State Park through to Mullungdung, only 115 to 215 koalas may remain. Over 180 sites managed to be surveyed, between a series of Covid lockdowns and a freak storm which closed all forests in the region for two weeks in June.

From 2 scientific studies (published 2014 and 2016) and FoE Surveys over 2019/20 and 2020/21, an estimated 43,000ha of land in South Gippsland/South Gippsland has now been surveyed for koalas.

FoE estimates a koala population between 1200-1300 animals across this 43,000ha. In the region, a population of ~2000 animals is highly likely.

The best quality forest sites (3,500ha) in the Strzelecki's have an estimated koala population of ~800 animals *(Phillips and Allen 2014)*. (0.25 koalas per hectare).

A follow up report *(Phillips and Wallis 2016)*, including data published in the 2014 report and covering 10,500ha estimated a koala population of 945 animals (0.09 koalas per hectare).

FoE estimates that for most of the areas outside of the best Strzelecki habitat, the koala population falls dramatically to ~0.02 koalas/ha.

FoE's 2021 surveys focused on Won Wron and Mullungdung state forests. FoE estimates the koala population at Won Wron State Forest to be between 25-50 animals and for Mullungdung between 70-140 animals. *(These estimates are between 0.01-0.02 koalas/ha or between 43-86 times less than recent estimates by the Victorian State Government. (see 'Modelling Koala abundance across Victoria' G.W. Heard and D.S.L. Ramsay).*

The 2020/21 surveys (again) confirm Mountain Grey Gum as the preferred tree species for koalas in the Strzelecki Ranges/South Gippsland region and confirms the wider dispersal of koalas throughout the Strzelecki's and the Gippsland Plains.

Average tree girth at survey sites was 451mm. Average tree size where a scat was detected was 808mm, highlighting koala preferences for larger trees.

40% (69) of the survey sites showed signs of being burnt since 2009. 5% (8) of the survey sites showed signs of firewood cutting.

Only 1 scat was found in a recently burnt site and 1 scat found in an area of firewood activity.

4 scats were located in an area that is planned to be logged by Vicforests who appear to be increasing their activity in the region. This was the only planned logging coupe that was surveyed."

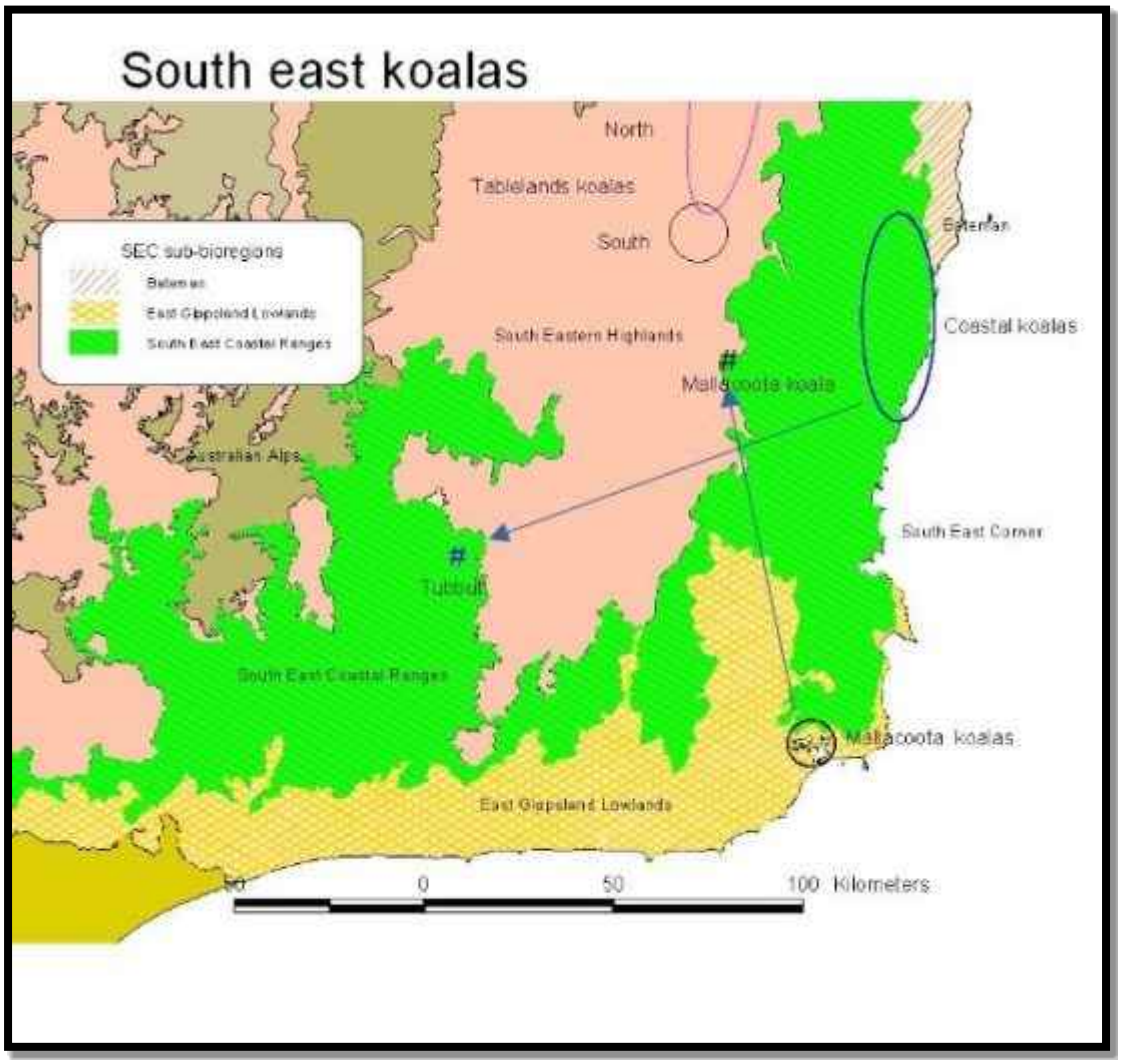
Naturally Occurring SCIVI Vegetation Types Around the Tuross River and Cadgee Areas

- e19 Bega Wet Shrub Forest
- e20p299 Southeast Lowland Grassy Woodland
- e31 Southeast Hinterland Dry Grass Forest
- e32A Deua-Brogo Foothills Dry Shrub Forest
- e34 Southeast Coastal Gully Shrub Forest
- e46B Southeast Lowland Dry Shrub Forest
- n183 South Coast Hinterland Wet Forest
- p30 South Coast River Flat Forest (*very likely*)
- p40 Temperate Dry Rainforest
- p89 Batemans Bay Foothills Dry Forest

Altogether, these forest types contain the following documented koala-used trees (at different rates in different regions) amongst their indicative species (see NSW Review of Koala Tree Use, 2018):

- Allocasuarina littoralis (She-Oak)
- Angophora floribunda (Rough-barked Apple)
- Angophora costata (Smooth-barked Apple)
- Corymbia gummifera (Red Bloodwood)
- Eucalyptus baueriana (Blue Box)
- E bosistoana (Coast Grey Box)
- E cypellocarpa (Mountain Grey Gum; Monkey Gum)
- E elata (River Peppermint)
- E globoidea (White Stringybark)
- E muelleriana (Yellow Stringybark)
- E longifolia (Woollybutt)
- E pilularis (Blackbutt)

Extract from Robert Bertram Blog



”Locations of the four genetically different koala populations in the southeast: It seems likely only the coastal koalas are endemic and they are identical to a koala found at Tubbut 30 years ago. A koala identical to those at Mallacoota was found last decade at Tantawanglo, where Victorian koalas were planned to be translocated.
These outcomes including the extinction over the past two decades of koalas in Nullica SF, Yurammie SF and Bodalla SF under the EPA's logging prescriptions. Along with those in the South east NP and now probably Kooraban NP are all closely associated with the EPA's corrupt regulatory strategy. My suggestion to the EPA was for it to acknowledge that most forests on the east coast are declining in health because the EPA has ignored soil science for over 25 years.”

Blogger Robert Bertram argues the drastic decline in South East koala numbers (to his estimates of between 500 and 1,985 hectares per koala) is related to soil degradation through forest management negligence.

Analysis

With the potential for koala population revival in mind, each portion of this work offered an enhancing or inhibiting weighting to our judgement of the quality of Bodalla State Forest's koala habitat, as follows.

- Background: Although the numbers are low compared with the area to its south, koalas have used Bodalla State Forest in the past, and appear to be doing so still. The AKF map appears to include Bodalla State Forest in its display of remaining forest and woodland habitat.
- SCIVI Vegetation Types: Across the *Positive Diagnostic Trees* and the *Others Also Occurring* in the 7 forest types, there are 12 High Use Koala Species, 11 Significant Use, 7 Irregular Use and 5 Low Use Species.
- Topography: Relatively gentle slopes in the East and North-East; rugged in the West.
- Watercourses: The Tuross River is nearby, but not within the Bodalla State Forest boundary. Whittakers Creek and Billa Bilba Creek probably provide the only other reliable fresh water until they become salty.
- Geology and Soils: The dominant, stony metasediment produces dry, low nutrient soils, mostly of a sandy loam texture. This reduces leaf nutrient quality.
- Fire: The most recent wildfire has had a severe short-term impact on habitat quality, and a measurable, though smaller long-term impact.
- BioNet Koala Suitable Trees modeling: In the East, there is medium suitability. In the interior and West, there is a clear distinction between the high suitability trees in gullies and the low suitability trees on ridges.
- BioNet Koala Habitat Suitability Modeling: Across the majority of Bodalla State Forest, the modeling displays a fairly even distribution of high and medium quality habitat, but the minority low quality habitat is significant.
- Endangered Ecological Communities: These are small, relative to the overall vegetation, but they contain good koala habitat.
- Sensitivity Biodiversity Maps: These are incomplete and external to Bodalla State Forest, but they demonstrate the importance of their contribution to connectivity.
- Forestry Corporation NSW GIS Mapping: This displays a diversity of forest types across Bodalla State Forest and the range of high use koala tree species therein.
- Harvest Plans: These reinforce the rate of historical koala records, but also suggest a potential carrying capacity of more than 5 breeding associations across Bodalla State Forest.
- Plot Surveys: There is a good match between the eucalypt species and other habitat factors in volunteer plot surveys, and FCNSW GIS and Compartment Harvest Plans. Plots BRR1 and BRR2 (27th November 2021) appear at the time of writing to confirm the reported sighting of October 2021 in Compartment 3005.
- Connectivity: Bodalla State Forest is central to North-South and East-West connectivity in the wider region.

- Other Materials: Bodalla State Forest is part of the zone expected to offer the highest probability of good future koala habitat under a high emissions scenario. Gow-Carey's study combines with the NSW Review of 2018 to explain the adaptation of South-East koalas to a wider range of tree species than was listed in the still-unamended SEPP44. The Gippsland experiences reinforce the Bodalla State Forest carrying capacity assumptions. Bertram reminds us of the importance of soil health and the significance of dieback as a habitat inhibitor.

Conclusions

This review confirms the volunteer Eurobodalla Koala Project Pilot Study proposition that Bodalla State Forest plays an important role in the region's koala habitat, despite inhibiting factors such as areas of rugged topography, soils, watercourse abundance, fire impact and large stands of Spotted Gum.

Bodalla State Forest is a viable location for home ranges, and is needed as a breeding connector for a sustaining regional koala metapopulation.

Bodalla State Forest must be a priority focus for any Shire-wide low-density koala population revival.

Sufficient habitat connectivity across the whole large, diverse Bodalla State Forest area and beyond, is still in place but its preservation is critical.

Further severe impacts from wildfire, other climate change impacts (eg degraded soils, landscape drying, CO2 affecting leaf nutrients), dieback, private clearing, urban development or over-intensive logging will need to be avoided.

Rehabilitation of cleared alluvial patches in or adjacent to Bodalla State Forest should be one priority for koala population revival. Maintenance/enhancement of safe connectivity between these patches should be another.

Aiming for a low-density koala occupancy rate, characterized by connected home range areas of about 350 hectares each, seems realistic and reasonable.